

FICS ICSC Concussion Update

Scott: Jordan is coming to you from Minnesota, which is north of Toronto, where I am coming from, although that is Canadian. That is a little bit, interesting for people. Jordan, being from Minnesota, me, being from Canada, we thought we would obviously make, a couple of cases, or at least, the case that we want to go through today. This is a hockey case. It makes a lot of sense. Minnesota has its, famous hockey here.

Scott: So, I just, I would encourage, some interaction within the chat. I think that will, really help us work through this material. Although we cannot see everybody on our screens, we hope, everybody enjoys the day, and we are looking forward to, going through some great information here as well.

Scott: For disclosures, unfortunately, I do not really have any financial disclosures to, to report. but I would say that I do have a few, publications in concussion. I am a member of an ECHO, sort of project here in Toronto with the University Health Network. they are looking at some complicated cases, and I am one of the authors on the CCGI and the ONF, guidelines here in, Canada and Ontario. Jordan, I cannot remember. Did you have any disclosures to add to that?

Jordan: I do not really have any disclosures. maybe I once did a presentation of the impact. I think we mentioned impact in here, so I think That is the only disclosure. Otherwise, I do not have to do everything. So, nothing on my end.

Scott: Perhaps at a different point in our career, we have more, financial disclosures to make. We look forward to that. So, the objectives here today, obviously, we need to circle back around to some, some basic background information, and we will touch on just pathophysiology.

Scott: We specifically want to go over some of the things that, we think are important from a sideline examination. Jordan's going to walk us through a bunch of, clinical practices and, clinical examinations that we think are, are helpful. Then we will discuss, return to support and return to learn, activities. If there is any, sort of tips on how to maybe prevent concussions, we will weave that in as well. So, again, we are hoping that there is some interaction, possibilities in this presentation.

So, here is the first, scenario, and this is, I think our intent here is to start with a bit of a bang. We will have a bit of, a concussion, sort of discussion to get this thing going.

[music]

I appreciate there is going to be people from various countries, attending this. This is a hockey collision. Something that would be quite typically seen, in a game. a high-speed, if you will, reasonably high-speed collision. Just to-to sort of orientate various things that we want to talk about today, this-this little video kind of captures it all.

I would invite any comments into the chat in terms of what you might think. Just, just seeing this video play out in front of you. it really takes about 15 seconds. It is a very short period of time. and this is a classic, mechanism, or concussion, particularly in hockey, but in other sports as well, where a player is not necessarily paying attention to what is in front of them.

This particular player, if you think about what happened in this video, was looking down at his feet, as he was moving forward. This, opposing player here probably came from about, 20, 25 feet away and, and made contact with the player. That is here on the ice, and he did not really see him coming.

Jordan: I think it is important when you talked about the speed that happens. It does not necessarily look good for these. These are younger individual's professions. Especially pros in hockey alone, you can get up to like 20 to 25 miles an hour. They can skate pretty quick. So even if it does not look that fast, it is like a motor vehicle accident just happened. Instead of having all the car to absorb that shock, you have some tiny little pads that, probably do not do the job. This is way too reminiscent of my entire high school football career of being a little person laid out. You do not see it coming half the time. And That is-- those are the worst ones there.

Scott: I mean, a chiropractor's role, there are various roles that a chiropractor could play. I will talk about this in few slides, obviously. But, if you were on the bench, and I do not think the athlete I am pointing to was, any kind of healthcare practitioner. This is probably a coach over here. There was at the beginning of this video, a collision that sort of was by the side of the net. Like, two players kind of went down by the side of the net.

As the first responder, therapist on-site, that might have caught your attention. That might have been the play that you were looking at, the first two athletes that went down. Then, this play here, transpires pretty much right in front of you. I do not really want to back it up again to glorify it, but right after that hit, the player is laying on his stomach, and quite clearly looks to be unconscious. You do not need to be unconscious to have a concussion, but being unconscious, speaks to the severity of it, for certain. As a first responder, and you are about to come out onto this, playing surface, you are really thinking to yourself, "Okay, this, this athlete is, well, maybe they will be conscious by the time you arrive," but in all first-response sort of scenarios where there is that high-speed collision like that, the first thought is his neck. So, as you are running out there, you are thinking, "Okay, I got to assess this, this player's neck. As you are running out there in hockey, you are running on ice, so there is a challenge with this just even to that. Therapists

do not fall on yourself. If you are the attending, first responding therapist, it is not helpful if you go down yourself. So, you get to the player, and the player is unconscious, you should be looking at the therapist on the other team, because an unconscious player on the ice it is highly likely that this player will be going to the hospital. It is probably likely that we are going to have to, activate some, first response, mechanisms to get this player off the ice and out of here.

There is some obvious first response, principles that, that we will obviously go through throughout this presentation. The other thing, and Jordan, you mentioned this, although they are young, and the speed that is involved there, right away, it is like, "Okay, there is going to be a return to play and a return to learning components of this," because these kids are in high school. That is where my head goes right away.

Jordan: I think you brought up a great point of that first initial contact. Because that is probably where my eyes would have gone. I probably would have been checking because they will take a second to get up. You could completely miss what is going on here. So, especially, sometimes, you must, ask them what exactly happened or when you get out there. You can get those little ones that you focus on, and then you miss what happens. It all happens within five seconds. That is all it takes.

Scott: Absolutely. So, the chiropractor's role in management. It is funny, in previous versions of this presentation, this will be the last slide. This will be sort of at the end of the presentation and my, friend, Pete Garbutt, wanted us to highlight the importance of, where the chiropractor's role in this occurs. So, instead of having this at the end, we put it at the beginning. It is not exactly like a Simon Sinek "Start with the Why," but, it starts with the important point here. What I would say is that this can be dependent on like, what environment we are in, what kind of a team, sport environment we are in, what our particular role is, or what our scope is. That, in many ways can be different from country to country, from state to state, or province to province. You need to be aware of, what your expectations are, going in. at minimum we need to be able to recognize concussions. We really need to be able to see that video we just saw and go, "That is going to be a concussion," at minimum. It might be something actually more than that. Jordan is going to go through a few slides here today on some of those other things, but at minimum we have a concussion. A chiropractor that is going to be on the sidelines, obviously, has to be able to have those first-responder skills, and be able to rule out some of those red flags, in particular, a cervical spine injury. Particularly, the collision involves the player having their head in a flexed position, whether that is into another player or into the boards or whatever. In our practices and in our clinics, obviously, we are adapt assessing and treating a cervical spine, so that is paramount. That makes up a large component of some of the symptoms that we see with concussions. Then might be written and Christine mentioned that I am part of the Exercises Medicine Canada Advisory Group. So, they are into the aerobic strength and conditioning protocols. There is, some emerging evidence that I would touch on later, in terms of what we want to do with people,

exercise-wise. This is a great, sort of place where we can, have any real impact in our practices as well.

Besides that, this goes with all, concussion issues, is education. Educating the players, educating, the athletes, their parents, the coaches, other people involved. Education is key to good concussion management. here in Toronto, I think it is the same to you, Jordan in Minnesota, good concussion practices have multi-disciplinary, individuals. Like, there is, there is multiple practitioners that are working in a team to, to really work with athletes that have been concussed. I have colleagues that are excellent at doing Vestibular Ocular, rehab. I have some other colleagues that are excellent doing neurological, things. we can have training to do a good number of the treatments associated with concussion care. I would just stress that we do the things that we are best at. If you have other people in your circle, so to speak, we should be utilizing those people as well. If you happen to be in a very remote area, and, and you do not have very many, colleagues to contribute to concussion care, well, then, as a chiropractor, we have a, in our scope, to do several the different treatments that we are going to obviously go through here today. But it just would emphasize, and this is kind of an always thing the athlete or the patient is at the center of care. We have all the different healthcare, practitioners surrounding that.

I happen to be in downtown Toronto, and there is, excellent, physiotherapists that do the vestibular-ocular, treatment that are just down the street from me, and they have all these additional apparatuses, and it is great to be able to work with other healthcare professionals, to be able to manage concussion care. So, concussion occurrences, obviously, we are talking today about sport concussion. and obviously, boxing is a great way to get concussed. Concussions happen quite a bit in sports and it kind of really goes back to 2010. A hockey player named Sidney Crosby, probably one of the best hockey players in the world, suffered a severe concussion. If you look back, sort of historically, the number of media hits and the number of, articles and people talking about concussion has significantly increased since, that, in 2010. It is not just, sports that, can contribute to concussion. In fact, motor vehicle accidents are the leading cause of concussion. Now, if we marry those two concepts, what I will say is, in some of the more complicated cases I have worked with endurance athletes, is cyclists. A cyclist that is involved in a collision with a motor vehicle, can certainly lead to some significant, injuries for the cyclist not the concussion or notwithstanding the concussion, so.

But, my question to the audience, and Jordan and I will be, touching on and using something today called the SCAT5, a Sports Concussion Assessment Tool. But one of my colleagues, here in Toronto has done some research looking at a different tool, and that is the Concussion Knowledge Assessment Tool. So, interspersed in this, presentation today, I am going to use some of the questions, that Dr. Kazemi looks at quite often in this research. That is some questions here from this Concussion Knowledge Assessment Tool. So, the question, to start this off: What

is the definition of concussion? Select the best answer. I might have given away that first one already. a loss of consciousness for less than 5 minutes after an impact; B, a complex pathophysiological process affecting the brain; C, a structural brain injury caused by a mild traumatic force.

Jordan: We have got one vote for B in the chat. Correct very smart, the answer is, indeed, B. So, this is, you know, we are using these questions to help set the stage a little bit for when we move into some of these different topics, but, and I do not think these questions show up into the quiz at the end, Jordan. But I think that they will help with a couple of the questions at the end, if I remember correctly. Some of them are similar, but these are also different from the quizzes, so these are also some takeaways. By the end, if you can answer the quiz with these questions, you still remember something.

Scott: There you go. So, the definition of concussion. Well, it can get a little bit, if not confusing, but there are various different organizations, that have defined concussion. the go to for us, typically, is the sports, concussion consensus statement that comes out, every few years. This past year was supposed to be in Paris. it did not happen because of COVID. It will happen at the end of this year in Paris. So, Jordan and I will be able to update, this presentation for next year, and that will be great. But, a sport-related concussion, you know, is that traumatic brain injury induced by a biomechanical force. So, you need to have some symptoms, and you need to have a reason. You need to have that, that inciting incident, if you will. The video that I have shown you with the hit. It does not have to be, though, a direct blow to the head. It can be to anywhere in the body, where that force is then transmitted to the head. So, a rough hit to the, to the shoulder or to some other body part that then causes the head to do some quick motion, causes the brain to potentially jostle around inside of your skull. A quote that always comes back to me is a researcher he read in Toronto at CMCC, Howie Vernon. He used to always say, "It is really difficult to jostle your brain inside of your skull without moving your neck. So, do not be surprised when there're some neck components to your concussion." That said, let us work through a few other of these definitions.

The American Neurology Association. So, concussion, mild traumatic brain injury resulting from direct or indirect. CDC Heads Up, again, traumatic brain injury, sudden movement, and then we have this biochemical change that happens that we will describe in a few slides. It is typically described as a mild traumatic brain injury. It is interesting because, you know, it is a brain injury. So sometimes, maybe the mild is not necessary. But obviously, there are some more severe brain injuries.

Jordan: Yes, and even the point that that was two definitions from the CDC. We gave a bunch of American resources, and they are all different. Even these high-level organizations, they are not wrong, but all the answers are not the same. It is so hard to define.

Scott: Yes. So, another way of perhaps looking at it is that we have this mechanism, and then the signs and symptoms cannot be explained by some other reason. And the thing that kind of really jumps to my head every time I think about this slide is, at the end of a triathlon when people are particularly fatigued, exhausted, but maybe have some heat exhaustion, and there are potentially some heatstroke issues. If you really think about what those symptoms look like, that looks a lot like a concussion. Dizziness, vomiting, do not really feel that great, a little bit woozy. Other things that might show up in your clinic are low iron or anemia. There are some other DDxs worth considering if there is an absence of a mechanism of injury. Keep that in mind as we work through here. So, I have another question. Is concussion a brain injury? Select the best answer. No, because there is no abnormality on standard imaging; No, as the symptoms are only psychological in nature; Yes, because there is a functional disturbance; and yes, as there is a structural abnormality.

Jordan: Let us see, several other C's coming in

Scott: Well, I appreciate the audience interaction here, and I appreciate that we have some smart people in the audience because, indeed, the answer is C. It is a functional disturbance that cannot be seen on standard neuroimaging, and, again, we are foreshadowing some of the slides to come here. That said, when we look at those definitions, this mild traumatic brain injury, depending on the literature that you are looking at. Usually, that is the way it is referred to in the neurology text, whereas in the sports medicine literature, more often, call it a concussion. A concussion is a mild traumatic brain injury, but a mild traumatic brain injury does not necessarily have to be a concussion. There are some other possibilities. Regardless, the symptoms that we saw in the video was that loss of consciousness, not needed, but a headache, speech problems, photophobia, mood changes. There are some symptoms that are going to work across numerous of the DDx. Just keep that in mind as we work through this presentation. So, which of the following is true? A period of unconsciousness is necessary for the diagnosis of a concussion. If you pick that, you have not been listening so far, as the professor walks around in the front of the classroom. Over two-thirds of concussions involved loss of consciousness, a third to two-thirds involve loss of consciousness, or less than one-third of concussions involve loss of consciousness.

Jordan: A lot of people are going for D.

Scott: Winner, winner, chicken, dinner. Yes, D. We have some smart people in the audience. I love it. So, okay. Let us work through this. Some concussion pathophysiology. This is a work in progress, though. They are still studies continuing to be done. We have several studies on rodents, on rats, which is a model for us. But yes, this is going to be tough to really do in the human model with the technology that we currently have. What is generally considered across the board here is that we have this stretching of the neuronal cell membrane, and that is leading

to some dysfunction. That is really the working theory that is acknowledged across the board here. Then there is several researchers in this space, but Christopher Giza out of California has done some amazing work in this regard. I am going to use a couple of slides to show exactly what is thought to be happening here. This is just sort of an overview. Again, we have a stretch disruption, which leads to metabolic dysfunction, some general pathophysiological, and then some ionic dysfunction. And these components are at the bedrock or at the base of the symptoms that we then see after the fact. This is a specific slide that is from Chris Giza. What happens here is, with that stretch disruption, we have a depolarization. There is an actual potential and some neurotransmitter release. And then, it almost instantaneously levelled up the potassium. The K is coming out, and that forces us to activate that sodium-potassium pump and try to fix the situation of the potassium coming out. Then, of course, we have some hyperglycolysis and some lactate accumulation.

The thing that is a bit more damaging, though, than that scenario is the calcium that ends up coming in. That calcium that is coming in leads to mitochondrial dysfunction, which further challenges this sodium-potassium pump scenario. Calcium coming in leads to some oxidative phosphorylation. We have some enzyme activity and protein death. And this is all happening under the context of decreased blood flow. So, there is some transient decrease in blood flow, right at the start, right after the injury. The situation here with the calcium coming in leads to cell death. It leads to altered protein. It leads to an energy crisis with that sodium-potassium pump. It leads to some inflammatory markers increasing. And that whole mix is what is referred to as this cascade of events. Note that we do not spend very much time talking about it today, but maybe we just go back here.

This scenario with the calcium and the energy crisis will be the underpinning if you are thinking about why magnesium might be an important nutrient for athletes who have been concussed. It would also maybe make you think about creatine levels, and there is some research on that as well. In fact, I would say that if you are an athlete playing in a sport where strength and speed and collision are part of it, creatine makes a lot of sense for numerous reasons, not just muscle hypertrophy. Then, with that stretch disruption and cell membrane distortion, things like Omega-3, and specifically DHA, would be something that the nutrition person in the audience might already be, like, keen on. So, just putting out those couple of quick things. We have this cascade, and it leads to a bunch of symptoms. And the question here is, which of the following is a sign or symptom of concussion? Select all that apply.

Jordan: You also have a question, and I can answer, kind of. About magnesium, topical, or oral?

Scott: Usually, it would be magnesium glycinate, which would be oral.

Jordan: You typically have to get us better with the alginate so that it can actually cross the blood-

brain barrier. So, that is really important. Otherwise, it sticks outside, does not really help with the recovery, certainly, so it is the best.

Scott: Yes, there are some magnesium options that are less absorbable or have more of an impact on your gastrointestinal system than this. Well, all may be observable in an acutely concussed patient, but not all these signs or symptoms are actually associated with the diagnosis of concussion. This is a tough one because I am not giving you the ABCs. Just to move this along, I will reveal my answers to you, and it is headache, dizziness, confusion. I mean, if you see that hemiparesis in that athlete, you are thinking, "Oh God, is there a spinal injury here? Let me stabilize this athletes head or this girl's head. Let us activate some first response here," If you see a fixed dilated pupil, this might be more serious than a concussion.

Jordan: and I think you made a great point, yes. All these can be present if someone has a concussion, but there is something most likely more traumatic and severe as well. Same mechanism.

Scott: So, nausea, vomiting, those are potentially red flags. The emotional personality changes, you do not usually see those right away, but on the sidelines, that can come to light. So, it is generally nice if you know a little bit about graphics in advance, fatigue, temporary loss of consciousness. We have discussed this loss of consciousness issue. You do not need to have it, but it can be there and up to a third. The most common signs and symptoms of a concussion are headache and dizziness, and that speaks 2 of the Post-Concussive Syndrome as well, which is why It is not uncommon that, if you are a chiropractor, you are going to see concussion patients. There are some other things to note here, though, the blurred vision, the sensitivity to noise. I mean, sensitivity is delayed. Those can also be associated with the headache. The "I do not feel right. I feel like I am in a fog." Those can often be associated with dizziness as well as nausea or vomiting. We will work through this a little bit more when we get to the Sports Concussion Assessment Tool. But just pointing out, these are the most common signs and symptoms.

The good news is, most athletes, in fact, do recover, and they recover quickly from the concussion. That is actually a really key educational point to highlight in your practice because of all the media coverage. There are several patients who have come in with a fair amount of anxiety, having then concussed, and this could be a real problem for them moving forward. Most adults, 80, 85, 90%, recovered in 10 to 14 days. It is a little bit longer for children, and we will touch a little bit about that at the end as well. I gave you a bunch of those symptoms there, but how many symptoms of a concussion are required to make a diagnosis, 1 or more, 3 or more, or 5 or more?

Jordan: C and I have an A. Conflict for the first time, multiple-choice. Mark is on a C. All right. So It is 5 to 2.

Scott: It is indeed 1 or more symptoms. Of note, the more symptoms you have, and the more severe those symptoms you have, the worst score you might have on that on a SCAT symptom checklist, the worse the person responds. So, the more severe the symptoms happen to be, or the more symptoms you have, the longer it takes to recover. So, to make the diagnosis of a concussion, you simply need one or more symptoms and the mechanism. But if you do have 3 or more, or 5 or more symptoms, that would certainly clue you in the possibility that this might be a little bit longer than that 10 to 14 days I just discussed. Let us get into some sideline assessment slides here. I really want to emphasize here the understanding, utilization, and recognition of the red flags, and we will be using this SCAT5 document throughout the day of the presentation. The first thing on this sheet is the red flags. Step 1, red flags. What are those red flags? Obviously, you cannot read this sheet. Neck pain or tenderness, double vision, weakness, or tingling into those extremities. So, those things make you think of the possibility. Well, the neck pain and the weakness in the extremities make you think of possible spinal injury, right? Increasing or severe headache, Jordan, you will meet tons with that in a few slides.

Seizure or convulsion. If there is a seizure or convulsion happening, and you are on the bench, and you have not got there yet, you already telling somebody to call an ambulance, right? An ambulance is going to have to come to this scene if there is not any already at the end of the bench or something. Loss or excruciating consciousness is after, but the players in the sideline start getting tired, or they are getting sleepy, or they want to go lay down. That is a red flag. Vomiting, particularly, repetitive vomiting is a red flag. And then there is increasing restlessness or agitative combativeness. That is when you do need to know the players a little bit. If you are holding a player out of the game, and they do not think they have a concussion, they might be agitative or combative. So, those are the red flags that need to be identified because these are the things that are going to require some follow-up and sending off for some additional assessment.

Jordan: Scott, what do you think about vomiting, like, once versus twice, different qualities? Do you throw the line anywhere there? Do you allow any vomiting? Do you call it at one? I have heard different things, and I kind of have a different opinion, too.

Scott: Yes, out of the opinion of just vomiting one time, I am going to send to the ER. I will tell you that the more times you vomit, the more troublesome that will become or the more worried I would be. But if you could have one vomiting and it is not particularly dangerous, but in my box, if there is one vomit, I am going to send you over. It means that there is enough disruption to affect the vomiting center in your brain that caused you to vomit, right? Some of these red flags, not all of them, I mentioned a couple is more in tuned with a spinal injury, but a couple of these also reveal the possibility of a hematoma or a hemorrhage. Jordan, I am going to pass it over to you on these next couple of slides here to walk us through some of those cranial hemorrhages and perhaps to start off with the Glasgow Coma Scale. So, if you were to show up at the side of

the unconscious player besides doing your quick ABC, you are trying to figure out where this person might be on a GCS.

Jordan: Yes, I think it is important when you are looking at some of these scales, just not with the totally unresponsive as 3. You can be dead, and you can throw a 3

Scott: I think Mag is a 3.

Jordan: Yes, I got him once. So, when we are looking in that category, and we really use this roughly, say, is it mild traumatic brain injury? Is it moderate? Is it severe? But again, you can be dead and have a 3. Some of these mild, you are looking at a 13, 14, or 15, essentially. So, you come up, say, "Hey, how are you doing?" Maybe they look straight at you, but then they might be a little sluggish in their response. When they look at you, they kind of have to take focus, and they say, "I am okay," or something like this, or they are not really sure, and they just say something like, "What happened?" anything like that. You get an instant eye-opening but kind of a confused, disoriented response, and then they might take a moment. They might get up but kind of be a little unbalanced and then start walking. You are sitting in that 14, maybe down in a 13, and That is all within the range of concussion. Now, once you hit below a 13, that 13 to 9 level, you are in a moderate. So that is where we have more suspicious of something, more intense if they do not respond instantly to opening their eyes. It takes a while, maybe you have to do a sternal rub before they finally look at you, and they respond and be a little alarmed and looking about or more confused, disoriented. Or if you tell them, "Hey, can we get you up, walk you to the bench?" And they are confused, walked the other way, right those individuals. You have seen plays where they will walk to the other people's huddle or something like that. So, this can drop down very quickly. Once you hit below a 13, they said, "What the hell this scale is?" You really want to be really alert to what is going on there. We will go through a couple of hematomas here, what is going on, and where the brain bleeds out. But the bottom line is, once you have any suspicion of any of these, we go straight to the ER, right? CT. Rule number 1, make sure no one's dying. So do not super ponder, like, "Yes, well, I think It is epidural or subdural." Just send them away, but it is good to know somebody's background.

Probably, one of the more common ones is the first 2 we talked about. So, the epidural hematoma is when it is more highly associated with a skull fracture. So, epi is upon, so it is between that dura and the cranium there. More likely in adults to happen in the temporal region because it is the softer bone. So, you take a hit to the side of the head, more likely you get that side temporal skull fracture.

Children, because of how they develop and that their entire cranium's a little softer there. It can happen kind of anywhere in there. Once an epidural happens, it is 10% of all the TBIs that require your hospitalization. It can happen in non-traumatic things, but more likely, with these acute

traumas that happen between there. So, nerdy questions, you look at the middle meningeal artery. If any of you have to take advanced board certificates, that is usually a little question I like to throw at you. Subdural hematoma. This is the one where we used to say, "Hey, you cannot go to sleep. We are going to keep you up," which, going back through that whole energy deficit that Dr. Howitt talked about. It is really bad because people need sleep, but this is where we got the idea that we are afraid that people wouldn't wake up. So, that epidural hematoma, you usually have that acute and maybe unconscious, come back, and be really elusive, and then drop-down hell quickly. This is that slower nagging where they may have a slow bleed That is between the arachnoid and the dura matter, where they have this headache and, at first, there is like, "It is a 3 out of 10. No big deal. Of course, we pulled them from playing and whatnot." Then, the next day, it is like a 5, and then it is a 6, and when they wake up, and It is a 10 out of 10, the worst headache of their life. And they have a slow bleed That is getting worse and worse and worse. That is typically that subdural hematoma.

This is the one that is more likely because they might not go to the ER for a 3-out-of-10 headache, and you may not think to send them for that 3-out-of-10 headache versus that acute subdural trauma. Yes, you are not unconscious. You have a 6-out-of-10 headache. Hey, get a CT. This is the one that can get individuals, and it is more likely to occur in those older individuals just because of the weaker vascular that can affect individual cells. Therefore we used to say, "Do not go to sleep." You are afraid if somebody slow-bleeds.

Scott: Full disclosure there, Jordan. I should have mentioned that first disclosure. I have had 6 concussions in my life, and I am of the age where the first 3, I had to spend the night in the hospital overnight, but that being woken-up-every-half-an-hour scenario. I mean, you get the Jell-O in the morning, so that was not the worst thing, but we do not do that anymore.

Jordan: No, we will cover some of the red flag things later, but yes. We do not wake people up. It is really bad. Well, these last 2, not nearly as likely in your athletes' cases and not things they see as much as subarachnoid or something beneath it between the pia mater and arachnoid mater. Most likely, if this is going to happen, it will be in trauma. It can also happen with the typical strokes that you see. That is if I remember all the stats correctly at the top of my head. This is the least likely one that you will see. Intraparenchymal. Parenchyma just means tissue. You have one parenchyma. Anything that is parenchyma is tissue, so we are saying is It is inside the brain. Usually, you will see more ischemic strokes, right? Those ischemic things are happening, but we can have hemorrhagic strokes. So, it can happen in trauma by any means, but this is more likely to be one That is increased into those risk factors like hypertension, old age, anything that could put you at risk for having an either ischemic or hemorrhagic stroke. This is more likely what you will see. It is not as likely to happen with those acute traumas, but it can still happen. We are looking at imaging. That is why I said, if you have any suspicions of any of those, you really want to go on and just get a CT. Now, if it is truly just a concussion, you will not

get a response off MRI or CT or even an X-ray. They will be all negative if you are looking purely at concussion, right? So, once you get a positive CT, yes, you may have a concussion, but you will also have a traumatic brain bleed, which is not good. You should get that handled fast.

We will talk about some other associated signs, symptoms. So, you could have a concussion and have a vertigo fracture in the neck, and then we have all the cervical components as well. So, they can be correlated, going alongside, but a pure concussion has negative on these typical findings. And we do not get too much into it, but you can spend 5 to 10 thousand dollars in research and get some functional MRIs. You can look at some of these things, get some positive findings, or if you use a sensor imaging scan. But you are not doing that clinical practice, it is not really available. Maybe it is getting there, but you are not going to spend all that money on this. So, typically, if these are negative, you say, "Okay, it is not a traumatic, or It is not a moderate or more intense traumatic brain injury, but probably sitting in that concussion." We go through some guidelines to do these images, all right? So, we want to keep that in mind that we do not want to just reflexively image just because they have potential, and we will go through some more of these specifics. So, Canadians, they give us guidelines for everything that works well, so I always appreciate them for the guidelines they give us. Your far left, we are looking at more X-rays, right? So, when should we get an X-ray? This is a head injury. This is a concussion. But this is any clinical practice that you are looking at with that. So, over 65, right? If you are elderly, or you take a more severe trauma injury, this is one we are looking at during X-ray. So, a fall That is over a meter. Usually, we say, "Over a time and a half of your height." "2 times your height." "You fall off a ladder." "You should get an X-ray or something like that." Things that you may be suspicious of, and again, this goes into your comical exam. We will talk a little bit about this.

You are all well-versed on cervical exams and neck treatments. We are going to spend some time there, but you may not get X-rays or not initially get X-rays if it is just a simple rear-ended motor vehicle accident. They do not have signs and symptoms to start, or they are just sitting nonchalantly in the treatment room. This last one is kind of one that you may notice without doing the exam that They will readily look far to the side. If someone is hesitant to move the neck at all, they come up, and they say, "I do not want to move." Your body has that response to say something is wrong. For some reason, like, "I do not want to move my neck and head at all." They will be in very static posturing. They may look at you, but you see that they have a great hesitance to move. It might be a good indication to take an X-ray. If someone is just truly looking around and kind of looking over at you, looking around, yes, people can walk in with fractures, by any means, and That is where the clinical process comes in, but it is less likely if they are just actively moving around. It is no big deal. With the CT, we talked about the Glasgow Coma Scale that you are under 15 for over 2 hours, right? So, initially, they may have a delayed response. They may be a little confused. But within 2 hours, they are back up to 15. Not a big deal. That 13 or 15, it is all supposed to be a mild traumatic brain injury. If it stays for longer than 2 hours to wait for some symptomatology, we probably want to look at a CT or MRI. Then, any signs of

those basilar skull fracture we talked about earlier. We got the raccoon eyes, which, of course, where it looks like Dr. Howitt used to punch me in the face a bunch of times, and you just have that swelling, so you have blood That is just coming towards the surface of the eyes, and That is that pressure and bleeding internally, or the battle signs where you see down the side of the ear, so it leaks to pool in those soak eye or along the edges, so you will see some of those. That is a huge indication to take.

Of course, someone could be, in Taekwondo, punch in the eye is a different, focal sign, but That is where all your clinical process comes into. Vomiting more than 2 episodes. So, therefore I quizzed Dr. Howitt. You get a couple of responses. Is it one vomiting? Is it 2 vomiting? Where do we go into the red flag? It is not wrong. Just like Dr. Howitt said, they are projectile vomiting. Just once. Of course, It is a huge red flag. You should probably get a CT on that. But if one is really dizzy and they vomit once, and it is the only sign or symptom they had for this, it is probably not worth a CT. So, we can finally do this together. Amnesia. So, this will be anterograde amnesia. Antero being before, right? Amnesia, for more than 30 minutes before the impact, and then anything That is a dangerous mechanism entry. In most sports, if you see any of the collisions, the poor hockey player. There are dangerous mechanisms of the injury there, and then, occupancy. If you are ejected from the vehicle, with that, then anything That is loss of consciousness. Dr. Howitt talked about this earlier. The hockey player That is already out unconscious, several signs or symptoms, probably worth that CT. And then, as we talked about earlier, that Glasgow Coma Scale. And then, you may not see as much but delayed symptomatology. If it is over 14 days, and they are still having, oh, sorry, this one actually says 30, but some would look a bit more aggressively and say, "If It has been 14 days and you have symptomatology, you should probably get some advice." In these next few slides, we will just give you a nice Venn Diagram from those dang Canadians. If you are not sure, you are in between. It gives you a nice diagram for us simple people like myself that you could just follow through and look at, "Do they have any high-risk factors?" So we are looking at, "Ah, they are over 65, and they had a dangerous mechanism. I should definitely look down at X-rays, right?" This is just taking radiographs here.

If it is a yes, okay, pretty much instantly, you were in a remote vehicle accident. You are in a collision sport where it happened. It is instantly a dangerous mechanism. You have neck pain. You have head pain. We should at least probably do some radiographs on that. But maybe, we are not sure. You can do a full range of motion, and That is for some clinical exams.

Scott: Jordan, we are keeping that stuff in the back of our brain, even when we are going out there onto the picture of the eyes or whatever, right? So, some of those understanding what is in those lists, you already understand that when you are getting to address the athletes. So, you may know right at the moment in time that the athlete is unwilling to turn his head. It is likely that this athlete's going to need an X-ray. The other thing that when you were saying greater

than 65, but old-timers hockey are actually well-participated in events in Canada and even in Northern US where it is not uncommon to actually have a masters or senior-level athletes that are participating particularly in hockey. I mean, they are usually not trying to hit each other, and they go to work the next day if they are still working. It is not an uncommon thing to find that greater-than-65-year-old hockey player. Just saying.

Jordan: Yes, well, ultimate frisbee sounds like it shouldn't be contact where you or a bunch of ultimate frisbees, and they have the grandmaster league for 55 plus, and these athletes would outrun me. I feel ashamed and frustrated. Fit and active. And there are just accidental collisions, right? They are told any of these things where there is a high-risk, and we are talking specifically obviously with things and sports. This is anyone. We had a 65-year-old that was in a mild motor vehicle accident. They are just that much higher for these risks. So, CT, this is where we say that you should not just reflectively say, "Oh, you had a head injury. You should get a CT," because That is where we are going to get high health care dollars. Obviously, your patient's health and well-being are more important than the cost, but it can be a huge expense for someone to send them to an ER. They have an ambulance, specifically, and they have a CT all over for something that was pretty low like we put there. So, always go with your clinical exam and your intuition there. But this gives you a nice look at what is high-risk. And they still have diminished Glasgow Coma Scale after 2 hours with that. If you have any of those signs and symptoms. If you have any lung and have a tender point, they have a point that seems to give a little bit for skull fractures. And that vomiting over 2, again, you might tell that line 1 to 2 depends on who you ask with that for vomiting and what not. Then those the elderly individuals. That medium risk, that is where you have to pay attention, right? You were in that collision sports, like, a hockey player, or maybe something not as drastic, paying attention, but it might not instantly to say you need a CT. And that amnesia before impact, that happens, that retrograde amnesia. And this is where I had in Australia's rules footy player that matched all of these. Well, I did not see him for 2 hours, but not all of these.

He could not remember that his brother was in the hospital for getting cardiovascular surgery. Some of the important things. That was like 4 days prior. He did not remember that. He could not remember anything, like, 5 minutes after you asked him. He had signs and symptoms. He had all of these red flags, except he didn't vomit, but he's really dizzy. We sent him to the ER because we could not moderate him, completely clear on the CT, though. There is a hundred percent I stand by my decision but completely clear on the CT. So, even they have multiple of these, they are really helping. So, he goes into that. He just has a concussion, but it is not life-threatening at that point. So, some of those, better safe than sorry when you have multiple red flags. Second, impacts. So, this is when we get to return to play, return to learn all those important things. This is the number one thing that you are probably watching out for. Sometimes, people's signs or symptoms will go away, but we always want to go through the due diligence process for someone who is returning to play and learn.

Scott: Also, Jordan, when you said just the concussion, it is one that just a concussion can go bad, right?

Jordan: Really bad, yes. Okay. So, to start this, someone should have sustained the head injury previously. So, this is the second impact. Makes sense, the second impact. The problem is, it is similar to a concussion that we do not fully know what happens because looking at imaging after the fact, the unfortunate scenario that we talked about is most of the time, this is a pretty quickened, imminent death. We think is going on, and this is all from animal studies, right? Because although Dr. Howitt would like to hit me multiple times and track me with some MRI and imaging, it is probably not going to pass IRB for my safety.

Scott: No.

Jordan: Dr. Howitt talked about that initial energy deficit, right? I mean, all these static and all this metabolic injury and deficit That is going on, and then you get hit again, and your brain already damaged is covered from the first one. So, the second time it comes around, it has no chance whatsoever. So, it got this huge sympathetic flood, and we have some neurotransmitters. Essentially, you have blood going into the brain, but for some reason, our body is not allowing you to go out, so you have this increased pressure, all these bloods going in and in, but none of it is draining, so you instantly get this blood that is going on in that. The problem with this is that, unless you must be, let us say, Toronto or the Twin Cities where I am at, within 10 minutes on a neurosurgeon, if you are in any rural environment, you just, unfortunately, do not have high supply rate. You have death in 2 to 5 minutes, right? Because you have this really acute swelling. They essentially need to immediately go in, put you on life support, and cut open your cranium, your skull, to relieve the pressure. See those pictures with just the brain sitting there with pieces of cranium taken out? This is what needs to happen because we have just this super acute swelling and increased intracranial pressures. Now, after the fact and some of the MRI there on the last slides show hematoma, that is where it gets tricky. So, maybe they had a hematoma in their first injury, which is mild, right? Or there is this slow bleed, and then the second one ruptured it further, causing this very acute symptomatology, really intense fear reaction.

Or maybe they got a hematoma on the second hit because they are weakened, or it just so happened to be a more traumatic event or a little bit more rotation, something that adds to that. So, it is impossible to say just with studies, like, do we always get a hematoma? Or do they have a hematoma, the first one? Like, it is subdural, that minor headache, and they went back, and they lied about it. So, you got hit, and then it made it worse. We are not a hundred percent there, but if they got the CT or MRI on the first one, we probably would have picked up that brain bleed if it existed on the first one. What is really difficult is to tell how many of these happen. This study here went through, and they looked at just high schoolers, and I forget how many in that Scott if you remember, let me know, how many high schoolers they went through, but they had a pretty

large number, and they went through musical things, and they called some of these places, try to figure out how many second-impact injuries occur, and they get about 94 in 13 years, which isn't extreme, but these are all preventable deaths, and, It is one of those things that is not reported as much, and It is difficult to find. Because if you are in a rural environment, the 3 to 5 minutes, unfortunately, and sudden death. If you are not close to those and it is not documented in a proper hospital, these numbers do not show up, and all of these are preventable. I would say 99 and a higher percent are preventable if you do it properly, return turn to learn, and return to play.

Scott: Yes, and Jordan, the frequency does not seem to be extreme, but obviously, the outcome is totally extreme. And this is for those people that are in the audience that are from Ontario in Canada. There is now something we called Rowan's Law, which was a law that was created after a catastrophic injury with a rugby player who did have a second impact soon after a couple of concussions, and it highlights, actually, even the education on the front side of it. So, we talked about education when the person's in your clinic, but education about in the pre-season with the contact support about what concussion is and how to recognize it, not only for the players but for the coaches and for the parents as well.

Jordan: That is the public health aspect, just as the education.

Scott: I am going to try to get through a few more slides here on some key points for sideline assessment. Jordan and I, when we practiced this, thought about sometimes we might want to take a break. We are not quite hitting what we had predicted, but That is okay. My thought here is I am going to do probably another kind of slide or so, and then we will take a quick bio break and then move at that point. So, a key point I did want to make, this athlete's head is not inside of his helmet. He is on the ice, so he is not the headless goal here. But any player who may have had signs or symptoms of concussion is removed to comply and does not go back into playing that game. That is a principle, a standard across the board, that if we had not said that already, I just want to make that really crystal clear. Jordan's already drawn over this, but when we are out there and the player's unconscious, we are trying to get a sense of this GCS. Does the player open their eyes? If I speak to them, can I get them to open their eyes? Or can I get them to move? Or can I get them to say something? So, the eyes, the verbal, the movement help sort of gauge where that person is at. And will be particularly important to the paramedics if they should be called to the scene. One thing that I just reminded myself about when I looked down at my pen here, you know, the penlight. So, I have one of these on the side of my kit, on my little bag, and when I run into the pitch. And I always just shine that into the eyes of the athlete That is lying there with their eyes open. We want to check people's reactivity. Sometimes when you get hit onto the pitch, and this has happened to me before as well where I am working on one player, and then I hear something. Then they are calling for me to get back with the other player, and I really did not see it, and I am trying to ask if the player's around, what happened? We need to

be particularly cognizant of what that mechanism was, right? The loss of consciousness obviously is more concerning to us. Tonic posture, if you are seeing that the person's inflection or extension, ambulatory activated before you even get to the player. The one thing that we sometimes see is that motor and coordination are at that staggering state or phase. Just get the player off. I mean, if they are already coming towards you, just get them off the pitch. This is somewhat dependent on the sport you are in regarding how this is managed. But in soccer, we get them off the pitch, typically on the sideline. We have an opportunity to make the decision about whether they are staying off or we will allow them to go back on, obviously, not if it is a concussion.

In some sports like rugby, the play goes on. So, you have to make an assessment, and That is a different first-response, that there is no fire, no wire, no glass, no gas, check my environment, well, the play is going on. And then, there are some other sports, like, if you were in mixed martial arts, if you are out, then it is over, right? But the match might be over for the athlete. So, there are different contexts, obviously. But sometimes, it is challenging to say, "Is that a concussion? Or is that not a concussion?" If you are in the United States, watching football, they have people to watch the game, and then they are called out to the sidelines and say, "Can you please go check this player?" That is something that absolutely happens. And from my point of view, I will just say the bar is low. If you think That is a concussion, it is a concussion. Until you prove It is not a concussion, it is a concussion. Obviously, that is a red flag, not a concussion more severe than a concussion. But if you are unsure about, "Hey, was that really a concussion?" then consider it a concussion. Again, that athlete is not a therapist. That is a coach. But that athlete's unconscious. That is, at minimum, a concussion. So, another question, let us see if people are still awake with us, Jordan. Which of the following is true regarding the mechanism of a concussion: direct physical contact to the head is necessary; local damage to the brainstem; localized damage to the prefrontal cortex; localized damage to the hippocampus, we are really specific here, or a whiplash affects the brain caused by an impact to any part of the body may cause a concussion?

E is the correct answer. So glad to see we are making an impact there. The Standardized Concussion Assessment Tool. This is the cheat sheet and cheat code if you help. This is the thing that will drive your sideline assessment, and whether you have a paper copy like this, or you have it on your iPad or your phone or whatever, there is actually a pocket tool as well, a little one-pager. This will be the thing that is going to help you work through that initial assessment. In fact, I even use this in my clinic. When somebody comes in after a concussion, it will be the tool that I will use to work through an assessment. It has been shown not to be as useful after those first 3 to 5 days. But regardless, in my perspective, I would still use this as my go-to tool to open up a concussion assessment. On this particular tool, you have the Maddocks questions. This is kind of like, you get out there to the pitch, and your players are alert and awake and sitting there. These are the kinds of questions that you are asking the player, "Do you know where we are?" "Do you

know what the score is?" "Do you know who scored the goal?" Those kinds of questions are the questions that you can ask, at the same time, you are, like, "Where did you get hit?" and you are palpating the middle of their C-spine. "No, my neck is fine." The player is looking around, and you are like, "Okay." Possibility of a cervical injury or a spinal injury less, obviously. There are additional components to this in terms of the short-term and delayed recall. Those are not questioning for on the pitch side. Those are later. It is more standardized, "Where are we? What's happening?" that kinds of questions. I work a lot with soccer, so It is not uncommon where I get to the player, and the player's already saying to me, "Doc, I am fine. I just needed a break," or "Is he going to get a card?" So, again, it depends on some of the sports you are with and your understanding of the players. On that pitch, right away, though, I am trying to make a decision in terms of like, "Is this a spinal injury?" "Is this something where I need to stabilize the head?" "Is this something that I need to call for paramedics or for assistance with?" as I am trying to stabilize the neck?" Of course, the C-spine rules regulate the brain at the same time that that is happening. A cranial nerve exam. If you do have some additional time on the pitch and you are not quite sure, you can do this fairly quickly. Do a penlight for the reactivity, but a little age pattern here, like, we are testing cranial nerve. "It is 3, 4, 6." Like, "Are your eyes following me?" "Can I get you to do that?" "Can I get you to say" "Can I get you to shrug your shoulders?" "Can you hear that?" In certain environments, it is going to be more challenging to do some of those things.

The one that comes to mind is if you are going to check olfactory. If you want to check if the person can smell. Jordan, we have had a number of games where we are in the southern US, and when they want to wet the field before we play a soccer match. The water tends to be sulfuryl, let us just say. So, you can check smell by saying to the player, "What does this smell like?" and it does not smell good. The sulphur smell is pretty distinct. Anyways, not necessarily on the pitch. On the side of the pitch is when I might assess best. You know, I am going to check single leg, double leg, tandem stance. What does your balance look like? You might get a sense of that even just walking off the field. Cervical Flexion Endurance Test or some more sports-specific training. These are going to be some more things that are going to be, if you are on the sideline and you are thinking, "Geez, this is not," because at that moment in time, on the pitch, you are basically deciding, "Is this player not going back in? Or do I need to take the player back to the dressing room to do some more advanced testing or have a more of a quiet space?" If you are looking at that from back in the dressing room, let us just say, and you have a table there, okay, maybe you can check cervical strength at that point. I would do maybe a complete range of motion testing of the cervical spine. Of course, you could do your compression tests, your Jackson Spurling's, and things like this. A more comprehensive examination can occur on the sideline. Particularly, it is not uncommon if you have a table or plant at the side over, behind the bench, perhaps. There is nobody in the stands, at least, most of our stands these times. So, you can do some stuff in the COVID environment at the pitch side. But generally, I would take the athlete back to the dressing

room, kind of one of the other therapists that I am working with, to take the player back to the dressing room to do a complete assessment.

A King Devick Test is something that I did a paper on back in 2016. We looked at this as some utility as well, in terms of looking at vision and in terms of looking at ocular movement. This is just an additional test that we sometimes use where a player has to follow these lines or in test number where they see no lines and be able to track across there and then read off a series of numbers. Makers of this test sell cards that you can include in your kit. And those can be used as well to help further assess or further aggravate symptoms, which may be less than apparent. Another one that there is not a ton of research on but is interesting, and I know some of the athletes that did this at the University of Western Ontario, looking at reaction time having a little stick, and then you got to catch it and, you know. These types of things are interesting. They can be helpful, particularly if you have some baseline or understanding of where the person was before using it in this setting. Just a couple of quick things I wanted to point out. If you are on the pitch by yourself, this can certainly be more challenging. And it can certainly be more challenging if you are looking at one player for one injury, and then another injury happens, and then you have to get out onto the playing surface and then make a decision on a concussion.

I would absolutely recommend knowing a couple of things. And That is, like, who the therapist or who the first responder is on the other team so that you can assist one another. Who the other person would be within your own team that can be of assistance? We have talked about this a little bit in terms of which sport you are with. But knowing some of the regulations associated with the individual different sports, not the same in hockey as it is in soccer as it is in rugby, state the obvious. Having your little checklist of things, you are going to do, particularly important for anyone covering an event. I have been asked this in the past, so I just stuck this in as well. I keep showing or referencing the SCAT. There is a SCAT5 for a child as well, which is for the 5- to 12-year-old. The words are a little bit different. Some of the descriptions are a little bit different. Signs and symptoms with the parent. There is another form if you are dealing with the pediatric population. And I will just, again, emphasize the planning that is involved in the basics of sideline fundamentals. In an emergency situation, it is stressful. You need to check your own pulse before you check the patient's pulse. Then you have a bit of time here. But having a checklist and something that you can come back to. Some people say, "I do not really want a checklist. I do not want to have to." The checklist is what is so vitally important in these emergency situations. It is what the military uses to be able to absolutely not miss a beat and be able to be a high performer in a high-stress situation.

Jordan: Yes, I would just echo that. You think you get everything down, you are good, then suddenly, that hits. You see some other symptoms. Someone's got a fracture or something like that. It just goes out of your head sometimes. So, just having a checklist, even if you have memorized, having that backup cheat sheet. We are supposed to be the best and the greatest

when we do some of these things. But sometimes, it can be really flustering, dramatic things, and you have 5 thousand people looking at you. It is not hard to forget what you are doing, sometimes.

Scott: My next slide, I was going to ask about some management, and then we are going to go right into the next sort of clinical examination. Jordan, it is been about just around an hour and a half since we got going here. So, I think, if there is a time to take a quick 5-minute break, a bio break, now is the time. Jordan and I might fill up our coffees and get ready. So, we are going to take that right at this second.

5-minute break

Jordan: Dr. Howitt, chime in if you have something different but just a question in the chat, is it likely that you can affect the player's recovery if it is a concussion, but you do excessive concussion testing post-injury trauma? Usually, when we are looking to research or just personal experience with it, temporarily, you may increase their symptoms, right? If you do something, and we will talk about SCATs and VOMS and some of those. You have some different eye tests or anything like that, or maybe have whiplash and you have them just test an active range of motion. But long-term-wise, you do not really, especially when we get to the exercise, stress testing that Dr. Howitt gets into. We know that there may temporarily be an increase, but it does not affect their long-term recovery. That is still on average, or when we are doing some of these tests properly and implementing proper treatment, they recovered faster. Or even some of the quick screens, it does not resolve any of the long-term delays. So, unless you are doing some weird, crazy tests that really are not really supported by literature, you are not going to affect their recovery.

Scott: Yes, I would agree with that, Jordan. And I just would add to that. It is unlikely that you would be able to do excessive tests because the patient would not tolerate it. For the most part, the idea is that if you are doing additional tests, it is because you have not reached the threshold. So, if you are, you are sub-threshold, then you keep going on. As soon as you reach that threshold where the person starts to feel awful nauseous, dizzy, headache, whatever, they are not going to want to participate in those additional excessive tests and whatever that might be. But I agree, Jordan, the sooner that we can get people physically active after a short period of rest, the emerging evidence suggests that That is the way to go. Let us start with the next question: What is the appropriate management of concussion? We have not talked about this at all. So, this kind of sets us up for what we were about to talk about. Although, there is a couple of things here at the bottom that we have talked about, obviously, imaging-wise. Every concussed individual should see a healthcare professional. A concussed player can return to the game, stepwise increase in exercise and activity. If symptomatic, physical rest is always recommended. Mental

rest is always recommended. Signs and symptoms should be monitored. Full neurological examination is recommended. Mini-mental status exam and initial assessment, MRI, CT.

Jordan: Other options. I really think that one of these questions should be looking at all your action shots, and we can decide which one is the best. I want to know your photographer because I think we should vote on the best Dr. Howitt action shot on the field. That should be in the last. I wish I could stuff that in. Let us all vote on the best of Dr. Howitt's action shot.

Scott: Yes, I do have a few sideline pictures here, right? The middle third is correct. But it is also recommended that every concussed individual actually sees a healthcare professional. Again, rule out perhaps some of those red flags to provide some education and help progress the person that is even perhaps not severe. Education, education, education. I said it 3 times on that slide for a reason. I think we should try to move through some of the clinical examination slides that we have. And then we will see how much time we have left at the end to hit the return to play and return to learn slides we must work through what the suggestion might be in our clinical assessment, as we have described here, that Correlated Systems Examination.

Jordan: Perfect. you know, there are some slides here that we won't be able to spend tons of time on, right? We have got less than an hour left. We provided a lot of extra information. Like, all the tests, we will talk about all that is just laid out so that you can come back and review it. You probably will not be an expert if you've never done VOMS, but we are talking about doing it. The one time we talk about it, go through, and review it. Dr. Howitt referred to this in the very beginning, but you get to decide how much or how little you do, to a degree, right? Some of it is legally determined for you, do not break school practice, but you do not have to do it if you feel really uncomfortable or just do not want to be an expert in vestibular ocular things. You are 100% into understanding you need to refer and get those things checked out, but that does not mean that you have to be a pro at everything. Even if you take the entire concussion, and you say, "I am a chiropractor. I am just the best with the cervical spine musculature. I will have to handle that aspect and refer everything out," That is perfectly fine. Just make sure that they see the proper individual for this, right? I am not the best at nutrition. I can tell you basic nutrition from sports things and the concussion side.

But I cannot handle anything real in-depth. It is not my specialty. I try to put my energy in other places. So, some of these, you may not be comfortable doing it. That is fine. Just know when to refer out and when to help. So, you can cover, you can handle a lot of these, but it is really up to you if you really want to. We will be looking at this and the signs and symptoms checklists that actually came straight from the SCAT5. When someone walks in and they check all those signs and symptoms, you should think, "What systems could cause the signs and symptoms, and how am I going to specifically test them out?" A hockey player, if they had a headache, neck pain, dizziness, mental fog, and maybe a couple of other eye symptoms in there, you should break

those all apart and not instantly think concussion, although you should suspect it. Let us say, what is causing any of these? Yes, I will let you stop me if there is an important thing in the chat.

This is just covering what I said, right? We are really going off some of the Berlin consensuses. But also, when we get into exercise stress testing, some of those things, or advanced testing or things that you will think about maybe doing as clinical tests, we will cover briefly with that. But look at all these together, think about their signs and symptoms, and then make no assumptions about what is causing those signs and symptoms. Just test them out diligently.

Jordan: So, the primary thing that we look at for causing this, of course, is the brain. But besides that, the associated signs, or symptoms that we have are cervical, vestibulocochlear, ocular, and then TMJ is in there. It is, it is not as high in the list, but it certainly should not be forgotten there. So, if you place all of these and look at signs and symptoms that happen with concussion and signs and symptoms that can happen with each of these systems, it would be a ton of overlap. You may not think about the cervical spine causing difficulty with eye movements and showing some of that correlation things in balance, but it happens. Even fogginess, which instantly makes you think that someone That is mentally fatigued or has fogginess is a brain injury, might be due to the cervical spine effect. Vestibulocochlear, I think we all think of dizziness, some vertigo, headaches, it is causing some of that. But do not forget about some balance and the gait and some things that you think, "Oh, they are disoriented. It is a head injury," but the gait can be all due to the vestibulocochlear. Then, ocular, clearly. They take a shot to the eye. That is one thing. But also tracking, accommodations, smooth pursuit, those things that we will go through and cover. Always make sure that they see whether it is a neuro-ophthalmologist or you can do some at least basic screening testing.

Then, TMJ, we will talk about. If we had to just layout with everything that could be done, this is a decent test, assuming you do some baselines in there. But it is always back to your clinical intuition. The lab testing, we do not even really talk about it in this presentation. There is a couple of docs there. Because for the concussion, around we are in not support. Maybe with a more severe brain bleed, things like that, you will do some lab testing, but there is no in-brief lab testing, blood tests, or saliva tests. They are specific for concussions. Here is a good list. If you are not sure what is going on, they will give you something for that. So, this first segment is cervical spine disorders. This is where I will probably take the least time because I am sure you are all pros with some of these. We really just add some extra things on and just get your brain thinking about this, again, that initial impact That is really bad when we see that hockey player go down, you might think, "Oh my gosh, brain injury," anything like that, but do not forget about the cervical spine, which I am sure most of you do not. We are not sure 100% when a concussion happens and when whiplash things, but we know that whiplash can happen at like 3.5 G. And that all seems to be below the threshold of when a concussion happens, most likely. We do not have perfect data, but we know that pretty much any time someone has a concussion, some of

these brain injuries, pretty much guaranteed that they have a cervical diagnosis as well. So, they should be working pretty much, and you can groom it every single time. These are the same things that are up earlier. You know, you are looking for the red flags. Do we have something really severe? Do we have some joint laxity due to rupture of alar ligaments or any of this limited range of motion? When you get into the office, they do a more in-depth examination that you are probably all remarkably familiar with. So, some specific tests, though, that we will talk about in a second.

Here is just a general thing to get you thinking. All the signs and symptoms, at first, you may be really concerned about tingling going down the arms, and you want to make sure that it is not a brain bleed or real traumatic central nervous system. But that does not mean that they might have landed in a weird stretch position. Kids fell out like this, do something That is resulted in some of that neuropraxia, some of those minor peripheral nervous system injuries, or all the way across. This just makes you think of everything that could be a diagnosis and relate to the cervical spine. Just do not forget about it. This is some good literature that kind of addresses what I talked about earlier, but it also brings the vestibulocochlear system that we will talk about. When we look at all these same mechanism injuries, whether it is a motor vehicle accident, it is a traumatic sports injury, it involves the head and neck. And even if it is not a direct hit to that, it is a body shot, but they have signs or symptoms related. A large amount will involve the vestibulocochlear system and the neck. So, out of these 147 cases, they looked at who they think should refer to each, and they had some specialists in here, especially at that second bullet point, that neck treatment was recommended. And about half of the cases in vestibulocochlear, about 72. And together, you are still at 40%. So, an extremely high percentage you are going to be working together with that. So, keep that in mind. If anyone ever questions your role in head injury concussion, even if it is a cervical spine, It is right there, and It is prominent. We have tons of literature behind it.

Usually, when we are talking, and you look in the literature, we will just say WAD is Whiplash Associated Disorders. You know, it is a huge classification of whether it is a sprain or strain, and we do not have it in this presentation, from my memory. But the Canadians, freaking Canadians, have just the diagnosis and the 5 levels of Whiplash Associated Disorder. It starts with just mild pain to dislocation/fracture with neurological signs and symptoms. When you are looking at literature and what is responsible in there, you have different grades of that. This is kind of just a summary of being more general with our diagnosis for certain events. We are all pretty good with the cervical spine. Even if you do not think they may be related to the cervical spine, things to pay attention to can be. The difficulty with saccades, some of that fogginess, that gait instability, body coordination, and balance issues. Those are probably what people do not instantly think about with the neck, and it may not be a go-to, but if they have prolonged signs and symptoms, do not forget the relationship between the cervical spine and the symptoms. So, here, we will see if it plays. It should be on mute. This is just a video. If you want any of the videos,

you can send me an email, and they are just YouTube links, all right? I really want to match Dr. Alexandrina, who was a resident with me. We had our fancy little Oxford shirts there.

This is a test where just the rotating stool test in this swivel chair, right? So, their head is forward, and you want to test to see if we do any of this. Does this cause their dizziness? Because, while our vestibulocochlear and all this will stay central, we are putting torsion and changing the neck, and that could be causing. So, while we are static, but we move the neck, it causes some dizziness. Well, it is probably related to the cervical spine effect. A fancy thing that you can add on top of that is the fact that if you want to do a smooth pursuit, they may have no signs and symptoms if you are just taking them from each pattern. But if you put them at 45 torsions on the neck and add an H pattern in there, and then they maybe had minor signs, to start with, and they have more severe signs here, it is got some correlation or relationship to the neck there. So, if they have mild nystagmus, but then we do this, and they have more intense nystagmus, there is probably some association with a neck injury that is going on that is causing some of that gait. There is always a giant discussion about how we prevent concussions. The bottom line is, we have no 100% foolproof way to prevent concussions, right? And a lot of these are not even based to necessarily prevent concussion, maybe, maybe so, but also the associated signs and symptoms with them. So, of course, with a neck, we think about strengthening and stabilizing and working with. If you Google the Iron Neck once, they will follow you with tracked ads for the rest of your life. I think a month free of those tracked ads, so be careful what you search for.

Most of the time, our strength conditioning, we see the most benefit with our amateur athletes or our kind of grown athletes. So, pediatric, adolescent, high schoolers, research supports that, probably, if we do some strength and conditioning, it is going to reduce Whiplash Associated Disorders and maybe, in turn, help to make it where they are not as likely to have a concussion because they have a stronger base. Imagine me. I am pretty small. Pee Wee, in football, you put me at, like, 4 feet, just go into the sport for the first time with this giant helmet, this skinny little neck, you just create a bobblehead back and forth, right? I do not have the strength to even support my helmet, and then I get a hit. It just creates an even more rotational effect or effect going into there. So, we want to try to strengthen that, and we usually say, if someone has half aside, so, if up here, It is 60, and down here, It is 30, we should probably work on trying to poke them up a little bit. It is not as important where we do not see it as beneficial on a professional level because they've probably either inherently or purposely developed along the way, right? There are not many football players or hockey players that are young professional level. They would be scrawny littlenecks and big heads because they probably have been filled around along the way, for one reason or another. But those individuals are trying to get more, or they are starting in a context or even things like soccer. You are still heading doing all these things truly focus on trying to make sure we have the proper strength instability. We will talk about support for improved equipment along the way. So, right now, strength conditioning, cervical spine, but we will talk about others as well. Real basic things I am sure you are all aware of, just even doing

as a baseline screening. So, we do this with all of our football players, rugby players, anyone That is going into some sweat, it is doing a deep neck flexor test. So, we know that these noncontact individuals who are not wearing headgear should hold this for at least a minute, properly, without difficulty. That is just the basic level.

Now, the individuals that are wearing helmets, they are wearing headgear. This is not as much in literature, but more so just clinically, anecdotally looking at it, they should be able to hold that with a helmet on, right? So, if you must wear a helmet for your support, you should be able to tolerate that load and hold it for the minute as well, and optimally, we should be able to push you up towards 2 minutes there. So, your football player or anything like that can only get 15 seconds with a helmet on really working on strengthening and increasing that extra.

Scott: Jordan, this slide reminds me, Dr. Patrick Koski. He is presenting, I think, later tonight on vibration, I believe, or McKenna transduction or something. But anyway, we did not do a study on this, but in working up some pre-season professional players several years ago, it was apparent to us that those players that had previous concussions were not particularly good at the deep neck flexor endurance test. So, it gave us a little bit of food for thought in terms of some strengthening that might have been missed in the previous rehab of those concussions. I think this is a great test to add in, even if you are doing some sort of baseline pre-season medical as well.

Jordan: Yes, and we have not covered baseline. We did not track it specifically to do study. We have a women's current football team, and they would always have multiple neck injuries, concussions, things for that season. So, we did baselines, and we just put in the strength and conditioning. And now, we get maybe 2 concussions this season. I say That is all because of it, but we saw within 3 seasons a significant change there. So, one dash is burnt off.

Scott: It is interesting that you mentioned the women's team. There has been some discussion about the female athlete and the neck's strength being different from the male strength of the neck that might be somehow associated with why the symptoms take a little bit longer on the female side. There is obviously way more factor than that, but just food for thought.

Jordan: So, we will go on to vestibular ocular, vestibulocochlear things, and we will spend some time. We will make sure that we get there in time to just return to play, return to learn because that can be kind of complicated to you. All these here are references. So, going fast, send me some emails. I will be on the second one as well. Remember our general, just, pathophysiology anatomy That is going on. So, we have a stabler system. You have little over lifts that are within your utricles and saccules, and you have your 3 semicircular canals that really keep track of where your head is in space and any of these rotational things. So, a lot of times, what is happening in this is due to trauma or due to some other reason that will lift those little crystals that will sense

where you are position up is, if it gets dislodged, especially goes into one of those canals, you get some of these dizziness and balance issues that are going on that we will be testing for that. Most commonly, headaches and dizziness. It does not matter if it is trauma or non-trauma. The test is going to get their systems with that. Similar just to above, there is a lot of sports-related concussions. That is what SRC stands for, which has these associated signs and symptoms. So, do not forget about this typical system. Some things to look at ocular tracking reaction time. Dr. Howitt mentioned that, like, ruler test, and we do that. You can use some electronic testing as well. It is kind of hard to track reaction time, and you have no idea what it should be unless you have a baseline with that, so spatial orientation. Looking at that, even things like the King-Devick are pretty good for actually tracking through if you have a baseline, or even if it causes signs or symptoms that are the baseline. It is a decent kind of screening. If I had to pick a full assessment, if you like, I am going hammer this through. This is not probably the most in-depth, by any means, but this is all the basic tests that you want to hit for someone if they are having some of these sets, especially prolonged signs and symptoms that are recovering. H Pattern, we will talk about it. Convergence VOMS. We will talk about how supine roll. We will not really cover the best test, but the SCAT5, and I will mention covering eye fixation and things like that.

With doing and looking at semicircular canals and BPPV, and these kinds of old lists are replaced with 2 of the more common ways to do things. It is important that these assessments turn into rehabilitation. So, they are slightly different, but once we set that, we can kind of go into the rotation now. If I am not making progress with some of this dizziness within a week, and I think I am on point with my diagnosis and everything, I will refer out. I take care of more than basics and things to respond well, but this is one thing where I do not want someone to live with dizziness or nausea, so I will refer out quicker with vestibular ocular.

Scott: It is not an uncommon thing, Jordan, to hear me say the test is the rehab. The rehab is the test.

Jordan: Yes, and we will be talking about that some of the exposure things of that. So, convergence, they were all pretty aware of convergence. This is where the top, it says less than or equals 6 centimetres, measured twice. If it is greater than 44 centimetres, there is this statistical change. It is more relevant. You see some different numbers in different literature there, but it is usually around the 5 or 6 months there with that variability changing between adults and children. So, that convergence is where, if we are fancy, we have a sick within the slider on it. It should usually about 14-point font, and either a little letter A and E or just aligned, capital I, and we come in, and it will be braced right on their nose. And as soon as they get here, and they say, "Oh, I see 2," so you are looking like it says 2, then you can just instantly have a measurement. You can have them hold there and then pull out a ruler into that. It just gets a little bit trickier to get a proper measurement, but you are really coming in, and once they see 2 of them, then you measure from there. If I must do it right on the sidelines for some reason, it is

back to that. Man, these pens are super handy. I tell you what, with those lights on everything. I just have not looked at the bar or any of the writing on it. It is not perfect. But once they see the 2 bars, okay, we say, "Oh, you are there. How far apart are you?" If you do not have a baseline, though, it is one test that is not the best, more basic test that we have done before. These semicircular canals, the Dix-Hallpike, and the Supine Roll test. Your Dix-Hallpike will be for the anterior canal. It is important to pay attention to that because it will be about 80% of some of these BPPVs, and this dizziness That is associated with the semicircular canal. After that, the supine roll test tracks the horizontal canal. That will be the majority of the other ones. There is a posterior canal. We are not going to talk about that, and if I think it is a posterior canal, I refer that out, and I'll try through that. It is tricky, and it is usually the most severe dizziness or nausea that happens.

Dix-Hallpike here. This is not most curriculum for chiropractic programs here, but you just have the patient sitting up there straight-up. They are going to start looking at one side, and they are going to come all the way back and go into extension and just holding that down. So, there will be an extension, rotation off the side, and while they are coming down, they are not fixating on anything in particular. They are just laying their eyes, drag you across the side, but you are watching their eyes and their pupils, which is really important because you were looking for some up-beating stats. They can get some dizziness and some things with that, but you can get some convoluted signs. It is difficult to hold your neck, so maybe It is related to the cervical spine, but especially that up-beating nystagmus, it is really the positive sign that you are looking for. And, if you see it in both eyes, you are looking for the one That is worse on that side. Okay. So, again, this is for the anterior canal. That is up-beating nystagmus, and it is your most positive BPPV and related semicircular deficit that will happen. If you have a positive Dix-Hallpike, you move into the Epley's maneuver. It is remarkably similar, but you just hold things longer than that, right? So, the same patient begins sitting in bed, 45 degrees affected side, and they come back into extension. So, essentially, they are doing the same thing there, and then you just hold them there for 30 to 60 seconds, right? Then, they are going to turn their head, and we pretty much make this full pattern all the way around. So, they turn the head, then roll on to the side and then sit up. With these, it is really a repetitive exposure, and we will discuss this later, but you have to go through it and let them know that you will be dizzy when we do this and say, "Maybe you want to have a trashcan in your hands." It depends on how dizzy or nauseous they are. But it is only by this repetitive exposure that it gets better. If you are on point with your diagnosis for, like, an anterior canal deficit, they should respond within a week, and they are doing a bunch at home, and this is one time you may see someone once a day for five days in a row, and you are just doing decent stuff.

If they do not feel comfortable, do it at home. Otherwise, it should be something that they do like 5 times a day. Whatever their tolerance is, the more they can do it, the better and the quicker They will get. If this is the one associated condition with their dizziness. Usually, within a week,

repair things. That is why. Then, we go on to what is used for the horizontal. So, that is the supine roll test. So, this one horizontal canal, you are looking for that lateral bidding nystagmus. One of the similarities you see, there is the pillow there. So, it is definitely stacked or the stem extension when either neutral or slight flexion there. This one, you are rotating the head quickly from side to side. So, we rotate the head and start here to either the right or left, wherever you want to start, and you are watching. So, you go 90 degrees, and you just watch it, hold it, and then see any signs or symptoms. So, come back, beginning right, you will probably have to shift through stuff around. So, let them rest if they do get nausea or dizziness to one side. When they come back to neutral, we took all their signs and symptoms are gone and then give them a few seconds to rest on top of that. We now have a more proper baseline. Then, we are going to quickly go to the other side, 90 degrees, watch that. Watch their eyes, patient's signs and symptoms. With this, if it is a horizontal canal, in most cases, you will get positive findings on both sides. With your epulis and your anterior canal, usually, one side, you get symptoms, the other side, maybe or maybe not. Here, you are more likely to get on both sides. We are looking for a more severe reaction to it. Then, if you do get a positive supine roll test, you went to a barbecue. Barbecue roll because maybe the Texans made it up. I do not know. Texans like barbecue in America. It is like on the Barbie. You end up doing a complete roll. So, with epulis, you end up just kind of going from one side over up and sitting. Here, we make a complete circuit. So, start by laying on your affected side. So, if you went to the right, and you have the most signs and symptoms there, you are going to start with that. So, they are in a neutral position, laying on their affected side, looking that way.

Then, they go into a supine position. They go left lane, and then this is where it gets a little tricky, and you have to educate them through. You have them go face down, so they roll, and they are in a prone position, kind of head tucked, their chin tucked here, and they are kind of braced on their forearms with that, holding there, and all these are holding for that 30 to 60 seconds here. Then, they come back around to that original affected side, and they sit up. So, with this, just like you are flipping something on the Barbie, they go all the way around and complete circle, and this is where they retest and whatnot, you are going, looking for 3 times going through, you should see a little progression this time, but it will take more than just their initials, whatnot. So, those are the 2 most common things. If they do not progress quickly with those, I refer out pretty quickly because those should be more simple things. But if not, it could be something that I am not just as well trained. Additional things that you can do, and I would really like to play with targeted vision testing and whatnot, but it definitely takes some time to look into. The cover-on-cover tests, right, It is more of your basic physical diagnosis test. You are looking for more if they have phoria. If you are doing here, or maybe you are going back and forth, they are tracking, checking for phobia's, eye fixation, again, going back and forth, and checking. Do not forget that if they had a trauma, let us say, they got tackled and they hit their head on the ground, or they are a swimmer, and they have signs and symptoms, it could be something like a ruptured tympanic membrane. Do not forget about the simple things and really all their dizziness, and that

would be covered if you just looked in the ear and be like, "Yes, like you ruptured your tympanic membrane. That is probably what's causing you dizziness and whatnot." So, it can be those things that we do not think about that are causing it.

Remember, they went through a trauma, especially swimmers, so do not forget. If anyone takes a direct hit in that eye, you might want to just do an ophthalmic examination and see, did something happen to the eye itself anatomically that we wouldn't have picked up initially with that? I wish we had time, but we do not have much time. Just talk about, like, Lake Woods and whatnot. So, it comes from, well, I am sure It is numerous places in the world. But, in America, the University of Cincinnati started with some research and started to come, and then popular. What is really having this light board, this arcade game, right, the one where you try to smash things as quick as possible. Anyone that has deficit they go through, and they would either go through these reactions or even just looking at different ones, or we can combine, like, head and neck movements and eye movements, and really switch those up. Preventive-wise, so, we are coming back to this kind of wild times, so, preventive improvement, they said, like, a 50% change just by adding that into their university football, American football program. The question is, is it the fact that they look? Or they just generally increase the reaction time? So, if someone's coming at you, if you can react faster, just like our children kind of looking down, and he just looks up and gets creamed. If you can look up and react faster to that, a better position for being tackled, tackling to get hit, you are probably less likely to get injured in any way, shape, or form. So, we are not 100% sure of how it does, but we know that by doing this, we seem to, according to some literature, reduce the incidence of that.

Scott: Interesting performance effects there, too, Jordan, on the positioning. Like a quarterback being able to read the field or a goalkeeper being able to react quickly. So, there is some interesting performance with that as well.

Jordan: Yes, and even when I think about tracking like a puck or something. It does not matter if it is for a concussion, but being able to switch between a player and a puck or like a ball or anything like that, It is got some dual applicability. So, maybe we are hitting concussion. Maybe we are just saying increased general performance. That is why we do not have the best stats. So, we get the VOMS and move quickly here. And this will be we will leave most of this kind of up to review there. So, I apologize again. We will put more information as a reference here. The question people always have with VOMS is that they watch you, too, and they are like, "It doesn't matter if I have a head injury to not. I will get dizzy." And we probably all think that a little bit, but when we look at the sensitivity and specificity, it is really good between that 91 to 97-98, depends on what you look for. Or, if they have a head injury, they have positive VOMS. Even if you do not have a baseline, something is going on. Maybe It is a concussion. Maybe It is vestibulocochlear? But something is going on, and we should pull them from the play. Or the fact that if they have a positive finding, there is that deficit, we should go through the training, and

they probably would not have a positive with that. So, another study with that low false-positive finding back. It is good even if we think that everyone gets disabled, it is not actually true. So, more on why I said that the VOMS did provoke positive findings and healthy individuals, and it is got good sensitivity.

If you go and look at the PDF or just Google VOMS, it is a free resource, and it is out there. Did this come from Canada again? I cannot remember. The most important thing to remember when doing this is to track their signs and symptoms beforehand. Maybe they have some mild dizziness or headache, any of that. Track them after, and then wait till their symptoms go back to their baseline, and even give them like 30 seconds on top of that to chill. So, if you just keep compounding it, it is going to get worse and worse, and you will get some false positives for tests that may not be if you look in horizontal versus vertical. So, this initial thing, important to take this.

Scott: Jordan, you have some great slides in here in terms of what these you know, scholarly pursuits, the convergence Scott's.

Jordan: All I say is it is all on here. I can send you my little videos with an intern who signed the form, so we can take videos of them, right? That is the best part about having skills. Going through, I can send some of these. I know they will not play in the PDF, but happy to discuss this further. I think this is just a critical thing to anyone that has dizziness, head pain, headache, dual VOMS, and just check if you have signs and symptoms of going there. The return to learn, return to academic stuff is really important. TMJ next, usually, with TMJ, if they take a dress hit, I do not know why this girl is smiling? She is not actually getting hit. But those fight sports, where you get headaches, and you can get jaw pain, neck pain. Check out the jaw. Do not forget about the jaw or just landing and hitting, right? If they hit the ground and off to their side, where they take even any of this, it can cause jaw pain, discomfort with that.

Do not forget about the jaw. I have seen multiple people that post-concussion syndrome. But really, their jaw was just never addressed, and they had these headaches, and there is tension in there, and they were kind of grinding their teeth now. It just came down to some jaw work. It felt better in a week” and I was like, people suffered for a long time because we did not do a full clinical exam.

Scott: In my sort of thought on that, I have done a little bit of case report on this, and as a swimmer, Jordan. But, like, it is fixed the opening pattern. So, with the jaw work, you can get a better muscle balance between the tear guide and the gastric in terms of opening the mouth. I found that, clinically, that is been quite effective.

The one question that came up earlier about, like, what is the new stuff that is been happening in the last couple of years?

I mean, first off, let me just say emerging evidence or new evidence is just that. What is most informative clinically is the total body of evidence. So, although I get excited and be interested in new papers, or new things that are coming out, you must put this into the context of the total body of evidence in terms of how That is going to affect what you are going to do clinically. With that said, the emerging evidence in concussion is, and this is what is different from even a couple of years ago, is being, after that short, brief period arrest, getting them to be physically active. There is research to show that if you are physically active before a concussion, that is going to be helpful in your prognosis. And there is research to show That is emerging that your ability to do some cardiovascular activity, particularly a buffalo concussion treadmill test earlier, is if your diagnostic prognosis information, but it also is therapeutic.

This is the space that is changing. This is the space that I would expect to be updated even more on the next consensus. This and mental health. Those are the two sorts of areas that I would say are the things that are changing in the concussion world. That is what I would draw your attention to. I know we do not have a ton of time, but there are a few things that I wanted to cover here before we try to wrap this up. In the buffalo concussion treadmill test, it is key. It is clutch. I would go so far as to say, if you are going to be managing concussions in your clinic, you should have a treadmill in your play. Yes, they do have a bike test as well. So, there is a way to do this on a bike. But I feel strongly about this scenario. It is not that hard of a test to do. You need to be able to track the person's heart rate. You need to be able to track their perceived exertion and how their symptoms are going. I have it on the screen right here, these couple of little slides.

A person will walk on a treadmill. You have a yield of 3.2 or 3.6, depending on their height and speed. And then, you just keep increasing the incline on the treadmill as you are monitoring symptoms. And what you are after here is to get them to be on there for 20 minutes, if you can, or up to 85% of their heart rate. And you are trying to correlate, "Where can I get you to exercise? Where's the threshold?" So, if you start adding symptoms or your symptoms get worse, that is what you are looking for to shut them down and then, to get them to exercise below that threshold. I have a couple of slides in here about some more intense exercise testing. So, one of my friends here in Toronto, and one of our colleagues, Ken Marshall, has done a bunch of work on this. It is the Chicago Blackhawk test where the gaps keep Goodman test. That is the actual athlete who did it. And we are talking about hockey. So, it just seemed like the natural thing to throw in here as well, in terms of that case, but the exercise testing is more extreme.

This is where you were talking about the previous question. And when you have high-end athletes, professional athletes, you need to test them in a way That is more substantial to monitor what they can do, where their symptoms are at, to feel comfortable about returning

them. I am surprised no one asked it yet, but how about those concussions, those tests on the computer? They can be helpful, but they are not the thing. Just because you pass that test does not mean you are clear. I do not really use it like that anyway. In fact, I would say the greatest utility on those tests would be one more thing to stop the person from returning. As opposed to the thing that clears them, it is the one thing that I find might stop them when they look to be physiologically pretty good, but cognitively not quite there yet.

I would strongly recommend the use of the buffalo concussion treadmill test. A baseline test is not necessary to make a diagnosis of concussion or to manage concussion. But it can be helpful certainly if we are trying to make some challenging decisions on a person's return to play. Having that information in advance. A couple of more questions slides on here. This will be where the teacher will tell you about the answer before everyone has the chat in, so you can pay attention to this. What are some factors and red flags, is the way these questions are asked? This is different from the red flags, you know, in that acute scenario. We are talking here of what are those things that are going to make the prognosis takes longer. Prolonged loss of consciousness or the severity of the symptoms is something that absolutely does younger age, female repeated concussions.

A bunch of concussions kind of close together is the things that absolutely have been identified. I did put some resources in here for you, athletes. This is one of the uh documents that I helped contribute to this. This is a living document that should be continually updated. And it has this information about the paediatric side of things and why they take longer to recover. And again, adolescent paediatrics, we are looking at 4 weeks, as opposed to the 7 to 10 days. That is more typical than 85% of the general pop. We mentioned this previously, but also that inactivity. So, it looks like you might be more exposed to getting a concussion if you are playing sports. Playing sports helps you have a faster recovery than if you were not physically active whatsoever. Return to school should happen before return to play. These slides are organized in this way intentionally. So, I do have a little stepwise progression in here to consider. This is a great resource. This is a return-to-school- after-a-concussion strategy. This is, again, sorry, Jordan, but this is another group here in Canada. The Parachute Foundation. They put together this resource that is helpful.

Basically, you are not looking to keep the person out for too long because returning to school earlier seems to be helpful in the overall prognosis. But you need to be sub-threshold. You need to be sort of living below the level That is making the symptoms worse. We can absolutely be helpful in this regard. Your scope of practice, depending on where you are, a letter to the teachers, a letter to the educational institution, in terms of accommodations, and what things would be appropriate for any student-athletes returning to school. Returning to sport happens after return to school. And again, we have this stepwise progression. It is one of the things that was highlighted in the last consensus statement. We need time to move from one step to the

next. In terms of a sports scenario, we are looking at doing the first light activity and sports-specific activity and drills without contact before we get to those drills with the contact.

You want to do the drills with the contact before you would turn to that gameplay. Each of those things, you know, you are looking at 24 to 48 hours between each step, assuming you pass. And if you do not, then you go back. We have been talking about hockey and some of the examples in football. The helmets help. Well, certainly helmets help. You will not get a skull fracture, but they do not necessarily reduce the concussion occurrence.

We talked about this. It does not even have to be to the head, to the shoulder. The neck moves, the brain goes inside of the skull. Does a mouth guard help? Well, a mouth guard will help you keep your teeth. The evidence has not been useful in demonstrating that it reduces concussion occurrence. So, how do we reduce concussions, in general? Well, prevent them from happening, recognize them, manage them properly. In a hockey setup, there are some rules that might be helpful in this regard. Diagnosis and not returning if you do have a concussion is key. And there are hard conversations that sometimes must happen if too many concussions in too short of a time with too long of recovery on concussions. Well, then, sometimes, the discussion is about, perhaps you are at the end of your career. So, I think this is the last question that I was meant to ask, and some of the long-term consequences well-reported in the media, but we are looking at dementia, depression, headaches, and the long, sort of at the bottom here, the possibility of chronic traumatic encephalopathy. It is something That is continually being researched and investigated.

[END]