Concussion – Recognition, Treatment and Advice – Ref295

with Donna Sanderson-Hull and Dr Cameron Marshall

5th April 2023

TRANSCRIPT

Please note, this is not a verbatim transcript:

- *Some elements (repetition or time-sensitive material for example) may have been removed*
- *In some cases, related material may have been grouped out of chronological sequence.*
- *The text may have been altered slightly for clarity.*
- *Capitalisation and punctuation may be erratic…*
- *There may be errors in transcription. If something appears odd, please refer to the recording itself (and let us know, so that we can correct the text!)*

Steven Bruce
A good evening, and many thanks for joining me once again. I've got another fascinating show for you tonight because we're going to be looking at concussion. Of course, this is in the news in a big way at the moment in sport, what with players having been suing the Rugby Football League recently over brain injuries caused by the sport. And of course, there's concern in rugby union, as well as in soccer, where repeated heading of the ball could be a cause of longer-term damage. Now, I know what you're thinking, people don't come to us for concussions. So unless you do pitch side assessments for a local sports club or something, you might think this is all a bit irrelevant. But I wonder, first of all, I wonder how many patients we see who have undiagnosed concussion from their weekend sports or their other activities, but also we see the parents of loads of children who are involved in sport and it could be really useful to us if we can offer them appropriate advice about keeping their children safe. And I'm sure there's a whole host of other things which are important to us as well. And we're about to find out what they are, because I've got three guests this evening. The first is Cameron Marshall, who's a doctor of chiropractic in Canada. And Cameron has specialised in concussion and post-concussion syndrome for many years now. He's also a past board member of Brain Injury Canada, which is an organisation devoted to helping those with brain injuries as well as their carers. And not surprisingly, he couldn't make the trip to the studio this evening, but he's joining us via the video link. In the studio, however, I have two chartered physiotherapists, I've got Donna Sanderson-Hull and Nicola Hunt, both of whom have worked closely with Cameron and are involved in concussion training in the UK. Donna is actually, Donna you were telling me earlier on you work with the Minister for Concussion in Sport, haven't you? Which puts you at a quite elevated level. And Nicola, you are a specialist in neurological and vestibular aspects of physiotherapy, aren't you? So we've got some real experts with us in the studio and virtually this evening. Cameron, I don't know how much of what I said, is completely accurate or tells the whole truth. Do you want to fill in some gaps and tell us how chiropractic and concussion work together?

Dr Cameron Marshall
Yeah, I think that one of the first things I just want to kind of point out that you said, is that patients don't come to us for concussion. But the mission that we're on right now is to try and change that because there's actually a lot of things that chiropractors, osteopaths, physiotherapists can offer to concussion patients both from acute care as well as from persistent concussion symptoms, which is a huge issue plaguing both athletes, motor vehicle accidents, workplace injuries, that type of thing. So, dealing with those persistent symptoms, there's a whole bunch of things that osteopaths, chiropractors, physiotherapists can offer, and kind of our mission at our organisation Complete Concussions is to kind of change the narrative around that and educate these healthcare professionals as to what they can be doing to help these patients out.

Steven Bruce
Cameron, you mentioned a different organisation there, you mentioned Complete Concussion, which I think is an organisation that you've founded, haven't you? What's that for?

Dr Cameron Marshall
So I did my doctor of chiropractic in Canada, and then I specialised in sports medicine after that. And with that you're supposed to do research in a particular field and so my topic of interest became concussion, because at the time, a very famous hockey player in Canada was getting treated for his

concussion by a chiropractor. And I thought, well, that's weird, how do we even fit into this picture. And so it became my topic of focus for my research project and I ended up working with some very prominent researchers here in the concussion field, and it became my entire thesis and I worked on it for three years. And in going down the rabbit hole of examining the concussion literature, you start to realise that concussion isn't this kind of abstract thing, it actually is a treatable entity. And the treatment is rehabilitation. The treatment is exercise, and putting people on treadmills and providing dietary advice, and doing vestibular rehab and ocular motor rehab and also cervical spine treatment, manual therapy, adjustments and that type of thing. And so that just opened my mind up to go, oh my god, we actually are the treatment for this and yet nobody in my field knows this. Nobody in physiotherapy knows this. And so I started training people in Canada, after going through kind of self-teaching myself all of this stuff, and creating a network of clinics so that patients could actually find appropriate care, get the right treatment, get the right rehab. And so we formed a network now and now we're the largest concussion organisation in the world. We started in Canada, we have about 400 locations in throughout North America, Australia. And we're just kind of starting up in the UK now and forming a network throughout the UK.

Steven Bruce
That's all-fascinating stuff and interesting to hear how recent it all is. I can speak as having personally suffered concussion twice and I can distinctly remember getting absolutely no treatment for it whatsoever. I was just left to see when I got better. How much of the treatment or the treatment protocols that you've mentioned would be new to a physio, chiro, osteopath, and how much of it is just knowing which of our existing skills we use we adapt to treat concussion patients.

Dr Cameron Marshall
That's the interesting thing, a lot of it is stuff that's already kind of within your skill set. It's just applying it properly and knowing when and how to apply it and when to push forward and when to pull back. So a lot of it is stuff that is already in the repertoire of most professionals. The kind of flipside of that is there's also a bunch of kind of net new stuff that is more concussion specific that needs to create some additional training in that regard.

Steven Bruce
Right. Okay, so we're probably getting ahead of ourselves here, but I'm assuming that anybody in this country who wants to train specifically for treating post-concussion syndrome or concussion patients, I mean, there is a course setup here already?

Dr Cameron Marshall
Yes, there is and it's all online. We have a course for chiropractors, physiotherapists, and osteopaths, which is kind of more of the physical rehabilitation course. And then we have an occupational therapy course as well, which is more so on cognitive rehab, return to school, return to work. And then we also have a physician and specialist course, which is for physicians, but also mental health professionals, neuro optometrists, and vision therapists. There's a whole bunch of courses and they're all online, so they're available for everybody.

Steven Bruce
Yeah, and earlier on, you mentioned a couple of things that I didn't which could give rise to concussion. You talked about, well, not least hockey, but workplace injuries, and car accidents. So as you say, there's no head injury assessment applied strictly for someone who's had a car accident. People tend to make an assumption; you've got a whiplash injury if you've got any pain. But as far as I'm aware, there's no automatic assessment for concussion in this country, maybe Nicola, do you know better?

Nicola Hunt
Well, essentially, what tends to happen is that people will visit the accident and emergency and their huge focus is making sure that somebody hasn't got a skull fracture or a brain bleed. And so what often we find is that when people come to our clinic, and they say, oh, it's okay, I've been cleared, I've just got a concussion. And so the injury itself is downplayed to be something actually fairly low key and insignificant. And yet, that's what catches people out, because they end up with these huge symptoms that could be fairly catastrophic for their work in terms of not being able to drive a car, or every time the windscreen wipers go, they have to pull over and vomit or some really extreme symptoms. Or we have parents that will come in and say, my son was a straight A student and since he had a concussion, he can't read a book, but no one believes me, is this related to his concussion? And so we can then put some treatment into place and give them reassurance that actually it is related and it actually is an injury that needs to be treated.

Steven Bruce
So Cameron, have you got any examples you could share with us of people who have come to you in clinic for something perhaps completely unrelated, who you have discovered, through normal case history taking, that actually, there's a concussion element in their history.

Dr Cameron Marshall
Well, I mean, my practice is probably a bit unique, because they're all concussion patients. So that's all I see. So they're usually there, because they know that they have a concussion. But I think the problem with concussion and just the way we think about it is that concussion is very nonspecific, in terms of its symptom presentation. And so you can have a variety of things where somebody may be identifying some symptoms that they're having with something other than concussion. And it turns out, well, there could be some remote history of concussion that's kind of in there. So I think it's important just to keep that in mind when you're working with any type of patient, particularly after any type of traumatic event.

Steven Bruce
Give us a bit of science behind this, what's actually going on in somebody who suffers concussion?

Dr Cameron Marshall
So we used to think of it as being some sort of bruise to the brain, right, we used to call it the coup contrecoup injury, where the brain kind of bashed up against the skull and created some sort of bruising on the outer part of the brain. And what we now think about it as is a stretching of axons. So when the brain is impacted, it goes through acceleration and deceleration. So that's really what a concussion is, it's not the impact itself, it's the acceleration of the brain. And when the brain is kind of accelerating and moving around and shaking within the skull, provided it has enough acceleration behind it, you actually

are going to get stretching of the axons. So the individual kind of brain cells are going to stretch. And they're porous, so they're not kind of we think of an axon as like a tubular structure, but they're actually porous, there's pores kind of throughout it, and if you stretch it to a great enough degree, those pores will become opened. And inside of, if we get back into our kind of intro physiology type stuff, you have high amounts of potassium and sodium, both sides of the cell and you're gonna get ion exchange. Well, normally that's closed and those are meant to go through specific gated channels. Now If the brain gets accelerated and decelerated, and those pores stretch, they can actually open enough where you're going to get potassium coming out, sodium rushing in creating an action potential. So if you want to think about concussion in a simplistic term, concussion is just millions of brain cells that all at the same time get tricked into thinking that they've received some sort of signal. So they all start going under action potentials. So there's actually no physical damage to the brain that we can see it's actually a functional injury, it changes how the brain functions for a period of time. So we get this kind of electrical storm. And that's the initial symptoms that someone may experience that could cause someone to lose consciousness, it could cause somebody to have a seizure, it could cause somebody to just kind of be a little bit disoriented and out of it, you may have people off balance. And this is just because there's so much activity happening inside the brain that you can't make sense of it, everything is just kind of going on, it's chaos. So that's the first phase, that's called the excitatory phase. As part of that excitatory phase, you also get the sodium and potassium exchanging, you get sodium rushing in, but you also get calcium rushing into the cell. Calcium is the big problem. Calcium gets into the mitochondria, and it affects our ability to produce ATP. So if we, again going back to intro physiology, if you have an ion exchange, that's kind of passive transport, right, those are going down a concentration gradient. It does that fairly kind of risk free, it's fairly easy to do that. But then coming back and resetting that balance, because you're going against the concentration gradients, you require ATP. So calcium getting into the mitochondria affects our ability to produce ATP. So what you have here is a situation where you've created an imbalance. You've had the initial kind of symptom onset, usually that lasts for like, just a few seconds, right? So you see somebody get hit, maybe on the rugby pitch, they get up, they're disoriented, they're all off balance, and then they look normal after that. It seems to be a very short duration event. But the problem is the event has already occurred. And this is where I think sideline therapists have to be really, really diligent on this, because if a player gets hit and looks to be off balance or out at all, and then they start to look okay, the person might think, well, they're fine. The problem is, the concussion has already occurred, the initial excitatory phase may have passed, because that's usually very short duration. The problem now is that calcium has gotten into the cell, it's affected our ability to produce mitochondria. And then you get the second phase of concussion, which is called spreading depression. And what happens is, you're burning more energy to reset the balance, right? You're using ATP to get all the things kind of sorted, but you're not making any. So you end up losing this energy, you get this drop in ATP that happens over the next days, to potentially weeks. And in that kind of low phase of energy, this is when you have potentially persistent symptoms going on. This is when you're also very vulnerable. So any type of secondary impact can... if you think that your energy is up here at 100%, you get concussed, it drops down by about 20%. You're now down to 80. If you get concussed again, well, now you're way down here. And now you're potentially creating a situation where you're getting repeat concussions, now you're leading into kind of permanent damage and kind of all of those facts. So concussion by itself is a short term, functional deficit. If we look at it on MRI, it's normal. If we look at it on CTE, the brain looks normal, because structurally, everything is still there, it's still intact. It's this temporary, functional deficit that occurs. And if that functional deficit is taken care of, and we allow that energy to kind of restore back up, this is why we used to

prescribe rest, we used to tell people oh, just rest, you need to rest your brain. Because the thinking was, well, you're burning more ATP than you're producing, let's go and have complete brain rest, and don't use your brain for a few weeks, and let that energy restore back up. We now know that it doesn't actually work that way. So rest is actually not recommended anymore beyond like a day or two. But that was the thinking behind it, let's restore that ATP back up to try and kind of get those levels back-to-back to where they're at. So it's just a functional short term injury, if we take care of it we don't end up with these long term neurodegenerative consequences. I think the big problem that we're seeing now in professional sports, is that there's such a drive for me to play the next game and for me to finish the half and for me to be a part of my team and that, and especially at the professional level we're not allowing that recovery to take place. And so you end up with this low energy state and then you get hit again and now you're dropped down here, and now you're creating permanent damage and now you're having all sorts of problems. So the kind of quote I always say is, do we have a concussion problem or do we have a concussion management problem? And I think it's the latter. I think that if we actually took care of our concussions, we would not end up and we would not see what we're seeing now in professional sports.

Steven Bruce
Yeah, that was fascinating. Personally, I have no idea how elastic an axon is. So how long does it takes an axon to revert to its normal length, shape and porosity?

Dr Cameron Marshall
You can think about it almost instantaneously, right? It seems to be just this really short duration piece. And we don't actually have the timeline on that, but it does seem to be a very short duration piece. Just enough for the pores to stretch and come back. What we do know is how fast that actually happens. The acceleration needed in terms of linear terms is 70 to 120 G's of acceleration, where G force is being the force of gravity. So you have 70 to 120 G's, which is actually quite substantial. So if you look at something like a header in soccer, that's only about 18 G's, so it's well below the threshold that's actually needed to create this axon stretching and shearing. So that's why most headers don't cause concussions, I mean, if you get hit the wrong way or you're not expecting it, then that's a different story, because the head can whip back and forth and kind of cause that. Now the acceleration, most of the studies are done in sports, like football and hockey and if you have instrumented helmets on football players, you find that the the peak acceleration happens within the first six to 20 milliseconds of impact. So it's literally like if this person has no idea this hit is coming, it is instantaneous, the concussion occurs basically as fast as the hit occurs. So you really have no chance. But that's about as much as we know on that.

Steven Bruce
Why is concussion such an issue in what we would call football, and you would call soccer, then, if headers don't generally cause enough G force to induce concussion?

Dr Cameron Marshall
Player to player contact. So anytime you get a number of people running around chasing a ball, they're kicking each other in the head, it's not necessarily heading the ball, but it may be going up for a header and smashing heads with somebody else. 75%+ of the concussions that happen in the sport of football are actually player to player contact. Less than 10%, so it's between, I think it's 6% in males and 9% in

females, of concussions in more the youth level, so the youth to amateur level, are actually from ball contact with the head, the rest are player to player contact.

Steven Bruce
Right. Donna, when I suffered my concussion, and when I was working with sportsmen, the basic test for concussion was whether you could tell it was Wednesday or not. That was you get asked a question like that and if you could answer the question accurately, then you'd probably be allowed to carry on playing. I'm assuming we've got better protocols now in sport?

Donna Sanderson-Hull
Yeah, I mean, there is absolutely no doubt there is a lot of time energy going into how concussion is managed in professional sport. And all the national sporting governing bodies are working extremely hard on that at the moment. So obviously, the rugby union have now HIA, or head injury assessments. So if anyone has a concussive incident, that will be managed appropriately. They also have independent match doctors now, so it takes away some of the onus on the pitchside medical staff making those huge decisions. And also the pressure, when I was working at Bristol Rugby back then, as it was, it's Bristol bears now, you'd have your mic on and you'd run on the pitch and you'd have some angry coach saying, don't you dare take him off. Even though he was clearly concussed. And I remember many a scenario and if that player saw this now he'd know who he was, you know me hanging off the shirttails of players trying to pull them off, because one of the signs and symptoms is a little bit of aggression and you'd know that they'd had a concussive incident.

Steven Bruce
Hard to spot that in rugby. It's there from the outset.

Donna Sanderson-Hull
I knew he was like a puppy dog in the clinic room normally, so I knew that there had been an incident. But the player would want to stay on, so there was player pressure to stay on, the coaches would want them to stay on, yet the medical staff would find it incredibly difficult to bring people off.

Steven Bruce
There was a very public incidents incident of that wasn't there in the recent World Cup. There was a goalkeeper went up for a ball and got head contact with another player, and they kept him on the pitch and I think everybody watching said that man's got concussion.

Donna Sanderson-Hull
I feel very sorry for the Football Association at the moment because at least with rugby, they have made an intent to make that safer with the independent match doctor and taking that sort of onus off the hands of those pitchside medical staff. In football, they've really, really pushed hard to get what they call temporary concussion substitution so that they can take a player off and make accurate and safe decisions. But unfortunately, they haven't done it yet. And it's still not crossed the line for them to do that.

Steven Bruce
I think it was evident to everybody in that particular match, there's no way he was coming back on the pitch, and he certainly wouldn't have come back on in a rugby match, he just obviously had concussion. I've had a couple of comments in already. One of them is from The Anatomy Nerd who says that she's loving all the mitochondria and ATP levels of detail, it's lovely to be reminded that it is relevant to what we do. Yeah, I thought this would be and I'm gonna come back to that question I asked earlier on in a bit and say, what's come through your doors as physiotherapists that you wouldn't have expected, they weren't expecting it to have anything to do with concussion? But let me deal with the questions first, if I can. Stacy says this is a question for the speaker, so I'm presuming she means Cameron, because he's been speaking most. What can help someone who has long term post-concussion syndrome? Her mother's had it now for two years and her brain can't multitask.

Dr Cameron Marshall
That's a really big question these days, but I'll do my best to summarise it. So concussion is a short term, temporary injury. From what we know from the physiology that I just went through, we have this kind of drop in ATP, most of the research on that shows that that ATP recovers within about three to six weeks. So somewhere in that timeline, three to six weeks, you're gonna have recovery of the underlying what's called a neuro metabolic cascade. So you're gonna have recovery, that mitochondria gradually kicks that calcium back out, it gradually comes back online and starts producing ATP and we're able to kind of flush out the rest and reset the balance, and we're good to go. And in the majority of cases, 70% of cases, the symptoms go away within 10 days or so. In the kind of 30%, the remaining 30%, the unfortunate 30%, they end up with what's called persistent concussion symptoms, it used to be called post-concussion syndrome. So now it's called persistent concussion symptoms, same acronym PCS. So we have this metabolic dysfunction that happens initially. If you still have symptoms beyond a month, you're called PCS, persistent concussion symptoms. Well, why would that happen? If the mitochondria and all that stuff has recovered within that period of time, why would we have this? Well, there's five main reasons that this could be, number one is dysregulation of the autonomic nervous system. So the autonomic nervous system is fight or flight, right, which is your sympathetic side, and then it's your rest and digest. This also controls your heart rate, your heart rate variability, but also the blood pressure, and the response to oxygen and CO2 levels in the brain. So it's what regulates blood flow throughout the brain, we know that this system is impaired after concussion. So if you have ongoing impairment of the autonomic nervous system, things like increasing your cognitive load, increasing physical activity, if you start to exercise, it may bring on your symptoms. And that's actually the test for this, we do an exercise test to try and figure out what's your threshold. If you get symptoms, and at what point you get symptoms, that shows dysregulation of the autonomic nervous system. Number two is inflammation. So after concussion, you're gonna get inflammation of the neurons and also the supporting structure in the brain and the nervous system, so neuroinflammation. You get activation of these glial cells, which are support cells in the brain, and they're kind of the macrophages of the brain, if you will. There's also dysregulation in the hormones. So the pituitary gland just based on where it sits, can get like kind of a cross shearing as well. Also blood flow dysregulation, and also stress, lack of sleep, financial things, all these things put pressure on the hormone system. And we've seen, we've seen reductions in growth hormone and all sorts of other pituitary based hormones after concussion, and that can bring on similar symptoms as concussion. Number three is visual and vestibular dysfunction. So obviously, we know what the vestibular system and the visual system does. People that have dizziness or trouble with crowds or navigating their environment

may have some visual vestibular issues that requires rehab. So again, this is why our professions should be the ones kind of leading the charge. There's nothing really that a neurologist can do beyond ruling out some of the red flags that may be going on. But beyond that, the treatment is more diet, exercise, rehabilitation, and also education and kind of following the right protocols. Number four is cervical spine dysfunction. So with concussion you also get a whiplash. So concussion I mentioned before the forces are 70 to 120 G's of acceleration, whiplash or mild cervical strain injury only takes four and a half G's. So that means that anytime there's any type of concussion, there's always going to be a whiplash. And the literature has shown us that 100% of the time, there's always an overlap, the symptoms of whiplash, and the symptoms of concussion are identical. You cannot tell them apart. So if somebody's had a concussion and a whiplash. They think they've had a concussion, they haven't really considered the whiplash portion. They're walking around in their life wondering why they can't navigate their environment and why they can't think properly. Meanwhile, all the same symptoms come from neck dysfunction. The neck influences your visual function, the neck influences your vestibular function, the neck is associated with light sensitivity and sound sensitivity and tinnitus and ringing in the ears and cognitive function. And this is all based on neck stuff, which is why chiropractors, osteopaths, physiotherapists should be kind of leading the charge in this area. So that's number four. Number five is the psychological end of things. The unknown, anxiety, depression, post-traumatic stress, all of these things overlap directly with concussion as well. And so a lot of times when people think, oh, I have a concussion, I can't think properly, they start finding things in their environment, which kind of reaffirm that same belief, especially now with the media attention put on to it, it kind of can create heightened awareness and heightened levels of anxiety. And they think, oh, I can't pay attention at dinner parties, and I can't concentrate on anything. And what that does is as soon as that they're in an environment where they're in a conversation, they start going, oh, I can't pay attention, I'm not thinking about this. But meanwhile, their mind is drifting towards ruminating on the fact that they can't think about it, rather than actually trying to like spend their time focusing. So there is this overlap of kind of the mental health piece where we need to educate patients to bring that level down. Concussion is no longer after a month, if you think about it this way, concussion is initially a brain injury, that also causes a whole cascade of other events happening outside of the brain. The brain kind of recovers, right, but people have this fear that oh, this is my brain, and this can't be fixed. But all of those things I just mentioned, those five things that drive PCS and persistent symptoms, those are all treatable. Those are all treatable. Autonomic nervous system, we do things to balance it, rehab, diet. On the inflammatory side of things it's diet, it's supplements, it's repairing gut issues. Sometimes you end up with a change, what's called dysbiosis, where you have a proliferation of bad bacteria and not so much good bacteria. So it's resetting your gut. It's doing things to stimulate your vagus nerve and your parasympathetic nervous system to try and bring down the sympathetic, these are all treatable things. So it's a 100 treatable condition.

Donna Sanderson-Hull

Yeah, I just wanted to add in there, Cam, that it's really important to get across, when you say that people do come into clinic with this catalogue of symptoms and often they'll say, well, I was told that I didn't have a concussion because I didn't hit my head. And there's a real misconception that because there wasn't a contact with the head, that they hadn't suffered a concussive injury. And I think it's really important that we can educate the patient when they come in, we see a lot of people with high levels of anxiety around their injury. And the lady that's talked about her mum, you know, there's always this sort of overlay of anxiety about the fact that they keep asking people for advice, but they keep being told, no, you haven't

got a concussion, you didn't hit your head, or this isn't related. And actually, it's a real pleasure for us to be able to come in and really educate them about what's happened, the fact that you didn't need to hit your head, it was the acceleration and deceleration of that grey and white matter and that's why that sort of sharing of the brain has caused your initial symptoms, but there's no doubt that the ongoing situation can be treated, because it's likely to be based in one of those subsystems that Cam was talking about.

Steven Bruce
Robin sent in a question a short while ago. He's asking what are the indicators we might look for to tell whether a patient is at risk of he's saying chronic traumatic encephalopathy? I guess we could just say concussive injuries, couldn't we. Is it just high frequency injuries like sports athletes or boxers or is it the magnitude of injury as bigger risk? I'm not quite sure what he means by that.

Dr Cameron Marshall
Yeah, this is a whole can of worms. We're laughing about this because it is kind of a can of worms. It's quite a political issue. It's a very divisive topic, to be honest. Throughout the concussion space, it's very kind of polarising. But what CTE is, or chronic traumatic encephalopathy, is the long term neurodegenerative brain disease that's associated with concussion and also just contact sport. Now, I think a lot of the contention around it is that the media reports on it don't necessarily match the level of evidence we have in the literature. So the way that it's portrayed in the media reports is that this is a foregone conclusion, we have overwhelming evidence that concussion leads to CTE and leads to these neurodegenerative issues. But the reality of it is the research is still very, very early days, we have basically a case series of donated brains, we haven't really done very good trials looking at what the prevalence of this particular condition is in the general public. We've assumed that it's related 100% to head trauma, yet we don't know all the other variables, right? We're looking at a brain at the end of someone's life. And assuming that, well, they played rugby, they have this neurodegenerative disease, it must have been the contact. But we don't think well, could it have been were they taking any illicit substances throughout their life? What was their diet like? There's so many other factors that can lead to neurodegenerative disease.

Steven Bruce
My experience is that professional rugby players, well perhaps not professional, but rugby players take licit substances in vast quantities, such as beer. It sort of goes with the territory, doesn't it?

Dr Cameron Marshall
Yes, yes. And so another one that's affiliated, so for example, the disease is in the categorization of what's called a tauopathy. So it's a deposition of tau protein, which is the same category as Alzheimer's. Alzheimer's is also a tauopathy. There's different structures, so it's not the same as Alzheimer's, it affects different parts of the brain and there's kind of less beta amyloid than you would see in Alzheimer's but there still is some. But with CTE specifically, there's other tauopathies that look very similar to CTE. And so we have to really separate out is this related to brain trauma? Or is this something that's genetic? That just you we're finding it, we're just discovering this new disease? We haven't done a lot of work. There was a study that was done a couple years ago, by a guy named Grant Iverson that actually took a case series of brains that had no exposure to sport at all, and no exposure to head trauma at all. And they found CTE in six out of eight of them. So the same pathological diagnosis. So the question is, how

prevalent is this in the general population? And a lot of times when they have these donated brains, the symptoms don't necessarily match with the pathology. So how much is this pathology actually driving some of the symptoms that are experienced? There's just so many question marks that we still have, obviously, it could completely turn out that yes, head trauma is leading to this neurodegenerative disease. And I think that the proposed pathophysiological mechanisms do make sense, right? It's just chronic inflammation in the brain and what's causing chronic inflammation? Well, head trauma, but also maybe some of the other factors. And could we eliminate that by taking care of these injuries? These are all kinds of questions and so I think there's still a lot of work to be done in this space.

Steven Bruce
Yeah. I've got a couple of questions here from David and I'm not sure if it's the same David, but it's quite likely. He was talking in regard to what we were saying about professional rugby and so on. And he says, all well and good in professional rugby but what's the protocol in amateur rugby or schools rugby, how well is it looked after there? And if I just go on, the other David, if it is another David says, so many concussions get missed and he gets parents ringing him and asking if their child, mostly in rugby, is concussed. And his answer is always if you think he or she may have been concussed, then they probably have been so don't take the risk. What are your thoughts on that?

Donna Sanderson-Hull
Again, another massive topic to talk about today. But one of my, when I trained with complete concussions back in 2018, one of the big things that I tried to put across to my local club is that we need to be managing these concussions a lot better than we are doing. Kids are being pulled off weekend in, weekend out. My husband was the director of rugby at a private school and one of my clinics is based within a private school. So trying to put these protocols out into grassroots sports was very, very difficult and impossible, I have to say, as a one man band. That's how I got involved with Love of the Game, which is the organisation that's headed up by the Minister for Concussion in Sport, with the whole idea of if we can't do it at a sort of my level, just one person talking about how we need to bring in complete concussion management at grassroots level. So we went to the top we went to that level and very, very soon, I can't divulge too much information about it, but on the seventh 17th of April, there's new national guidelines on how to manage concussion.

Steven Bruce
Where?

Donna Sanderson-Hull
In the UK. And they're going to be hot off the press on the 17th of April.

Steven Bruce
So this is not just sport, this is, what, NICE guidelines?

Donna Sanderson-Hull
No, these are government guidelines on how we should be managing concussion in sport with a particular bias towards grassroots sports. And that's what Love of the Game we're trying to really improve on.

Steven Bruce
What I've got here, which I printed off earlier, are the SCAT3 and SCAT5 assessment things which are used in football and professional rugby. And we're not going to go through them, because they're horrendously lengthy and complicated and I thought a bit confusing as well, but are they useful? So I should say SCAT stands for Sports Concussion Asessment Tool.

Donna Sanderson-Hull
So essentially, there is a group of researchers and experts in the field that get together every four years to devise this assessment tool. And the last one was in Amsterdam in September, Cam?

Nicola Hunt
October.

Donna Sanderson-Hull
And there will be a new SCAT, I imagine, from all the research that's coming into play. And yes, it is the most standardised assessment tool, but it is not foolproof. And we need to widen the assessment of concussion. And again, this is what we do at Complete Concussions, we use the SCAT as part of that process. As Cam alluded to, concussion is very much a functional brain injury. So SCAT goes some way of assessing the functions of the brain, but it doesn't do all of it. So what we're trying to put into place is a better system of looking at a pre-injury baseline test of the brain, including the SCAT, but adding in neurocognitive tests and other tests to give a much more comprehensive idea of what a normal brain function is. So that if they get injured in grassroots level, there is some way of having more objective measures of seeing whether the brain has actually recovered by comparing those two tests.

Steven Bruce
I was gonna say so much of it is terribly, and I've used that word deliberately, subjective at the moment, isn't it? You're relying on a player who wants to get back to sport to give you his opinion of how well he feels he can function and parents who either want their kid to continue or don't want their kid to continue, or coaches who want the player to continue.

Donna Sanderson-Hull
This is this is why in my clinic we do these baseline tests using the software tools that Complete Concussion management have put in. Just to give you some context, in Canada it's around about 15,000 baseline tests that you're doing on kids per year. I think currently we've done 25 this year. So you can see the difference, we've not just got a concussion management problem, we've got a cultural problem around concussion. I think the British tend to be very reactive. When the concussion has occurred, we'll go and seek out some treatments. I actually think that in Canada, people are a little bit more proactive and will go and have these, almost like an insurance policy around the brain. They'll go and have their kids have functional testing first, pre-injury, so that should they get injured, they have something to compare with that is more objective. And you're absolutely right, we need to improve on that in this country.

Steven Bruce
So let's give Nicola a go, because she's sitting there very patiently waiting to say her piece over on the far side. Tell us about your experience in dealing with concussion, at whichever level you care to.

Nicola Hunt
Yeah, so I see a lot of people that come in with concussion. I have a vestibular clinic so some of them will come in purely as thinking that they have a vestibular problem, they may have been to see an ENT consultant who told them they've got a vestibular problem, but when you actually dig back through their history, it all started when they had maybe a sort of fairly moderate speed rear end shunt in the car. They went to see somebody over here for their whiplash, they went to see somebody over here for their vestibular problem, and they've maybe had some anxiety so the GP gave them some anti-anxiety medication. And it's bringing that all together and sitting down and as we've said earlier, concussion doesn't have to be caused by a hit to the head, so they don't consider it to be a concussion, because they didn't have a hit to the head, they can remember the method of impact, it was a rear end shunt in the car, so therefore, it can't be a concussion and they've just got all these different problems that nobody's really making any progress with because they're not addressing the different five elements that contribute to the ongoing concussion symptoms, and then bringing it all together as one sort of treatment and rehabilitation package.

Steven Bruce
And Cameron was talking earlier on about different aspects of treating this, including sort of nutrition and so on. How much evidence is there behind all of this? Because of course, while you're going through any sort of treatment protocol, you're also adding in time, and so people might well argue, well, is it the time that's solving the problem or is it feeding your patient appropriately and all the other things?

Nicola Hunt
And there's a lot of evidence to support it. But I very recently saw somebody who is four and a half years post injury, still got ongoing symptoms and she followed the persistent concussion symptom diet advice and supplements for two weeks. And she was like, I can't believe the difference. And her symptom scores came down so much.

Steven Bruce
What was the dietary advice in outline?

Nicola Hunt
Very much clean diet. So avoiding the triggers that cause inflammation, so no alcohol, really good hydration, not oh I'll just drink my six glasses of water, but sort of two to three litres of water a day, no processed food, no sugar, and then adding in sort of supplements depending upon their individual diet, whether they're following vegan diet, vegetarian, looking at their different supplement needs.

Steven Bruce
So that probably actually answers a question that came in from Bess, who said, how should we manage someone who's had persistent concussion symptoms for three or more months? I guess you've got to do

a decent analysis to make sure it is concussion you're dealing with, which we would learn if we did the Complete Concussion training, the online training, how long is that training?

Donna Sanderson-Hull
So it's a 60 hour course. And I'm not gonna lie, it's intense, there's a lot of information, but you do come out with a really good framework. So in answer to that question, how would you treat PCS? I would be looking to find out what was the driver of that PCS, what was the subsystem that wasn't functioning properly, whether that being, as Cam alluded to earlier on, those five different pillars, is it something that's related to cervicogenic or vestibular or dysautonomia or a blood flow issue. So there are lots of tools and tricks that will allow us to assess that properly, and then we can put the right treatment into place. Another example, one of my very first patients, and I can mention it, because he put it all over Twitter, the beginning, he was a professor of psychology and he'd been chopping wood in the garden and the axe snapped and hit him on the head and he kind of almost knocked himself out.

Steven Bruce
He was probably lucky the blunt end hit him, rather than the sharp end.

Donna Sanderson-Hull
Yeah, exactly. He'd been around the country seeing all the best professors and looking for advice about what to do. And he really struggled to work out, he's obviously a very academic fellow himself, but it was just being able to talk through those sort of subsystems with him and actually really get to the nitty gritties of the assessment. And he was pretty much sorted within weeks and had been struggling for a long time. So it's very, very treatable,

Steven Bruce
Does everybody responds so readily?

Donna Sanderson-Hull
I had a lady who had been kicked in the face by a horse. And there are times when there is an element of PTSD that will go alongside it. And you do have to be very aware of the fact that, at some point, it's out of my scope of practice, if they need help. And Cameron mentioned that there are courses now for psychologists that can also do the course. So we're all on the same page, so we've all done the same courses. So I now know when to refer. And at that point, I knew I needed to get a specialist in. Thankfully, in my area, I had somebody who was Complete Concussion trained, so she knew exactly where I was coming from and she was able to take that patient on from me.

Steven Bruce
How many people are there in the UK who are Complete Concussion trained?

Donna Sanderson-Hull
There's a lot training at the moment, I think, as well. So we have at the moment eight clinics, we're just about to have a university come on board with us and some schools. So it's growing. It's growing. I think once these Amsterdam, the new concussions consensus guidelines come out, usually in around about May time, and the new guidelines from the government. I know on those guidelines, it will be requesting

that people have timely access to evidence based concussion care. The problem we have at the moment is that we don't have that structure from primary care level right the way down to private clinics, we need to have that structure in place.

Steven Bruce
If that's not coming out as a NICE guideline, how is it going to reach GPs?

Donna Sanderson-Hull
So this is again what the Minister for Concussion in Sport is working on. And I think at the moment, they are now trying to set up what they call regional concussion centres, they've got around about 20 regional concussion centres earmarked. The idea being that there'll be adequate training in A&E departments and in primary care, then if anyone has a concussion, they will be signposted to these regional concussion centres. The problem is once they get to regional concussion centres, there's going to be a huge number of people going to those centres, because people will now know how to diagnose it correctly and signpost, the problem is from those regional concussion centres, they then need to go to what we call local concussion centres. And this is where we need help. Because both Nicola and I were discussing over dinner before we came here, the volume of patients that we get through our doors, we can't cope with we. We get inquiries from Denmark, and everywhere.

Steven Bruce
And Cameron said his books are full with just concussion patients.

Donna Sanderson-Hull
And the problem is that we in private practice, I can't advertise concussion services at the moment, because if I do, it will sink my practice. We're a musculoskeletal clinic as well as concussion clinic, we only have a certain number of rooms and a certain number of practitioners. So if we start advertising, and we can't deliver the service that we're promising, that's a problem. So that's why we're on a bit of a mission at the moment to say, help, we need more people.

Steven Bruce
You've hit another nerve there as well, haven't you? Because one of the first things that people say when the word advertising is mentioned, is where does one stand with the Advertising Standards Agency? Are you allowed to say you can treat concussion? Is there sufficient evidence for that to be acceptable?

Nicola Hunt
Yes, there is. This is evidence-based practice in how to treat concussion and persistent concussion symptoms.

Steven Bruce
But you know what they're like up there. If it's not written on their list of things you're allowed to talk about, then...

Donna Sanderson-Hull
There's no doubt that the course that we've done, and the way that it's structured is that we get from Cameron every month, what we call concussion research update. So every month, the research is analysed and put into an applied form. So that then that gets put through to us as practitioners so that we are working at an evidence-based level the whole time. And it has to be said that we don't work outside of our scope of practice, this is all within our scope of practice. And we also know how to refer on to the right individuals that hopefully will all be part of the same education piece.

Steven Bruce
This is a piece of string question. But if someone comes to you, and having done your assessment, you say, right, this person has got some form of concussion, whether it's post concussion syndrome, or whatever you might term it, how many times are they likely to have to come back before they're resolved?

Donna Sanderson-Hull
So we'd have different clinics here, because I suppose me being a sports medicine clinic, I'm more likely to see the acute concussion and very worried parent. So from an acute perspective, we follow a set protocol on making sure that they are safely returned back to school and safely returned back to any sporting activity. And you can actually do that probably within three sessions. Because as Cam says, the brain will recover. And as long as you give it the appropriate rehabilitation in the amount of time, there will be no issue.

Steven Bruce
If you're dealing with children, it's got to be really critical to get that timing right, though, hasn't it?

Donna Sanderson-Hull
And you've got to look at professional sport, if they're trying to turn around people with a concussion in seven days and we know that the recovery levels are 22 days, trying to tell a youngster who's 15 that wants to be like his idol, whoever on TV. Well, he's got back in seven days, why can't I? That's quite a challenge. So we have to educate them and the parent. So we'll see them within three to four treatments max. Nicola, on the other hand, who may see more PCS.

Nicola Hunt
it takes longer than those. But you get a very steep drop off of symptoms very often after the first session, because they've got somebody who can explain to them why they're getting their symptoms. They can explain to them what the management plan is, we're going to look at these five pillars that drive persistent concussion symptoms, we're going to assess them, we're going to put in treatment plans from that, and just the education around that it is a concussion, it's a functional brain injury, the fact that you've got a clear scan does not mean that there is nothing wrong with you or it's all in your head. Any more than obviously, it is in their head because it's a concussion. But I think a lot of the people who have had these symptoms for longer time, feel very unheard or very dismissed, because they keep going back and back and back.

Steven Bruce
Now we need to get off our bottoms in a minute, but I've got a question for you, Cameron. I think this one comes from an osteopath, so there's a joint interest in this but he says, have you ever come across a long-term concussion which could be related to poorly executed cervical manipulation, high velocity thrust?

Dr Cameron Marshall
So I think it'd be very challenging for someone to actually provide the amount of force required for a concussion, but I think a lot of patients may assume that they have a concussion. If you think about whiplash neck dysfunction causing the same and similar symptoms as concussion. This happens all the time, patients will have a manipulation and they will feel dizzy, have headaches and all of these things. I look at that more so as likely just cervical dysfunction, right? Somebody's maybe gone a little bit too hard with the manipulation, maybe done a little bit of damage in there, and they start to have headaches, they start to feel dizzy and all that stuff. I find it would be very difficult for somebody to reach the level of acceleration needed to cause an actual concussion injury. But I think creating neck dysfunction is totally possible. And in those patients, oftentimes when you start poking around their neck, you're able to recreate all their symptoms. And so I think it's more so that.

Donna Sanderson-Hull
And I think there's also the issue that if you're doing hivelocity manips that there is going to be a response from muscle tissue and that may alter the way that the afferent input in the muscle spindles are reacting around the neck. So you may then get, as a consequence of increased mobility in the joint, you might get increased tension within the muscle. And that tension within the muscle then can create some of the problems with maybe cervicogenic dizziness or headache.

Steven Bruce
Okay, so last one, before we move. Dee has asked whether there's any link between post concussional whiplash and arterial dissection or increased risk of aneurysm?

Dr Cameron Marshall
Yeah, I mean, with any type of head neck trauma, that's a concern, because just of how those vessels run. Anytime you're gonna have like a whiplash mechanism injury, it's got to be high on your differentials. That's part of what we go through in doing kind of our initial evaluation. The number one concern in looking at any acute concussion patient is ruling out the red flags. So typically, based on your history and your examination, the things you're doing are cranial nerve examinations or doing cerebellar testing, you're looking for signs of potential arterial dissection. And in those cases, you're obviously immediately referring that to the hospital. So yeah, obviously a concern and it's something that we cover throughout our training of patterns of both vertebral artery dissection as well as carotid artery dissection because they do they do happen frequently in these injuries.

Steven Bruce
Okay, I think that segues very neatly into what you're going to show. What are you gonna show us, Donna? Nicola?

Donna Sanderson-Hull
Well, I think Nicola is going to show you how to do a vestibular ocular motor screen, or VOMS. And I'm going to show you a little bit of testing for potential cervicogenic dizziness.

Steven Bruce
Ok, shall we go and do that?

Nicola Hunt
So we'll start with the VOMS, the vestibular ocular motion. So when you have a concussion, then you can get a disturbance of the reflex between the vestibular system and the eyes. So we can learn a lot by looking at the eye movements as to whether there is a pathology going on there. So invest very heavily in craft sticks, all the really high tech stuff. So, we're gonna start just keeping your head still, and I'm going to ask you to just do some eye movements. So the first thing I do is can you see the X nice and clearly?

Donna Sanderson-Hull
Yeah.

Nicola Hunt
Okay. Can you keep your eyes still...

Steven Bruce
We should point out there is an X on the end of the lollystick.

Nicola Hunt
There is an X on the end of the lollystick, yes.

Donna Sanderson-Hull
And just to just to point out, what we tend to do when we're doing this VOMs test is to just ask the patient what their current symptoms are. So some of the symptoms we might ask them is, do they currently feel dizzy? Do they have a headache? Do they have any nausea? Or do they have any fogginess?

Nicola Hunt
Yes, and we'd score those out of 10 for each symptom. So then we'd start with smooth pursuit. So if you can clear that, if you keep your head still, you follow with your eyes. So we do two, and then we'd go again.

Steven Bruce
Why two?

Nicola Hunt
That's where it's protocolled to do, because if you keep going for a long time everybody's going to feel a little bit nauseous. The eye muscles are very small, they fatigue quite quickly if you were to keep your head still and move your eyes side to side for any length of time. And again, for that reason, we're not

going right over here, we're just doing a small movement across from there, because again, we don't want to be getting right into end gaze. And then you'd say has that changed your headache now?

Donna Sanderson-Hull
No.

Nicola Hunt
Has that changed your dizziness?

Donna Sanderson-Hull
No.

Nicola Hunt
Has that brought on any nausea?

Donna Sanderson-Hull
No.

Nicola Hunt
And any sort of fogginess, brain fog?

Donna Sanderson-Hull
No.

Nicola Hunt
Okay, and then we would do the same thing going vertically. And then we would just go through the questions again. So headaches, dizziness, nausea. And that would be smooth pursuit. Then we'd do saccadic eye movements, so we'd get two sticks, I've got an X and a Y on mine. So again, if you can, again, just keeping your head still, if you just look towards the X then the Y. X, Y, and keep moving your eyes back and forth between those. So you would do those eye movements. And then again, we would score headaches, nausea, dizziness, and fogginess out of ten for each one.

Donna Sanderson-Hull
And it's really about making sure that they have the ability to lock their eyes onto a target, and to unlock and then lock again onto another target. And sometimes you may detect little issues with that, what we call saccadic dysfunction, they're not able to lock onto a target. And the issue with that is when people will say oh, when I'm reading my eyes skip, or they're skipping words, because they can't lock on.

Nicola Hunt
So what you're looking for is it goes to this target and to this, rather than it stops short and then corrects or overshoots, and then comes back. So that's what you're clinically looking for.

Dr Cameron Marshall
One thing to add on there, too, if I can. A lot of times, Donna mentioned it real briefly there, but a lot of times visual dysfunction is misperceived as cognitive dysfunction. People are saying I can't read, I can't focus, I can't concentrate on things, I can't watch the TV, I'm losing focus and memory. But really, it's because their eyes are missing words, potentially, they're skipping over words, they have to reread sentences, they attribute it to a cognitive problem. But actually, it couldn't be an ocular motor visual function problem.

Donna Sanderson-Hull
And again, just to reiterate that, because I'm working within a school environment, it will be the parent that comes in and says, he was a straight A student and now he's really depressed because his grades have dropped. And actually, it could be something based in the ocular motor function.

Nicola Hunt
Yes. So then we're looking at convergence. So how well the eyes can work together. So if you want to put that on there, okay, so are you happy with me holding it? And then if I bring this in, so I want you to just focus on, there's some letters on this card, so we're just going to bring them in, I want you to focus on it nice and clearly. Tell me when it goes double.

Donna Sanderson-Hull
Now.

Nicola Hunt
And then you would take that measurement. So you would look at the measurement for that as to how many centimetres. So that was nine centimetres.

Steven Bruce
I'm assuming you want your patient wearing their eye correction or whatever while they're doing this?

Nicola Hunt
Yes, vision corrected.

Donna Sanderson-Hull
There's some normative data that for normal is around about five to seven centimetres for convergence. But if they do wear eyeglasses, because you've got age related eye problems, then they must do that test with their eyeglasses.

Nicola Hunt
And one of the things you may say, you can get it and they will bring it right the way up to their nose and say, no, no, I can't see it double. And that's why you need to make sure you're watching the eyes and are the eyes actually coming in and converging. Because if the eyes aren't converging, you won't get a double image. So if one eye is moving across, and then again, that needs further investigation if they're not able to converge, because convergence is part of your cranial nerve screening. So you would need to do that. And we will repeat that, I'm not going to go through it again, but we'd repeat that one three

times and take an average of the three. So then the next one of the VOMS is to look at the vestibulo-ocular reflex. So the vestibulo-ocular reflex happens at speed and it's the ability to keep our eyes still with our head moving. So to make sure that we are getting the vestibulo-ocular reflex, we set a metronome to 180 beats and what we're going to do is I'm going to hold this out in front, I want you to keep your eyes focused on it and turn your head side to side with your eyes focused on it. And if you can turn your head in time with the metronome. And again, you would ask for any increase in headaches any change to dizziness, nausea.

Donna Sanderson-Hull
Dizziness would be about two out of ten.

Nicola Hunt
And then you would repeat that but getting you to nod your head this time. And again, you would score the dizziness.

Steven Bruce
I don't know about you, but I don't think that Donna was nodding our head as fast as that metronome was going. And I don't blame her either!

Nicola Hunt
Slightly behind the metronome.

Steven Bruce
So okay, if someone doesn't know it in time with a metronome, is that a problem?

Nicola Hunt
Again, it depends. If they're close, then you're close to getting into vestibulo-ocular reflex. The issue is if they're going too slowly, is it because they don't want to because they know it triggers symptoms and they're inhibiting? And again the cervico-ocular reflexe is a slower speed. So you could be looking at dysfunction of the cervico-ocular reflex rather than the vestibulo-ocular reflex. So if they can't do that comfortably, there is another test that we could look into as more vestibular test, which is passive, where the therapist would do a quick head impulse test, which they don't control the speed of the movements the therapist does. So that would be the other way of doing that. And then the final one of this will be the visual motion sensitivity. So you can either get them to use a stick or focus on their thumbs. And we just take the speed of the metronome going side to side, so what we're going to do is just focus on your thumbs and swing your upper body side to side with the metronome beat. Doing that at 180 beats a minute is going to be a little bit quicker. So we just do this one. So from side to side for each beat. And then again, you would ask them any change to dizziness, nausea, headaches, and that would be your VOMS.

Steven Bruce
You don't do that one vertically then?

Nicola Hunt
No, but again, that's something that you do take into consideration. So particularly with sports people if they're saying that they're having issues with running, and that's that up and down test, then that's something that you want to look into further. The VOMS is a screening test and it indicates that you need to go on and do more vestibular testing and vestibular rehab, based on the findings of your VOMS.

Steven Bruce
Okay.

Dr Cameron Marshall
It's also become somewhat of a diagnostic as well. The evidence that's emerging on this is finding a pretty good categorization of concussion versus not. So in the event that you don't have really objective good baseline testing, the VOMS has kind of become a bit of a stop gap in that in that regard to try and use it as a bit of a diagnostic tool. So it can somewhat categorise people concussion versus not.

Steven Bruce
So we move on to the chair and the laser now?

Donna Sanderson-Hull
So now we're moving on a little bit more to being specific to see whether actually muscles around the neck are an issue or if there's some cervicogenic issues for the onset of some of the symptoms. So we'd be looking at trying to put the neck into different positions to see whether that brought on any of their dizziness or dysfunction. One of the easiest ways to do that is to get somebody into a swivel chair. So if I just get you to sit down there, Nicola. So we want to take out the element of the vestibular system, but just look at whether the neck is bringing on any of those symptoms. So I would stabilise Nicola's head in this position and just ask her to rotate 45 degrees and back again to the other side. And now just do that a little bit faster, Nicola, so you can just spin from one to the other. And I'd probably get her to repeat that 10 times or so. And if she was dizzy in that situation, then that's a pretty clear indication that the only thing that's happening there is neck torsion, and essentially what you'd be looking for then is what are the tissues that are being sort of stretched and moved in that situation? And could it be the stretch or the contractions of those muscle tissues that are creating sort of altered cues to the visual and cervico-ocular motor reflexes, and then giving rise to that sense of dizziness or just feeling off. I think some of the cervicogenic dizziness symptoms are much more subtle. People will describe it, Cam will probably corroborate this, but they'll describe it as, I wouldn't say I was really dizzy, the room's not spinning, but they just feel that the floor feels like it's coming up towards them or they just feel just off kilter. So it's not quite as important. I had one lady recently that came in, had a car accident some time ago, and she was still suffering with a lot of dizziness, and she thought it was because her brain was injured. And again, we did quite a lot of testing, when I was talking to her in the assessment, she spent the entire assessment like this. And I said, can you put your head into a neutral position? She said, I am in a neutral position. So her joint position sense was really off kilter. So that gave me the indication that perhaps proprioceptively, she was getting the wrong cues. And so we've got a nice little test here I can show you, what's called the the joint position error test, and we use a snazzy little laser to just give the patient an idea of where their head is in space. Because if she's spending majority of the day thinking that this is

neutral, then the information that her eyes are getting and the vestibular system is getting is all off kilter. So she's not able then to get the correct sensory motor information.

Steven Bruce
So we've got our laser fixed your forehead.

Donna Sanderson-Hull
Yep. So the idea is that that we want to have this just about a metre away from the patient. And we just get them to put the laser pointer and you can see we're aiming for the centre of the bullseye there. So that's what we want them to do. The idea now is to get her to do a little bit of rotation work with her eyes closed, this is actually quite a difficult test even on the uninjured individual, I have to say, but it does give people a real indication of where they are in space. So I'd be asking Nicola to close her eyes, and to just take her head 45 degrees to the right and back to the centre. And the idea is that she hits somewhere around that bullseye, anything to sort of five-centimetre distance away from the bullseye would be considered as normal. But we take a sort of mean of six goes at that. And then if they're way out with that, and they can't get to the middle, they have no idea where they are in space, that is a rehab tool for me. So I spent lots of time with this lady...

Steven Bruce
I was going to say, is this also a remedy as well?

Donna Sanderson-Hull
Yeah, exactly. So like with all MSK, what they fail at actually becomes the exercise. And people say, oh, yeah, but it makes me dizzy when I do that. Well, for this particular lady, the first thing I needed to do was to do some active work on her cervical musculature to allow her to get into that position. So I did lots of manual therapy, lots of active release techniques to try and get her to be able to have the right information going into the ocular motor system, we did some retraining with this little tool. And it was like a real process. And people worry about feeling dizzy during the treatment but again, like with any musculoskeletal, it's all about graded exposure. So we're saying, look, it's okay to be dizzy, it's okay, if you've got sensory motor issues, and then we take you to a shopping mall. Just go and do that for five minutes. But then, if that takes you 10 minutes to recover, let us just sit like that for a while until you get more resilient. And then you can build up the graded exposure. That about right, Cam?

Dr Cameron Marshall
Yeah, exactly.

Steven Bruce
Are you done on the exercises?

Donna Sanderson-Hull
Yeah, I mean, again, just quickly, if Nicola just sits at the end of the bed. Just taking those smooth pursuits that we looked at from the ocular motor function point of view, we can also look at that, again, in what we call the neck torsion position. So again, just putting some of those muscles, sternocleidomastoid, your suboccipital muscles, all under a little bit of tension, and seeing whether the convergence changes, and

whether actually the distance starts to change because she's now in a torsion position, and the neck muscles are giving the wrong information. And similarly, you could do smooth pursuits in this position, and see whether actually, she had no symptoms when she was in neutral, but actually smooth pursuits were a problem when she was in that neck rotated position. And again, great, I can then get my neck treatment going for that.

Steven Bruce
Cameron's got a slide he wants us to look at as well.

Nicola Hunt
I'm seeing somebody with exactly that issue, no problems with smooth pursuit in neutral, but as soon as you add in neck torsion their smooth pursuit is abnormal.

Donna Sanderson-Hull
And like Cam says, this is our bag, this is where we can really make a difference to patients and they walk out and go, I've been dizzy for nine months and you've just done two treatments on my neck, got me practising this kind of stuff at home, and I'm no longer dizzy. That means a lot to people.

Steven Bruce
Cam, do you want to talk to us about these slides?

Dr Cameron Marshall
Yeah, there's just a couple of things that I wanted to talk about.

Steven Bruce
I'll tell you what, while you do that, we're gonna get back to our seats and the slides will be up while we do that, you carry on talking.

Steven Bruce
I'm not sure if the audience can. It's only you, Cam.

Dr Cameron Marshall
Sure, yeah. And I don't know if you can appreciate this but I just recently got back from Dallas, Texas. I did a presentation on the association of neck dysfunction and visual function and I gave it to a group of neuro-optometrists. So it was actually a vision training neuro-optometry conference and I presented on all of the evidence that shows how neck dysfunction actually influences ocular motor function. And ocular motor function is a huge test in the concussion world, we look at the siccads, we look at smooth pursuits, we do all these VOR testing and so the eyes are a big kind of gateway into the central nervous system. But what people don't realise is how much they're influenced by the cervical spine. So I don't know if you can appreciate this, but this is a video of me just demonstrating this. If you take a patient and you guys can try this in your own practice if you haven't done this, but take a patient who lying supine on the table and have them look to the right, just with their eyes, just have them look right. And then you try to turn their head, and it'll go very, very easily. But if you tell them to look right, and you turn their head left, there will be a tonne of resistance. It's because your eyes are wired with your neck. So when when your eyes

go one direction or the other, the muscles that go that same direction will engage in preparation, anticipation of turning in that direction. So I don't know if you can appreciate this. Can you hear this video or is that only me?

Dr Cameron Marshall
So I'll just kind of talk through it. So I don't know if you're able to appreciate this, but I'm going to turn his head to the left. And he's going to look right and I'm going to turn him right. But now I'm going to have him do the opposite. So do you see how there's that kind of glitch where it resists? So that's just kind of one thing. Now this just shows, neck dysfunction associated with visual symptoms, this is 50% of people with neck pain and dysfunction will report these types of symptoms, concentrating harder to read, visual fatigue, sensitivity to light, blurred vision, words moving on the page, difficulty judging distances. Now a lot of times in the PCS world and the post-concussion world, if you're going to your neurologist and saying, oh, I have trouble seeing things and my eyes are hurting and I have sensitivity to light and i it's because I had this concussion. They're going to immediately think, oh, it's just a brain injury, there's nothing we can really do about it, go home. But in reality, there could be a neck issue here, there could be an ocular motor issue, there could be a vestibular issue, but there could be a major neck issue that needs to be addressed. And this is kind of the big thing we're harping on, is that we are the treatment for concussion, whether you know it or not. And so I want people to be encouraged not to shy away from this, but just to learn more about it, develop the skills, develop the repertoire, because there is a massive, massive, massive patient population that desperately needs our services for this particular issue. And so I just wanted to kind of highlight that, as things you wouldn't think are neck related could actually be neck related.

Steven Bruce
Sure. I'd like to turn to a few more questions from our audience if I can, because we've got very little time left. So the first one, came in ages ago actually from Di who sounds as though he's from the valleys. He says he's followed the rugby football and now the women's rugby union return to play protocols for rugby teams that he works with, two weeks rest plus graduated return to play, which relies on player honesty. What are the current thoughts and should World Rugby rethink return to play protocols, especially in amateur sport? Well, of course, you kind of touched on that, haven't you Donna?

Donna Sanderson-Hull
Yeah, World Rugby are rethinking those protocols. The issue is that that they're very much symptom lead, in terms of the return to play. And it does require quite a lot of honesty. You've also got the concussed patient advocating for their own health, they're having to manage their own symptoms, and sometimes if you've got somebody who's pretty switched on and intelligent, that's actually quite easy to do. But actually, those return to play protocols can be pretty confusing for people. I think you even said, the SCAT's really confusing. It can be really confusing, and yet we're expecting people to manage their own return to play guidelines.

Steven Bruce
Especially at an amateur level when they try to make sense of these things. They haven't got highly paid doctors trying to do it for them.

Donna Sanderson-Hull
And as Cam said right at the top of the talk, it is a functional brain injury, we surely have to be looking at the functions of the brain to make correct judgments about whether they are safe to return to play with good, functional, objective measures. We use neurocognitive testing. So there's an app that Complete Concussions have got which has got inbuilt neurocognitive testing that can be done right on the phone. It's really easy. The one thing I will say about the SCAT, although it is part of the baseline testing that we use, as a standalone tool some people do use that as a baseline test. So they'll do those questions beforehand, but the problem with a SCAT, it normalises after about 72 hours. So if you've got somebody that comes and sees you in clinic, and you're sort of comparing their SCAT pre injury to post injury, it's actually useless. And so the return to play guidelines are slightly lacking really.

Steven Bruce
David's sent in a useful question here I think, because we've talked about your clinical testing regime over there. He's asked about, what do you look for in terms of signs and symptoms apart from the obvious? And I think he's talking sort of immediately postinjury because as I said, in the old days, it was you answer a simple question, who is the prime minister or whatever it might be? That's pretty difficult in this country, perhaps, at this time, because it might vary from day to day. But you ask them a simple question. But now we've got better protocols, but what sort of things are being commonly missed by people checking for concussion, particularly in amateur sport?

Donna Sanderson-Hull
I think in amateur sport, it has to be said that all you need is a mechanism of injury and one of the 22 signs of concussion, and at amateur sport level they should be off. Regardless.

Steven Bruce
And those 22 signs are readily available, I'm sure, somewhere.

Donna Sanderson-Hull
Yeah, absolutely. But the key thing is the Scottish rugby union have got a lovely slogan, if in doubt, sit them out. There should be absolutely no questions asked. No prime minister questions or what's your name questions in amateur sport, any mechanism or any one of the 22 signs, they're off. And if in doubt, sit them out. It's just not worth it. I think in terms of professional sport, then you could then go on to ask a few questions. Obviously, on a pitch side situation, your primary thing to look for, particularly if they've lost consciousness or they're lying flat and unresponsive, is are they breathing? Have they got a cervical spine injury? Those are the first two things that you should always be looking at. I think one of the questions that we always ask first, certainly when I was a physio back in the olden days, when I could run on the pitch, was just to simply ask what their name is and at least you know that they're responding to you.

Steven Bruce
Depends on you knowing what their name is as well though.

Donna Sanderson-Hull
Yeah, I don't know if that's right or not. And then you may go on to ask a series of what we call Maddocks questions and, as I say, once you've ruled out that there's any cervical spine injury, you might then get them up into sitting, but you're then looking for one of those 22 signs of concussion as well. So you might sit them up, they might answer all the questions perfectly, they get on their feet, and the first thing they do is run in the opposite direction to where they're playing. And then you think, actually, they haven't got a clue which way they're going. And you see this a lot on some of the fantastic videos that the NFL put out where, there'll be huge collisions and the first thing that happens is this player gets off and then sort of stumbles and collapses and his mates are holding him up, and they kind of try and carry him on. So that's what you should be looking for.

Steven Bruce
Kim says, so if you don't have an actual knock to the head is the force for example of a roller coaster ride, okay? It might give an adrenaline rush in some and extreme anxiety in another.

Donna Sanderson-Hull
My husband is a classic for this, he can't go on the waltzes without having extreme nausea.

Steven Bruce
That's normal, surely? They're horrible things.

Donna Sanderson-Hull
But also, any kind of roller coaster ride. And that was since a pretty big event for him.

Steven Bruce
Well, here we are, Cameron, you've got a slide up. Tell us what this one says.

Dr Cameron Marshall
Yeah, just for comparison. So I'll do the first one first. So this is looking at all the studies that have been done with instrumented helmets looking at concussion G forces. And basically, you'll see here that the average or the mean is usually around 100 G's. And then the range of that is 70 to 120, as I've mentioned previously. So this is a systematic review that's kind of gone through...

Steven Bruce
These are in, as it says in the small print up there, those were in clinically diagnosed concussion cases?

Dr Cameron Marshall
Yes.

Steven Bruce
So those G forces are directly associated with concussion?

Dr Cameron Marshall
Yeah, so what they'll do is they'll put instrumented helmets on teams and teams of players, and they'll follow the data. So they'll look at every impact over a 10 G threshold. And then the ones that get diagnosed with concussions, they'll look back at the data and say, okay, well, how much force was that? And then they'll take all those concussions and kind of bucket them, and so you have that you have that here. And if you look at the comparisons, so standing at sea level is one G, a sneeze is three G's, space shuttle launch and reentry is only three G's, which is surprising, roller coasters, high G roller coasters, only 3.5 to 6.3 G's. Well below the threshold required for a concussion injury. Now, if you have that G force and then smack your head off something, there may be obviously more G force there because you're coming to an abrupt stop. Hearty greeting, slap on the back. This one happens all the time. They'll say I was out with my friends at the pub and somebody came up and said, hey, John, I haven't seen you in a while and give you a smack on the back and then they think they've got a concussion. Well, it would be very unlikely.

Steven Bruce
We might have to speed through these a bit, because we are running out of time, but the one that stands out from me is that an Olympic boxer all out punch to the face, a jab, is only 58 G

Dr Cameron Marshall
Yeah, interesting, right?

Steven Bruce
I'd have thought that would be up with the football players.

Dr Cameron Marshall
Yeah, that's like a straight on, from the shoulder jab. You don't see many boxers get knocked unconscious with a jab, right? Usually it's a hook. And if you look at the G forces in a hook, the rotational acceleration far surpasses the concussion threshold and that's usually where those injuries happen. So that's it.

Steven Bruce
Interestingly, though, some of those things that you were talking about earlier on, I mean, soccer header was way down the list there. And yet, you can't rule these things out as potential causes of injury, I guess, of one sort or another.

Donna Sanderson-Hull
I think no, and the whole topic of sub concussive injuries. So no symptoms necessarily, but they are getting repetitive head trauma. Well, that's just another topic in itself. And that's going to be pretty difficult with the research to monitor that with sub concussive impacts.

Steven Bruce
Mark has asked a question, which I suspect we can't answer here. It says, would a physio or chiropractor or osteopathic approach differ regarding the C spine elements of concussion?

Donna Sanderson-Hull
No, or I don't think so from a physio point of view. I've been trained by Complete Concussions, which is very chiropractic lead. But still, I'm trained in being able to deliver adjustments, I'm also trained in dry needling, and manual therapy. And I would guess, that someone who has a primary clinic of doing a lot of adjustments is also trained in dry needling and soft tissue release techniques and rehab. So I think our paths do cross quite a lot. It might be that I'm not doing the volume of adjustments in my clinic that perhaps a chiropractor or an osteopath does, and they might not be doing the volume of rehab. But I think that in this situation with a standardised training protocol, and this is what we're trying to get is a standardised evidence-based treatment protocol around the country, so that we're all singing off the same hymn sheet.

Steven Bruce
Yeah, I think there's such a vast spectrum within each of those professions as well that I always think it's very difficult to say, this is what an osteopath would do or this is what a chiropractor would do. There's a huge variety even within the professions, isn't there? Mike has asked if we, after the show, can send out references to the current evidence, which for using physical therapy to treat concussion. Now, again, I think that might be quite difficult, because presumably, you can use physical therapy to treat concussion, provided you've been taught how to do it incorporating some of the tests that we were looking at earlier on. Am I right?

Donna Sanderson-Hull
There's a stack of evidence. There are so many articles. I think you even have the stats on how many articles per month were coming out in the concussion space, Cam. There are stacks and stacks of research and articles with supporting evidence for what we do from a physical therapy point of view. So yeah, and I'm sure Cameron would have those to his fingertips as well.

Steven Bruce
If there's a couple of recent ones you could share with me, Cam, then perhaps I can send those out to the audience.

Dr Cameron Marshall
The issue is that there's, like our course for example, it probably has about 2500 references to it. So we have a research team that goes through the research every single month and kind of compiles it all, you're not going to find one or two papers that say, I guess you probably could now, I could probably find a systematic review that says physical therapy, but it's not really going to give any of the audience really an idea of what to do with that, because physical therapy is a broad definition. What you will find is if you start looking at what's the research on sub symptom threshold exercise and concussion treadmill testing, you'll find hundreds of references on that showing that sub symptom threshold exercise testing and rehabilitation is good for concussion. So that would be in the bucket of physical therapy. Then you'd look up concussion and neck and how many research articles show that neck therapy is good for it. So everything is kind of categorised and compartmentalised. But they all would fall under the realm of physical therapy, physical medicine, chiropractic, osteopathic medicine. So it's hard to necessarily find one or two, unless I found you a general systematic review that said that physical therapy, there was a recent one that said physical therapy within the first 10 days after injury is associated with improved

outcomes for concussion patients. So this has to happen pretty early on. But I don't think that really helps your readers other than giving them a little bit more credibility towards either patients or GPs in their area to say that, hey, this is something we should be dealing with.

Steven Bruce
Yeah, I suppose to some extent, Mike was probably working on that basis, that we need to be able to justify that we can do things. Probably the last question here, Pip asked whether any of you, and I think I'll direct it at you Cameron, have any of you come across evidence for cranial osteopathy or the chiropractic equivalent, of course, sacral occipital therapy, as a treatment for concussion?

Dr Cameron Marshall
There's not much specifically on those modalities. But if you just take cervical spine as a whole, some papers will use cervical spine rehabilitation exercises, and they'll show positive benefit. Some will show manual therapy and they'll find benefits, some have acupuncture for headaches post-concussion and they show benefit. So it's very kind of compartmentalised. And so the specific technique of craniosacral doesn't have much evidence on it at all or specific with cranial bone manipulation, there's not much on that either with respect to concussion, unfortunately, but there's a lot of evidence on each compartmental piece showing that these elements are involved.

Steven Bruce
Thank you. And I made an assumption that that would be more Cameron's part of the ship than yours. We've kind of run out of time. So I want to thank all three of you very much. Cameron, grateful for you giving up what I imagine must be the middle of your day to be with us and deliver so much useful, interesting information. I know the ladies in the studio wants some of those polo shirts that you're wearing because they look pretty funky. You might have to send a couple of those over.

Dr Cameron Marshall
This is our logo. This is our complete concussions logo.

Steven Bruce
Okay. Thank you, too, for coming up here. Yours was a bit more of a hike, wasn't it, than Nicola's, but yeah, great of you to give up the time to come in. And there's clearly quite a lot of interest in this from from our perspective. One thing, Cameron, I'm sure you and I talked about whether you had anything which might twist the arms of osteopaths and chiropractors to do the complete concussion course?

Dr Cameron Marshall
Actually, we do. We're running a sale right now. I'm just going to bring it up the link right now.

Steven Bruce
Don't say that, say it's especially for my viewers, that's what you're supposed to say.

Dr Cameron Marshall
Yeah. It is, it is. Where is it?

Donna Sanderson-Hull
While Cameron's just quickly looking at that, I can't reiterate enough for everyone that's watching to look at the news in the next two weeks, it will really put the emphasis on that we need more therapists.

Steven Bruce
So here we go. We'll push this out instead of $2000 US, it's $1500 US.

Dr Cameron Marshall
Yeah. And that's for the 60-hour course. Now I put a QR code up. I don't know if you can show your viewers just full screen of this, but if they just hold their phone up over this QR code.

Steven Bruce
I'll send it out to them anyway, Cameron.

Dr Cameron Marshall
Sounds good. But you get $500 off for the month of April.

Steven Bruce
Okay, thank you. Well, that's it. We've had 440 people watching, which is a pretty good number, I think. So there'll be more watch the recording, of course, and more people drawn to your site. And hopefully, it'll make a difference for a lot of patients as well. Thank you very much. That's all we've got time for this evening and I hope you found that as useful as I have. A quick look ahead, if I may, as I always do. Just look to next week on Wednesday, that's the 12th, I said, we were going to be replacing our case based discussion with a show all about getting access to free money. Well, it turns out I fibbed. The case based discussion is going to go ahead as planned. So if you've got any interesting or challenging cases of your own, that either we can help with, and when I say we I mean an audience of 600 or so, or that we might just find interesting and learn from, then please let us know. Just send us an email and we'll be in touch to find the details. After that, we've got an evening of cauda equina syndrome with the excellent James Booth that's on Tuesday, the 18th. And then two days after that, I've got Carl Todd joining me for a talk about connecting the hip to the spine. And that one's Thursday the 20th and that will be over our usual lunchtime slot. The show about free money I mentioned, it will go ahead, but we've now rescheduled it for the 25th of April. And we're going to be telling you how you get access to all sorts of different and fairly well-hidden grants, which we've used to great effect in my own clinic and in APM. We'll tell you how to get through the paperwork and we'll explain how we can help you to navigate that bureaucratic mess as well. And finally, another plug for the Simeon Niel-Asher and Professor Bob Gerwin course in May, all about dry needling. As I said before, it's the best course on dry needling that you're ever likely to go on, so whether you've done it before or whether you've never needled, this is a brilliant, brilliant course and you should consider it. Bob is a professor of neurology from Johns Hopkins medical school in Baltimore, he's flying in for the course. Simeon, a world expert on trigger points, he's flying in for the course. And between them, it really is just brilliant and they're all over the safety aspects of needling as well. 19th to 21st of May. There's a link on the screen to the booking page. I think one place might just have gone because I think we might have talked Donna into going on that course as well. If it's cash flow that's holding you back there, there's an opportunity to pay in four instalments. Anyway, that's enough from me. Enjoy the rest of your weekend and have a great bank holiday. Bye for now.