

0:01 Dr. Charles Tator

[Your Complex Brain theme music] I played hockey every winter day of my life when I was a kid. It's a great game, but it caused me a lot of anxiety when I was confronted with kids in wheelchairs because of hockey. Like, I never would have believed that a sport could end up so tragically.

0:32 Heather

[theme music continues] This is Your Complex Brain, a podcast all about the brain, the diseases that impact it, and the path to finding cures. I'm your host, Heather Sherman, and I have the great pleasure of working alongside the team at the Krembil Brain Institute in Toronto, Canada, a leader in brain research and patient care. In each episode, we'll take you behind the scenes into our clinics and research labs to meet the game changers of the future. We'll also empower you with the latest research to help you take charge of your own health. You'll hear directly from people who are living with brain disease, as well as their loved ones and the care teams who support them. Join us on a journey to unravel the mystery of your complex brain. [theme music continues then fades out]

1:24 Commentator 1

Coming out to take a look at Josh Johnson.

01:29 Commentator 2

Oh, my goodness.

01:31 Commentator 1

I think his head hits the ground. So, they're making him come off and get checked out.

1:34 Reporter 1

[gentle, flowing electronic music] Giving your brain a break after a concussion could improve your recovery, according to new research.

1:39 Reporter 2

We actually surveyed parents at today.com and found that nearly 90% of them worry about concussions if their children play contact sports.

1:49 Heather

[pensive electronic music] Every year, 40 million people worldwide sustained a concussion, a type of traumatic brain injury caused by a hit or jolt to the head. We often hear about concussions in the context of sports, but most occur as a result of everyday life, from running or biking, accidental falls, and motor vehicle accidents. While the vast majority of those who suffer a concussion recover in time, there are many who experience lasting symptoms and researchers and clinicians want to know why, including Dr. Charles Tator who's made it his life's mission to educate the public and the healthcare community about the impact of concussion and to advocate for change in youth and professional sports. [music fades out] Fran Rider is an athlete and a leader in women's hockey. She has pledged to donate her brain, post-mortem, to the Canadian Concussion Centre's Brain Bank at UHN. Here is Fran's story. [rhythmic electronic music]

3:00 Fran Rider

My name is Fran Rider and I am the President of the Ontario Women's Hockey Association and heavily involved in women's hockey. I grew up in Etobicoke. I was born in 1951. My dad was a firefighter, my mom was a lifetime volunteer helping kids, and my dad was also an athlete, basketball player, baseball

player, and we were true hockey fans, sports fans. I absolutely loved hockey, love the Toronto Maple Leafs, desperately wanted to play hockey. Girls didn't play at that time. My hockey was playing on figure skates on a backyard rink with a hockey stick and absolutely loving it until 1967/68 when I learned about the Brampton tournament and started playing hockey. I was 15. The youngest player in our team was nine; the oldest was 44. It was full body checking. I went from figure skates to full body checking in no time, and I was happy being on the bench but the players wanted you to play and be part of the team and, at that point, I started playing hockey. [music fades out] I played for about 30 years.

[uplifting electronic music] When I started to be involved in 1968, I started to volunteer as well, and I wanted to do anything and everything I could in the world of hockey, and that took me to working on various orgs at team level, league level, association level. Certainly, as we were growing and building, we were watching the trends of the game. The equipment was very, very inferior. The equipment did not fit women properly. The helmets did not fit properly, the hands, the gloves, the shin pads – none of the equipment fit well. The sticks weren't appropriate, but we were working towards making equipment better and also learning, very early, the spinal injuries that were starting to pop up in hockey. And, we worked with Dr. Pashby as he was working to put the face shields on players to save eye injuries, and Dr. Tator was certainly very close to Dr. Pashby in that goal. And, as we saw a movement into spinal injuries and severe spinal injuries and paralysis and even death through hockey, we connected with Dr. Tator who was very, very keen to do research on spinal injuries, the mechanism of the injury, and worked very hard for prevention and quality of life through spinal injuries. We couldn't believe that we were working with someone of his prestige, his knowledge, his credentials, and the fact that he cared and he was so humble and gave so much to each person he came in contact with, and wanted to do so much to make the world of sport safer.

[energetic electronic music] In 2018, Jen Kish, Kerrin Lee-Gartner, Cassie Campbell, and myself donated our brains to Dr. Tator and his team for research on the female brain. There's a lot of studies on differences between female and male brains and different types of brains and the differences to bring some sophisticated research and studies to ensure that the best possible things can be done to treat people while they're alive, and the study of post-mortem brains, when Dr. Tator asked for female brains, I was very, very happy and I trusted him totally and was quite happy to provide my brain when I'm done with it.

The caliber of sport is getting higher and higher and higher, with improved equipment and improved training methods, so the equipment is stronger, but it also is so strong, it's actually creating some injuries with the shoulder pads and elbow pads and how to prevent that. The speed is so much quicker on the same size of ice, so the shots are harder, the game is faster, the shifts are shorter. There's a lot of things that are evolving in sport and it's important that the sport experts and the medical community work side by side to create, you know, research and initiatives and, ideally, prevention and also management. [music fades out] Certainly, a concussion, a brain injury is something that is not visible, and trying to get individuals to understand that a brain injury has no bearing on the importance of the game is really, really important, and we are trying, on an ongoing basis, to make sure that parents, coaches, and all those involved in sport understand that a suspected brain injury or brain injury needs complete care, regardless of whether it's a practice, an unimportant game, a house league game, or a championship game. The brain needs to be properly treated, and that's one of the challenges we have is getting people to accept the fact that what they can't see is real and it needs full and complete attention and prevention in order to preserve athletic careers and preserve life.

[light, bubbly electronic music] I have never been officially diagnosed with a concussion. You know, we didn't know concussions back in the early days when I played sports and I know, even as a water skier, I crashed into a marine railway once and had no clue where I was. I played center fielder in ball. I remember, multiple times, diving for a ball. One, I just crunched my head so hard, I had no clue where I was on the field and many, many times in hockey, with the body checking, I would run into an opponent or run into the boards and certainly feel nauseous, feel the symptoms of concussion, but not be aware that I should pay attention to what was going on. It was basically, you know, "Get up, get back onto the ice," and at that point in time, the trend was okay, if you were nauseous or you had a headache, or you were dizzy, you got somebody to wake you up every hour. That was as far as we ever went in those days and we just did not know that that type of thing needed our care. I saw colleagues many, many times in the same situation so, you know, we're very, very thankful that this research and treatment is available now. I'm not sure how some of us survived, but I do know other teammates in the game had to stop playing completely because they had brain injuries, they didn't know it, and they ended up right out of the sport. [music fades out]

[light, electronic music] I'm incredibly proud of Dr. Charles Tator. He continues to contribute to the medical community and continues to contribute to the sport community. It's so good to see him honoured the way he is, but it's important that people understand the true person he is, and he's such a caring individual for each person in this society and he's got the big-picture contributions he's made, but he also has made such a powerful difference in the lives of so many people and it doesn't matter what our lot in life is, what we work at, what we do in society; we've got that 24 hours each day to make a life, and Dr. Tator, you know by his personal communication, he brings such a joy to that person's life and he makes them feel that they matter, and there's nothing more a person can do in this world than what he does. [music fades out]

9:57 Heather

[gentle electronic music] Dr. Charles Tator is a neurosurgeon and researcher with the Krembil Brain Institute, as well as the Director of the Canadian Concussion Centre at UHN. He is a legend in the world of concussion and spinal cord injury, and I am thrilled to welcome him today to the podcast. Dr. Tator, thanks so much for being here.

10:16 Dr. Charles Tator

Well, thank you for inviting me.

10:18 Heather

I am so excited to talk to you about your research and about your advocacy for concussion safety, but first, I wanted to sort of give our audience a bit of a masterclass in concussion, because there's still so much confusion, it feels like, about concussion out there. So, can you just start by explaining to us, what is a concussion?

10:37 Dr. Charles Tator

A concussion is a brain injury that is extremely common in our country and, in most cases, does respond to treatment, but in some cases is very resistant. And also, there are very significant complications that can occur if they are not managed correctly. So, even though it's benign in most cases, it can become malignant, in fact, in that it can cause death or prolonged disability if it's not managed properly.

11:21 Heather

And, you use the word "malignant". I think a lot of people associate that with cancer. That's not what you mean here, though.

11:27 Dr. Charles Tator

No. In this case, malignant means it can be catastrophic, for example, resulting in death, or lifelong disability.

11:37 Heather

Okay, so we're going to get into all of those details but, as a physician who has seen so many patients over the years with concussion, what are some of the most common scenarios in which someone might get a concussion, and maybe a few of the not-so-common scenarios, because I bet you've probably seen everything.

11:53 Dr. Charles Tator

That's a very good point, because we now recognize that concussions occur in many different walks of life. For example, it's always been associated with sports and recreation, and so we've always known that hockey, football, rugby causes a lot of concussions, but we really weren't aware that some of the other causes are so frequent, for example, concussions at work: somebody works in a warehouse and something falls off a shelf and bangs him in the head; concussions at school, for example, both as a student or as a worker at school, teachers being struck by balls on the head, unexpectedly, on yard duty; concussions in motor vehicle crashes – wow, that's become a real problem on our streets and highways, especially from rear-end collisions, so we're learning more about those; and then, finally, another unrecognized cause is intimate partner violence and other forms of criminal assault cause a lot of concussions. In fact, it's stated that probably one third of women experience some form of intimate partner violence, and it's often a hit to the head that causes concussions. So, there are about 400,000 a year in our country, so 1% of the population of 40 million or so get concussed each year and, since about 25% of those do not recover promptly, it's quite a burden of health disability that results from concussion right across the country.

13:52 Heather

One third of women – that is something we don't often hear about, this connection between intimate partner violence and concussion. I know there's a lot of research going on in that area. When it comes to concussion, though, what are some of the most common symptoms? I mean, how do you even know if you have a concussion?

14:08 Dr. Charles Tator

That's a really important question. In fact, we spend a lot of time trying to teach people how to recognize concussions, so the word that we use is "recognize" and we would like the entire country to be able to recognize when a kid has been concussed or when an elderly person has been concussed, so we want everybody to know what the symptoms are and how to recognize a concussion and, if there is unconsciousness, then it's easy. You see somebody lying on the pavement, for example, who's not moving, then it's easy to know that that's been, at least, a concussion type of brain injury, perhaps an even more severe brain injury. But the problem is only a small percentage of concussions end up as unconsciousness. So, the others, though, produce a whole variety of symptoms that we can learn to recognize, for example, nausea, vomiting, somebody complaining of a headache, somebody complaining of dizziness, some memory impairment. "You already told me that." "Oh, I did? I don't remember telling you that." So, memory problems are very common. We also have a whole bunch of symptoms that show up in certain activities, for example, using a computer may make you headachy, it may produce a feeling

of nausea or a feeling of imbalance, and we call that computer screen intolerance. You may have vertigo or any other type of imbalance or unsteadiness of gait and, in fact, if you add them all up, there are actually about 65 symptoms of concussion.

16:11 Heather
65? Wow.

16:13 Dr. Charles Tator
So, we want people to really know that it can be of whole variety of symptoms that people complain of, to indicate a concussion. [pensive electronic music]

16:22 Heather
And, I guess the most important message is, if you even suspect that you may have a concussion or that someone you know or love has a concussion, you need to seek help, because you never know.

16:31 Dr. Charles Tator
Exactly right. We want people to seek advice, especially from a medical doctor, but also from a nurse practitioner. So, in the province of Ontario, those are the only two types of health care professionals who are given the responsibility of diagnosing a concussion, and some other provinces of our country, additional health care providers are included and, as long as they're trained properly, we are happy to include others but, at the present time, the only two in Ontario—and I think that's a good rule—are medical doctors and nurse practitioners.

17:16 Heather
For the vast majority of people who deal with symptoms that are prolonged, what is the impact on their quality of life?

17:23 Dr. Charles Tator
So, by one month, 75% are better. That's the usual statistic. But that means that there's still 25% of that large number of people who are going to go beyond a month, and believe it or not, have some of those symptoms forever.

17:46 Heather
Wow.

17:46 Dr. Charles Tator
But good management, good treatment, will reduce that number to a small number who don't get better.

17:55 Heather
Can you tell us Dr. Tator, what is happening in the brain when a concussion occurs, physiologically?

18:01 Dr. Charles Tator
Well, we don't really know. We suspect that there may be, for example, a blood flow problem, and one of our team members has some evidence that there is a problem in blood flow after concussion and that that may be a way to help diagnose concussion, if you can see that certain areas of the brain are not getting enough blood or getting too much blood. But, it's unproven at this point. We've been after a blood flow problem at Krembil in concussion for the last 10 years and we're continuing this work. [music]

fades out] Dr. David Mikulis is world expert in that, a member of our team, and he's continuing to study that very point.

18:57 Heather

We talked a little bit about treatment. It used to be that if you were diagnosed with a concussion, the remedy was a lot of quiet, no stimulation, no TV, no lights, but, you know, that seems to be changing. Can you tell us a little bit more about that?

19:12 Dr. Charles Tator

Well, you are right. That has completely changed. So, 20 years ago or so, when I first started thinking about concussions seriously, it was the recommendation, "Go and sit in a dark room and don't move around too much," and now it's the opposite. We want people to be active. In fact, the modern approach to concussion is, "Okay, sit around for maybe 12 hours or so, but after that, you should be doing physical activity," but it has to be tempered. It has to be according to what your symptoms are. We don't want to for example, make people dizzy and have them fall again and get another concussion, because that's an important lesson that we've learned and that is that concussions are cumulative. So, we do want them to be active from a very early time and that activity should be what is best tolerated and what is best tolerated turns out to be activities that don't move the brain around too much inside the head.

So, for example, let's take walking or jogging. So, in my view, fast walking is perfect. It gives you enough exercise. You can actually work up a sweat by fast walking. Jogging, I think, doesn't suit most people, at least soon after a concussion, because when you jog, the brain does move around inside the head and that is actually the mechanism of causing a concussion in the first place, when the brain moves around too much inside the head, especially if it moves too quickly, like Jello on a plate, so it's very, very delicate and it does not like to be jostled around. So, a lot of people can't jog until a few weeks have gone by, without, you know, getting a headache or making themselves dizzy, but they can do fast walking, they can do swimming. So, certain activities are much better tolerated than others but the message is, "Get going, don't lie around, but do respect your symptoms."

It's our job to try to make people as informed as possible, and to watch for signs of what we call going over your threshold. So, teaching people the concept of threshold is an important aspect. It's okay to go over a little bit. Otherwise, you don't know where your threshold is. And, by the way, this idea of threshold doesn't just apply to physical activity, but also applies to mental activity, so it means that if you're, you know, focusing on your homework, if you're a kid who just got concussed or if you're a school teacher and you're preparing tomorrow's lesson, then you have to respect that cognitive activity, like mental activity, does also consume energy and you may go over your threshold and bring on symptoms like headache, dizziness, and each individual has, like, hundreds of thresholds, one threshold for every activity that they do.

22:57 Heather

So, it's important to exercise, it's important to get back into some of your routine, but not to push yourself too hard.

23:04 Dr. Charles Tator

Exactly. One of the great things that we have learned is why exercise helps, and it isn't for the usual reason. You know, the reason that exercise works is not because of endorphin, like everybody loves

exercise because it gives them a great feeling, like a feeling of accomplishment and a feeling of exhilaration.

23:34 Heather
Mm-hmm.

23:34 Dr. Charles Tator
[pulsing electronic music] But now, we know that growth factors are not just one but a whole bunch of growth factors are manufactured by the brain. Imagine the brain now being recognized as a drugstore. The brain is your personal drugstore...

23:51 Heather
..making its own drugs. [chuckles]

23:52 Dr. Charles Tator
..making its own drugs—good drugs, not bad street drugs, but good drugs—for helping you recover from concussion, for example. These growth factors are very powerful and although they are produced all the time-- the brain is busy producing these growth factors 24 hours a day, but in very modest amounts, and it takes exercise to increase the amount of growth factors and, when you've had a concussion, you need more of those growth factors to help your brain recover. So, there's a purpose. You're filling up the shelves in your own drugstore in your brain when you exercise. [music fades out]

24:41 Heather
Amazing. I thought about being a pharmacist once, so I didn't realize I already am.

24:47 Dr. Charles Tator
Exactly.

24:48 Heather
Dr. Tator, you talked about the sort of discovery of growth factors and how that has impacted concussion, but I guess I wonder, what are we seeing in terms of improvement in recovery now that people are taking this new approach?

25:01 Dr. Charles Tator
That is one of the research topics that we're onto at Krembil, and that is to actually measure when, for example, people go back to work. The return-to-work aspect of what we do is very important, as well as the return-to-learn aspect for kids, or even university students, and we have learned quite a bit about, "What are the risk factors to look at?" and most importantly, "What dose of work is permissible?" You don't want the return-to-work process to fail, and it does fail in many patients and they're back to square one and it's very demoralizing. And, you know what? You need a trained professional for that, so we often call upon another member of the healthcare team, the occupational therapist, to get it right. "What dose is permissible for this patient?" and you have to match the patient to the work environment, and the same thing with school. "What dose of school should we start off at? Should we send a kid to school five days a week? Or, perhaps every other day might be a more successful pattern for return to school." So, these have been improving gradually, over the years. The other thing that we've learned a lot about is mental health.

26:42 Heather

Mm-hmm.

26:44 Dr. Charles Tator

If you neglect your own mental health when you're trying to get over the effects of a concussion, it's not going to work, so we spend quite an effort on examining mental health both in a patient-doctor relationship, but also from a research point of view, determining what is the nature of the mental health problems that people who are concussed encounter, and I can tell you, it's very frequent. Probably a third or so of patients have significant mental health. If they were depressed before, you can be sure that a concussion is going to enhance that depression, and the same is true of anxiety, and with concussion, it's often a combination of anxiety, and depression and some people even add to that by having some PTSD or Post Traumatic Stress Disorder. As an example, like in the motor vehicle field, we see a lot of people who've been concussed as occupants of motor vehicles, and you may be surprised that that still happens, but in fact, there are some problems with automobiles that have not been properly dealt with in terms of passenger occupant safety. We've looked at recently more than 100 patients who were concussed as occupants of motor vehicle crashes, and it's quite incredible what we learned that has to still take place to improve occupant safety.

28:37 Heather

Can you tell us a little bit about what you learned and maybe some of the differences in gender between men and women in some of these instances?

28:45 Dr. Charles Tator

Well, that is exactly one of the lessons that we learned, and that is that women are much more susceptible to concussion when they are occupants of motor vehicle crashes than men, and that mirrors what happens in other causes of concussion. For example, in sports and recreation, we've recognized for a long time that, in basketball and in hockey as big examples, that women are concussions more frequently than men, in terms of the proportion of women concussed, who are playing any of those sports. Well, the same thing is true in motor vehicle crashes. When you're an occupant of a motor vehicle crash and a woman, and especially if it's a certain type of crash, a rear-end collision, you can be more at risk than men, and we think that there's probably a unifying factor there between sports and motor vehicle crashes, in that the neck muscles of women are not as well developed as the neck muscles of men, and that's what we call anthropometric difference. But, you can do something about that to strengthen your neck muscles, and we believe that all women basketball players, hockey players, and now, with this new information about motor vehicle crashes, we think all women should take some time to improve their neck muscle strength, and it's very easy to do and it's very safe to do it and it's called "isometric neck muscle strengthening exercises". You can look it up and learn how to do it, and you should do it every morning for about five minutes in front of a mirror to strengthen your neck muscles so that, if you're an occupant of a motor vehicle, especially if it's struck from behind, you'll have more strength to prevent this type of movement at the time of the crash, because that movement jiggles the brain and results in a concussion.

31:13 Heather

Wow. Okay. So, just to recap, you're saying that, based on your research and based on some of the findings that you've noticed in motor vehicle crashes that you've been studying, women actually have less strong neck muscles, and you believe that this is probably the reason why women are more susceptible to concussion and why they suffer longer and more severely from it. Is that right?

31:36 Dr. Charles Tator

Exactly right, Heather.

31:38 Heather

[upbeat electronic music] Can you explain a little bit more about this isometric training, I guess you would call it, or these exercises? How does it work?

31:45 Dr. Charles Tator

Sure. And, the reason why we can tell everybody to do it, is because it's completely safe. You do it with your own hand on your forehead, or on the side of your head or at the back of your head. For example, put your hand at the back of your head and press your head against your hand. All those neck muscles that are resisting movement are being strengthened by that exercise. And, the next one is put it on the side of your head and do the same thing in front of a mirror. We recommend that so your head will be perfectly straight on your trunk and, when the head is in perfect alignment with the trunk, you can't possibly do any harm to the joints in your neck or to the discs in your neck by doing that exercise.

32:41 Heather

Okay, well, we will make sure to put a link on our website for anybody who wants to check that out. I do also want to talk about sports. You've been a pioneer in advocating for concussion education and safety in youth sports and all sports really, especially hockey. So, how did that all start for you, and tell me about some of the biggest changes that you're most proud of as a result of your advocacy? [music fades out]

33:03 Dr. Charles Tator

I played hockey every winter day of my life when I was a kid and, even in university, I played hockey for the Faculty of Medicine hockey team, and I still go to some of the NHL games so I'm still a big hockey fan. It's a great game, but it caused me a lot of anxiety when I was confronted with kids in wheelchairs because of hockey. The game that I loved, I was looking after kids who ended up in wheelchairs. Like, I never would have believed that a sport could end up so tragically, and one winter—I think it was in the 1980s, in fact—we had three or four kids in one winter who were in wheelchairs because of hockey, and what we found out when we went beneath the surface was they all got there because they were pushed from behind and they were catapulted into the board so that when the head hit the board, the body was almost horizontal and ended up in a wheelchair – not a wheelchair for a day or a week or a month but a wheelchair forever. When I had to try to put the pieces together again after a major paralyzing injury in hockey, I got very active in advocating for improved injury prevention methods and, over the years, we have seen great improvements.

I wasn't alone. In fact, injury prevention really is a team sport. You need a whole army of people on your side to make differences. And, eventually, it happened that hitting from behind, for example, in hockey, became a recognized infraction. When we started, there was no specific penalty against hitting from behind. So, there is now. That's just one example. Body checking in concussions, currently is a big item for us because we just did another study which gave us data on who's getting concussed by body checks, and it turns out that a lot of kids between the legal age of 13-- so, it was decided a few years ago that 13 was the proper age to allow body checking in hockey, so our data indicate that's way too early – way too early for the developing brain in all those kids. We want the age of body checking raised and I'm very pleased that the Canadian Pediatric Society also recognized us and they recommended that the age be raised to 15. But our data indicate that the age should be raised to 18. You should hold your breath and hope. If you're a mother or a father of a kid playing hockey, you should try to help us get that age up to 18. Kids should be allowed to enjoy the game of hockey and not worry about some big goon kid crashing

their loved ones into the boards to get a concussion from a body check. That shouldn't happen till they're 18 and over. [glitchy electronic music] So, we want people to jump on that bandwagon, so if anybody's listening to this who has a kid playing hockey, who's less than 18, put them in a non-checking league, and help us advocate for increasing the age of permissible body checking to age 18. How's that for a plug?

37:34 Heather

[laughs] That's a great plug. You're never one to shy away from asking for what you want or what you feel is necessary. If it were up to you would body checking be eliminated completely?

37:44 Dr. Charles Tator

You know what? That would even be better, but I think being realistic, if they're 18, they can skate fast enough, they can think fast enough, they can protect themselves better, and you know, the argument that, "Well, if you wait till 18, they won't really know how to body check," you know, I think you could learn how to body check properly in about half an hour, so I don't buy that argument. [music fades out] So, I think 18 is a good age. We have to do the same thing in soccer. Youngsters shouldn't be heading the ball. There are too many kids getting concussed in soccer, and we're now seeing-- you know, I mentioned some of those catastrophic effects of repetitive concussion earlier, but we are now seeing that soccer is not exempt from these long-term consequences, as many soccer aficionados thought they were. But, it's now painfully apparent that soccer is joining rugby and hockey as high-risk sports for later memory decline—chronic traumatic encephalopathy—and it occurs in people who have had too many concussions, and it robs them of their minds as they get older. Now, fortunately, the data is showing it doesn't happen to everybody. Just because you had a concussion doesn't mean you're going to lose your memory. But, if you've had a lot of concussions, you're on the list for potentially having trouble as you get older, and it's completely preventable by reducing the number of concussions that you have so, if you can exert some injury prevention measures, it's so much better than having to put the pieces back together again after the major injury has occurred.

39:56 Heather

That's incredible just how much we've learned, you know, even in the last 20, 30 years about concussion symptoms, recovery, but even all the research that's being done on the long-term effects, as you say. I wanted to ask you, because you mentioned athletes, we heard from Fran Rider at the start of the episode, and she's one of several female Canadian athletes that you've worked with who's pledged to donate her brain to the Canadian Concussion Centre's Brain Bank after they die. Can you tell us a little bit more about the Canadian Concussion Centre in terms of the mandate, and also about the Brain Bank and the importance of studying women's brains?

40:30 Dr. Charles Tator

It's very dear to my heart because we started Canada's first, and still only, brain bank for concussed athletes. We started with athletes, but I would like to expand it to others, others who have had repetitive concussions and who are suffering, so not just the athletes. We want people to donate their brains to our center because we have the ability to examine those brains very carefully afterwards for the biomarkers of brain degeneration that are related to repetitive trauma. This is a very complex issue, how to sort out what was going to happen anyway, if you're unlucky enough to have an Alzheimer's gene, for example. Is that what caused the dementia as you got older, or is it because of the 20 concussions that you had when you were a teenager? So, that takes a team of skilled people and that is what we have at Krembil, and the Canadian Concussion Centre is just, you know, one of the arms of Krembil, and we have all the brain power to interact with. Like, we have one of the world's greatest

neuropathologists working with us on this problem, so it takes a team to do this work and, because we're a center within a center, we have the capability to do the work and to do it right. When we say this or that is going to be good for your brain, or this or that is bad for your brain, we do it with certainty, and we try to do it in a way that people can understand – the modern terms, knowledge, translation. So, we take that seriously and we try to translate our work into plain language so it can be useful.

42:55 Heather

[soft electronic music] Which is what you're doing today and what you've been doing in your webinar series, which I'd also like to ask you about, because this is a great opportunity for people to be able to learn more about the research.

43:05 Dr. Charles Tator

Well, we started the webinars series pre-COVID. We found out the other day that, in about 24 countries, people are watching our webinars series. [Heather chuckles]

43:20 Heather

Amazing.

43:21 Dr. Charles Tator

We're hoping that lots of workers who get concussed can get back to work sooner by watching the webinars, but so can students get back to school earlier, and so can athletes get back to doing their sports earlier. There's a lot of tremendous information given by a whole variety of people. We have psychiatrists, exercise specialists, we have orthopedic surgeons, neurosurgeons, neurologists, social workers, and that indicates the multidisciplinary nature of the treatment of concussions. [music fades out]

44:03 Heather

I agree. I've had the chance to watch many of these webinars and they're a great resource. So absolutely, we'll make sure to put a link on our website so everybody's got access to it. Dr. Tator you talked a little bit earlier about looking at some of the differences in people who are more likely to recover from a concussion, versus people who may have prolonged symptoms. Can you tell us anything about the results that you found, so far, in terms of specific factors or predispositions?

44:29 Dr. Charles Tator

Well, we know that repetitive concussion is important. In other words, every time you've been hit, and have had a concussion, your brain remembers it. Even if you've made a good recovery, you do not go back to square one, and we know that because the subsequent concussion occurs at less force than the first concussion, so your brain retains the memory of concussion, even though you may have made a very good recovery, and we do not know what accounts for that susceptibility to subsequent hits. In fact, we don't really understand the exact nature of concussion. Dr. Tartaglia, my colleague, has been looking for exactly which marker will denote concussions so we can measure that. We can measure it in the spit, we can measure it in the blood, we can measure it in the spinal fluid, but we don't know what to measure because, so far, we don't know which one is the culprit, to measure. So, we don't have a biochemical biomarker. We don't have an imaging biomarker. All we have are symptoms and signs. That is really an impediment to further progress in treatment, for example – not knowing exactly what to target. That is one of the problems in this field, and we've been working diligently on finding a biomarker for the last 20 years. [rhythmic, up-tempo electronic music] So have other groups around the

world that we communicate with regularly, and there isn't one. Isn't that amazing? So, why don't you get busy and find one?

46:35 Heather

Gotta get right on it. What about age and gender when we're looking at people who are more likely to recover from a concussion or not? How did they factor in?

46:44 Dr. Charles Tator

Well, age is a factor. Age is a factor with kids, for example. Very young kids seem more susceptible, and then the elderly are more susceptible. So, at either end of the spectrum of aging, there's susceptibility to concussion, and again, we don't know why that is, and the gender differences are very big. We just don't know. A lot of effort has been put forth in trying to determine if there's a hormonal factor that protects or makes one more susceptible to concussion, like, for example, at various portions of the menstrual cycle, and that research is still going on without a definitive answer, in my view. [music fades out]

47:35 Heather

When you think about, in your career, all of the advances that have been made in research and in treatment, what are you the most proud of?

47:43 Dr. Charles Tator

Well, I think I'm most proud of the fact that we are preventing concussions from happening by safety measures. We're preventing concussions from happening in the first place. That's the best, by telling people what causes concussion. For example, not wearing a seatbelt can cause more movement of the brain inside the head, avoiding body checking at a certain age. For example, women got that message in the 1990s and men still haven't gotten the message as well as women did because they're still allowing body checking in kids' hockey, for example. Just advising an elderly person to use a cane, especially if they're a little unsteady walking, or if they have a little dizziness as many elderly people do, using a cane can prevent falls and prevent concussion. It could be lifesaving. Telling kids to tell an adult when you have a headache, when you have dizziness after a hit in rugby, or hockey, or soccer or whatever. Kids must tell. That's the slogan of Rowan Stringer Law. [gentle, electronic music] We now have concussion laws in Ontario, so I'm proud of the fact that that has happened and that I may have played a bit of a role in bringing that about. So, I think that's probably where I've been engaged more productively.

49:29 Heather

Thank you so much for talking with me today. I really appreciate it. I can't wait to see what's coming next for you. Thanks for being here.

49:36 Dr. Charles Tator

Well, thank you for inviting me. It's been a pleasure. [gentle, electronic continues]

49:45 Fran Rider

If you do have a suspected concussion, maybe you sit out for a week, maybe you sit up for months, but you know you've got a long life ahead of you. You can continue in sport and a higher quality of life through taking a few steps, giving up a little bit now to look after your health. But, boy, will you benefit in the long run, and that's so important that people understand that.

50:16 Heather

[Your Complex Brain theme music] Thank you to Dr. Charles Tator for joining me on the podcast today. Thanks also to Fran Rider for sharing her story. If you'd like to hear more Fran's interview, please go to our website, uhn.ca/krembil, and click on the show notes from today's episode.

This episode of Your Complex Brain was produced by Jessica Schmidt. Our executive producer is Carly McPherson. Thanks also to Dr. Amy Ma, Twayne Pereira, Suzanne Weiss, and Megan Andheri for their production assistance. [theme music continues]

For more information about the Krembil Brain Institute, please visit uhn.ca/krembil , and you can reach us by email at krembil@uhnresearch.ca, but please note that, due to privacy regulations, we cannot answer any personal health questions. Thanks for listening. We'll be back in two weeks with another exciting episode. Have a great day. [Your Complex Brain theme music fades out]