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# Kids and concussions - the latest science on risks and long-term effects



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Isaac (left) and Joanna (right) had to give up their favourite sports due to multiple concussions. Isaac got his first bad concussion playing non-contact youth hockey. Joanna got hers playing competitive soccer. (Elizabeth Doherty)

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**Why kids are vulnerable to concussions**

Isaac was 7 years old when he sustained his first concussion. He playing non-contact hockey. Joanna was 15 years old when she got her first concussion while playing competitive soccer. It was a long and hard road to recovery for both of them. They each suffered a number of setbacks and subsequent concussions. And they are just two examples of a silent epidemic that stems from playing sports.

Dr. Paul Echlin, a physician and researcher at Elliott Sports Medicine clinic in Burlington, Ontario, says it doesn't even take a hit directly in the head to result in a concussion.

The peak incidence of concussion in sports and recreation appears to be around the age of 14, 15, 16, where you know every time a kid is sitting in class and learning something, there are new connections being made. The concept of plasticity exploding in that age group may account for this increased susceptibility.-

*Dr. Charles Tator, Canadian Sports Concussion Project*

"It can be a hard jar to the body. But what happens is a rapid movement of this gelatinous, intricate organ that's multi-lobular," he says. "When it gets sudden motion with a hard hit, either directly or indirectly, it makes [the brain] move in rotational and translational motions. All parts of the brain are affected."

He describes what happens to the brain as "shearing," as it reacts to the fluid dynamic forces within it.

"It's not like it's a big rock going back and forth. It's actually traumatizing because of the rapid movement on these microstructure, these cells and cell bodies and dendrites. These are the connections between cells."

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According to Dr. Charles Tator, who runs the Canadian Sports Concussion Project at Toronto Western Hospital and is a professor of neurosurgery at the University of Toronto, researchers have known for years that the growing brain has a greater susceptibility to concussion than the already developed brain.

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something, there are new connections being made. The concept of plasticity exploding in that age group may account for this increased susceptibility."

That's why he says we need to be especially careful about brain injuries when it comes to children, adolescents, and young teenagers.

### **The effects of hits to the head that don't cause concussions**

Everyone pays so much attention to hits to the head that result in concussion, yet science is starting to show that all the other hits people get can also cause substantial damage.

Dr. Echlin says a colleague of his from Harvard University recently studied European soccer players and swimmers who were not diagnosed with concussions to see the effect of what are called "sub-threshold" head injuries. Examples might be headers in soccer or running into the end of the pool for swimmers, that do not cause any concussion symptoms.

They found out that those individuals who had not been diagnosed with concussions had a lot of the white matter — injuries [like] the ones that did have concussions.- *Dr. Paul Echlin, Elliott Sports Medicine Clinic*

"They found out that those individuals who had not been diagnosed with concussions had a lot of the white matter — injuries [like] the ones that did have concussions."

"We saw this also in our latest white matter and the metabolic study," says Dr. Echlin. "We just studied the ones that were not diagnosed at the ringside or the field ... and they also had evidence of trauma during the season."

What this boils down to is the cumulative effect of multiple small hits could have the same effect on the brain as one big hit.

### **Long-term risks of repetitive hits to the head**

Most people can get over their concussions in a week or two, but for others, like Isaac and Joanna, their symptoms persist. When that happens, it's called "Post Concussion Syndrome."

Dr. Echlin says in his clinical experience, "the brain does heal. It does remodel, if it's given a chance." The best way to treat a concussion is to limit incoming stimuli, so the brain has a chance to rest. If a person gets another concussion while their brain is still recovering from a previous one, that's when the symptoms can last even longer.

"The brain does heal. It does remodel, if it's given a chance." - *Dr. Paul Echlin, Elliott Sports Medicine Clinic*

He says the cumulative effects could result in, "memory deficit, can be emotional, or psychiatric components of anxiety or distress. It can be loss of ability to concentrate. It can be light and sound sensitivity, all the basic symptoms you initially experience with post concussion syndrome, they can become long-lasting."

Ann McKee, director Boston University's centre for research into the degenerative brain disease chronic traumatic encephalopathy, or CTE, discusses her study of NFL football player Aaron Hernandez's brain, projected on a screen, behind right. McKee says Hernandez suffered severe damage to parts of the brain that play an important role in memory, impulse control and behaviour. (The Associated Press/Steven Senne)

When this happens, Dr. Tator says, "A lot of those early post concussions symptoms drop out and other ones come to play. For example, major loss of memory, major difficulties in concentration, sometimes movement disorders like Parkinson's like stiffness, and irritability, and change of personality."

He says, the personality change impulsivity, "has been implicated as perhaps one of the reasons some of these players have actually committed suicide."

Repetitive trauma can cause the accumulation of a protein called, p-tau, which stands for phosphorylated tau.

"Tau is in all of us. It's in all of the fibres that connect nerve cells. It's one of the important structural proteins that stabilized the tiny tubules in nerve fibres. So it's a very important protein," says Dr. Tator.

After many concussions, the protein tau becomes abnormal and becomes p-tau. It's the accumulation of that protein that's accompanied by severe damage to the cells that contain it.

Unfortunately, CTE can only be diagnosed upon death.

When we examine the brains at autopsies of people who've had multiple concussions, we see the accumulation of that abnormal protein.- *Dr.*

*Charles Tator, Canadian Sports Concussion Project*

"When we examine the brains at autopsies of people who've had multiple concussions," says Dr. Tator, "we see the accumulation of that abnormal protein."

Scientists still don't know what causes this protein to become abnormal in the first place, but they're working on trying to figure that out.