

tackled the issue with a story asking: “Does football have a future?”

But it’s taken a player of the calibre and promise of Crosby to convey the gravity of the injury to many Canadians. (His influence can’t be overstated: a recent national poll revealed he is the second most popular Canuck, after Gretzky.) Crosby is a case study in what we know, and more importantly, what we don’t know, about concussions, why they vary from person to person, the best ways to prevent and treat them, and whether anyone really can escape their long-term effects.

The current consensus among experts is that 80 per cent of individuals appear symptom-free within 10 days of getting a concussion. But there is no certainty about whether subtle changes persist in the brain. Or about what’s happening in that 20 per cent who don’t recover quickly. A 2006 study by neurologist Dr. Kevin Gordon at Dalhousie University in Halifax estimated that there are 110 concussions per 100,000 Canadians annually—a lowball figure, since many go unreported or undiagnosed. That means there are roughly 37,600 concussions in Canada today, and 7,500 won’t disappear within two weeks. Put another way, this would be like all of the players in the NHL, NFL, CFL and MLB having a persistent concussion—times two.

The incidence of concussion is even higher among children and adolescents (up to 200 per 100,000). In youth, the injury is harder to detect, and the symptoms tend to be more severe and take longer to subside. The impact on development could be more serious too, says Dr. Jeffrey Kutcher, a neurologist and professor at the University of Michigan. “Until about 19 or 20 you’re still gaining neural connections, so any effect before that has the

potential for changing the final course of that person’s cognitive ability.”

But many parents don’t know their children have been brain injured, suspects Philip Schatz, a neuropsychologist at Saint Joseph’s University in Philadelphia who studies concussion in youth: “Kids have sustained concussions and either they’re not aware of it or they haven’t told anybody about it.” Children can’t articulate their symptoms, or they are confused with other conditions that cause vomiting, fatigue, and irritability, while teens and their parents might attribute them to adolescent drama.

In this way, Crosby’s concussion made him typical, too: he became just another kid who got hit once, and played it off until he got hit again—and was forced to sit out his favourite game. What’s happened to him has turned the eternal debate about changing pro sports rules and building better equipment into a gut-wrenching discussion about regular boys and girls who’ve suffered concussions—and whether they won’t reach their full potential because of it.

“It’s horrible that Sidney had to sustain an injury like he has. But this is a common problem that’s not being talked about enough,” says Dr. Paul Echlin, a sports physician in London, Ont., who published a shocking study last fall indicating the rate of concussion among junior hockey players to be at least seven times higher than previously thought. “You can’t turn your head [on the issue] when you know this injury is occurring at an epidemic proportion” in young people, he says. “This is the most precious resource we have. Their future is at stake.”

FEW PEOPLE KNOW that as well as Ken Faloon, a stay-at-home dad in Halifax. His son Jacob

**Eighty per cent of people are symptom-free within 10 days. That leaves thousands each year who aren’t.**



**Down:** In two games, Crosby suddenly went from being the golden boy of hockey to just one more pro athlete incapacitated with a concussion

## HEALTH

# The damage done

Sidney Crosby is a case study in what we know, and what we don’t know about concussions—and whether anyone can escape their long-term effects

UNTIL A MONTH ago, there was nothing typical about Sidney Crosby. At 23, the Pittsburgh Penguins captain had already won the Stanley Cup, an Olympic gold medal, and the praise of Wayne Gretzky, who raved in December: “He’s the real deal. He’s the best player in the game.” Crosby had been on a 25-game scoring streak, amassing goals at a faster rate than ever before in his career—and the longest run since Mats Sundin’s 30-game tear almost 20 years ago.

Crosby’s streak came to a crashing end, however, when he was diagnosed with a concussion in early January—having endured two massive blows only a few days apart. The

first time, Crosby took the cold, hard shoulder of Washington Capitals winger David Steckel to the side of his head. The velocity of the hit snapped his neck back, and spun him in the air for a full rotation. His 200-lb. body thudded onto the ice, and as Crosby hunched over, his mouthguard slipped out. Eventually, he skated to the bench, bent over. Despite a sore neck, Crosby shrugged off the pain, and played in the next game.

That’s when a crushing check by Victor Hedman of the Tampa Bay Lightning slammed Crosby’s head against the boards. The collision happened so fast that startled fans on the other side of the Plexiglas jerked back in

their seats as if Crosby might come hurtling right into their laps. Instead, he melted onto the ice and doubled over. When his face was finally visible, the grimace said it all. “Sid the Kid” was done. Suddenly and spectacularly, Sidney Crosby went from being the golden boy of hockey to just one more pro athlete incapacitated with a concussion.

If they weren’t so serious, concussions could be ridiculed as a sports cliché, like missing front teeth. Nearly 50 NHL players have been out of commission because of the injury, including a few who haven’t healed from last season. Concussions aren’t limited to hockey. Canadian Justin Morneau, a prized

first baseman with the Minnesota Twins, missed the second half of last season because of a concussion he got in July. Canadian speed skater Kristina Groves, a four-time Olympic medallist, just announced she won’t return to the rink this season because of a concussion she received in November. Meanwhile, the NFL is perpetually embroiled in controversy over mounting evidence that repeated hits to (and with) the head are tied to brain damage seen in its former players that resembles Alzheimer’s disease. Even *The New Yorker*, known more for intellectual commentary than athletic analysis, has

**Blow to the head:** The velocity of the hit by Washington Capital David Steckel snapped Crosby’s neck back and spun him in the air a full rotation



BRIAN BABINEAU/NHL/GETTY IMAGES

YOUTUBE



## Identifying a concussion

Concussion should be suspected in the presence of any one or more of the following: symptoms (such as headache), or physical signs (such as unsteadiness), or impaired brain function (such as confusion), or abnormal behaviour.

### 1 Symptoms

Presence of any of the following signs and symptoms may suggest a concussion.

- Loss of consciousness
- Seizure or convulsion
- Amnesia
- Headache
- "Pressure in head"
- Neck pain
- Nausea or vomiting
- Dizziness
- Blurred vision
- Balance problems
- Sensitivity to light
- Sensitivity to noise
- Feeling slowed down
- Feeling like "in a fog"
- "Don't feel right"
- Difficulty concentrating
- Difficulty remembering
- Fatigue or low energy
- Confusion
- Drowsiness
- More emotional
- Irritability
- Sadness
- Nervous or anxious

### 2 Memory function

Failure to answer all questions correctly may suggest a concussion.

"What venue are we at today?"

"Which half is it now?"

"Who scored last in this game?"

"What team did you play last week/game?"

"Did your team win the last game?"

### 3 Balance testing

Instructions for tandem stance  
"Stand heel to toe with your **non-dominant** foot in back. Your weight should be evenly distributed across both feet. You should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."

Observe the athlete for 20 seconds.

If they make more than five errors (such as lifting their hands off their hips; opening their eyes; lifting their forefoot or heel; stepping, stumbling, or falling; or remaining out of the start position for more than five seconds), then this may suggest a concussion.

**Any athlete with a suspected concussion should be IMMEDIATELY REMOVED FROM PLAY, urgently assessed medically, should not be left alone and should not drive a motor vehicle. For the complete SCAT2, go to [macleans.ca/concussion](http://macleans.ca/concussion)**

got a concussion while playing high school football in late 2009, and it's clear he is still processing what happened. "I don't want anyone to go through what we went through," he told *Maclean's*. "It was very traumatic. It put years on my life, and it really put a stop to Jacob's. Everything he was doing came to an end in an instant."

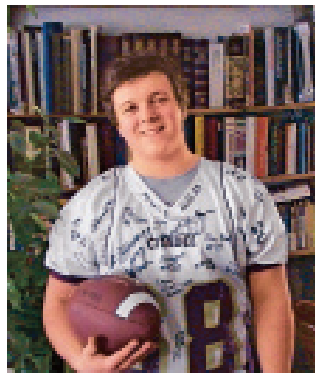
It was Thanksgiving weekend, and the second-last game of an undefeated season for the Citadel Phoenix, when Jacob, then 15, was put into play. As he was running down field, a hulking mass blindsided him with a helmet to his left jaw and temple. Jacob collapsed backwards onto the grass. "I literally saw stars. The cartoons have it bang on. Then I saw colours: green, yellow, purple. It was really weird." He got up, but could barely keep his balance. At the sidelines, he told the coaches he felt nausea and suspected a concussion. They gave him ice for his throbbing jaw and said to take it easy.

In the ensuing days, Jacob didn't feel quite right, but he continued to go to school, where he was taking advanced classes as part of the pre-international baccalaureate program. "I thought it was the best thing to do," Jacob says, "to try and stay on top of it." He also worked out at the gym with his friends. But soon, Jacob started getting "splitting" headaches, especially while attempting to solve complex math formulas, something he used to do with enviable ease.

For the next two weeks, Jacob stayed home except for a visit to his family doctor, who encouraged the Faloons to keep on eye on his symptoms, and assured them he'd be okay eventually. When the headaches began to lessen, Jacob resumed his former routine. And then the debilitating headaches resumed too. This cycle went on for six months—until finally, in April, when Jacob's dad got him an appointment with neurologist Dr. Kevin Gordon.

By that point, battling headaches had left Jacob—usually vibrant, articulate, studious and active—feeling depressed and lonely. "I just isolated myself in my room with no lights and slept for as long as possible," he recalls. "It was the most boring time of my life." His father can't shake the memory of sitting on the back deck with Jacob one day. "He was so upset, and he said, 'Dad, I don't know what's wrong with me.'" Neither did he. "It's a horrible feeling. You feel so helpless."

When Gordon came into the examination room, "The first thing he said was, 'You're going to get better,'" recalls Jacob, who immediately felt "a rush of relief." But getting better meant Jacob would be "bored" for a while yet. The current treatment for concussion is two-pronged: cognitive rest and physical rest until all symptoms have subsided. If even one symptom resurfaced, Jacob had to revert to the rest-and-wait stage. To track his progress, Jacob charted his symptoms and their severity every day using a questionnaire called the Sport Concussion Assessment Tool 2 until he reached a zero score. (See the sidebar on this page for a pocket version and [macleans.ca/concussion](http://macleans.ca/concussion) for the complete version.) It took nearly three months.



End game: Archibald-Faloon's marks dropped after his concussion

During their time with Gordon, the Faloons (Jacob's mother, Martha Archibald, is an architect, and he has two brothers) realized that a helmet-to-helmet collision Jacob had experienced during practice just two days before the game had probably caused a concussion too. Jacob had figured it was just a ding and a nosebleed. "It seemed trivial," he says, so he didn't bother telling his parents.

That first blow likely made the second one worse. "There is good evidence that a concussion on top of a concussion is associated with more symptoms and a longer recovery," says Gordon. The Faloons also learned that Jacob's efforts to push through the headaches by continuing to go to school and exercise had actually perpetuated his symptoms.

That news devastated Jacob's dad: "There's nothing worse than realizing that you're trying to do something that was wrong," he says. "I feel like I could've gotten him to Dr. Gordon sooner, or that I wasn't aware enough. I like to think of myself as smarter than that."

What happened to Jacob Faloon is not uncommon. "Although awareness and knowledge is increasing, there are still concussions that are unrecognized and therefore not managed appropriately," says Dr. Laura Purcell, a sports physician and professor at McMaster University in Hamilton. Adds Dr. Karen Johnston, a neurosurgeon at Athletic Edge Sports Medicine and professor at the University of Toronto: "If someone tells me they've had one, I usually add a zero to the end [meaning 10] because it's always underestimated."

When concussions are suspected, they're often downplayed. Schatz points to research



Lifelong challenges: Ron Perowne today and at Bishop's University in the '70s



that concussed high school players don't always tell someone about their injury. Why not? "The players want to play. They fear being taken out of the game, or losing their position on the team," explains Echlin, while coaches and parents put too much emphasis on winning, and pushing through the pain. Adding to the problem is the cutesy language surrounding concussions: when players shake their dizzy heads, they're "getting the cobwebs out." When they can barely get stand up, they've got "Bambi legs."

Even measures put in place to take concussions seriously, such as reporting all injuries to the league, are ignored. A 2006 study by researchers at Simon Fraser University in Burnaby, B.C., compared concussion rates in youth hockey as reported by coaches and players versus official reports to the British Columbia Amateur Hockey Association. It revealed a massive disconnect: official reports indicated fewer than one concussion per 1,000 game hours, while coaches noted nearly eight, and players declared up to 24.

Last fall, Echlin discovered the true prevalence of concussions among young people after following two junior hockey teams for a season (players ranged in age from 16 to 21). In 52 games, there were 21 concussions. Only three of those concussions were self-admitted by players, and more than one in four of those players sustained another or

recurrent concussions that season. "This is with a trained specialist physician on site," he says, adding that without that, "I don't know how many would've been picked up or treated."

This is compounded by the fact that historically many sports team doctors (minor or major league) have been specialists in orthopaedics, with a particular focus on bones and ligaments, not the head. "But they were the ones having to deal with all the brain injuries, which didn't really make a lot of sense," says Johnston. "Obviously they were doing the best they can, but couldn't bring a deep understanding to that venue."

The question that looms large is, what does one concussion or more mean in the long run? "Almost all the science until recently has been in adults and young adults," says Johnston, and it's unclear to what extent the current rest-and-wait approach to treating adult populations should be extrapolated to kids, or whether they need more extensive care. The lack of understanding makes doctors even more concerned. "We are very conservative with children," she explains. "They suffer more with this injury, their recovery

patterns are different, and they obviously have developmental milestones that they're going through that may suffer."

New research is illuminating the situation. One study by Schatz analyzed data for more than 2,500 healthy high school athletes across three states and found that those who had a history of two or more concussions were more likely to report concussion-related symptoms—such as headaches, balance problems, sensitivity to light and noise, trouble concentrating and sleeping, irritability, nervousness—than their peers who had one concussion or none. His previous work has shown that students who have had two or more concussions scored lower on measures of attention and concentration, and did worse in school.

That's what happened to Jacob Archibald-Faloon. Before his concussion, he received marks in the high 90s, took classes a grade ahead of him, and won awards. In the months after his concussion, he was so debilitated that he couldn't process information, let alone make it to class regularly. His grades dropped significantly, and he wound up flunking two courses. Until the headaches took over his life, Jacob thrived on academic challenges. "I didn't dislike any subjects. I liked school," he recalls. "But the concussion made me like it less and less."

Today, Jacob's headaches are gone and he's back at school full time. His marks have picked up, he says, "but my organization and work ethic isn't what it used to be." This change still stuns his father, who remembers the days when he'd have to tell Jacob to stop studying.

"After the concussion it was the longest time before he had that endurance. It wouldn't have tired him in the past." The Faloons have every hope that Jacob will continue to make great strides at school, and he's already considering universities and career options, including law or medicine. Had Jacob not received care for his concussion, his future might not have seemed so bright. Very likely, says Gordon, "he would have had headaches for the rest of his life. And I think he would have not gone to university."

AT 61, RON PEROWNE wonders too how his life might have been different had he never had a concussion—or seven. The former



## SPORTS

# THE NEXT GOLF POWERHOUSE?

AH, THE GREEN hills, the genteel landscapes, the quaint charm of a good, long golf game...

England, Wales, Florida? No, Turkey. The Mediterranean country is set to become the new mecca for both wealthy, club-swinging visitors from northern Europe and investors looking to pour money into new golf courses and resorts, according to KPMG.

With its warm climate and fine reputation as a tourist destination, Turkey can easily compete with two wealthier and more established sunny havens for Europe's golfers: Spain and Portugal. Already, Ankara has been aggressively promoting itself as the go-to spot for the pale, sunscreen-covered northern folk who regularly descend onto southern Europe in peak holiday season. Golfers, usually a more monied crowd, are particularly sought after and specifically mentioned as a target group in the government's tourism strategy for the next decade. And while both Spain and Portugal have been hard hit by real estate market busts, Turkey is now one of the few places in the world that's still building golf courses.

The country is already popular with second-home buyers in the U.K., Germany and Sweden, the top three golfing nations in Europe. Also, unlike other warm, low-cost and nearby destinations like Croatia, Turkey doesn't bar foreigners from full ownership of locally purchased property. Old deterrents to outside investment, such as widespread corruption and Byzantine bureaucracy, aren't such a problem anymore, according to experts.

The local golf industry is also counting on fast economic growth to bring a growing class of well-to-do Turks to the golf course. The country, KPMG estimates, already has the highest share of young golfers in Europe. In 2010, juniors accounted for over half of Turkey's golfing population, compared with 10 per cent in the U.K. and Ireland, which together make up Europe's largest golf market.

That reflects a broader trend of slow-growing or declining numbers of golfers in rich countries and burgeoning populations of golf-lovers in developing countries. The nouveau riche have embraced the sport with gusto from Abu Dhabi to China, which now boasts Jack Nicklaus-designed courses, night golfing and at least 300,000 golfers. **ERICA ALINI**



**Out for the season:** Kristina Groves is still recovering from a concussion back in November

defensive back for the Montreal Alouettes received a career-ending hit while running back a punt in 1974. One player tackled Perowne around the knees, and another rushed into the back of his ear. He was knocked out, carried off the field and hospitalized for a few days. "I remember fantasizing about coming back and catching the kicks again, and I had a momentary feeling of fear," Perowne told *Maclean's* from his home in Montreal. "I'd never had that before. I was afraid of getting hit and getting hurt. As soon as I felt that, I knew my career was over."

Over the years, Perowne has become a voracious reader of the latest research on the long-term effects of concussions. He's also reflected on his injuries, and how they might have changed him. It all adds up in his mind: after his first two when he was a kid, he became easily distracted, and had to drop out of advanced classes; after his next five as a young man, he began struggling with memory loss, poor concentration, depression, and low confidence. Although no doctor has ever told Perowne as much, he believes those lifelong challenges are linked to the damage done to his brain from repetitive blows to the head.

It's not a wild hypothesis, considering the growing body of evidence on chronic traumatic encephalopathy. CTE is a degenerative disease resulting from repeated brain injuries, including concussions. It causes memory problems, confusion, paranoia, aggression, depression and eventually dementia, according to the Sports Legacy Institute, a pioneering organization that studies CTE with Bos-

ton University. It was co-founded by Chris Nowinski, a former WWE wrestler, whose own career ended because of concussions, and who later wrote an acclaimed book about the dangers of brain injury in sports.

Researchers used to think CTE only happened to boxers, but over the last decade it's been famously discovered in the brains of athletes who played other sports, especially football. The findings have been stunning. The brain of NFL star Andre Waters, a big hitter who committed suicide at age 44, resembled that of an 85-year-old Alzheimer's patient. Mike Webster, also of NFL fame, became severely demented before his death at age 50. CTE affected NHL player Reggie Fleming, who died at 73 after battling depression. It's also been discovered in the brains of two young athletes, ages 18 and 21. Though CTE manifests differently in each player, the message is the same: "Hits to the head do matter," says Nowinski, who has struggled with headaches and mood issues over the years. "I'd be crazy not to worry. That's partly what motivates me to help find a cure."

More and more scientists are studying the long-term effects of concussion. Recently a "brain bank" was established at the Toronto Western Hospital to examine donated brains of deceased athletes. Perowne also plans on donating his brain for research when he dies.

For now, he is participating in a study at the Université de Montréal looking into the decline in brain function of retired athletes who had concussions decades ago. In 2009, those researchers found that this population had "significant

reductions" in episodic memory and exhibited "significant motor-execution slowness."

While all this work is going on, young athletes across the country are playing hockey or another sport they love. Crosby has just begun "light" skating, the next step toward getting back in the game. Jacob Archibald-Faloon has decided to redirect his energy toward running track. "I'm thinking I'm done with football. Me and my dad talked about it a lot. It's just high school football. In the overall scheme of things, it's such a small part of my life. To get another concussion would be really bad for my brain. And seeing as my marks suffered, we wouldn't even want the possibility of that," he says. "It was a very hard decision to make, but I know it was the right decision." **CATHY GULLI**

**That brain damage is found in hard-playing NFLers is one thing. But 18- and 21-year-old athletes?**