The Ethics and Implementation of the National Football League's Concussion Protocol

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Alexandra Labus

Spring 2023

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Joshua Earle, Department of Engineering and Society

Introduction

More than 40% of retired National Football League (NFL) players show signs of traumatic brain injury through MRI scans done by Francis X. Conidi, MD, DO, of the Florida Center for Headache and Sports Neurology and Florida State University College of Medicine in Tallahassee, FL. This is a stark difference in only the 5-10% of total athletes across all other contact sports showing signs of concussive injury (American Academy of Neurology, 2023). The NFL's lack of consideration for head trauma has been a persistent problem in the multi-billion-dollar industry, leading to many players facing turmoil in the years following their career. Heading into the final week of the 2022-2023 season, the NFL reported 135 players receiving a concussion during the pre-season and regular season (Bagley, 2022).

Throughout this paper I investigate the social and psychological factors of traumatic brain injury in the NFL. I argue that the NFL has been unethical in the way they have tried to mask the damaging effects of these injuries on retired players. After explaining what traumatic brain injury is, I use two primary case studies and then an analysis on the findings of a neuropathologist. I display information that supports my argument of the unethical behavior of the NFL. There needs to be a higher focus on, and more preventative measures for the safety of the players in the NFL. The damages of concussions on NFL players have been dismissed by the league for far too long.

Review of the Effects of Brain Trauma and NFL Involvement

A concussion is a blow to the head that can lead to brain injury, resulting in negative cognitive symptoms and a lack of ability to perform basic motor functions. Concussions and other severe brain issues can lead to someone having reactions resembling a PTSD diagnosis.

Certain levels of concussive injury can even go as extreme as early on-set dementia or some form of paralysis (Raizner-Slania, 2022). When doctors diagnose a patient with any form of a brain injury, the best way to recover quickly and completely is by limiting any activity that is physically demanding. Once considered fully recovered, there is still doctor encouragement to gradually get back into your normal routines and everyday activities instead of resuming your life as usual. Recovery is not a simple process. If you overexert yourself, there is a higher possibility of reinjuring and receiving another concussion (CDC, 2010). Medical professionals are growing increasingly concerned over many of the concussions turning into cases of chronic traumatic encephalopathy (CTE). CTE is an extreme version of brain injury that causes many consequences far beyond the standard concussion. Instead of feeling exhausted or having a minor headache, CTE can alter your entire personality permanently. Often, having multiple concussions in a lifetime is the cause of CTE.

In the NFL, over 11% of players get formally diagnosed with a concussion every season (Johnson, 2022). There has been an increase in concern over the amount of head trauma that has occurred in the league, with medical professionals reconsidering the safety of the NFL in its entirety. Most researchers who have investigated the effects of concussions on NFL players believe it is highly detrimental to those players' lives after they retire from the sport. CTE is becoming increasingly diagnosed across retired players. These players have likely lived with CTE without a diagnosis for years. Scientists and medical professionals have begun to protest how the NFL handles these concussions, and the process the NFL uses to determine if their players are in good health. When the NFL determines a player is in “good health” they immediately return them to the action. The NFL also has their own team of staff that run these tests. As a result of this increased attention, there has been a rise in protest and demand for

change in how the NFL screens and evaluates players who may have suffered from some form of a head trauma. The Concussion Protocol is a mandated agreement the NFL must follow and is the baseline for evaluating head injuries in the league.

Review of the Concussion Protocol

At the beginning of each season, the National Football League Players Association (NFLPA) reevaluates the Concussion Protocol. The protocol allows the NFLPA to modify it at any time during the season if the league approves it. The NFL and NFLPA work together to form this agreement annually prior to the start of the season. The NFLPA is a union that stands to protect the player's health, rights, and family from mistreatment within the league. The NFLPA collectively bargains deals that secure significant increases in well-being for each player's life. Their top goal is to guarantee the players have a safe experience while in the league but also after their time ends in the league. The NFL each season works to change rules that could lead to player injury. To mitigate risk, the Competition Committee is mostly in charge of identifying potentially dangerous rules. They are the ones who evaluate targeting rules, which involves head-to-head contact. Dozens of safety and health committees work together to create the safest environment that they can for the league. The NFLPA has a designated sector, the NFL Head, Neck, and Spine Committee that crafts the protocol for neurological damages (Concussion Diagnosis and Management Protocol, 2022). This group consists of a team of neurological experts and other medical professionals that work diligently on researching all injuries that can lead to head, neck, or spine damage. This committee is the largest advocate for concussive safety in the league.

Recently the Concussion Protocol and neurological team have been working on updates that they believe can lower concussive injury. Notably, in 2013, the NFL rules committee made a rule change regarding the crown of the helmet. “No longer will a player who is downfield three yards or more be allowed to deliver a blow with the top of the helmet.” The intention behind this rule was to limit the amount of head injuries; directly impacting the top of your head leads to a higher chance of this form of injury occurring (Roy, 2013). In 2019, the NFL banned wedge and blindside blocks. These forms of tackles also would lead to surprise impact to the head that could increase injuries (NFLPA, 2019). Most recently, in 2021, the NFLPA identified three helmet models that were less protective than others and agreed to ban them (NFL Operations, 2022). New helmets were also created for players who wanted extra support. These helmets have grown more prevalent in the past few seasons. The NFLPA prides itself on accomplishing advancements each year in the league, and the Concussion Protocol is a key aspect of this improvement.

Concussive Injuries Cannot be Ignored

Traumatic brain injury has been plaguing the NFL for many years, but the first concussion protocol was written in 2013. This protocol originated from a study paid for by the NFLPA to investigate the health of retired NFL players. Granted $100 million dollars, the Harvard Medical School ran the study. The focus of this study was incredibly broad, from joint issues to heart attacks, but discovered the most about traumatic brain injury (Ezell, 2013). At the time, this was called a concussion assessment guideline developed by the Head, Neck, and Spine Committee. This initial policy had guidelines for evaluation and rules on education about traumatic brain injuries (Flynn, 2016). There is no set amount of time a player must sit out for

this protocol, as since its creation, that depends on getting medical clearance by an approved doctor from the NFL (Gurarie, 2022). The average player can receive clearance in just nine days (Bagley, 2022). Before the concussion protocol's creation, there were minimal protections for traumatic injury. If a player were to give his team a thumbs up, they would continue without a second thought. Even after the creation of the protocol, there were still signs of ignorance around the extremes of concussions. An example of this is Panthers quarterback Cam Newton, who faced four helmet-to-helmet injuries in a season-opening game against the Denver Broncos. Newton collapsed on the field and laid motionless for a few minutes. He was never evaluated by a trainer or a doctor and returned to the game. The NFL did not call a medical timeout because there was no "clear visual evidence" that the player had faced any harm (Flynn, 2016). Even with the protocol in place, the NFL did not follow the correct steps. The lack of safety awareness is apparent in the case study of former NFL player Mike Webster.

Methodology

Social construction of technology (SCOT) is the methodology used to decide which aspects of technology are successes and which are seen as failures through human use. An example of this is determining if there is an inherent issue with the concussion protocol, or if it is more in the hands of who implements it. SCOT evaluates how human technology does not determine human action, but instead human action affects technology (Bijker, 2018). Weak concussion protocols can lead to long-lasting, harmful effects on these players, yet the NFL teams keep them implemented. The concussion protocol itself is not inherently against NFL players, but it is the users of the protocol that can skew its benefit. This creates a question of

whether the protocol itself is wrong, or if it is the NFL using the protocol in a detrimental way to player health.

Patient Zero: Mike Webster

Mike Webster died suddenly in his 50's from an assumed heart attack caused by unknown reasons. Many retired football players have a challenging time adjusting to their new identity and life. While many of these players faced hardship in changes, Webster's reaction was much greater than the average retired player. He became incredibly lethargic, he did not eat meals, and was found meandering the streets of Pittsburgh. Despite living in a nice home, he was often found under bridges, outside train stations and in his truck, sleeping, freezing, and starving. He would approach random people, screaming incoherent things at them, and scare the Pittsburgh public. His teeth fell out, and he attempted to use super-glue to put them back in place. He had such severe insomnia that he would use a taser to zap himself to sleep. (Laskas, 2015). The NFL oversaw monitoring Webster's health, despite Webster requesting for an outside source to evaluate him. They denied Webster's request as they wanted only their own staff to see him.

Forensic pathologist Bennet Omalu performed the autopsy on Webster, and he discovered that Webster faced many traumatic injuries across the years he played in the NFL. Omalu concluded that the human brain could not handle the consistent impact that Webster faced playing football. Through this research, Omalu announced that he believed the cause of death was the effect brain trauma had on him. Omalu found calluses on Webster's brain and a shelf of scar tissue that was lined in the exact spot a helmet would have fallen across his forehead. Family revealed that Webster was in such a bad mental state near the end of his life that it was difficult to achieve even the simplest of tasks, such as brushing his teeth (Lartey, 2015). Mike

Webster is often viewed as “patient-zero” in the analysis of what playing a high contact sport such as football can do to the brain. These studies have led scientists and doctors alike to question the safety of allowing people to continue playing the game after facing multiple traumatic head injuries (Hollin, 2021). Webster played year after year, despite knowingly facing an exorbitant number of head injuries. Known as “Iron Mike” he acted as if nothing ever affected him. It had even been speculated that his brain damages equated “25,000 automobile crashes” in over 25 years of playing (Brain Injury Research Institute, 2023). Mike Webster’s health has led to an increase in studies on the brains of retired players, showing evidence that many of them result in CTE.

The Mishandling of Tua Tagovailoa

Two decades later, in September of 2022, Miami Dolphins quarterback Tua Tagovailoa suffered a series of injuries. In the second quarter of their Week 3 game against the Buffalo Bills, Tagovailoa went down with an unknown injury that caused him to stumble around until it was apparent, he could not hold himself up anymore. The Dolphins medical team took him back into the locker room and had him evaluated underneath the then current concussion protocol. Tagovailoa was then subsequently cleared of having any sign of head trauma and instead diagnosed with a non-descriptive minor back injury. He returned to the game, and played without further incident, leading the team to victory. After the game ended, the Dolphins had to play five days later against the Cincinnati Bengals. Tagovailoa was listed as questionable in those five days to play. It was reported that during the game he had only received a lower back injury and not a head injury, meaning as long as he was not too sore, he could start for the team (DeArdo, 2022). Soon after the game against the Bengals began, Tagovailoa hit his head hard on the turf,

and immediately began seizing. He was incapable of standing and held his hands in an odd position over his face. The Dolphins once again carted him to the locker room, where this time he was diagnosed with a severe concussion.

From his analysis, it was determined that there were signs of a concussion the prior week despite passing the pre-existing concussion protocol (Louis-Jacques, 2022). This led to a whirlwind of controversy over whether or not the Dolphins wrongfully placed Tagovailoa back in the game, despite being aware of his status. In response to his injury, the NFLPA and the NFL swiftly updated the concussion protocol, adding additional steps that will make the players undergo a stricter evaluation to be cleared for play. It was assumed that the Miami Dolphins played Tagovailoa, despite signs of concussive injury, likely because they believed that he was their best chance at victory, not considering the dangers to his long-term health (Concussion Diagnosis and Management Protocol, 2022). Tagovailoa's injury led to a conversation about whether the current protocol was designed to benefit the teams, and not the individual players.

Improving Player Safety: Doctor Omalu's Triumph

The ethics of concussion protocols are debated; some believe that players making the active decision to play through these injuries are doing so on their own free will and therefore should be allowed to continue, whereas others think it is morally wrong to allow them to continue to injure themselves, permanently. There is rarely a weekend of NFL football without at least one head injury. Now, more than ever, professional football teams are looking for ways to minimize the negative public opinion of concussions caused by the game. There has been an increasing uproar and debate over the amount of head trauma that occurs in the league. Not only is negative press an issue, but there is also an issue in rosters staying stable with the amount of injury that occurs. Professional teams are looking for ways to prevent concussions without

causing a disruption to the team's roster and altering how the team functions week to week. The consistency in concussion injuries occurring in the league has created pressure for the NFL to reconstruct their protocols and studies. The main argument created is whether allowing players who have been previously concussed is ethically correct. Many medical professionals, such as Dr. Bennet Omalu, often regarded as the largest leader of this movement, support the discontinuation of play after a head injury.

Omalu first discovered CTE in Mike Webster in 2002, at the time of his death. He claimed Webster's depression and dementia were due to the time he spent in the NFL playing football. Beyond his claims about Webster, Omalu stated that he believes that non-fully developed brains should be allowed to partake in the sport; meaning no participation until 18-25 years old (LAist 89.3 FM, 2023). If this recommendation were followed, the NFL would be permanently destroyed, as many players fall underneath the age of 25, and some of the most pivotal years of learning the game are when these players are in college. Omalu's findings were that no blow to the head would ever be safe, regardless of the amount of padding. He is hopeful that in the coming years there will be some form of helmet design that is more preventative of concussions.

After announcing his belief that Mike Webster died due to consistent brain trauma in 2005, Omalu thought that the NFL would welcome his findings and work alongside him to improve the game to a safer level. Instead, the NFL responded with denial of his claims and chose to ignore his work, acting as if Omalu was not a reliable resource. An NFL approved committee called the "Mild Traumatic Brain Injury Committee" wrote a rebuttal to Omalu's initial findings (SPYSCAPE, 2023). This committee's members were not neuropathologists, but rheumatologists, as in joint experts. They claimed that Omalu was constructing the narrative he

wanted to find instead of using factual information. The NFL even asked for Omalu's article to be retracted from the masses. Omalu then authored a secondary paper, "Chronic Traumatic Encephalopathy in a National Football League Player: Part II," publishing it despite the NFL's protests and requests for the papers to be removed from the public eye. Omalu pushed back for many years before the NFL would acknowledge that his claims were in fact correct. Julian Bailes, a neurosurgeon who worked as the Pittsburgh Steelers doctor for a decade, was the first ex-NFL employee to tell Omalu that he believed him. In an interview from 2012 Omalu admitted that he at times wishes that he had never looked at Mike Webster's brain. Omalu stated "It has dragged me into worldly affairs I do not want to be associated with," in reference to discovering CTE. He coined it as his only regret (Laskas, 2009). Even after his work was confirmed, Omalu believed that the NFL consistently tried to find evidence to disprove his claims. In 2020, the Washington Post alleged that Omalu "built a career off distorted science," claiming that his work was all lies and that he twisted medical information. Omalu came forward to announce that he believed the NFL had hidden behind a journalist to try to muddle his work (Fleming, 2020).

Mike Webster was only the first of the findings of CTE. Terry Long, a 45-year-old retired player, died from consuming antifreeze. Long showed signs of depression, memory loss and expressed abnormal behavior. This is what led to the second publishing on CTE from Omalu. Then, Andre Waters was denied disability under the NFL retirement plan despite showing obvious signs of neural deterioration. Waters later committed suicide to escape the pain he was facing. Omalu confirmed he had CTE. Justin Strezelczyk, at only 36 years old, was claiming to hear evil voices and ended up crashing into a tanker carrying corrosive acid and causing an explosion. More and more cases of retired players acting abnormal were presented to Omalu, and every time he found a case of CTE (Laskas, 2009).

Omalu's work became widely known in the media, leading to the public eye learning of his findings. Many found this to be an $8 billion industry against the most well-intentioned, young, scientist in Pittsburgh, Pennsylvania (Laskas, 2009). Omalu released a memoir called *Truth Doesn't Have a Side,* and a film was made about his journey, *Concussion*. This film made between $55 and $65 million dollars from box office and DVD sales (The Numbers, 2015). The film framed the NFL as a greedy and ego-driven industry, with Omalu being a brave opponent. *Concussion* showed the public how CTE can eventually take away an athlete's well-being, and how the NFL determined that that was a price they were willing to pay. Omalu was the first successful doctor to break through the NFL's strategy of covering up their imperfections, a strategy which they still use today (Reed, 2015).

Partially based on the findings of Omalu, in 2011, 4,500 NFL players sued the league for not properly informing of the risk of CTE and the significance it could have on the rest of your life. The NFL denied any wrongdoing and claimed they had given the appropriate medical care to their players throughout the years. In 2013, the NFL reached a $765 million dollar settlement to compensate the 18,000 retired players over concussion-related brain injuries. This also included access to pre-paid medical exams for all of them so they could gauge the damage they faced in the league (NFL, 2013). The league has changed its rules since the 2013 settlement, by modifying the medical protocols for concussions. The NFL has always been known to want to keep a positive social image. Michael LeRoy, who teaches at the University of Illinois at Urbana-Champaign said "The league is keenly sensitive to its public. It changes the conversation and really lets the air out of the publicity balloon." The plaintiffs said that the NFL did not warn players at all about concussions until 2010. Despite informing them of concussions, the league still did not do much to adjust for preventative measures (Belson, 2013).

Conclusion

The integrity of the NFL was not questioned on a grand scale until there were findings of CTE. Instead of facing the truth, the industry did everything they could to prevent evidence of malpractice within their medical teams. Throughout this paper, I explain the impact of Dr. Omalu's findings and how the NFL has adapted to the uproar against concussions. By using a series of case studies and statistics, I argue that the NFL needs to increase safety and awareness of concussion injury in the NFL, regardless of what it may do to the teams financially. The NFL needs to put their players' health first and limit the chances of life-altering injuries. Regulation of traumatic brain injury would help ensure that less retired players face the horrors of what CTE can do to their lives. The NFL faced incredible pushback over the handling of Tagovailoa in 2022, resulting in an increase in concussion protocol safety. Hopefully, this shows that the NFL is learning from the mistakes they have made and can work harder to keep players from a guaranteed life of misery. While playing football will never be fully safe, there are certainly more ways to increase protection beyond the concussion protocol. If the NFL takes recommendations from licensed professionals such as Dr. Omalu, together, they can make the future of the league stronger and safer.

Bibliography

American Academy of Neurology. (2016). Study: More than 40 Percent of Retired NFL Players had Brain Injury. https://www.aan.com/PressRoom/Home/PressRelease

Bagley, Tucker. (2022). Concussion List for NFL Players this Season, plus NFL Protocol Policies. *Sharp Football Analysis.* https://www.sharpfootballanalysis.com/analysis/concussion-list-tracker-players-nfl-protocol-policy

Belson, K. (2013). N.F.L. Agrees to Settle Concussion Suit for $765 Million. *The New York Times.* https://www.nytimes.com/2013/08/30/sports/football/judge-announces-settlement-in-nfl-concussion-suit.html

Bijker, W. (2018). The Social Construction of Facts and Artifacts. *STS Infrastructures.* https://stsinfrastructures.org/content/scot-poster-4s-1983

Brain Injury Research Institute. (2023). "Iron" Mike Webster. https://www.protectthebrain.org/Brain-Injury-Research/Memorial/Mike-Webster.aspx

CDC. (2010). Facts about Concussion and Brain Injury: Where to get help. *Heads Up Clinicians.* https://www.cdc.gov

CTV News. (2015). "Concussion": The Doctor Who Went to War with the NFL. *Youtube*. https://www.youtube.com

Didehbani, N. (2013). Depressive Symptoms and Concussions in Aging Retired NFL Players. *Oxford University Press.* 418-424. doi: 10.1093%2Farclin%2Fact028

Ezell, L. (2013). Timeline: The NFL's Concussion Crisis. *PBS.* https://www.pbs.org/wgbh/pages/frontline/sports/league-of-denial/timeline-the-nfls-concussion-crisis

Fainaru-Wada, M. Fainaru, S. (2013). League of Denial. *Crown Archetype Publishing.*

Fleming, Kirsten. (2020). CTE doctor Bennet Omalu claims NFL behind Washington Post hit piece. *New York Post.* https://nypost.com/2020/02/08/cte-doctor-bennet-omalu-claims-nfl-behind-washington-post-hit-piece

Flynn, E. (2016). What is the NFL's concussion protocol? *Sports Illustrated.* https://www.si.com/nfl/2016/09/16/nfl-concussion-protocol-policy-history

Furness, Z. (2016). Reframing Concussions, Masculinity, and NFL Mythology in **League of Denial**. *Routledge Taylor and Francis Group.* https://www.tandfonline.com/doi/full/10.1080/15405702.2015.1084628

Gurarie, M. (2022). What is a Concussion Protocol? : A Guideline for Safe Return to Activity Following Concussion. *verywell health.* https://www.verywellhealth.com/concussion-protocol

Guskiewicz, K. (2006). Recurrent Concussion and Risk of Depression in Retired Professional Football Players. *Medicine and Science in Sports and Exercise.* doi:10.1249/mss.0b013e3180383da5

Hollin, G. (2021). "Learning to Listen to Them and Ask the Right Questions." Bennet Omalu, Scientific Objectives, and the Witnessing of a Concussion Crisis. *Frontiers in Sports and Active Living.* doi: 10.3389/fspor.2021.672749

Johnson, M. (2022). NFL Concussions Reportedly Dipped Significantly in 2021. *Sportsnaut*. https://sportsnaut.com/nfl-concussions-statistics-2021/

LAist. (2023). Dr. Bennet Omalu and the autopsy that shook the NFL. *kpcc.* https://www.kpcc.org/show/take-two/2015-12-23/dr-bennet-omalu-and-the-autopsy-that-shook-the-nfl

Lartey, J. (2015). Concussion: Doctor Who Fought NFL Says 'No Equipment Can Prevent' Such Injuries. *The Guardian*. https://www.theguardian.com/us-news/2015/dec/28/concussion-prevention-football-safety-brain-injury-bennet-omalu-nfl-will-smith

Laskas, J. (2015). The Brain That Sparked the NFL's Concussion Crisis. *The Atlantic.* https://www.theatlantic.com/health/archive/2015/12/the-nfl-players-brain-that-changed-the-history-of-the-concussion

Laskas, J. (2009). Bennet Omalu, Concussions, and the NFL: How One Doctor Changed Football Forever. *GQ Sports*. https://www.gq.com/story/nfl-players-brain-dementia-study-memory-concussions

Louis-Jacques, M. (2022). Following Review of the Handling of Tua Tagovailoa's Injury, NFL, NFLPA Agree 'the Outcome in This Case Is Not What Was Intended'." *ESPN.* https://www.espn.com/nfl/story/_/id/34755142/following-review-handling-tua-tagovailoa-injury-nfl-nflpa-agree-outcome-case-not-was-intended

Navarro, S. (2017). Short-term Outcomes Following Concussion in the NFL: A Study of Players Longevity, Performance, and Financial Loss. *Sage Journals.* doi: 10.1177/2325967117740847

NFL. (2022). NFL Concussion Diagnosis and Management Protocol. *NFLPA.* https://www.nfl.com/playerhealthandsafety/resources/fact-sheets/nfl-head-neck-and-spine-committee-s-concussion-diagnosis-and-management-protocol

NFL. (2019). Better Rules to Build a Better Game. *NFLPA.* https://www.nfl.com/playerhealthandsafety/equipment-and-innovation/rules-changes/better-rules-to-build-a-better-game

NFL. (2013). NFL, ex-players agree to $765M settlement in concussions suit. https://www.nfl.com/news/nfl-ex-players-agree-to-765m-settlement-in-concussions-suit

NFL Football Operations. (2023). Player Health and Safety. https://operations.nfl.com/inside-football-ops/players-legends/player-health-safety

Omalu, B. (2010). Chronic Traumatic Encephalopathy (CTE) in a National Football League Player. *Journal of Forensic Nursing.* doi: 10.1227/01.neu.0000163407.92769.ed

Raizner-Slania. (2022). Why the NFL Needs to be More Proactive in Preventing Concussions. https://www.raiznerlaw.com/blog/why-the-nfl-needs-to-be-more-proactive-in-preventing-concussions

Reed, K. (2015). Read the GQ Article That Inspired the Movie Concussion. *League of Fans.* https://www.leagueoffans.org/2015/12/08/read-the-gq-article-that-inspired-the-movie-concussion/

Roy, J. (2013). NFL Crown-of-the-Helmet Rule: The End of Football as We Know it? *Bleacher Report.* https://bleacherreport.com/articles/1578475-nfl-crown-of-the-helmet-rule-the-end-of-football-as-we-know-it

SPYSCAPE. (2023). Bennet Omalu: The True Superhero Who Fought the NFL and Won.https://spyscape.com/article/bennet-omalu-the-true-superhero-who-fought-the-nfl-and-won

The Numbers. (2015). Concussion (2015). https://www.the-numbers.com/movie/Concussion-(2015)

University of Michigan Health. (2023). Concussion in Athletes. https://www.uofmhealth.org/conditions-treatments/brain-neurological-conditions/concussion-athletes-neurosport