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Concussions related to Football

By Jerry Stephen

Abstract

Concussions are a major problem in football. They cause short and long term problems. Much is known about the causes of concussions in football, little is yet known about how to truly really decrease the amount of concussions and the effects a concussion really has on an individual, I propose to look at efforts being put in remaking helmets, physiological effects on the brain, and the long term behavioral and emotional effects of concussions. There is an ongoing research to solve the concussion in football. Scientists are learning about the physiological effects on the brain and the long term emotion changes due to a concussion. Studies have shown a football hit is just like a car crash. They are trying to get as close as possible to a concussion proof helmet. Athletic trainers are getting away from the grading scale and trying all concussions as severe.

Introduction

America's favorite sport is football. Concussions are the most troubling problem in this sport. Football has been around for over 145 years. It has gone through hundreds of changes from rule changes to equipment changes. Most of the recent changes have been to prevent concussions. The National Football League has tried to improve the helmets, the way players tackle, modifying penalties, and have onsite doctors to look for concussion type symptoms.

Let's first explore the history of concussions. A concussion is an injury to your brain that causes problems with how the brain works. It can affect memory, balance, concentration,

judgement, and coordination. It is the most common type of traumatic brain injury. It was first mentioned and talked about in *The Hippocratic Corpus*. This is a collection of medical works from ancient Greece. It talked about loss of speech, hearing, and vision from “commotion of the brain” (Carr). The loss of mental function by shaking the brain was the only understanding of concussions until the 19th century. Since the 19th century, we have made huge steps in understanding concussions.

Now the relationship between football and concussions is even more recent. This problem has been troubling the NFL for the past 20 years. It became a huge topic after a doctor by the name Dr. Ann McKee performed a study on former NFL players. On September 30, 2014, she announced that 76 of the 79 brains she examined tested positive for chronic traumatic encephalopathy (CTE). CTE is a degenerative disease found in people with repetitive brain trauma. Other studies have been performed and have led the league to its changes to the game. One major rule change was a penalty for leading with the head. It was first only for defensive players but now it is for everybody. Another rule change was protecting receivers when catching the ball. Defensive players cannot hit the receiver in the head when he is defenseless. These rule changes have helped but there is still more improvements needed.

These are two very familiar topics to me. One I have been playing with my entire life. The other has just recently entered my life. I have had two concussions in my football collegiate career. They were both unique in how I felt and the symptoms I had. This sparked my interest in concussion; however, I was already extremely intrigued about the brain itself. I was also

worried if I were to get anymore concussions would it affect my future career choice and my life in general.

Although much is known about the causes of concussions in football, little is yet known about how to truly really decrease the amount of concussions and the effects a concussion really has on an individual, I propose to look at efforts being put in remaking helmets, physiological effects on the brain, and the long term behavioral and emotional effects of concussions. Researchers and scientist still many unknowns with concussions and how to prevent them in football. One question is can we ever make a true concussion proof helmet. Helmets have come a long way from when football first started until now. There still isn't a great helmet to stop concussions or to decrease your chances sustainably. Beside the helmet issue, I wonder what the NFL and scientist are doing to deal with concussion problem in sports. Is there any technique or idea to lower the number of sports related concussions.

Some unknowns to me are the long term effects of a concussion and what actually happens to the brain during a concussion. Most people know the brain shakes in the skull during a concussion but what other physical and physiological features occur. Another unknown is the scale for grading a concussion. How accurate is this scale. From my personal experience I feel there is no true scale for a concussion. My first concussion I didn't lose consciousness or become very dizzy but I was out for almost two weeks. My other concussion I still didn't lose consciousness but I couldn't see anything and I couldn't walk right. However, when they asked me the concussion questions I passed all of them but one and I returned to play the next week.

Have you ever heard a football collision is like a car accident? Well I also want to investigate the physics behind this claim. If it is really like a car accident, then how can individuals walk away from those collisions unharmed? Based on what we know about car accidents they shouldn't be able to do this. My methods used to answer these questions were through multiple research articles. I will take the information I obtain and use it to evaluate and answer the questions above. I will also take into account my personal experience involving concussions and the preventions but in place to stop concussions I have been told about by my coaches and athletic trainers. This will give us an insight of what is supposed to be known to all football players and what is actually known and told to them.

Concussion and Football Analysis

Concussions are a very important topic in today's society. It has all over the news with all the former NFL players having issues or deaths because of repetitive brain trauma. There are several studies and papers involving concussions now. Most of them are related to football since most concussions are sports related. Four of the articles I read and analyzed are dealing with concussions and football. The others deal with the long term effects of concussions, the physiological problems during a concussion, the scaling of concussions, or the effects of multiple concussions.

The four articles that relate football and concussions have broad differences in their focus. Some of the focuses are comparing frequencies of concussions between high school and college, neuropsychological function of athletes with concussion, and how much force is generated with football collisions. One also goes into depth about possible improvements to

helmets to decrease or be more aware of concussions. These articles helped answered the unknown questions. It answered the comparison between football and car collisions. They answered if the grading scale for concussions was truly accurate. The articles showed how and what the scientist were doing to help decrease the amounts of concussions. One article even answered the most asked question about every having a concussion proof helmet.

Physiological process during a Concussion

There are multiple physiological dysfunctions caused by a concussion. Immediate after a brain injury indiscriminant release of neurotransmitters and unchecked ionic fluxes occur. These ionic shifts lead to acute and subacute changes in cellular physiology. The sodium-potassium pump works overtime causing a much higher need of ATP. This need for ATP causes an increase in glucose metabolism. A huge sugar rush goes to brain where diminished cerebral blood flow is occurring. These two problems are why the brain is more vulnerable to a second injury and potentially causing longer-lasting deficits.

After the initial glucose rush the brain goes into a depressed metabolism phase. This can cause increased levels of calcium impairing the mitochondrial oxidative metabolism. This uncontrolled calcium accumulation can lead to cell death and it may be the cause for unconsciousness. . A huge problem with a concussion is the reduction of magnesium in the brain. Magnesium helps improve motor performance and memory. It is also important for maintaining the cellular membrane potential and initiating protein synthesis. Low levels of magnesium may unblock the NMDA receptor channel leading to the increased calcium level.

Quite a bit of information is known about what happens to the brain physiologically but scientists aren't quite sure what each dysfunction role is in a concussion. There is a huge need for more research in this area. They are currently running test on animals, mostly rats, to see how each change independently affects the rats. These studies show help explain how and why each physiological dysfunction occurs.

Long term effects of Concussions

Our first question is about the long term effects concussions and cause and the effect on the person's friends and family. The main focus on is behavioral and emotional changes concussions can have. Each person's effect is varies because it depends on what part of the brain is damaged because of the trauma. The force can cause tearing to the brain and soft tissue that supports it (Hart). The certain parts of the brain control certain functions. For example the frontal lobe controls personality and impulsivity. If this is damaged the person maybe not have control of his anger or aggression. He may not be able to have self-control as well. This is an example of one side of the effect. The opposite could also happen. This is called the "flat affect". It means someone's personality may become muted or be emotionless (Hart). Some other symptoms based on the location are depression, risky behavior, egocentricity, negativity, verbal or physical outburst, lack of empathy, or impulsive behavior. The person could also develop mood swings. It can seem like they are on an emotional ride going from extreme happiness to extreme sadness and loneliness.

It is vital that the friends and family of the person dealing with the effects understand it is not the person's fault (Hart). It is due to their brain injury that they are acting this way. It can

be difficult on the family members or friends if the person doesn't realize he or she is behaving differently than before the injury. Some ways to help the individual are with a neuropsychologist or behavioral therapist. Other easier ways are for the person with the symptoms to find support. It can be from a friend or family member or even a support group or peer mentor. It may be easier on the person if he has someone that can relate to where the individual is if the person helping has gone through the same burden.

Comparing Football and Car Collisions

In order to compare these two, scientist had to develop a high tech helmet to detect the force generated by each blow. Stefan Duma was the project leader for this experiment. He is an engineer who specializes in car crashes and safety equipment. They said on average football players get struck in the head 30 to 50 times per game (Dakss). The helmets they used to conduct the experiment regular helmets with built in sensors. These sensors are the same kind of sensors that trigger car air bags. The monitoring helmets were developed by a New Hampshire company called SIMBEX. The company plans to start selling these helmets to different teams.

The method used was a rotating with eight helmets among 38 players. They went to all different position groups. Their results ended up with 3,312 hits during 35 practices and 10 games (Dakss). The hits were monitored on the sideline by a laptop Duma used. The computer received the angle and severity of impacts form from the helmets. The helmets measured hits in multiples of the force of gravity. The results showed half of the hits recorded were greater

than 30Gs and the hardest hits measured to be greater than 130Gs (Dakss). We know now the force in the hardest hits, but how does it compare to a car accident.

If the car is traveling at 70 miles per hour and gets in an accident, then the force is 98Gs (Allain). This is less than the hardest hit. If a car is traveling at 85 mph and wrecks, then the force is 120Gs. Another value less than the hardest hits measured (Allain). The results prove that indeed a hard football hit is like a car crash. The data surprised the team physician P. Gunnar Brolinson. He said he didn't realize players were absorbing so much force. He also believes there are unknown factors in how players are able to withstand football hits than other people. Some possible reasons are stronger neck and shoulder muscles than most people. Also the adrenaline could play a role in it. Another source believed the more right angles being put into shoulder pads are also helping with reflecting the blow.

Evolution of the Football Helmet

Football has always had to worry and deal with head injuries. The head injuries seen today aren't as gruesome as the past. The first helmet ever worn was the Circa in 1903 (Pop Warner). It was made out of leather. The leather was soft, thin, and very little padding. It was so small and simple it could be folded up and put in a player's pocket. The reason for this help was to protect against cauliflower ear not stop head injuries. The Circa helmets were the only ones used until the 1930s. They switched from soft leather to hard leather. This time it was to protect the head. It added thicker padding and a strap to reduce the force of the impacts. Over the years they kept adding more padding to the leather helmet. The helmet started to fully

cover the ears and made on field communication almost impossible. In the 1950s, leather helmets stopped being used due to the risks of such minimal equipment (Pop Warner).

John T. Riddell Company was the first to introduce the plastic helmets. His company started with making shoes. He made the first removable cleat football shoe. He also designed the web suspension helmet used in WWI. He brought this design into the football helmet as well. He also changed the helmet straps to attach to the chin instead of around the neck. Until 1940s, helmets weren't required but the ruled changed when the first face mask was developed (Pop Warner). Riddell continued to advance the helmet by making the first custom air-fit helmet. This design allowed the player to have his helmet fit better with putting air in the helmet plus the pads already in place. The air also helped with reducing the impacts.

Some other changes to the helmet were with the design of the facemask and the material used to make the helmet. They switched from using a soft plastic to polycarbonate helmet. There was switch because the plastic helmets often broke on the first impact. Scientist preferred the plastic over the leather because it was reducing the amounts of head injuries and facial injuries. The polycarbonate element was stronger than plastic and could absorb more force than metal. This is style the material used for today helmets. Riddell has continued to make changes to their helmets to get closer to the highest goal of a concussion-proof helmet.

Concussion Proof Helmet a Myth

One recent study has made head way into improving helmets. The researchers analyzed six years of head impacts among 1833 college football players from eight schools wearing either a Riddell VSR4 or Riddell Revolution helmet. The Revolution no longer had the screws in the forehead area. This allowed for more face mask flexion and dispersing impact energy around the helmet instead of the head. These helmets were equipped with the sensors and found a 54% lower risk of concussion with players wearing the Riddell Revolution. This study also proved it is impossible for a helmet to be 100% concussion proof.

It is not a failure of equipment or technology. It is simple a biological fact. The force striking one's head can't be prevented. Energy is force and energy can't be eliminated. It has to go somewhere. Good helmets lengthen the duration of the impact itself, reverberating energy through different structures and materials (Gessel). It lowers the high G value strike to a smooth curve of deceleration. The helmet helps lower the blow but eventually you will have to feel the blow. A great example is like pumping the brakes before you slam into a brick wall (Gessel). The end result is the same because you hit the wall, but it lowers the impact. This is the same with the brain and a helmet. It does help but it can't stop your brain from smacking against your skull causing a concussion. Some researchers believe helmets give players a false sense of security and invincibility so they are even more aggressive than usually (Sifferlin).

Since we have learned that we can't make a concussion proof helmet, do we stop helmet research? The answer is no. As the previous study showed, we can improve helmets to decrease the likelihood of a concussion. The scientist in the research experiment said improving helmet design to lessen the damage of a concussion is just as critical (Sifferlin).

Conclusion

We have looked at how concussions play a huge role in America's favorite sport. Football is a rough sport. We love this great game so we need to keep focusing on making it as safe as possible. It could be with more rule changes, improvement of equipment, better understanding of concussions, or a mixture of all these different aspects. The main questions have been answered and addressed by analyzing the readings. The huge question about concussion proof helmets has been answered. The troubling long term effects because of a concussion have been shown and exemplified. The hidden physiological functions after a concussion have been brought to the surface and revealed. The saying about car crashes and football hits was proven to be true.

I was surprised by some of these findings. I wasn't aware someone could have a behavioral or mental change and not even know. They are completely unaware of the change and the impact on their loved ones it can have. This is a bit alarming since I have had a few concussions myself. Another surprise was a football impact creating more force than an 85 mph car crash. This was mind-blowing because I have been hitting people and getting hit for over 12 years. The force to me is just normal and now knowing some hits I have delivered or received could have possibly been like a bad car crash is crazy.

I wasn't surprised about the newer helmet, Revolution Speed, being better than the old Riddell helmet because that is what is expected. The new version is supposed to be better than the older one. I know this isn't the case all the time but I am also going by my own experience. The Revolution helmet fits better on my head and I don't feel the hit as much. With the old

Riddell helmet, it was always hard to put on my head. I didn't think anything of it because that how it had always been until the new helmets came out. I also felt the difference with hits as well. I didn't get those "woo" feelings after a big hit as much.

These findings are more than just about football, science and the brain. It is also about protecting our youth and future generations from past failures. We need to learn from our history and not make the same mistakes twice. We have more technology and information about concussion. We should be able to minimum them and not have a big of issue as we do now. Society's eyes are all over this topic now and the NFL can't hide it any longer. The issue has become so big they made a movie about it. Hopefully we care more about the safety of our peers than the money and excitement of the game of football. We can still produce a great game while keeping the players safe now and later in their lives. They deserve to live long healthy lives just like the rest of us.

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