Football Helmet Safety Technology: The InSite System
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INTRODUCTION

Shortly after graduating from the University of Pittsburgh with a degree in biomedical engineering, I joined the work force and earned a job as a neurological consultant for Riddell, a football helmet company for the last 76 years [1]. At Riddell, I have the distinct privilege of helping to design, create and test new concussion limiting technology as it relates to the brain for football helmets from youth leagues, all the way to college and professional football.

CONCUSSIONS AND HEAD TRAUMA

Concussion technology is a relatively new innovation that has gained attention in the public eye due to its traumatic effects that head and neck injuries can have on players long term. High force hits to the head or neck can cause a multitude of injuries such as concussions, contusions, and in some extreme cases, paralysis or death. Concussions are the most prominent brain injury and it occurs when the brain shakes enough to bump against the skull [2]. These “traumatic brain injuries” can cause long term effects such as dementia, depression, reduced cognitive ability, sleeplessness, early-onset Alzheimer’s, and a debilitating and latent disease known as chronic traumatic encephalopathy [3]. There have been a multitude of players that have joined a lawsuit in recent years against the National Football League for “alleging that the NFL failed to acknowledge and address neurological risks associated with the sport and then deliberately failed to tell players about the risks they faced” [3]. Unfortunately, over the past several years, multiple NFL players have chosen to take their own lives in response to suffering with the head problems in their post-football lives. This list includes Hall of Fame inductee Junior Seau, former Atlanta Falcons safety Ray Easterling, and most recently, San Diego Chargers safety Paul Oliver in 2013 [4].

In a recent study, two groups of men ages 40-65, who all played high school football and also matched in age, education, and pre-morbid IQ were asked to do a memory study. The difference between the two groups of men is that one group reported having a minimum of one concussion before the age of 18 in their high school football programs. According to the study, the men’s neural activation associated with verbal encoding and memory retrieval were studied. The results were that “indicated that those with concussive histories had hypo activation in left hemispheric language regions, including the inferior/middle frontal gyri and angular gyrus compared with controls” [5]. In layman’s terms, this means that multiple concussions before the age of 18 may be associated with late-life memory deficits. This is just another example of the serious repercussions that multiple head injuries can cause through a persons lifetime.

These serious consequences of brain injury that are a direct result from football deserve a serious amount of attention from a multitude of professions. As an engineer, it is an obligation to use my skill set to help create a safe product in football helmets to help maintain America’s most popular sport.

At Riddell, I work with a team of highly skilled engineers who spend their days helping to design and perfect a new form of concussion sensor that helps recognize significant force on the head and neck. This new helmet insert, the InSite impact response system (shown in Figure 1 below), comes with three major components in order to help alert an off field coach or staff member that a player may have suffered some sort of had trauma. When the sensor receives a certain force, an alert goes to the off field monitor where trainers can track players hits and assess the head injury. This new product is revolutionary and will eventually be in every helmet in the football world.

FIGURE 1 [11]
Riddell’s InSite Impact Response System (padding inside helmet) and Alert Monitor

AN ETHICAL PREDICAMENT

Riddell contacted me as one of the head engineers to find a way to maximize profit and get the cost of creating the system below a certain manufacturing cost threshold. After reviewing our product, my team of engineers and I found that the only way to reduce the manufacturing cost even more significantly is to “cut corners” on the creation and replace the technology with shorter battery life and smaller circuits. Both of these have repercussions that could be detrimental to a company’s integrity and a players safety. With a shorter battery life, helmets would need replaced more often than the original battery life allowed. This would mean teams looking for similar technology elsewhere that has a longer battery life. More importantly however, the smaller circuits can have dire effects on the safety of product...
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users. With shortened circuits, the InSite IRS may not register every significant hit that a player takes. If the InSite isn’t registering every big hit, this puts the player at a risk of playing through head trauma, which could worsen their condition and cause serious injury. On the other hand, if I do shorten the battery life and the circuits, I can gain favor with my superiors and quickly rise in the ranks in Riddell and also boost my resume for other companies to see and hopefully offer me better jobs. This ethical dilemma is one that, like all other types of engineers, we face at least once in our careers.

**AN ETHICAL BREAKDOWN**

As I ponder my difficult situation, I take time to consider the pros and cons of the choices I make. As an engineer, I know I am held to a high standard to which I must adhere and make careful, informed, and reasonable decisions on the products that I make. In order to do that, I took a long look at the Code of Ethics for the National Society of Professional Engineers (NSPE) and The Biomedical Engineering Society (BMES). These codes of ethics allowed for me to realize my responsibilities as an engineer.

**National Society Of Professional Engineers**

The National Society of Professional Engineers is an organization that created a set of guidelines that every engineer is expected and obligated to follow when working in their profession. This set of guidelines consists of six main canons that all engineers must adhere to. Three of the six canons pertain to my ethical dilemma.

The first ethical canon states that “Engineers, in the fulfillment of their professional duties, shall hold paramount the safety, health, and welfare of the public.” This was the most relative to my particular situation. By cutting corners for Riddell, I would not be keeping the safety, health, and welfare of football players at the highest standard possible.

Canons two, three, and five were not particularly considered when reading through the guidelines because they didn’t pertain to my situation with Riddell.

Canon four reads, “Engineers, in the fulfillment of their professional duties, shall act for each employer or client as faithful agents or trustees.” By not being able to guarantee that the InSite impact response system would continually work without problems. Those clients would no longer be able to trust me if I worked against them in lessening the quality of the product in order to save money for the company.

Finally in canon six, “Engineers, in the fulfillment of their professional duties, shall conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession. As an engineer, I owe it to my fellow peers to keep the name of an engineer in good standing. By designing a helmet that only works “most of the time,” I am putting the name of engineers up for critique. As a profession, we are here to create and enhance everyday objects to help advance society [6]. While the NSPE lays out canons for all engineers, The Biomedical Engineering Society specifies the ethics for my particular field of study.

**Biomedical Engineering Society**

According to the Biomedical Engineering Society Code of Ethics as a biomedical engineer, I have an obligation to “use my knowledge, skills, and abilities to enhance the safety, health, and welfare of the public” [7]. This is just like the first canon of the National Society of Professional Engineers and holds true particularly to Biomedical engineers. By not creating the most quality product that I can, I am also violating one of my Biomedical engineering professional obligations in the fact that I am not, “Strive by action, example, and influence to increase the competence, prestige, and honor of the biomedical engineering profession” [7]. By not following this canon, I am not doing my best to improve the engineering profession. However, by doing the opposite and helping to inform on the best way to design the helmet to maximize safety, I am contributing to society in the best way I know how by helping to save future football players (and players from all sports) from different head traumas that can be harmful and even life threatening.

**HEAD INJURIES: UNDETECTED**

If designed, created, and manufactured correctly, the InSite impact response system could be extremely beneficial to society, which directly correlates with the first canon in the code of ethics by The National Society of Professional Engineers. By transmitting the information off of the field, players can sustain a jarring hit and stay in the game without having to come out and be evaluated as long as the hit does not register on the alert monitor as one that could be hazardous to the player’s health. If this system wasn’t in fact, there could be a multitude of injuries to players that no one would be made aware of.

In one particular case, an 18-year-old high school football player was studied after an incident in his hometown football game. The player was reported to have come to the sideline after taking off his helmet, and fell to his knees and vomited. After he lost consciousness, he was taken to the hospital and treated according. It was found that this particular player suffered a hematoma in his brain. A hematoma is a swelling that is filled with blood caused by blunt force or multiple consecutive concussions [8]. At a later time, the player recalled that he had been hit hard twice in the head during the game. He recollected that he had felt dizzy, and nauseous but continued to stay in the game [9].
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With Riddell’s InSite system, a coach, trainer, or staff member could have been made aware of the first hit and removed the player from the game for evaluation and could have saved multiple resources such as money and time and grief for that particular family.

In a different, recent study, a group of 11 youth boys ages 15-19 years old were the subject of a study of football players with relevance to concussions. These boys were to be put into one of two categories: 1. No clinically diagnosed concussion and no changes in neurological behavior or 2. Clinically diagnosed concussion with changes in neurological behavior. When trying to place the players in one of these categories, researchers found that some players fit a third, unexpected category. These players “exhibited no clinically-observed symptoms associated with concussion, but who demonstrated measurable neurocognitive (primarily visual working memory) and neurophysiological (altered activation in the dorsolateral prefrontal cortex [DLPFC]) impairments” [10]. This finding proposes that more young players may be experiencing some sort of head trauma that is going undetected and could be playing through serious injury that puts them at a major risk. With Riddell’s InSite system, we could expose these head issues and keep the players safe.

Incidents like these are the main reason that I work with Riddell to help create such a unique product. I know that with my particular skill set, I can help players avoid these types of head traumas and keep them on the field playing. One perk of this InSite system is that it is not limited to football. The same system can be put into helmets of any sport including ice hockey, lacrosse and even boxing.

A CHOICE TO MAKE

Over the past few weeks I have consulted an incredible amount of sources to try and wrap my head about what the right choice for players safety and my career would be. I referenced the National Society of Professional Engineers Code of Ethics, the Biomedical Engineering Society Code of Ethics, multiple case studies of the results of concussions, and even called my mom to ask for advice and read a Bible. I came to the conclusion that even with the potential advancements in my career and extreme monetary gains, I could not be the one responsible for the injuries of athletes that could be life long and even life threatening. Therefore I have decided to tell my employer that my team and I have done all that we can in order to minimize the production cost of the InSite impact response system. As a former athlete myself, I sympathize with the competitive drive of any athlete that wants to continue to play in the game even after a big hit. However, the repercussions are too severe and dangerous. The sport of football is all about the big hits. That is what makes it so much fun to watch. However if we don’t start implementing safety measures, the sport will become extinct and be ruled too dangerous to continue playing.

Author of the Harry Potter Series J.K. Rowling once wrote, “It takes a great deal of bravery to stand up to our enemies, but just as much to stand up to our friends” [12]. In this difficult situation, Riddell is my friend and I must make a stand. I refuse to sit by and help the company I work for put football players at risk by not having a product that continually works the way its supposed to. The product generates a formidable income as it is, and even though everyone wants to make money, putting youths at risk is where I draw the line. I pride myself on my morals and my ethical decisions so after consideration, I was proud to make the decision to keep the safety, health and well being of the football world as my first priority.

REFERENCES

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ADDITIONAL SOURCES

http://www.webguru.neu.edu/professionalism/research-integrity/ethics-case-studies

http://biodesign.stanford.edu/bdn/resources/ethicscases.jsp


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