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VICIS Report: An Overview of Football's Dangers

Concussions. The word that could send chills down a mother's back or a victory screech from the team as a reward for hard effort. More importantly, what do you think of when hearing the word, concussion? It is said that the main cause of concussions is "not from a single blow to the head, but it's really the totality of blows that took place over the season," (Eric Nauman, an associate professor of mechanical engineering and an expert in central nervous system and musculoskeletal trauma). The brain has a 'consistency of gelatin' states the Mayo Clinic, but it's an overall soft squishy organ that's surrounded by spinal fluid and a very hard skull. With a little help from Newton's 3rd law of motion, identifying how the brain receives a concussion is quite simple. When you crash into something, or someone your body can't react fast enough to stop, instead your body continues to move at the speed you are in before. So although your body has stopped, the brain (a free floating organ in your skull) continues to move. Thus, it crashes in your skull and begins to swell, bleed and hurt. Concussions can cause a "brief loss of consciousness after the injury, memory problems, confusion, drowsiness or feeling sluggish, dizziness, double vision or blurred vision, headache, nausea or vomiting, sensitivity to light or noise, balance problems, slowed reaction to stimuli" (Healthline).

Furthermore, the real question that needs to be answered is, how do we really prevent concussions in sports? First things first, helmets aren't considered a way to prevent concussions, in fact it was “invented to prevent more severe injuries such as skull fractures” (BrainInjurySafety andPrevention). The general way to keep yourself safe and reduce the risk of receiving a concussion out on the field is making sure you use proper techniques. For example, in the video at CDC.gov, it is mentioned that in football many players use head to head contact as its main collision. Robert Cantu, an MD a Neurosurgeon at Boston University states that it's actually against the rules to use head to head contact in a game. Teaching the proper ways to use equipment and physical skills in the game is one of the main ways of prevention. Also, there are certain rules and regulations now, especially the amount of practice time given to professional football players to reduce the risk of concussions.

A great way to intervene impulse, momentum, Newton's laws of motion, collision, our physics teacher assigned a fun activity for the class to create their very own helmet that could withstand a one kilogram collision. The challenge was on! The task was to create a helmet that could withstand a one kilogram weight without being crushed. The harder part was to fit a raw egg in that helmet during that process; if the egg breaks, you have failed your mission. WE also had specific restrictions including the circumference and height measurements, overall look and a team name. Weighed at .45 grams, our structure survived two crash tests. The first crash test was indirect and missed our helmet. The second crash test was more direct and counted as a pass. More specifically, we used twelve cotton balls, two pipe cleaners, one stuffing foam, two styrofoam cups, two sponges, three springs and one cardboard to create our helmet. That totaled to one hundred and eighty dollars (our teacher rearranged the costs).

Sponge - There were two distinct layers of sponge. The thin navy blue part faced upwards (towards the ceiling) on top of our helmet. That layer is commonly used to scrub off stubborn grime and food was the first layer. The other layer was a light blue sponge, thick, soft and easily absorbs liquid. The reason why we used sponges was because it was considered the 'cushion'. In a more physics perspective, the sponge acts like a shock absorber. The force of the strike that the weight creates gets absorbed into the sponge, hopefully lengthening the time. The key importance of this experiment was time and force. The greater the time, the lesser the force, the lesser the time, the greater the force. It would be quite ridiculous to think that only a sponge can help protect the egg though, so there were a few other materials that saved us in this experiment.

Styrofoam - Was supposed to be the main exterior or base of the 'helmet'. If given the option to redesign, I would have used a harder material as the base exterior because styrofoam seemed a little flexible. Although I consider them flexible, they are very sturdy. Before creating the actual helmet, my idea was when the weight hit the styrofoam structure the weight would just travel through the cup adding pressure to its structure but never makes it fall and that's due to Newton's 3rd law. The purpose of the styrofoam cups was to stuff it with sponge and cotton balls so it can make the structure less 'flexible' and a little more stiff. If the weight hit and crushed the styrofoam cup, there would be 'shock absorbing' materials that could relieve some of that stress. Not only that, but sponges help with Newton's 3rd law of motion as well.

Cotton Balls - I 'immobilized' my egg with exactly six cotton balls. Tightly packing the egg between cotton balls and sponge helps prevent impact strikes from happening between the styrofoam wall and shell. Cotton balls, like sponges, are a type of 'cushion'. It absorbs the shock that the impact has bestowed upon it. In more simpler terms, the force of impact transfers

through the soft 'cushion' like fibers. Newton's third law of motion comes into play and those soft 'cushion' like fibers respond back by flexing back into its original shape.

Springs - Were used for decoration purposes. However, while observing my classmates and their projects, a boy had four very large springs tied on top of his helmet. Although his design was a bit choppy, those springs literally deflected the one kilogram weight. I believe it was a very large impulse when the weight hit the springs because that was a result of an elastic collision.

Pipe cleaners - Also used for decoration purposes. I used one as a mouth guard to secure the egg in place when the collision occurred.

Cardboard - Was mainly used to secure both cups together, however it was also used to create a wall between the egg and the sponge. For example, I had a layer of sponge, cardboard, then another layer of sponge underneath, then finally the egg. When the weight collides with the helmet, the impacts shock gets absorbed by the cotton balls and sponge, but the sponge has a layer of cardboard underneath to prevent the shock from traveling any further down.

One foam piece - This foam piece wrapped around the egg and kept it 'immobilized' with the cotton balls. Its thick layer helped 'absorb' the impact strike so the egg couldn't feel it.

Last but not least, some future ideas that prevent sport related concussions may include a new helmet. "The holy grail for helmet makers is establishing the best absorbing material to cause diluted acceleration at the transfer contact between helmet/head collisions depends on the absorbing materials characteristics to deflect and deform within a stiffness performance during the contact " (cerebrovortex). Mouth guards are also an equipment standard that might be going under change in the near future. Some researches believe it's best to go to the basics, try to find a

system that we could use NOW. However, the only idea we can use now is changing the rules of the game. What do you think we can do to prevent concussions?

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