CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

S0310

Project Title

Better Helmets, Fewer Sports Related Concussions?

Abstract

Objectives

My goal was to engineer a helmet that would lower the g-force of an impact which could prevent or decrease concussions in soccer (and other sports). I identified the problem that there are few options or helmets that prevent and/or reduce concussions for soccer players yet receiving a concussion is very common (18% of injuries in high school soccer are concussions).

Methods

I created four different cardboard prototypes based on my own research of animals and other work. For the prototypes, I also used foam, metal springs, plastic packing air bags, and rubber bands. I wired, soldered and programmed a 200 g Arduino accelerometer. For programming, my mentor Dr. Frewen helped me code the internet version to show the highest g-force felt on impact. For the final draft, I designed and 3D printed the main shells and pieces of the prototype. I also lasercut extra pieces on a laser cutter to fit in additional pieces that the 3D printer could not print correctly. I designed and cut these pieces on my own. I then used a soldering iron and 3D printing filament to assemble the final draft helmet.

Results

I used four prototypes, each using a different material and/or system, and one control with no extra material (just cardboard). The four materials in the prototypes were rubber bands, air bags, foam, and springs. I tested the prototypes with two methods: (1) dropping the prototypes from different heights (1-2.5 ft) and (2) dropping weights on the prototypes (50-200 grams). I placed the arduino under the prototype, ensuring the prototypes were hit with the force of impact first. According to my research, a concussion results from 95 g-force (Gs) to the body. I determined that three of my prototypes were most effective in minimizing the g-force of the impacts: the air bags, foam, and springs. I used the foam and spring contraption to make the final prototype and that was the most effective out of all of the prototypes in minimizing g-force.

Conclusions

I learned that a combination of foam and springs to absorb the g-forces were most effective in reducing g-force to a head or object receiving impact. My final prototype used both foam, springs, 3D printed pieces, and lasercut pieces and the results showed it succeeded in reducing g-force. This information could be used to create a helmet that can be used to reduce concussions in soccer. There are few options for helmets to prevent concussions in soccer and many have no evidence demonstrating that they work. By reducing the g-force of an impact on a soccer player's head, my prototype could give soccer players a chance to return to soccer more quickly after a concussion because it lessens the injury, or could even prevent concussions

Summary Statement

I created a helmet that minimizes the g-force of varying impacts in order to reduce concussions in soccer players.

Help Received

I did all of the work myself but Dr. Frewen helped me with troubleshooting the arduino when I couldn't figure it out and with teaching me how to 3D print.