CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

S0333

Project Title

The Effect of Football Helmet Inflation on Energy Absorbance

Abstract

Objectives/Goals

The objective of this experiment was to determine the effect of football helmet inflation on the amount of energy that the helmet absorbed.

Methods/Materials

In order to test the hypothesis, an anatomically accurate human analog head was constructed using a mannequin head which was hollowed out and the cranium was replaced with a coconut shell while the remaining space inside the head was filled with simulated cerebrospinal fluid. An accelerometer was placed inside the head and secured to a modeled brain stem. It was used to determine the forces exerted on the human brain and the head was placed inside of a Shutt DNA football helmet. The helmet was then struck in the same place by an air powered pneumatic cylinder pressurized to the same 550 kPa each time to ensure maximum consistency.

Results

It was found that at lower helmet pressures the energy absorbance was slightly higher (approx. 0.3% difference). At 100% inflation, 99.25% of the energy was absorbed whereas at 80% inflation, 99.34% was absorbed; at 60% inflation, 99.46% was absorbed; at 40% inflation, 99.47% was absorbed; at 20% inflation, 99.48% was absorbed; and at 0% inflation, 99.51% was absorbed. The average deviation was found to be extremely low at 0.026%.

Conclusions/Discussion

Under normal circumstances the 0.3% difference would have likely been deemed inconclusive, however the human brain is so delicate that this seemingly small energy difference could have a profound clinical impact; especially when considering that for professional players, 0.3% of the impact is still a difference of nearly 7 newtons.

Summary Statement

I demonstrated that by lowering the inflation pressure within a football helmet, the risk of a player getting a concussion could be lowered.

Help Received

I did the majority of the work myself, however I received help with the research from Kalli Ickes, A.T.C and Dr. Jonathan Minor, M.D. I also received aid on my experimental design from my stepfather, Ryan Jonson, who is a mechanical engineer.