



ABSTRACT

Current combat helmets consist of an exterior fiber composite shell with an interior soft foam padding. This foam layer provides additional protection by absorbing shock transferred from helmet shell to skull through compression upon impact. Existing research does not consider precompression that occurs while wearing the helmet; the accuracy of these models used to model force propagation is therefore limited. This affects predictions of the risk of impact-induced traumatic brain injuries. Four different size helmets have been instrumented with contact pressure sensors on the interior padding system. We will use these instrumented helmets to measure head-helmet interface contact forces on volunteer users. We hypothesize that interface forces will change depending on whether the user fastens the helmet strap and that male and female volunteers will additionally contrast due to statistical differences in head size. The experiments conducted will be used to calibrate finite element simulations of impacts on a helmeted head to develop higher-performing energy absorbing materials capable of reducing the risk of impact-induced traumatic brain injury.

INTRODUCTION

- Precompression is naturally present and brought on by the weight of the helmet, the fit of the head within the pads, and use of the chinstrap
- Prior studies on ballistic impact with combat helmets have failed to considered precompression of padding [1,2]
- A characterization of contact forces has not been previously attempted







The padding is compressed by the weight of the helmet (A). The padding is further compressed by buckling the chinstrap (B). The padding is fully compressed when bullet hits the helmet (C).



Northeastern University **College of Engineering**



Head/Helmet Contact Force Characterization in Combat Helmet Systems D'mitra Mukasa¹, Michael Marchev¹, Turner Jennings², Sinan Müftü², Rouzbeh Amini^{2,3}

1 Young Scholars Program, Northeastern University, Boston, MA

2 Department of Mechanical and Industrial Engineering, Northeastern University, Boston, MA

3 Department of Bioengineering, Northeastern University, Boston, MA



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(p<.05) when the chinstrap is applied. We hypothesize that the difference between male and female pressures could be a result of smaller head and or M helmets. We further hypothesize that the increased difference from strapped data could indicate that males fasten the strap more tightly than



Recorded demographic data (age, gender); measured head length, width, and circumference; documented contact forces with and without chinstrap



Helmet assembled with contact pressure





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[1] Tan, L.B. et al., Int J Impact Engrg, 50, 2012:99-112 [2] Rodríguez-Millán, M. et al., *Mat Des*, 110, 2016:391-403









METHODS

Obtained S, M, L, XL Advanced Combat Helmets with Oregon Aero pads and assembled as instructed; sewed pressure sensors onto all pads with connection to Arduino



Diagram of pressure sensors calibration setup

FUTURE WORK



considered



Simulated top pad contact pressure difference between (A) 0.5 mm and (B) 1.5 mm padding compression

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REFERENCES



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