MEASURING HIGH SCHOOL FOOTBALL HEAD IMPACT EXPOSURE WITH AN INSTRUMENTED EARPIECE (DASHR): A PILOT STUDY


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Introduction/Objective

• Mild traumatic brain injuries (mTBI) are a complex and common problem in recreational, youth, collegiate and professional sports.
• Development of objective assessment and diagnostic techniques are beneficial for concussion diagnosis and management, but also provide the opportunity to identify more subtle injuries that potentially result from sub-concussive impacts. [1]
• Measuring head acceleration during potential concussive and sub-concussive impacts can provide insight into the correlation between head movement and risk of brain injury.
• The primary challenge associated with collecting meaningful motion data from existing wearable devices centers around the rigidity of the attachment to the body. Without rigid attachment to the body, the movement of an instrumented device such as a helmet or other head mounted system does not necessarily correlate to the movement of the skull.
• The goal of this pilot is to analyze data collected with a novel in-ear sensing device (DASHR), to demonstrate the magnitudes, durations, and frequencies of head impacts experienced by a high school football player during a game.

Subjects: One (1) football player at the high school level, instrumented with custom fitting earpiece. The subject was a defensive player participating in a conference game.

Data Collection: The DASHR earpiece was fitted in the subject’s left ear, and collected linear acceleration data at 1000 Hz. The linear acceleration was given in the form of the three individual axes and the resultant.

Impact Criteria: Acceleration pulses greater than 5 g with a minimum pulse duration of 5 ms were classified as head impact events. The first 20 minutes of data collection were disregarded as device deployment and adjustment time prior to the start of the game.

Data Analysis: Assuming the head-earpiece system to be a rigid body coupling, triaxial linear acceleration data was examined to determine the quantity and magnitude of head impacts.

Methods

# of Impacts ≥ 5 g Average Duration (ms) Avg Peak Linear Acceleration (g)
Overall 12 18.5 ± 13.0 8.0 ± 3.7
First Cluster (20 s) 5 17.4 ± 8.4 8.5 ± 5.5
Second Cluster (107 s) 5 14.6 ± 9.8 8.0 ± 2.6

Conclusions/Ongoing Work

Conclusions:
The results show that an in-ear sensing apparatus can be successfully deployed as a tool for understanding magnitudes of impact. From these pilot data, we observed that a defensive player experienced impacts clustered near a single, higher magnitude impact.

Ongoing Work:
Perform more robust analysis of individual impacts in order to potentially automate the analysis and classification of events. Make ongoing adjustments to the DASHR sensor to improve power efficiency and ease-of-use.

References/Acknowledgements

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