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

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Introduction: Mild traumatic brain injury (mTBI) and concussion is a significant health issue, specifically within athletic and military environments. Head injuries resulting from athletic contact exposure pose potential long-term health risks to athletes across all levels of play. Wearable devices can provide researchers access to a variety of data, ranging from biometrics to head movement. The primary challenge associated with collecting meaningful motion data from existing wearable devices centers around the rigidity of the attachment to the body. Without solid contact 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.

Objective: 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 high school football players during a game.

Methods: Subjects were football players at the high school level, instrumented with custom fitting earpieces. The earpieces were manufactured similarly to hearing aids, ensuring a rigid fit to the subjects' bony ear canal. Assuming the head-earpiece system to be a rigid body coupling, triaxial linear acceleration data was examined to determine the quantity of head impacts and to produce a frequency distribution of impact magnitudes for each position. Acceleration pulses greater than 5Gs with a minimum pulse duration of 5ms were classified as head impact events. The first 20 minutes of data collection were disregarded, as it consisted primarily of the time period from device deployment to just before the start of play.

Data and Results: Data examined included sensor data from one defensive back, playing in a regular season game. Over the course of a single game, the player experienced 12 head impacts. The maximum impact magnitude was 18.2g, with a pulse duration of 12ms. Impacts averaged 7.97± 3.72g, for a duration of 18.5±13.0ms. Additionally we can observe that impacts were typically clustered. Five impacts occurred over a 20 second timespan (duration = 17.4±8.4ms, magnitude = 8.47±5.5g), and another five over a 107 second timespan (duration = 14.6±9.8ms, magnitude = 8.02±2.58g).

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

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