Football helmet

- The Influence of Headform Pose on the Blunt Impact Performance of American Football Helmets
- Correlating Magnetoencephalography, Diffusion Kurtosis Imaging, Biomechanics, and Neuropsychology in American Youth Football
- Youth football helmet fit assessment and association of prior fitting, issuance and initial season
- Characterising biomechanical and situational aspects of high magnitude subconcussive impacts in Canadian collegiate football
- Distribution of position-specific head impact severities among professional and Division I collegiate American football athletes during games
- Who Is Keeping Score: The Effect of a Mercy Rule on Head Impact Rates in Canadian High School Tackle Football Games
- Tackle Techniques and Characteristics Associated With a Concussion in Tackling Players in the National Football League
- Position-based assessment of head impact frequency, severity, type, and location in high school American football

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American football is the sport with the highest rates of concussion injuries. Biomedical engineering applications may support athletes in monitoring their injuries, evaluating the effectiveness of their equipment, and leading industrial research in this sport

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Improvements in the modern helmet have demonstrated beneficial effects in reducing concussion risk in American football players. However, previous studies yield conflicting results regarding the protective quality of leatherhead football helmets. There is limited research comparing the modern football helmet and the modern hockey helmet, with one previous study demonstrating the football helmet as providing a lower risk of concussion.

Huang et al. compared the head acceleration produced in a leatherhead football helmet vs a modern football helmet vs a modified modern football helmet with softer padding vs a modern hockey helmet in helmet-to-helmet strikes.

Accelerometers were placed on the frontal, apex, and parietal regions of a Century Body Opponent Bag manikin. Each type of helmet was placed on the manikin and struck by a swinging modern football helmet. The G-force acceleration was determined in three-dimensional axes of 100 total helmet-to-helmet impacts.

The leatherhead football helmet was the least protective in reducing G-forces. The modified modern football helmet did not provide a significant difference compared with the modern football helmet. Significantly greater G-forces were produced in a collision between 2 modern football helmets in comparison with 2 modern hockey helmets.

The leatherhead football helmet was the least protective, and the hockey helmet was the most protective, with the football helmet being intermediate. This study provides additional insight into the inconclusive evidence regarding the safety of leatherhead football helmets and into the design of football and hockey helmets in the future [1)].

Over an entire season, a cohort of 20 collegiate football players wore impact-sensing mastoid patches that measured the linear and rotational acceleration of all head impacts during a total of 890 athletic exposures. Data were analyzed to compare the number of head impacts, head impact burden, and average impact severity during helmet-only, shell, and full-pad practices, and games.

Helmet-only, shell, and full-pad practices and games all significantly differed from each other ($p \leq 0.05$) in the mean number of impacts for each event, with the number of impacts being greatest for games, then full-pad practices, then shell practices, and then helmet-only practices. The cumulative distributions for both linear and rotational acceleration differed between all event types ($p < 0.01$), with the acceleration distribution being similarly greatest for games, then full-pad practices, then shell practices, and then helmet-only practices. For both linear and rotational acceleration, helmet-only practices had a lower average impact severity when compared with other event types ($p < 0.001$). However, the average impact severity did not differ between any comparisons of shell and full-pad practices, and games.

Helmet-only, shell, and full-pad practices, and games result in distinct head impact profiles per event, with each succeeding event type receiving more impacts than the one before. Both the number of head impacts and cumulative impact burden during practice are categorically less than in games. In practice events, the number and cumulative burden of head impacts per event increases with the amount of equipment worn. The average severity of individual impacts is relatively consistent across event types, with the exception of helmet-only practices. The number of hits experienced during each event type is the main driver of event type differences in impact burden per athletic exposure, rather than the average severity of impacts that occur during the event. These findings suggest that regulation of practice equipment could be a fair and effective way to substantially reduce subconcussive head impact in thousands of collegiate football players. [2)].

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Huang JJ, Goya KN, Yamamoto BE, Yamamoto LG. Comparing Impact and Concussion Risk in Leatherhead and Modern Football and Hockey Helmets. Neurosurgery. 2023 Jan 13. doi: 10.1227/neu.0000000000002355. Epub ahead of print. PMID: 36637294.
2)
Reynolds BB, Patrie J, Henry EJ, Goodkin HP, Broshek DK, Wintermark M, Druzgal TJ. Practice type effects on head impact in collegiate football. J Neurosurg. 2016 Feb;124(2):501-510. Epub 2015 Aug 4. PubMed PMID: 26238972.