

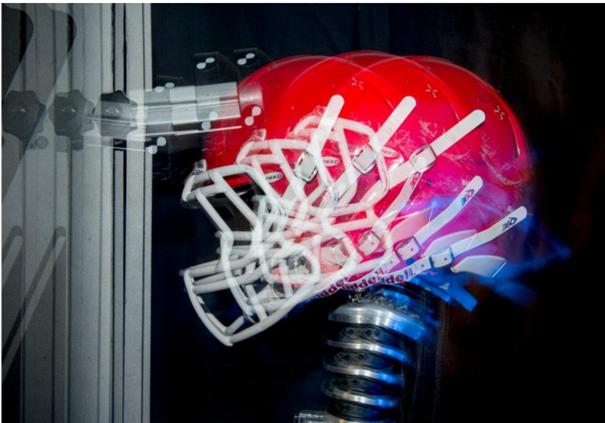
Football Helmet Design and the Risk of Concussion

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Question

Are there any improvements to football helmets that reduce the incidence of concussion?



Evidence-based Answer

- In high school football players, appropriate helmet fit appears important in decreasing concussion rates. The effect of increased padding is unclear (SOR: **B**, epidemiologic and conflicting cohort studies).
- In college and professional players, increased padding, softer grades of vinyl nitrile padding, and increased helmet size and weight to accommodate additional padding may reduce concussion risk (SOR: **C**, bench research).

Concussion In Brief

- **CDC: Estimates 1.6-3.8 million annual sports-related traumatic brain injuries**
- **Linear acceleration** (transient increases in intracranial pressure) + **rotational acceleration** (microstructural strain response in brain tissue) → **Concussion**
- **Growing evidence: Multiple Concussions** → **long-term cognitive impairment**

Data Review Summary

A 2017 Systematic Review of 48 selected studies assessed strategies to reduce sport concussion (Football pertaining studies: N=11,454, high-school, college and professional athletes).

- Appropriate fit reduced concussion symptom severity and duration (with poor-fit: hyper-excitability RR 2.38, P 0.04; drowsiness RR 1.46, P 0.005; Subjects 7% more likely to have symptoms greater than 1 week)
- Helmet design with increased padding over mandible & zygoma found to have 40% decreased relative risk (P=0.027), 2.3% decreased absolute risk of concussion
Concussion rate in superior performing helmet 5.3%; 7.6% in standard helmet
- Retrospective Analysis of 1,833 athletes (1,282,444 head impacts): Helmet with increased mandible & zygoma padding reduced concussion risk 54% (P=0.0305) when compared to standard helmet
- Conflicting data: A Descriptive Epidemiological Study included in Review, 3,528,790 high school athlete exposures with 2,900 reported concussions: higher proportion of concussed athletes wore the model with thicker padding, 63.4% compared with all football athletes (51.7%) (Injury Proportion Ratio, 1.23; 95% CI, 1.19-1.27)

A 2012 study: 1,850 laboratory simulation impacts on 17 modern helmet designs, assessing translational and rotational acceleration conditions

- 4 designs exhibited statistically significant perceived concussion risk reduction (7.3-14% reduction in translational acceleration P 0.0; 8.4-15.9% reduction in rotational acceleration P 0.015)
- Differentiating Characteristics of 4 superior designs: increased energy absorbing padding

Data Review Summary

2006 Laboratory study conducting linear impact tests on 5 modern football helmet models compared to 1990s baseline model

- Assessed translational head acceleration and rotational head acceleration to ascertain “severity index”
- Average reduction in concussion risk with newer helmets 10.8% (6.9 – 16.7%)
- “Testing shows that the selection of softer grades of vinyl nitrile, coupled with increased thickness, can absorb impact energy, lowering head accelerations and reducing the risk of concussion.”

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