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Preliminary examination of guardian cap head impact data using instrumented mouthguards

PURPOSE/BACKGROUND

One recent innovation in protective helmet technology is the Guardian Cap (Guardian Sports, Peachtree Corners, GA), a layer of padding that affixes to the exterior shell of a helmet as a means of further attenuating the magnitude of head impacts in contact sports. Guardian Caps have grown in popularity in recent months across all levels of football. Unfortunately, little to no on-field measurements exist to validate their usage. Our study presents preliminary non-video verified data addressing whether Guardian Caps reduce head impact magnitude.

MATERIALS & METHODS

Nine NCAA Division I American football players wore dental scanned and fitted instrumented mouthguards (iMU) to record head impacts (3200Hz; Prevent Biometrics, Edina, MA). Each iMU contains a triaxial accelerometer and gyroscope to measure linear and rotational kinematics. The football players' positions varied, but all were deemed high-dose players (20 impacts ≥10gs per week) and considered “starters” by the coaches. Each player's head impact data were obtained for three closely matched full-contact workouts wearing traditional helmets (PRE) and for three closely matched full-contact workouts wearing Guardian Caps affixed to their traditional helmets (POST). Participants were included if they 1) used the iMU without interruption, 2) were not injured or missing practice time during the 1.5-week observation period and 3) were outfitted with Guardian Caps during POST workouts. Using the iMUs, the workload, total number of impacts, peak angular acceleration (PAA), and peak linear acceleration (PLA) of the impacts were ensemble averaged and analyzed. In addition, the PRE and POST practice sessions were collapsed and analyzed. All head impacts were filtered by Prevent Biometrics but were not video verified. Our preliminary research indicates that Prevent Biometrics’ filtering techniques (based on the true positives) are 92% accurate when compared to video verification (Murray et al., in review).

RESULTS

A total of 799 true positive head impacts were recorded during the six practice sessions. The average workload ($p=0.746$), average PAA ($p=0.776$), average PLA ($p=0.224$) and total impacts ($p=0.697$) showed no significant time effects across the six recorded practices. No significant time effects were observed from PRE to POST for average workload (PRE=115.9±63.9J, POST=81.1±38.1J; $p=0.148$), average PAA (PRE=947.6±89.1rad/sec2, POST=1034.4±222.4rad/sec2; $p=0.247$), average PLA (PRE=16.7±1.4g, POST=17.4±2.9g; $p=0.411$; Fig. 1). However, a significant time effect for the average number of head impacts was noted ($p=0.029$), with a reduction in average total head impacts at POST (10.9±5.2) compared to PRE (18.67±8.9).

DISCUSSION/CONCLUSION

This study suggests that the average total head impacts were reduced upon implementation of the Guardian Caps, but this difference was only noted after collapsing data from the PRE and POST practice sessions. However, the measures of head impact magnitude (workload, PLA, and PAA) did not change. The reduced total impacts with the Guardian Cap could be due to behavioral changes in the players due to Guardian Cap implementation. This study further suggests that Guardian Caps were not effective in reducing the head impact magnitude experienced by NCAA American football players. This study exemplifies the need for continued on-field research on the efficacy of Guardian Caps before they are endorsed.