REPETITIVE HEAD IMPACTS IN YOUTH FOOTBALL: DESCRIPTION AND RELATIONSHIP TO WHITE MATTER STRUCTURE

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Background: A growing body of evidence has suggested that repetitive head impacts (RHIs) in collision sports produce changes in white matter tracts of athletes as detected by diffusion tensor imaging (DTI). Few studies have examined DTI in 8-12 year old collision sport (CS) athletes, compared them to non-collision sports (NCS) athletes, and correlated findings to accelerometry data.

We sought to explore whether, after a single season of participation in youth football, 8-12 year old male CS athletes will: 1) have change in DTI fractional anisotropy (FA) of commonly injured brain regions, 2) have FA differences when compared to an age-matched NCS cohort, and 3) whether there is a correlation between FA and number, magnitude, and location of impacts.

Methods: Thirty five 8-12 year old male participants in an organized youth tackle football league were recruited (CS) and matched with twelve 8-12 year old male participants in a local swim team (NCS). Each cohort underwent brain MRI with FA at 5 regions of interest (ROIs) before the youth football season and again immediately following the football season. CS participants’ helmets were instrumented with a force switch sensor to record number, magnitude, and direction of head impacts throughout a single season. Descriptive statistics were calculated for age, height, weight, FA values in all DTI ROIs (Anterior Corona Radiata (ACR), Cingulate Cortex (CgC), Genu of the Corpus Collosum (gCC), Posterior Limb of the Internal Capsule (pIlC) and Splenium of the Corpus Collosum (SCC)), magnitude of head impact recorded by accelerometry by season, game and practice, number of hits by season, game and practice and by direction (top, side and rear). A mixed model (group by time) repeated measures MANOVA was conducted to determine if there were any differences in FA between the CS group and the NCS group from pre- to post-season. Correlation and regression analyses were carried out to determine if there was a relationship between the changes of FA from pre- to post-season and number and magnitude of head impacts in the CS group.

Results: The average age of participants was: CS: 10.11 years, NCS: 10.17 years. The average height of participants was: CS: 56.89±4.06 inches; NCS: 59.92±5.00 inches (p=0.04). The average weight was: CS: 84.23±21.51 lbs; NCS: 84.75±24.04 lbs, (p>0.05). A total of 1905 hits were recorded for 34 participants in the CS group for the season, 341 (17.9% of total) collected during 7 games and 1564 (82.1% of total) observed during 31 practices. A total of 301 impacts (15.8% of total) with magnitude >= 80g were collected. For brain ROIs investigated with FA, no significant interaction between group (CS and NCS) and time (pre to post season) was observed (p>0.05). Correlation analysis revealed a significantly positive and moderate relationship between increase of left CgC FA from pre to post season and the total magnitude of lateral head impacts (r=0.40, p=0.03).

Conclusion: Our cohort of 8-12 year old male football players sustained fewer impacts when compared to prior accelerometry studies on youth football, although there was a larger number of higher force impacts recorded. There was no significant change in FA measurement of white matter integrity in our youth football players after a single football season, nor was there any difference detected in FA between youth football players and an age-matched cohort of swimmers. There was a significant correlation between total magnitude of hits sustained by youth football players during the season and an increase in FA in the left CgC. Whether this finding is adaptive or pathologic remains unclear.
Significance: There is no evidence that 8-12 year old male football players sustain significant white matter changes after a single season of tackle football, although there is positive correlation of FA of the left cingulate gyrus to total magnitude of head impacts over the season.

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