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NEWS

Longitudinal Strain Measures of White Matter Tracts in Youth Football Players

Thursday 10:40-10:50 AM | SSQ19-02 | Room: S402AB

PURPOSE

We characterized longitudinal strain of the white matter in youth football players compared to non-contact sport control athletes and tested the hypothesis that axial and radial shape changes of fiber bundles would be associated with participation in contact sports and serve as a new neuroimaging biomarker of subconcussive head impact exposure.

METHOD AND MATERIALS

Twenty-three male youth football players (Age=12.1±1.2 yrs) and 13 male non-contact sports control participants (Age=10.6±1.7 yrs) were recruited for this IRB approved study. Longitudinal brain MRI data, including diffusion tensor imaging (DTI) were acquired before and after a single sports season (approximately 3-months) . Longitudinal registration was performed between pre-season and post-season T1-weighted images. DTI processing included geometric distortion correction, eddy-current correction, fitting of diffusion parameters, and co-registration to T1-weighted images. The voxel-wise fiber-specific deformations (axial and radial strains) were estimated by aligning 3D deformation tensor derived from longitudinal T1-weighted images to the co-registered eigenvectors from DWI. Parameter maps for axial and radial strains were registered to the study-specific template. We compared total and voxel-wise white matter volume change rates between football players and control participants using a linear regression and multiple comparison correction.

RESULTS

There was greater axial strain (contraction) among football players compared to controls in the body and right splenium of the corpus callosum ($p < 0.01$, 340 vox) (upper panel of figure). There was greater radial strain (expansion) in the splenium of the corpus callosum among controls compared to football players ($p < 0.01$, 219 vox) (lower panel of figure).

CONCLUSION

Axial and radial strain data demonstrated more directional contraction and less expansion, respectively, in the football group compared to non-contact sports controls. These tract-specific strains in white matter tracts may reflect changes associated with repetitive sub-concussive head impact exposure.

CLINICAL RELEVANCE/APPLICATION

There is growing concern regarding the long-term consequences of repetitive sports-related subconcussive head impact exposure on the developing brain. We propose a novel white matter tract-specific morphometry method to analyze the effects of repetitive subconcussive impacts on brain developmental trajectory.