Diffusion tensor imaging in sports related concussion

Two advanced imaging techniques-diffusion tensor imaging (DTI) and magnetic resonance spectroscopy (MRS) have been at the forefront of research as a result of their noninvasiveness and ease of acquisition, and hence it is thought that the use of these neuroimaging modalities has the potential to aid clinical decision making and management, including guiding return-to-play protocols [1)].

Diffusion MRI techniques have been used to study brain white matter (WM) changes following SRC; however, longitudinal studies that follow injured athletes from the acute to chronic stages of injury are sparse.

A study explores potential persisting effects of the injury, which serves as a follow-up to a previous work that reported WM changes in the acute and subacute phase of SRC recovery. Concussed high school and collegiate football players (n = 17) and well-matched teammate controls (n = 20) were followed up at 6 months postinjury with diffusion tensor (DTI) and diffusion kurtosis imaging (DKI) as well as measures of self-reported symptoms, cognitive functioning, and balance. Results of tract-based spatial statistics (TBSS) analyses revealed continued widespread decreased mean and axial diffusivity compared to control subjects in 6-month follow-up scans. On the other hand, kurtosis metrics, which were significantly higher in concussed athletes in the acute phase, had normalized. WM tract regions-of-interest (ROIs) were created from significant clusters in the TBSS analysis, and linear mixed effects (LME) analyses were used to look at longitudinal changes in these ROIs over time. LME analyses revealed few time × group interactions indicating findings were relatively stable over time. In addition, acute concussion symptoms predicted diffusivity measures at 6 months postinjury. Findings indicate that DTI and DKI may be useful tools in assessing concussion severity, recovery, and possible long-term effects of concussion [2)].

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Dimou S, Lagopoulos J. Toward Objective Markers of Concussion in Sport: A Review of White Matter and Neurometabolic Changes in the Brain after Sports-Related Concussion. J Neurotrauma. 2014 Jan 23. [Epub ahead of print] PubMed PMID: 24266534.
2)
Lancaster MA, Meier TB, Olson DV, McCrea MA, Nelson LD, Muftuler LT. Chronic differences in white matter integrity following sport-related concussion as measured by diffusion MRI: 6-Month follow-up. Hum Brain Mapp. 2018 Jul 2. doi: 10.1002/hbm.24245. [Epub ahead of print] PubMed PMID: 29964356.