Prolonged MRI post-concussive changes in young hockey players
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Introduction: Mild traumatic brain injury (mTBI) or concussion is thought to invoke an acute and complex neural cascade of metabolic, structural, and functional changes. A correct and prompt diagnosis is imperative and currently relies on clinical protocols like Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT), which attempt to quantify and monitor post-concussive symptoms. These symptoms generally resolve quickly, however these tests rely in part on patient self-reporting. Recent MR imaging studies suggest they may not be sensitive to remaining neuronal vulnerability. Here we aim to (a) identify possible biomarkers by examining acute changes following a diagnosed concussion and (b) assess longitudinal within-subject changes post-concussion changes to identify sustained injury or recovery mechanisms.

Methods: Young male hockey players were recruited for this study (ages 11-14) which includes an independent baseline group of healthy hockey players (n = 16) and players assessed within 72 hours of a diagnosed concussion (n = 14) with follow-up 3-months after their injury (n = 13). ImPACT and balance measures were gathered and the MRI protocol involved a ten-minute resting state functional MRI (RS-fMRI) scan and a diffusion tensor imaging (DTI) acquisition.

Results: Immediately following concussion ImPACT visual and verbal memory capabilities decreased while the number and severity of symptoms increased. Balance centre of pressure lengths increased significantly during double tandem stance indicating an increase in postural sway. These generally returned to baseline levels by the 3-month timepoint when participants have returned to play. Our RS-fMRI metrics revealed subtle, unique patterns of negatively correlated regions immediately post-concussion and there were no significant DTI changes. At the 3-month follow-up, we observed significant structural and functional changes with our DTI and RS-fMRI data, respectively. Axial, mean and radial diffusivities were all decreased within the cingulum and superior longitudinal fasciculus white matter tracts. RS-fMRI connectivity was significantly increased in a number of different regions throughout the brain.

Discussion: These group-level results may indicate prolonged axonal injury even 3-months post-concussion, while the changes in RS-fMRI connectivity patterns may involve disruption in communication and neuroreparative mechanisms. A correlation analysis between the clinical and MRI data will be explored to further decipher the physiological meaning of these changes as well as differentiating individualized injury and recovery patterns.