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**Title**

Quantification of the temporal change of diffusion patterns following mild traumatic brain injury

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Despite the emerging applications of diffusion tensor imaging (DTI) [1,4], there is a lack of longitudinal investigation on the evolution of diffusion based patterns in mild traumatic brain injury (mTBI), which may help to predict the recovery and assist in studying the long term impact caused by mTBI. Although the newly developed DTI techniques, such as voxel-wise analysis, region of interest (ROI) based analysis and tractography [3], have demonstrated their capability to detect mTBI related regions, they are not effective solutions for quantification of the temporal changes of mTBI. Furthermore, these methods rely on statistical analysis based on reasonably large data samples, which may not be suitable for case studies, such as tracking recovery of function in an individual.

In this work, we proposed an effective approach for longitudinal DTI study of mTBI, in which a group based independent component analysis (GICA) [2] is employed to a group of diffusion scalar maps arranged according to their data collection time points post injury. The DTI datasets from three mTBI subjects and six control subjects were used and four types of diffusion scalar maps were calculated, including fractional anisotropy (FA), mean diffusivity, axial diffusivity and transverse diffusivity. The results show that the GICA decomposes the group maps into a number of spatially independent components (ICs). The desired component is the one that represents the common spatial pattern within the group data, which is separated from noise, artifacts and unknown spatial patterns. The timecourse obtained from GICA represents the distribution of the selected IC in the group data, which reveals the temporal changes of the diffusion patterns during recovery of mTBI. In addition, we proposed to define a ROI by a skeleton of mean FA maps created by FSL [5], which allows quantitative comparisons to be performed in tract-focused regions, further revealing the trends of recovery in ROI based analysis. Our approach fully utilizes the outcomes of the spatial components and timecourse from the GICA model and provides a way to quantify pathways of change in longitudinal studies of mTBI.

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