

Using diffusion MRI to study tissue microstructure in traumatic brain injury (TBI)

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Traumatic brain injury (TBI) is a major cause of disability and death worldwide, accounting for about 30% of all injuries and deaths in the USA [1]. The pathology, which ranges from severe to mild, can cause microstructural changes (some on the scale of microns) within the brain, including cell varicosities, micro-glia cell migration, and tissue loss [2,3]. While clinical MRI is routinely used to detect robust physiological and vascular abnormalities, more subtle cellular alterations are challenging to observe, identify, and characterize using conventional MRI methods. TBI can often only be detected at autopsy. Diffusion MRI methods, which are sensitized to the local microdynamics of tissue water, are promising techniques to probe subtle changes in brain microstructure and advances in the measurement and modeling of higher order diffusion may improve both sensitivity or specificity for the detection of brain abnormalities following injury. In this talk we will evaluate how diffusion tensor imaging (DTI) [4], mean apparent propagator (MAP-MRI) [5] and double-pulsed field gradient (d-PFG) [6] are being employed to quantitate microstructural features in the brain. We will also examine evidence from phantom [7] and tissue MRI studies and assess their value and potential for the detection of cellular alterations that accompany TBI [8,9].

References

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