Joint Department of Biomedical Engineering
Marquette University / Medical College of Wisconsin

Announcement of Public Dissertation Defense

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Engineering Hall, Room 423
Marquette University

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ABSTRACT

UNDERSTANDING WATER DIFFUSION IN EXPERIMENTAL SPINAL CORD INJURY REMOTE FROM INJURY EPICENTER

Diffusion tensor imaging (DTI) has demonstrated success as a biomarker of spinal cord injury (SCI) severity as shown from numerous preclinical studies. However, artifacts from stabilization hardware at the lesion have precluded its use for longitudinal assessments. Previous research has documented *ex vivo* diffusion changes in the spinal cord both caudal and rostral to the injury epicenter. The aim of this dissertation was to quantify the structural changes that lead to different diffusion measures in the rat cervical spinal cord after a thoracic contusion injury in an attempt to find a biomarker of injury. Animals received a thoracic contusion injury and underwent Magnetic Resonance Imaging (MRI) at three time points after injury. The rats' post-injury locomotor performance was assessed weekly using the Basso, Bresnahan, and Beattie (BBB) scoring scale.

First, the relationships between BBB scores and MRI were assessed using region of interest analysis and voxelwise linear regression of DTI and free water elimination (FWE) modeling to reduce partial volume effects. In the second aim, the extent of axonal injury and astrocytic proliferation were assessed histologically and compared to the diffusion metrics. Water content in different tissue compartments of the cervical cord was also investigated using quantitative T_2 (qT_2) imaging. Finally, the sensitivity of using varying diffusion times was explored by comparing the conventional pulse gradient spin echo sequence with a novel technique, oscillating gradient spin echo (OGSE).

The results suggest that diffusion tensor imaging parameters, specifically axial diffusivity (AD) and mean diffusivity (MD) can be used as measures of chronic injury severity, but their sensitivity in the acute stage needs to be further explored. Edema was not evident from the qT_2 measures, however, in the OGSE study, the fact that longer diffusion times were most sensitive to injury suggest that the most impactful changes resulting from spinal cord injury occur in the extracellular space on the whole cell scale

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