ABSTRACT
DIFFUSION TENSOR IMAGING OF THE CENTRAL NERVOUS SYSTEM FOLLOWING AN INJURY TO THE SPINAL CORD AND CELL TRANSPLANT

Michael B. Jirjis, B.S.
Marquette University, 2013

The purpose of this dissertation was to characterize the use of magnetic resonance diffusion tensor imaging (DTI) as a diagnostic and prognostic tool in understanding the changes that occur throughout the spinal cord and brain following a spinal cord injury (SCI) and following stem cell transplant. The diffusion of water inside the nervous system has been shown to be dramatically altered around the lesion site following a traumatic SCI. However, following damage to the spinal cord, little is known about the diffusion characteristics away from an injury. Even less is understood about DTI’s sensitivity to regenerative transplant treatments.

To evaluate the sensitivity of DTI in the central nervous system (CNS) following a traumatic SCI, diffusion metrics in the brain and cervical spinal cord were compared for four different injury severities in a thoracic contusion model of a rat SCI. Also examined with the use of DTI were the structural changes in the cervical region of the spinal cord after transplantation of C17.2 neuronal stem cells.

The findings from this dissertation suggest that diffusion tensor imaging is sensitive to changes in tissue structure for regions remote from injury and for cellular environments influenced by stem cell transplant. Mean water diffusion in the distal locations of the spinal cord and in the brain was seen to decrease following a spinal cord injury. When neuronal stem cells that are known to elicit astrocytic development are transplanted into the spinal cord the mean water diffusion increases. These results further clarify the prognostic and diagnostic value of diffusion tensor imaging after a spinal cord injury and following regenerative treatment strategies.