



JOHNS HOPKINS

BIOMEDICAL ENGINEERING



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Electrophysiological and Structural Assessment of Spinal Cord Injury

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Abstract: There are roughly 11,000 new incidences of spinal cord injury (SCI) every year in the United States. Around 400,000 Americans are currently living with the devastating effects of spinal cord injuries. According to the NIH, among neurological disorders, SCI's cost to society ranks second only after mental retardation. Acute spinal cord injuries can be 'anatomically incomplete' with spared demyelinated axons showing physiological continuity across the lesion. Even a small number of spared fibers after SCI, with immediate treatment, can greatly improve the quality of life of patients. Knowledge about the spared fibers sooner rather than later will help physicians to plan strategic treatment and limit secondary injury and devise ways to prevent progression of the injury. In addition, research in the area of stem cell and gene therapies aims to produce therapeutically-induced functional recovery in the animal model, yet the existing methods lack the ability to quantitatively measure, in vivo, the resulting regeneration and neurophysiologic recovery of the spinal cord.

This need motivates us to develop experimental methods and quantitative assessment techniques for event-related neurological monitoring of SCI recovery and rehabilitation. I will present experimental methods to create calibrated SCI in two model systems: Contusion and Experimental Autoimmune Encephalomyelitis (EAE). Next, I will present neuro-electrophysiological function monitoring using Somatosensory Evoked Potentials (SEP). Our group has developed novel signal techniques for acquisition and analysis of these bio-signals. One recent method developed by a BME graduate student is shape analysis technique for SEP signals. The results from SEP signal analysis are compared with the traditional behavioral analysis (BBB open-field test) and histology. In order to obtain structural information on the injured spinal cord, we utilize the method of diffusion tensor MRI.

The second part of our research involves investigating the effects of therapeutic hypothermia and stem cell therapy. I will present preliminary results of the effects of temperature manipulation on the SEP signals and the results of transplanting human embryonic stem cell derived immature oligodendrocytes to aid recovery of spinal cord structure and function. These two research domains form the primary focus of our long term research on developing diagnostic and therapeutic methods for evaluating and treating spinal cord injury. Our hope is that these techniques would not only be applicable in basic (animal) research but also translatable for future clinical studies.

Upcoming seminars:

January 28: Dr. Xiaofeng Jia, Biomedical Engineering, JHU
February 2: Glenn Prestwich, The University of Utah

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