

EMG and Muscle Structure as Predictors of Functional Recovery in SCI

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Project Summary Abstract

Motor and sensory loss in upper and lower limbs due to spinal cord injury (SCI) is devastating, and predicting functional recovery is of utmost importance to veterans with SCI. Even a slight improvement in the American Spinal Injury Association (ASIA) scale can correlate with large functional gains. In current standard practice, functional recovery is predicted solely based on clinical examination. This assessment is somewhat subjective and does not address underlying pathophysiology. Improving our ability to predict functional gains can help us better tailor rehabilitation programs to maximize neurological return.

This pilot project will evaluate the utility of quantitative EMG to predict the extent of functional recovery in the upper limb in SCI. We have developed quantitative EMG decomposition methods for measuring the waveforms and firing patterns of individual motor units to obtain information about denervation and impaired motor control. Quantitative EMG can provide an objective, quantitative assessment of specific spinal segments and peripheral nerve tracts that cannot be revealed by clinical exam alone.

Patients admitted to the SCI Center with acute cervical SCI will receive a physical exam and an EMG exam during their initial stay and at 3 and 12 months post injury. The tests will target two muscles in each of the C4-C8 myotomes. For the physical exam, the extent of muscle involvement will be estimated according to the ASIA scale. For the EMG exam, 10-second-long signals will be recorded during moderately low levels of voluntary contraction at 4 sites in each muscle. The EMG signals will be analyzed off-line using EMG decomposition, and indices of denervation and impaired motor control, including incidence of fibrillation potentials, mean motor-unit-action-potential amplitude, recruitment stability, and firing-rate variability, will be tabulated.

The data will be analyzed with respect to these questions: Q1: Do quantitative EMG parameters correlate with ASIA scores as an objective assessment of the level and extent of cervical spinal cord injury? Q2: Are quantitative EMG parameters in conjunction with ASIA scores measured during the three months after injury predictive of recovery as measured at 12 months after injury?

This study will provide preliminary data for a subsequent investigation of the ability of quantitative EMG to identify patients who will respond favorably to specific rehabilitation modalities, such as electrical stimulation. It will also provide information about motor unit firing patterns and impaired motor control in persons with SCI that is currently lacking from the literature.