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MetroHealth Medical Center

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Abstract Submission Form

Poster Title: **Movement-related cortical stimulation for enhancing corticospinal excitability below the level of incomplete spinal cord injury: A Proof-of-Concept Case Study**

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Location of Laboratory: **Old Brooklyn Campus**

Category: **Physical Medicine and Rehabilitation/Clinical Research**

After sustaining an incomplete spinal cord injury (iSCI), not only is the transmission of signals at the site of the injury affected, there is evidence that higher brain structures are impacted as well. Studies have shown that the excitability of intracortical circuits within the primary motor cortex is decreased and delayed, leading to decreased ability for initiating movement and recruiting residual spinal motor neurons. TMS has been studied as a modality for enhancing corticospinal excitability and facilitating muscle activation below the level of injury in individuals with iSCI. One approach to target intracortical circuits is to pair TMS with motor intention; also known as movement-related cortical stimulation. In able-bodied, movement-related cortical stimulation has been shown to modulate corticospinal excitability (CE) in a spike-time dependent plasticity manner. We hypothesize that delivering TMS during motor intention will enhance corticospinal excitability and thus improve activation of muscles below the level of injury. One person with chronic incomplete tetraplegia participated first in a crossover study, where we investigated the impact of TMS timing on corticospinal excitability when delivered 50 ms prior to or after movement (1-week washout), based on muscle activity of the abductor halluces. In a follow-up experiment, the participant received 5-consecutive treatment days of movement-related cortical stimulation where active TMS was delivered 50 ms prior to movement onset for 15-20 minutes (120 total stimuli per session). Experiment 1: CE was assessed before and immediately following: (a) Sham TMS delivered 50 ms prior to movement onset; b) Active TMS delivered 50 ms prior to movement onset; c) Active TMS delivered 50 ms after movement onset. We found an increase CE when TMS was delivered prior to movement initiation, but not following sham stimulation and when active TMS was delivered after movement onset. Experiment 2: We assessed CE and volitionally controlled motor unit recruitment at baseline, the beginning of each treatment session, post 3-days treatment, and post 7-days treatment. Five consecutive treatment sessions of movement-related cortical stimulation resulted in increased CE as well as improved volitionally controlled motor unit recruitment up to 3-days post treatment, where outcome measures returned to baseline by 7-days post treatment. Future studies will extend these findings to a larger sample population and investigate whether movement-related cortical stimulation can be used to prime the motor circuitry prior to receiving therapy in order to impact motor recovery in the iSCI population.