tDCS and hand function recovery in SCI

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Goal
The purpose of this study is to explore the effects of Non-invasive Brain Stimulation, called Transcranial Direct Current Stimulation (tDCS) on the hand function recovery in subjects with spinal cord injury (SCI). Our hypothesis is that brain stimulation will enhance the motor performance of the hand after only one session, measured by Hand Robot kinematic.

Transcranial direct current stimulation (tDCS)
TDCS is a popular technique used to modulate brain function by inducing prolonged, yet transient, shifts in cortical excitability (Priori et al, 1998; Nitsche, 2008). TDCS works by delivering a weak constant direct current through electrodes placed on the scalp of the brain in the area of interest (Alonz et al, 2012). The current penetrates the cranium and alters the activity of the brain directly beneath the electrodes by decreasing or increasing the neuronal firing rates (Schabrun, 2010). Depending on the type of protocol used, TDCS can either excite or inhibit neuronal activity (Schabrun, 2010). A single session of TDCS has previously been shown to modulate neuronal excitability for up to 90 minutes post-stimulation (Nitsche, 2000 & 2003). Thus, the technique has gained considerable interest as a tool for treating a number of neurological and psychiatric conditions (Alonz et al, 2012).

The Hand Robot
The InMotion HAND™ robot attaches to the InMotion ARM™ robots and provides assist-as-needed™ gross grasp and release motion. It also works together with the InMotion ARM™ robot to provide assist-as-needed™ support for functional reach-grasp-release movement. There are several distinct protocols of assessment for the InMotion HAND™ robot. The Grasp Adaptive has the patient grasp and release provides patient performance metrics over 80 movements. The Reach Adaptive requires the patient to reach, grasp and release with both InMotion ARM™ and InMotion HAND™. In this scenario, the performance metrics are only provided for the “reach” portion of the activity. The Pick Adaptive requires a patient to reach, grasp, hold, and release a target. In sum, the InMotion HAND™ robot will provide us a fine evaluation of kinematic aspects of hand function in a SCI population.
**Study Inclusion/Exclusion Criteria**

**Inclusion criteria:**
- Age: 16 to 65 years
- Time since injury more than 6 months ago (chronic)
- Presence of some motor function in the hand (able to turn on a page or pick up a small object)
- Cervical level of injury. Complete/Incomplete. Traumatic/Non-traumatic
- Medically stable

**Exclusion criteria:**
- History of head trauma and/or cognitive deficit
- History of stroke, seizures or other intracranial disease
- Medically unstable
- Pre-existing medical conditions interfering with unrestricted movements of the hand/arm (e.g. osteoarthritis, injury to the joints)
- Inability to provide informed consent
- **Contraindications for non-invasive brain stimulation (NIBS) techniques (TMS & tDCS):**
  a. Implanted metal devices in the head (as an intra-cerebral vascular clip or any other electrically sensitive support system)
  b. Presence of cardiac pacemaker or implanted medication pump
  c. Past Medical history of seizures or unexplained spells of loss of consciousness
  d. History of medication-resistant epilepsy in the family members
  e. Significant medical or psychiatric illness
  f. No skin conditions

**Study Protocol**

tDCS protocol includes 3 independent sessions lasting approximately 2 hours separated by 7 days. Participants will be assessed on Clinical evaluation (motor power), Functional tests (Box and Block), and Hand Robot evaluation.

**Duration:** ~120 min (2 hours)

**Location:** **Burke House,** Billings Building (Building #4), Robotic Clinic (ground floor)

**Session:**
- Consent form and clinical questionnaires (only for the first session).
- Evaluation pre-intervention (~40 min): Clinical scales, functional test, and robotic evaluation.
- Intervention (~20 min): tDCS
- Evaluation post-evaluation (~40 min): Clinical scales, functional test, and robotic evaluation.

If you are interested please contact **SCI Robotic Research** for more information:
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