current density and $B_z$ distributions under the same conditions. Results showed good agreement between experimental and simulated $B_z$ and PCD distributions for both electrode configurations. These results suggest MREIT techniques would be a valuable tool in experiments designed to further understanding of TACS mechanisms, validate TACS and TACS computational models and potentially improve TACS therapy.

Abstract #37
DIFFERENTIAL COUPLING OF THE DORSOLATERAL PREFRONTAL CORTEX WITH DEFAULT NETWORK AND VISUAL CORTEX IN PATIENTS RECOVERED FROM DEPRESSION AFTER CONVULSIVE THERAPY

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Abstract
For individuals with treatment resistant depression (TRD), convulsive therapies are the present gold-standard treatments. Mechanism of action of these treatments, however, are presently unknown. The present study evaluates resting state functional connectivity (rsfMRI) prior to and following convulsive treatment in order to both analyze brain mechanisms underlying TRD, as well as brain mechanisms associated with effective treatment response. rsfMRI analyses focus primarily on subgenual cingulate, a region that has been associated with TRD based upon anatomical, metabolic and connectivity approaches, and interactions of subgenual cingulate with dorsolateral prefrontal cortex (DLPFC). This network has been extensively implicated in the pathophysiology of depression, but optimal approaches to manipulation remain unknown. Our rsfMRI data from patients with TRD reveals that the left dorsolateral prefrontal cortical area, which is more anticorrelated with the subgenual cingulate in healthy subjects, is functionally connected to the visual cortex while simultaneously de-coupled from the default network after treatment. This indicates that suppression of default network activity is intimately coupled with top-down modulatory influences on sensory cortical activity. In summary, our study detected a previously unknown role for the DLPFC as an important hub in the interplay with large-scale networks. Such network dynamics between visual cortices and default network has not previously been reported as a measure of efficacy of convulsive treatments.

Abstract #38
CHANGES IN HAND FUNCTION AND MOTOR CORTEX EXCITABILITY IN CHILDREN FOLLOWING tDCS AND CIMT THERAPY IN CHILDREN WITH UNILATERAL CEREBRAL PALSY WITH DIFFERENT PATTERNS OF CORTICOSPINAL ORGANIZATION

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Abstract
Neuromodulatory interventions such as transcranial direct current stimulation (tDCS) have the potential to improve motor function in children with unilateral cerebral palsy (UCP). However, the neural mechanisms underlying behavioral changes following tDCS are less clear. To investigate this, we compared hand motor function and cortical excitability in children receiving active or sham tDCS paired with constraint-induced movement therapy (CIMT). In addition, we compared outcomes based upon corticospinal circuitry pattern, a potentially important predictor of response to behavioral and neuromodulatory therapies.

Children with UCP were randomized to an intervention of tDCS (0.7 mA contralesional cathodal M1–SO montage applied for 20 min) within a 2-hour CIMT session (n = 10) or sham tDCS and CIMT (n = 10) as a control (clinicaltrials.gov NCT02250982). Hand function (Assisting Hand Assessment-AHA) was assessed before and after the intervention. Cortical excitability assessment included resting motor threshold (RMT) and motor evoked potential (MEP).

In the contralesional hemisphere of the intervention group, the MEP amplitude increased (active = 2.6±3.5%; sham = -0.17±1.6%) and RMT increased (active = -320±311 μV; sham = 697±693 μV), yet no differences were noted between children with contralateral or ipsilateral organization. Improvements in hand function were significantly greater in children with contralateral compared to those with ipsilateral organization (F(1,1) = 7.79, p = 0.01). No significant differences in hand function were observed between intervention and control groups (F(1,1) = 1.83, p = 0.20). These data suggest that corticospinal tract organization and tDCS dosing should be explored in future tDCS studies with focus on individualized treatment.

Abstract #39
BEYOND HOME USE MEDICAL DEVICE: TRANSCRANIAL DIRECT CURRENT STIMULATION COMBINED WITH DIGITAL HEALTHCARE

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Abstract
In recent years, non-invasive neuromodulation techniques have gained increasing attention not only from research communities, but also from medical and healthcare industries. As an alternative to conventional medicine, transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) have shown its unique advantages, such as no systemic side-effects and fast onset of efficacy. However, in spite of the advantages, these techniques have been discouraged for use at real clinical settings due to some limitations, including high cost and poor usability in comparison to conventional medicine.

In order to overcome such limitations, we have developed a novel neuromodulation healthcare system consisting of two components: 1) a medical device with improved usability and reduced production cost, and 2) software-based healthcare services with enhanced patient compliance and increased quality-of-care. A multi-center, double-blind, randomized, controlled clinical trial is being conducted for the treatment of major depressive disorder at the time of abstract submission and is expected to be finished in November 2016.

Abstract #40
TOLERABILITY OF UP TO 4 MA tDCS USING ADAPTIVE STIMULATION

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Abstract
We develop and validate an adaptive controller to maximize tDCS intensity up to 4 mA, while regulating tolerability. The controller increases stimulation intensity incrementally up to 4 mA while querying subject discomfort. The intelligent controller can learn from historical sessions across a population and within each session in order to adjust applied current up to a tolerated level. In a single-blind design with healthy subjects, we compared: 1) sham stimulation; 2) convention fixed 2 mA; 3) adaptive stimulation up to 4 mA based only on within session history;
Abstract

Neurofeedback requires successful detection of non-stationary events in EEG, such as alpha spindles, which are 0.5 - 2 s bursts in the 8-12 Hz range in EEG. Alpha spindles in the parietal/occipital brain regions are correlated with fatigue, drowsiness, and reduced driving performance in experiments of prolonged driving [1]. Alpha spindles occur during periods of drowsiness and accurate detection could help prevent accidents in many industrial and military sectors. EEG-based detection methods are non-invasive and can be directly related to other brain biomarkers. We compare SDAR (Sequential Discounted AutoRegression), a dynamic, statistically based algorithm based on MP (Matching Pursuit) with Gabor atoms that we are developing. The factors influencing the sensitivity of cortical neurons to artificial stimulation are still not fully understood. While advances in computational modeling software improve the ability to estimate the fields arising from a given set of stimulating conditions, the factors governing the sensitivity of individual neurons to such fields have not been completely elucidated. Here, we used mouse brain slices to study the sensitivity of individual cortical neurons to different forms of stimulation. Small electrodes or micro-coils allowed stimulation to be confined to a narrow region within targeted cells and enabled the sensitivity of individual regions to be compared. In naïve (previously unstimulated) L5 pyramidal neurons (PNs), the proximal axon had the highest sensitivity to stimulation. Interestingly however, repetitive stimulation caused the sensitivity of the apical dendrite to increase beyond that of the axon; the number of stimuli required to induce the switch was comparable to the number delivered during common rTMS paradigms. Once the change in sensitivity occurred, it persisted for the duration of our experiments (up to ~1 hour). Consistent repetitive stimulation induced the change with fewer pulses than trains in which stimulation was intermittent. Many aspects of the response (peak firing rate, duration, etc.) were different for different types of PNs. Rotation of the micro-coil allowed the sensitivity to field orientation to be tested and revealed that fields oriented along the long axis of PNs were highly effective but those oriented orthogonally did not induce spiking, even for delivery of several thousand stimuli.

Abstract

A major contributor to the adoption of transcranial Direct Current Stimulation (tDCS) is the portability and ease-of-use. The preparation of tDCS electrodes remains the most cumbersome and prone-to-error step. Here, we validate the performance of the first “dry” electrodes for tDCS. Dry electrodes are defined as electrodes that exclude: 1) any saline or other electrolytes, that is prone to leaking; 2) an adhesive at the electrode–skin interface or 3) any electrode preparation steps. The Multilayer Hydrogel Composite (MHC) electrode design fulfill these criteria. The MHC electrode performance is verified using a skin-phantom, including measurement of current distribution characteristics at the phantom surface and inside the electrode using a novel sensor array. Experimental data were compared against the finite element method (FEM) model of MHC performance. Further validation of the MHC electrode performance was conducted in in human trial including tolerability. Under the conditions tested (2 mA and 20 minute), the MHC electrode performance was comparative with the state-of-the-art sponge electrodes (Pre-Saturated Snap EasyPad).