

**Reference:**

Chen, L. Leon, et al. "Real-time brain oscillation detection and phase-locked stimulation using autoregressive spectral estimation and time-series forward prediction." *IEEE Transactions on Biomedical Engineering* 60.3 (2013): 753-762.

**[0446]****DEEP TMS AUGMENTATION TREATMENT FOR FIBROMYALGIA: A SAFETY AND FEASIBILITY STUDY**

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**Introduction:** Fibromyalgia (FM) is a prevalent chronic pain syndrome, with limited therapeutic options. Repetitive Transcranial Magnetic Stimulation (rTMS) is emerging as a potential new treatment modality for FM. Deep TMS (dTMS) is a novel modification of standard rTMS, capable of delivering stimulation to a greater depth. This preliminary study is the first to explore the efficacy of dTMS as an augmentation treatment in FM.

**Method:** Eleven FM patients completed a 20-day treatment protocol, in order to examine left dorsal-lateral prefrontal cortex (DLPFC) excitation via dTMS using the h-coil. Clinical and psychophysical measurements of pain were evaluated each week, and 2 weeks after study completion. The primary outcome measures were the changes in pain measures from baseline to visit 20: Short Form- McGill Pain Questionnaire (SF-McGill) and Brief Pain Inventory (BPI). Secondary outcomes were FM clinical measures such as the Fibromyalgia Pain Questionnaire (FIQ). Demographic and clinical measures are summarized in Table 1.

**Results:** Patients demonstrated a significant reduction in pain symptoms ( $p=.024$ ) and improved functioning ( $p=.022$ ) at visit 20 (figure 1) Demographic and clinical measures are summarized in Table 1. A significant decrease in FM symptoms that are not directly linked to pain (sleep disturbances, cognitive impairments and tiredness) was found only at follow-up ( $p=.044$ ). Depressive symptoms were not reduced, indicating that pain reduction among our subjects could not be attributed to the antidepressant effect of dTMS. Treatment was well tolerated and no significant side effects were reported.

**Discussion:** dTMS was safe and tolerable as augmentation treatment for FM patients. It reduced pain intensity in FM, improved function, and may have induced changes in neuroplasticity. Further double-blinded controlled studies, with a larger sample, are required to confirm and more accurately assess the therapeutic utility of dTMS in FM.

Keywords: Fibromyalgia (FM), pain, deep transcranial magnetic stimulation (dTMS), dorsal lateral pre-frontal cortex (DLPFC)

**[0448]****EFFECTS OF TDCS OVER BROCA'S AREA COUPLED WITH LINGUISTIC TRAINING ARE NOT SPECIFIC TO LANGUAGE.**

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Previous studies have shown beneficial effects of tDCS on linguistic processing, suggesting a high therapeutic potential in neurogenic language disorders. However, it is largely unknown whether these effects are specific to linguistic processing: i.e., whether enhanced linguistic performance is caused by enhancement of linguistic ability per se or by a general increase in attention, cognitive speed, etc. Our study aims to address this issue and provide a better understanding of the nature of tDCS effects.

24 healthy young participants received tDCS with parameters common in previous applications of tDCS to language processing: 20 minutes of anodal stimulation targeting Broca's area (anode placed at F7, reference placed at

Oz) at 1.5 mA, compared to sham stimulation on a separate day. During stimulation, participants practiced two linguistic tasks: naming and lexical decision (word/non-word decision). After stimulation, participants performed these two tasks but also an untrained non-linguistic task (Eriksen Flanker task) that aimed to measure general executive control. Anodal tDCS resulted in a non-significant speed increase in lexical decision ( $t(23)=1.48$ ,  $p=0.15$ ) and a trend for speed increase in the Flanker test ( $t(23)=1.79$ ,  $p=.09$ ). More importantly, individual response to tDCS (measured as the difference between a participant's mean reaction time in anodal and sham condition) was significantly correlated between each linguistic task and the non-linguistic Flanker task (naming and Flanker:  $r=.58$ ,  $p=.003$ ; lexical decision and Flanker:  $r=.45$ ,  $p=0.03$ ).

The results suggest that any effects of tDCS applied to a "speech area" and coupled with online linguistic practice may be non-specific to language processing. Instead, they may be mediated by a general enhancement of executive processing. This finding is relevant for planning therapeutic use of tDCS in neurogenic language disorders (e.g., selecting patient profiles likely to benefit from treatment, selecting concurrent behavioral therapy, etc.).

Keywords: tDCS, Broca's area, language, executive processing

**[0449]****EFFECTS OF ON AND OFF SUBTHALAMIC NUCLEUS-DBS ON PREFRONTAL CORTEX ACTIVATION DURING A COGNITIVE TASK: AN fNIRS STUDY**

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Subthalamic nucleus (STN) deep brain stimulation (DBS) therapy is an effective treatment for the appendicular motor symptoms of Parkinson's disease (PD). The STN contains multiple segregated circuits subserving motor, cognitive and mood functions through distinct connectivity to cortical regions. Therefore, we examined prefrontal cortical (PFC) effects of "ON" and "OFF" STN-DBS on executive function (Go/NoGo) using functional near-infrared spectroscopy (fNIRS).

**Methods:** Out of 8 PD STN-DBS patients, we present here preliminary analysis of a male (62y) PD patient with bilateral STN-DBS (unipolar, 180Hz, 3.5V). The patient was tested after 12h withdrawal of dopamine medications in both an "OFF" and "ON" DBS session separated by 30min. The subject performed a computerised Go/NoGo task with 3 alternating Go/NoGo blocks of 30s duration (20 trials/block) interspersed with 30s rest. Reaction time (RT) and accuracy (omission-Om and commission-Cm errors) results were the average of the 3 Go/NoGo blocks. During performance of the Go/NoGo blocks, changes in oxygenated (O<sub>2</sub>Hb) and deoxygenated (HHb) haemoglobin concentrations were measured by a fNIRS system (Oxymon MklIII, Artinis Medical Systems) covering the bilateral PFC regions.

**Results/Discussion:** Clinical motor performance (UPDRSIII) improved from OFF (31) to ON (20). RT during Go and NoGo was ~40ms faster in OFF (460 and 364ms) than ON (516 and 407ms). Furthermore, the NoGo condition increased misses (Om) in ON (7%) than OFF (0%); while false alarms (Cm) were similarly increased in ON (27%) and OFF (30%). The Go and NoGo conditions increased bilateral PFC activation (i.e., increase in O<sub>2</sub>Hb and decrease in HHb). However, there was a general decrease in PFC activation in OFF relative to ON, and this was more obvious in Go than NoGo (see Fig. 1)

**Conclusion:** These preliminary results indicate that STN-DBS modulates neurovascular responses in the bilateral PFC that are associated with response inhibition.

Keywords: Executive function, Prefrontal cortex, Functional near-infrared spectroscopy, Go/NoGo