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Pain relief by deep repetitive transcranial magnetic stimulation applied with the H-coil

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Introduction: The aim of the present project is to apply repetitive transcranial magnetic stimulation (rTMS) over the leg motor area by using a H-coil in order to obtain pain relief. The H-coil is an improved coil which may easily target the leg motor area with intensities lower than the commonly used circular on figure-of-eight coils.
Objectives: 20 patients (12 men, mean age 70.1±7.0 years) with diabetic chronic neuropathic pain are be enrolled in a double-blind placebo-controlled cross-over study protocol.
Methods: Subjects are be randomly assigned to start the study with the sham or real stimulation. In each subject sham and real stimulation will be applied with a time interval of 1 month. Real stimulation will be applied over the leg primary motor area in 30 consecutive trains of 50 stimuli delivered at 20 Hz, at 100% of motor threshold, separated by intertrain intervals of 30 seconds. Sham stimulation is performed with a sham coil.
Results: The effects of rTMS (real vs sham) on pain relief are be evaluated through subjective reports by using the VAS, DN IV, NPSI, MMPI, McGill Pain Questionnaire, Beck Depression Inventory and objective assessment by using the LEP and the RIII reflex. At baseline patients referred a similar subjective pain sensation in both real and sham sessions (VAS range pre real 3–8.5, pre sham 3–9.5; mean±SD pre real 5.3±2.0, pre sham 5.6±2.5). One way ANOVA analysis on the VAS values showed a significant decrease of pain sensation after real stimulation ($F(2.16) = 4.04$; $p < 0.03$), bur not after sham stimulation ($F(2.16) = 0.36$; $p = 0.7$).
Conclusions: Based on this observation, the deep brain stimulation, epidural and transcranial motor cortex stimulation modulating pain perception through indirect neural networks, have been applied for treatment of drug-resistant neuropathic pain in humans.

P19.13
Pain reduction in a CRPS patient due to tDCS and sensorimotor training. A single case study

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Introduction: Patients suffering from Complex Regional Pain Syndrome (CRPS) show cortical reorganization in the primary somatosensory (S1) and motor (M1) cortex with shrinking of the hand representation. There is a correlation between the amount of perceived chronic pain and the magnitude of cortical reorganization. Restoring the original representation of the hand has been shown to be associated with the relief of pain. As is known from learning paradigms (e.g. learning Braille), training can enlarge cortical representation. Thus, it is conceivable that sensorimotor hand training (ST) for patients suffering from CRPS might lead to a restoration of their original organization of S1 and M1, resulting in a reduction of CPRS symptoms. Furthermore it is known that motor learning can be enhanced by anodal Transcranial Direct Current Stimulation (tDCS).
Objectives: Does anodal tDCS enhance the effect of a specific sensory training with consecutive reduction of pain?
Methods: One patient (female, 43) suffering from CRPS for 17 months participated in the protocol. A double-blind crossover design (2 weeks washout) was used with anodal or sham tDCS applied for 20 min. to M1 while the patient was performing the ST. Pain was evaluated on a visual analogue scale (VAS).
Results: With sham tDCS 41 patterns were correctly identified during ST by the patient. With application of anodal tDCS 88 correct patterns were identified. Pain ratings before treatment were 7.87, dropping to 0.45 after anodal tDCS, which was not the case after sham tDCS (6.91).
Conclusions: This single case study showed an enhanced effect of training when anodal tDCS was applied concurrently with ST. This approach led to a promising reduction in pain in this 43 year old patient suffering from CRPS. Thus, these data support the evaluation of this innovative therapeutic strategy in a larger group of CRPS patients.

P19.14
Rhythmic transcranial magnetic stimulation locally entrains natural brain oscillations

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Introduction: The generation of brain rhythms by transcranial brain stimulation and exploring the behavioural consequences thereof ("entrain and measure approach") would allow to test for a causal role of oscillations in shaping behaviour.
Objectives: To test whether brain oscillations can be entrained by Transcranial Magnetic Stimulation (TMS) when delivered at the natural frequency of a brain area. Specifically, we examined the possibility of entraining a right parietal α-generator by TMS at individual α-frequency.
Methods: TMS-site was first individually identified using a parietal α-localizer task (attention orienting), MEG and source localization in MRI. Ten subjects then underwent 62-channel EEG under neuro-navigated TMS in 4 conditions: 5-pulse TMS trains delivered (1) at individual α-frequency (α-TMS) and three control conditions, consisting of (2) arrhythmic 5-pulse TMS, (3) α-TMS at an active but suboptimal coil orientation, and (4) α-TMS at an inactive (sham) orientation. Evoked oscillations were examined using wavelet analysis over the train, detailed waveform analysis per each of the five pulses, and computation of phase locking values (PLV) across trials.
Results: Parietal α-TMS triggered a parietal α-power increase. The α-response at the target site showed a progressive enhancement with a maximum towards the end of the train. This was due to significant phase locking of α-activity to the TMS pulses (PLV), which depended on pre-TMS α-phase, i.e., the on-going α-oscillation. None of these effects were observed in the control conditions.
Discussion: Our results demonstrate that frequency-tuned TMS can drive brain oscillations through a progressive synchronization of the underlying generator. The dependence on pre-TMS phase suggests the entrainment of natural oscillations instead of the imposition of an artificial rhythm. This shows that TMS can generate functionally relevant brain oscillations, and by extension that entrainment is one mechanism of TMS-action.

P19.15
One left-sided dorsolateral prefrontal cortical HF-rTMS session affects emotional neuronal processing in healthy women

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Introduction: Although repetitive Transcranial Magnetic Stimulation (rTMS) is currently used to investigate neural connections in the living human brain, it remains largely unclear as to how rTMS can alter emotional processing in non-psychiatric samples.
Objectives: We examined in 'uniform' samples of healthy female volunteers whether a single high frequency (HF)-rTMS session applied to the DLPFC could influence the processing of positively and negatively valenced emotional stimuli.
Methods: In our earlier research, we developed a specially adapted fMRI paradigm with only baby faces as 'emotional' visual stimuli. We especially focused on lateralized anterior hemispheric functioning while these salient emotional visual stimuli were being processed.
Results: In essence, one active high frequency session (left or right) attenuates stress-related responses in the cortico-subcortical regions of the right anterior hemisphere, such as the insula and the amygdala. Furthermore, active left-sided HF-rTMS results in enhanced task-related processing caused by the neuronal activation of the left DLPFC, which could indicate that females are more able to empathize with the depicted happy baby faces, possibly by the integration of different high-order cognitive processes.