Toward Standardized rTMS Algorithms for Pain Relief

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Background: Despite its effectiveness, rTMS use in chronic pain lacks standardized therapeutic protocols. We aimed to develop a reproducible algorithm using evidence-based parameters, particularly drawing from the methodologies and findings presented by Jean-Pascal Lefaucheur and Nadine Attal

Methods: A comprehensive literature review of existing rTMS protocols for chronic pain treatment was conducted, focusing on the relationship between stimulation parameters and clinical outcomes. Data were systematically categorized to identify common patterns and key predictors of treatment response, leading to a phased algorithm design.

Results: The proposed algorithm (with flowchart) includes:

•Phase 1 (Assessment): Evaluation of parameters such as pain intensity, psychological factors (HADS, PCS), pain localization, pain duration, and previous treatment history, with special emphasis on prior neuromodulation treatments.

•Phase 2 (Induction Protocol): M1 High-frequency rTMS at 10 Hz, 100% of resting motor threshold, 3000 pulses/session, 5 consecutive daily sessions for two weeks.

•Phase 3 (Response Evaluation): Assess pain reduction ≥30% is considered improvement. Non-responders undergo target adjustment to DLPFC or alternate M1 regions.

•Phase 4 (Maintenance): Progressive reduction in session frequency for sustained pain relief.

Discussion: We have already implemented this standardized rTMS algorithm at Fundación CENIT, achieving positive clinical outcomes in chronic pain, emphasizing phased induction, personalized adjustments, and long-term maintenance strategies. Validation in large-scale trials is recommended to confirm its clinical utility.

rTMS Paired With Augmented Reality Training to Treat Chronic Neck Pain

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Background: Chronic neck pain (CNP) is a debilitating condition that reduces quality of life and is one of the leading causes of disability globally. We have developed a novel augmented reality sensorimotor training (ARST) task that promotes targeted goal-directed cervical movements. Repetitive transcranial magnetic stimulation (rTMS) has the potential to enhance the beneficial effects of ARST. The objective of this study is to investigate effectiveness of rTMS paired with ARST to reduce pain and improve function.
Methods: Ten participants with CNP took part in either REAL rTMS plus ARST or SHAM rTMS plus ARST for four weeks (3-5 sessions per week). Both groups received the same ARST training which required participants to make goal-directed cervical movements to track moving targets presented virtually. Clinical outcomes included pain intensity, tampa scale of kinesiophobia (TSK), neck disability index (NDI), range of motion (ROM), PROMIS-29 V2.0, and patient perceived global index of change (PGIC).
Results: There was a similar reduction in pain intensity in the REAL (21%) and SHAM (28%) groups immediately following the intervention with greater improvement seen at two-weeks post-intervention in REAL (37%) and not SHAM (24%). There was a clinically meaningful improvement in NDI in both groups at all time points and increases in ROM in all four directions.
Discussion: This is the first study to combine rTMS with augmented reality to treat patients with CNP. The results from this study suggest that rTMS promotes longer-term retention of the gains that are achieved via sensorimotor training.

Use of Repetitive Transcranial Magnetic Stimulation Within a Multimodal Approach to Treat Comorbid Depression and Chronic Back Pain

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Background: A handful of randomized controlled trials have shown that repetitive transcranial magnetic stimulation (rTMS) at the primary motor cortex (M1) can significantly reduce central and peripheral neuropathic pain. However, use of rTMS for pain lacks FDA approval. We describe use of rTMS for back pain.
Methods: A 68-year-old male with treatment resistant depression in the context of chronic lower back pain presented for evaluation. History of six surgeries included nerve ablation and spinal cord stimulator placement without improvement. At initial visit, PHQ9 was 24 and pain was 8/10. We initiated intermittent theta burst (iTBS) TMS and concurrent medication management and psychotherapy. Given lack of improvement in depression and pain after 2 weeks of daily sessions, we initiated a M1 rTMS chronic low back pain protocol (Ambriz-Tututi, 2016).
Results: A Magstim Rapid Stimulator was used to stimulate the left M1 motor cortex, motor

threshold was determined, and stimuli were delivered daily for 20 sessions at the following settings: 20Hz, 76% of the resting motor threshold, 10 biphasic pulse trains during 10 seconds, intertrain interval of 28 seconds, for a total of 2000 pulses. He continued to attend monthly medication management and weekly psychotherapy sessions. By session #30, the patient felt great improvement in pain (4/10) and depressive symptoms (PHQ9 < 12). rTMS sessions were discontinued.
Discussion: There are only a handful of studies assessing rTMS treatment of neuropathic pain with varying outcomes. Randomized control trials are necessary to evaluate efficacy of current rTMS treatment protocols, especially in the context of concurrent psychotherapy and psychopharmacology.

Age is Just a Number: Real-World Effectiveness of TMS for Late-Life MDD

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Background: Depression treatment in the elderly is associated with a range of challenges including lower response rates to antidepressants, increased risk of adverse effects, the presence
of multiple concomitant medications and multiple comorbidities. The analysis presented here highlights the real-world effectiveness of TMS for MDD in the largest cohort of elderly patients analyzed to date.

Methods: Data from the NeuroStar TrakStar Database were analyzed for 7,874 individuals, aged
70 and above, who were diagnosed with MDD. Antidepressant response was assessed by response and remission rates for the PHQ-9 and CGI-S before and after treatment. Analyses were
conducted in ITT, completer (> 20 sessions), and full treatment (> 36 sessions) samples. Pearson correlation coefficient was used to analyze the correlation between patient age and the percent change in PHQ-9 or CGI-S.
Results: In the full treatment sample (36 sessions), 64.87% of patients met response and 39% met remission criteria with the PHQ-9, while 75% met response and 56.35% met remission with the CGI-S. Results were largely similar in the ITT and completer groups. Antidepressant effectiveness was a function of number of TMS sessions, with effectiveness improving with longer courses. Correlations between age and PHQ-9 and CGI-S scores were (0.052) and (0.17)
respectively.
Discussion: This is the largest analysis of elderly adults treated with TMS to date. TMS resulted in marked improvement in depressive symptoms. The magnitude of benefit and dependency on

number of treatment sessions suggests similar effectiveness to that found in adolescent, young-adults and adult samples. There was no correlation between age and treatment effectiveness.

Accelerated rTMS on a Special Operations Active Duty Military Male With a History of Posttraumatic Stress Disorder and Traumatic Brain injury: A Case Study
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Background: A 43-year old United States Army Special Operations male with 20 deployments over 23 years of service presented with a history of posttraumatic stress disorder (PTSD), nightmares, depression, anxiety, and traumatic brain injury (TBI).
Methods: The patient was not currently taking any psychotropic medications. He underwent 27 sessions of accelerated rTMS (aTMS) over five consecutive days. The patient received a sequential bilateral protocol consisting of 10Hz to the left dorsolateral prefrontal cortex (DLPFC) followed by intermittent theta-burst to the right DLPFC and Fz location. Standardized clinical scales were administered at baseline and several posttreatment time points.
Results: The PCL-5 decreased from 42 at baseline to 27 at 2 months posttreatment. The PHQ-9 was 11 at baseline, 5 at 2 weeks posttreatment, and 7 at 2 months posttreatment. The QIDS was
11 at baseline, 2 immediately after treatment, and 8 at 2 months posttreatment. The GAD-7 was 12 at baseline, 3 at 2 weeks posttreatment, and 6 at 2 months posttreatment. The Disturbing Dreams and Nightmares Severity Index indicated a nightmare disorder with a baseline score of

13 that decreased to a subclinical score of 9 at 2 months posttreatment. The Post-Concussion Symptom Scale (PCSS) was 62 at baseline, 14 immediately after treatment and 51 at 2 months posttreatment, with only 1 category 6 selection compared to 4 category 6 selections at baseline. Discussion: Significant symptom reduction across varying clinical scales was observed. This case study suggests that aTMS may treat mental

Psychotropics and Sex Drive: Can rTMS Bridge the Gap Between Remission and Libido?

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Background: Loss of sexual desire in patients with MDD and/or GAD is considered a common adverse drug reaction to libido-altering psychotropic medications, including SSRIs, SNRIs, prolactin-elevating antipsychotics, and benzodiazepines. Low libido is a significant issue for patients that can cause frustration and decreased quality of life. Prior research has shown that excitatory rTMS may ameliorate low libido and inhibitory rTMS may treat hypersexual disorders, but research on a psychotropic-rTMS combined clinical treatment effect on libido is lacking. The current study investigates the impact of rTMS on low libido in patients who are taking psychotropics.
Methods: Patients taking libido-altering psychotropic medications were selected (N = 33), and were grouped based on protocol: left DLPFC (n = 21), right DLPFC (n = 4), or Bilateral (n = 8) rTMS. Treatment followed standard rTMS protocols for each patient. Patients were rated using the BDI-II and the GAD-7. No human subjects committee approval was necessary as data came from routine clinical practice.
Results: 75.8% of patients (n = 25) showed significant improvement in low libido symptoms ($\bar{x}$ = 83.99%), despite continuing psychotropic treatment. Improvements were seen within each individual protocol group; left DLPFC (n = 17, $\bar{x}$= 87.25%), right DLPFC (n = 2, $\bar{x}$= 75%) and bilateral (n = 6, $\bar{x}$= 77.78%).
Discussion: This study is the first to find a significant positive effect of rTMS on low libido in MDD and GAD patients taking psychotropics. Further research on the management of low libido through non-pharmacological methods such as rTMS is needed.

Preliminary Observations of Personalized Repetitive Transcranial Magnetic Stimulation (PrTMS ®) for mTBI/Concussion

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Background: There are no FDA-approved treatments for the chronic sequelae of concussion. Repetitive transcranial magnetic stimulation (rTMS) has been explored as a therapy, but outcomes have been inconsistent. To address this, we developed a personalized rTMS (PrTMS®)
protocol involving continual rTMS stimulus frequency adjustment and progressive activation of multiple cortical sites, guided by spectral electroencephalogram (EEG)-based analyses and psychological questionnaires.
Methods: We acquired pilot clinical data for 185 symptomatic brain concussion patients who underwent the PrTMS® protocol over an approximate 6-week period of daily, 5x per week treatment sessions. The PrTMS® protocol used a proprietary EEG spectral frequency algorithm to define an initial stimulation frequency based on an anteriorly graded projection of the measured occipital alpha center peak, which was then used to interpolate and adjust regional stimulation frequency according to weekly EEG spectral acquisitions.
Results: The Concussion Symptom Inventory (CSI) in 56 patients of all ages detected a significant decline in concussion symptoms after PrTMS® was initiated with mean symptoms scores dropping by almost 70% from 33.5 to 10.5. The mean number of treatment days in this group suggested that patients responded rapidly. Only 2 of 56 patients failed to respond. PrTMS® improved concussion indices and normalized the cortical alpha band center frequency and peak EEG amplitude.
Discussion: This potentially reflected changed neurotransmitter, cognitive, and perceptual status.
These observations may suggest further prospective research on PrTMS® as a promising treatment choice for patients with persistent concussion symptoms and exploration of the spectral
EEG as a concussion biomarker.

The Use of Transcranial Magnetic Stimulation (TMS) in a 44-Year-Old Woman with Tinnitus

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Background: This case report discusses the application of Transcranial Magnetic Stimulation in tinnitus. Tinnitus is a prevalent auditory disorder characterized by the perception of sound without an external source. Traditional treatment options are limited and often focus on managing symptoms rather than addressing underlying mechanisms. TMS has emerged as a potential therapeutic option for tinnitus.
Methods: A 44-year-old woman presented with a 3-year history of persistent bilateral tinnitus, described as a high-pitched ringing sound. After a comprehensive evaluation, the patient was enrolled in a TMS treatment program. The following protocol was employed: Five sessions per week for four weeks. The left temporoparietal junction (TPJ) was identified as the target site due to its role in auditory processing. The TMS device used was a figure-eight coil, delivering 1 Hz

rTMS (repetitive TMS) with 1,200 pulses per session.
Results: The visual analogue scale reduced from 8/10 to 4/10. The patient reported enhanced

quality of life, with improved concentration and sleep quality. Follow-up at three months post-treatment indicated sustained improvements in tinnitus perception.

Discussion: This case illustrates the potential efficacy of TMS as a treatment for tinnitus. TMS can modulate the neural circuits involved in tinnitus perception. Further research, including larger controlled studies, is needed to confirm these findings and establish standardized treatment
protocols. This case highlights the importance of exploring innovative therapies for tinnitus, particularly for patients who have not responded to conventional treatments.
62. Using TMS to Map Language Hemispheric Dominance: A Case Report

Long-Term Efficacy of rTMS at Motor Cortex for Mild TBI Related Headaches
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Background: Persistent headaches with frequent debilitating headache exacerbation is one of the most common debilitating chronic pain conditions in either military or civilian population

with MTBI. This high prevalence of MTBI related headaches (MTBI-HA), also known as post-concussive headache is often associated with neuropsychological dysfunctions. This double-blinded randomized controlled trial aimed to assess the effect of repetitive transcranial magnetic

stimulation(rTMS) in reducing both persistent and debilitating headache symptoms and co-morbid neuropsychological impairments.

Methods: 10 sessions of MRI-based neuronavigation guided (NNG) active (10hz, 2000 pulses) and sham rTMS were delivered to the left motor cortex via a double-blinded A/P coil (MagVenture) with pre-, post-one week, one-month, two-month and three-month headache and neuropsychological assessments
Results: Overall mixed model repeat measure and pair-wise ANOVA indicate active(N=31) rTMS can significantly reduce the frequency of persistent headache and the duration of debilitating headache respectively at two and three post-treatment visits with associated improvement in daily activity and concentration interference, attention and word processing speed, and retention and recall accuracy in comparison to sham(N=38) rTMS.
Discussion: In short, 10 sessions of NNG rTMS at the left MC can significantly reduce headache symptoms and interferences of concentration and daily activities associated with MTBI-HA and

improve concentration and some aspects of cognitive impairment associated with MTBI-HA although the treatment may result in a mild degree of transient short-term persistent headache exacerbation without ongoing maintenance intervention. Future studies should focus on the utilization of maintenance rTMS after the 10-session induction treatment phase in sustaining the benefits of the intervention.