

Personalized Repetitive Transcranial Magnetic Stimulation (PrTMS®) Reduces Major Depressive Disorder (MDD) Symptom Severity

Jacob J. Shawwa¹, Eugenio E. Reina¹, Alan Ho¹, Caleigh S. Roach¹, Matthew Kis¹, Philip D. Harvey PhD^{1,2}, Carl I. Schulman MD, PhD^{1,3}

¹ University of Miami Miller School of Medicine

² Department of Psychiatry & Behavioral Sciences, University of Miami Miller School of Medicine

³ DeWitt Daughtry Family Department of Surgery, University of Miami Miller School of Medicine

Objective: Evaluate the efficacy of PrTMS as an effective adjunctive treatment for MDD. We hypothesize that PrTMS will significantly reduce MDD symptom severity.

Background: Altered activity in the brain's default mode network (DMN), reflected in dysregulated alpha oscillations observed in EEG, is one hypothesis for the cause of some MDD subtypes. PrTMS utilizes spectral EEG guidance to iteratively optimize MDD symptom relief through low-power stimulation of multiple cortical areas. Adjustments of cortical treatment sites and stimulus frequency are guided by an algorithm identifying stimulation frequencies within the DMN alpha oscillatory band, targeting functional abnormalities.

Design/Methods: A retrospective analysis was performed of data collected during PrTMS treatment for MDD. Patients received 20 PrTMS treatments and were categorized based on initial PHQ-9 scores (moderate 10-15; moderately severe 15-19; severe 20-27). Paired t-tests were utilized to determine whether there was statistically significant change from baseline. Demographic variables were assessed for differences using linear regression.

Results: Mean age was 42±16 years (range: 18-101). Average treatment completion time was 77±57.7 days. 1673 patients (56.9% female; 43.1% male) completed 8365 PHQ-9 questionnaires. Of 713 with severe MDD, a significant decrease in score was observed from 23.9±2.8 to 14.7±7.9 ($p<0.001$). 68% exhibited improvement to moderately severe or better. Of 497 patients with moderately severe MDD, a significant decrease in score was observed from 17.0±1.5 to 11.0±6.1 ($p<0.001$). 71% exhibited improvement to moderate or better. Of 463 patients with moderate MDD, a significant decrease in score was observed from 11.9±1.4 to 8.1±5.5 ($p<0.001$); 87% exhibited improvement to mild and of those, 34% reached remission (PHQ-9<5). No effects of age or gender were observed.

Conclusion: These data support the use of PrTMS in reducing MDD symptom severity and underscore its potential role in therapeutic outcomes. Questionnaires like PHQ-9 can introduce

self-report bias, highlighting the need for prospective, controlled PrTMS studies to substantiate findings.

1. Please explain the scientific relevance of this abstract.

This abstract showcases the potential of Personalized Repetitive Transcranial Magnetic Stimulation (PrTMS®) as an effective adjunctive therapy for reducing symptom severity in Major Depressive Disorder (MDD). By targeting dysregulated alpha oscillations within the brain's default mode network, PrTMS therapy offers a personalized neuromodulation approach tailored to individual brain activity patterns by utilizing spectral EEG guidance to iteratively optimize MDD symptom relief. The significance of this study lies in its evaluation of the neurophysiological mechanisms underlying certain MDD subtypes, assessing the potential of a non-invasive, individualized neuromodulation treatment tailored to personal brain activity.

2. Include a brief statement of the intent of the study and the current state of research in the field. Specifically, what quality gap (limitation or problem) in the practice of neurology does this research address? Practice Gap: ‘A professional practice gap is the difference between actual and ideal knowledge, competence, performance and/or patient outcomes. When there is a gap between what the professional is doing or accomplishing compared to what is "achievable on the basis of current professional knowledge’

The practice gap addressed by this research is the lack of tailored neuromodulation techniques that can be adapted to the brain's diverse functional abnormalities. Traditional treatments often fail to account for the role of individualized dysregulated brain networks in MDD. This study retrospectively evaluated a personalized approach to traditional rTMS therapy, aiming to bridge the gap between understanding brain activity and applying treatments designed to correct neuroanatomical dysfunctions, particularly in MDD. By focusing on personalized, non-invasive neuromodulation, this study addresses the need for more precise neurological interventions intending to optimize patient outcomes.