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Predicting rTMS Treatment Response in Major Depression Using Minimal-Electrode EEG and Machine Learning

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Introduction: Repetitive transcranial magnetic stimulation (rTMS) is an established therapy for treatment-resistant depression, yet response variability limits its clinical efficiency. Resting-state electroencephalography (EEG), offering accessible neural biomarkers, may enhance individualized prediction of treatment outcomes through machine learning integration.
Objectives: This study aimed to determine whether a reduced 8-electrode EEG configuration could predict rTMS treatment response as accurately as a 30-electrode system, using nonlinear EEG features and optimized classification algorithms.
Methods: A total of 100 patients with major depressive disorder underwent pre-treatment EEG before a two-week accelerated intermittent theta-burst rTMS protocol (1800 pulses/session, 3 sessions/day separated by 60 mins for 10 working days). EEG features—including band power, coherence, phase-lag index (PLI), and phase-locking value (PLV)—were extracted. A two-stage feature selection process (recursive feature elimination and sequential backward selection) preceded linear discriminant analysis (LDA). Predictive accuracy was assessed by 5-fold cross-validation and 1,000 shuffle iterations.
Results: Multi-feature EEG models consistently outperformed single-feature analyses in predicting rTMS treatment outcomes. The 8-electrode model achieved 78.9% accuracy and an AUC of 73.3%, comparable to or surpassing the 30-electrode configuration. PLI was the most robust single predictor, while combining multiple features markedly enhanced classification performance. Among six tested classifiers, LDA yielded the most stable and generalizable results, particularly with limited training data, underscoring its clinical applicability.
Conclusions: Resting-state EEG combined with machine learning can reliably predict rTMS outcomes in depression. Importantly, high accuracy was achieved using a minimal 8-electrode montage, highlighting the clinical feasibility of low-cost, rapid EEG applications for personalized neuromodulation strategies.

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Repetitive Transcranial Magnetic Stimulation in Post-Herpetic Trigeminal Neuralgia: A Case Report in a 71-Year-Old Female Patient

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Introduction: Trigeminal neuralgia (TN) is a debilitating neuropathic facial pain that profoundly impairs quality of life (Khawaja & Scrivani, *Dent Clin North Am* 2023; 67 99–115; Sveinsson et al., *Laeknabladid* 2025; 111 62–67). Post-herpetic TN, frequently observed in older adults after herpes zoster, often shows insufficient response to pharmacotherapy (Niemeyer et al., *Curr Pain Headache Rep* 2024; 28 295–306; Rohmayanti & Kurniawan, *J Pain Headache Vertigo* 2023; 4 1–6). rTMS over M1 has shown analgesic efficacy in chronic neuropathic pain (Wang et al., *Front Neurosci* 2023; 17 1158737; Dai et al., *Front Neurol* 2024; 15 1365445).
Objectives: To report clinical application, tolerability, and preliminary outcomes of rTMS in an elderly female with chronic PHN-TN refractory to multiple treatments.
Methods: A 71-year-old woman with >30-year left-sided TN after herpes zoster had daily pain. MRI excluded compressive lesion; EEG showed no epileptiform discharges. High-frequency rTMS over M1 (facial area): 10 Hz, 25–30 trains/session (100 pulses/train), 30-s inter-train interval, total 2,500–3,000 pulses, at 90–110% resting motor threshold; course 30–35 sessions with maintenance; 15 sessions completed at reporting. All identifiers removed and written informed consent was obtained.
Results: Well tolerated; transient photophobia, mild balance disturbance; no serious adverse events. VAS pre/post each session; Sunnybrook for facial function; SF-36 for quality of life. Comparative analyses ongoing as treatment continues.
Conclusions: rTMS appears feasible and safe for PHN-TN resistant to medication in an elderly patient, with preliminary signs of pain reduction and functional/quality-of-life improvement. Long-term follow-up and multidimensional outcomes (VAS, Sunnybrook, SF-36) are warranted to evaluate durability and effect size.

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