E-Poster

EP-379

Multifocal Non-Invasive Brain Stimulation for Enhancing Motor and Cognitive Functions: A Comprehensive Systematic Review

Topic: Neurostimulation (rTMS, tDCS, etc.)

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BACKGROUND

Multifocal non-invasive brain stimulation (NIBS) has emerged as an innovative approach to modulate motor and cognitive functions by simultaneously targeting multiple brain regions. Despite its potential, the efficacy and underlying mechanisms of this technique remain to be fully elucidated. This systematic review aims to evaluate the effectiveness of multifocal NIBS in modulating motor and cognitive functions, focusing on stimulation protocols, targeted brain regions, and both behavioral and neurophysiological outcomes.

METHODS

We conducted a systematic search of PubMed, EMBASE, Cochrane Library, Scopus, and Web of Science databases up to August 26, 2024, following PRISMA 2020 guidelines. Inclusion criteria encompassed human studies utilizing concurrent dual-site or multifocal NIBS with pre- and post-intervention behavioral assessments. Studies on deep brain stimulation, cortico-cortical paired associative stimulation, sequential stimulation, case reports, and reviews were excluded.

RESULTS

Out of 1,359 initial records, 18 studies met the inclusion criteria (12 cognitive, 6 motor). Cognitive studies predominantly employed tDCS/tACS targeting the frontoparietal network, while motor studies focused on DLPFC-M1 dual-site stimulation. Neurophysiological data from EEG and fMRI revealed network-level modulations. Behavioral outcomes were mixed, with some studies reporting improvements in executive function, response inhibition, and motor learning, while others showed no significant advantage over sham stimulation.

CONCLUSION

While multifocal NIBS shows promise, its efficacy is currently limited by heterogeneous study designs, small sample sizes, and inconsistent findings. Future research should prioritize multi-arm trials, incorporate neurophysiological biomarkers, and develop personalized stimulation protocols to optimize the effectiveness of this technique.

Statement of Disclosures

This research was supported by the Bio&Medical Technology Development Program of the National Research Foundation (NRF) funded by the Korean government (MSIT) (No. RS-2024-00356694).

Doi: 10.5606/archisprm.2026.EP-379

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