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Effectiveness of Advanced Non-invasive Electroceutic Interventions on Gait Rehabilitation in Parkinson's Disease: A Literature Review

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ABSTRACT

Gait impairment is a common motor dysfunction in Parkinson's Disease (PD) marked by dragging feet, shorter steps, and slower walking, often leading to disability and poor quality of life. Noninvasive Brain Stimulation (NIBS) techniques like repetitive Transcranial Magnetic Stimulation (rTMS) and transcranial Direct Current Stimulation (tDCS) have shown promising results in addressing these issues by modulating cortical excitability. These painless methods target reduced activity in premotor and primary motor regions, with tDCS also influencing basal ganglia function through a distributed cortical network. This study synthesises current literature on the effectiveness of advanced non-invasive interventions, such as rTMS and tDCS, in improving gait rehabilitation in PD patients. An initial search across databases including PubMed, Google Scholar, Scopus, and the Cochrane Library yielded 22,004 studies using keywords like "transcranial direct current stimulation," "transcranial magnetic stimulation," "gait," and "Parkinson's disease," combined with Boolean operators AND and OR. However, only five studies met the inclusion criteria, specifically assessing the effectiveness of these interventions in this population. The reviewed literature primarily focussed on gait and related parameters, employing outcome measures such as the Timed Up and Go (TUG) test, Unified Parkinson Disease Rating Scale (UPDRS), 10-minute walk test, and 6-minute walk test. Two studies found no statistically significant differences ($p>0.05$) between the tDCS with gait training group and the sham group, while one study highlighted the potential effectiveness of combining anodal tDCS with gait training in improving balance, leaving the evidence inconclusive. Additionally, two studies assessed rTMS, with one demonstrating that frequencies of 1 Hz and 25 Hz were more effective than sham treatment, while the other showed that 10 Hz rTMS improved gait outcomes in PD patients. Future high-quality trials with larger participant samples and long-term assessments are needed to provide more conclusive evidence on the effectiveness of tDCS and rTMS in gait rehabilitation for PD. Comparative studies exploring different frequencies and stimulation protocols are essential to identify optimal treatment strategies. Such research will help establish robust clinical guidelines for non-invasive brain stimulation in this population.

Keywords: Cortical excitability, Transcranial Direct Current Stimulation, Transcranial Magnetic Stimulation