The Effect of Transcranial Direct Current Stimulation on Balance and Mobility in Children with Cerebral Palsy: A Systematic Review

Danielle Frank, SPT, Courtney Jo James, SPT, Sarah Kosik, SPT, Krista Ziegler, SPT, Dr. Renée Hakim, PT, PhD, Board-Certified Clinical Specialist in Neurologic Physical Therapy, Dr. Nicholas Rodio, PT, DPT
Department of Physical Therapy, University of Scranton, Scranton, PA, United States

INTRODUCTION

Transcranial direct current stimulation (tDCS) is a form of non-invasive brain stimulation that applies a weak and constant direct current to the brain to modulate neuronal networks of affected and non-affected hemispheres. tDCS is an emerging approach for enhancing neuroplasticity and rehabilitation outcomes.

PURPOSE

The purpose of this study was to review the effect of tDCS on balance/mobility in children with cerebral palsy (CP).

METHODS

A literature search of CINAHL, PubMed, Cochrane, ProQuest, ScienceDirect was conducted using search terms: Pediatric AND (cerebral palsy or perinatal stroke or stroke) AND (direct current stimulation OR current stimulation OR transcranial OR stimulation OR microcurrent). Search limits: English, human subjects, pediatric (0-18 years), peer-reviewed. Selection Criteria: Children with CP, interventions included tDCS, outcome measures involved balance and/or mobility, study design was limited to RCTs. Two reviewers independently assessed each study for methodological quality and came to a consensus based on PEDro guidelines.

RESULTS

A total of 121 articles were screened for eligibility. Following detailed appraisals, 7 RCTs met criteria. PEDro scores ranged from 8 to 10 (average=9.14). Samples ranged from 6 to 24 subjects (126 total) with CP GMFCS Levels I-III (age range 4-12). Treatment parameters included 1mA of anodal tDCS placed over the primary motor cortex in 6 studies or the cerebellum in 1 study. Five studies applied tDCS during treatment for five 20-minute sessions with 2 weeks, while two studies applied a single session of tDCS for 20 minutes. Four studies applied tDCS combined with virtual reality (VR) training and three studies examined tDCS with treadmill training (TT). Outcome measures included temporal distance (via gait analysis and 6MWT), kinematic analysis (Gait Profile Score), functional performance (GMFM-88, PEDI, TUG), and balance (sway and PBS). 6 of 7 studies had statistically significant improvements in balance and/or mobility with co-interventions as compared to usual care (3 with VR and 3 with TT; p<0.05). 5 of 7 studies reported sustained improvements at 1 month follow-up. 6 of 7 studies found significantly greater improvements with anodal tDCS combined with VR (3 studies) or TT (3 studies) when compared to a control group (p<0.05).

CONCLUSIONS

There is strong evidence to support the use of tDCS combined with VR or TT to improve balance/mobility for children with CP compared with usual care. The 5 of 7 studies conducted over a 2-week period (10 sessions total) showed sustained performance in balance/mobility at 1 month follow-up. Both single session studies showed immediate improvements in gait velocity and sway velocity for the tDCS groups. Limitations included small sample size, repeated authors, and wide range of subject impairment levels (GMFCS I-III). Further research should focus on the effect of tDCS at different intensities, duration, and frequency in order to determine the ideal parameters of tDCS treatment for this population to increase function.

CLINICAL RELEVANCE

All studies concluded that tDCS is a safe and feasible intervention for patients with varying types of CP, though not currently approved by the FDA in clinical settings. Multiple 20-minute sessions (10 sessions over 2 weeks) of 1mA anodal tDCS should be considered by clinicians as a potential treatment option in conjunction with balance/mobility training for children with CP.

REFERENCES