The effectiveness of transcranial direct current stimulation on ambulation in persons with Parkinson’s Disease: A Systematic Review

Caitlin Liberatore, SPT
Melissa McEnroe, SPT
Brian Esterle, SPT
Lindsay Fluehr, SPT
Overview

- **Background**
  - Parkinson’s Disease
  - Effect of Parkinson’s on Gait
  - Transcranial Direct Current Stimulation

- **Purpose**
- **Methods**
- **Search Terms**
- **Inclusion and Exclusion Criteria**

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- **PEDro Scores**
- **Results**
- **Conclusions**
- **Clinical Relevance**
- **Limitations**
- **Future Research**
- **Take Home Message**
Background

- Parkinson’s Disease
- Effect of Parkinson’s on Gait
  - Temporal-Distance Gait Parameters
- Transcranial Direct Stimulation
Parkinson’s Disease

● Clinical features of PD\(^1\)
  ○ Resting tremor
  ○ Rigidity
  ○ Bradykinesia
  ○ Postural instability

● Typical gait deviations\(^1\)
  ○ Freezing of gait (FOG)
  ○ Festination
Effect of Parkinson’s on Gait

Temporal-Distance Parameters of Gait:

1. **Cadence**: number of steps per minute
   - Fluctuates, increased or decreased cadence
   - Mild/Initial PD: slightly reduced
   - Advanced PD: increased with small, rapid steps and decreased stride length (festination)
Effect of Parkinson’s on Gait

2. **Stride length:** distance covered in 2 steps (consecutive heel strike on same leg)
   - Consistently decreased
   - Leads to postural instability → increases fall risk

3. **Velocity:** average horizontal speed over one or more strides
   - Consistently decreased
   - Freezing of gait
Transcranial direct current stimulation (tDCS)²:

- Non-invasive, painless brain stimulation treatment that uses direct electrical currents to stimulate specific parts of the brain.
- A constant, low intensity current is passed through two electrodes placed over the head which modulates neuronal activity.
- Two types of stimulation with tDCS: anodal and cathodal stimulation.
  - Anodal stimulation → excites neuronal activity.
  - Cathodal stimulation → inhibits or reduces neuronal activity.
Purpose

The purpose of this study was to determine the effectiveness of transcranial direct current stimulation (tDCS) on ambulation for persons with Parkinson’s Disease.
Methods

● **Databases:**
  ○ Proquest Central, MEDLINE/PubMed, CINAHL, Cochrane Library

● **Search Limits:**
  ○ English, human subjects, Peer reviewed, RCTs

● **Selection Criteria:**
  ○ Adults 18 y/o + with PD, intervention included tDCS and an outcome measure of temporal distance and/or functional gait
Search Terms

(Parkinson* OR PD) AND (Transcranial direct current stimulation OR tDCS OR tDC) AND (Gait OR mobility OR ambulation OR gait velocity) NOT (transcranial magnetic stimulation OR TMS)
Inclusion and Exclusion Criteria

- **Inclusion Criteria:**
  - Temporal-distance gait
  - Ambulation ability

- **Exclusion Criteria:**
  - Not a randomized control trial
  - Did not measure gait
Records identified through database searching (n = 56)

Additional records identified through other sources (n = 0)

Records after duplicates removed (n = 33)

Records screened (n = 33)

Records excluded by title and abstract (n = 5)

Full-text articles assessed for eligibility (n = 28)

Studies included (n = 7)

Full-text articles excluded, with reasons (n = 21)
- Does the patient have a diagnosis of PD? (n=5)
- Are the subjects in the study human subjects? (n=2)
- Is the patient receiving tDCS? (n=3)
- Is the study an RTC? (n=4)
- Does the study test or measure gait? (n=2)
- Is gait the primary outcome? (n=5)
## PEDro Scores

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Average Score: 9.14/10  
Strong level of Evidence
Results

- Samples ranged from 10-25 subjects with mild to moderate PD

- Treatment Parameters
  - 2mA of tDCS applied anterior to central zone or left dorsolateral prefrontal cortex of brain
  - 13 to 20 min duration, 3x per week for 2.5-4 weeks
  - Applied during on phase of medication
Results continued

● Primary outcomes
  ○ 10 m Walk Test, 6 min Walk Test, Timed Up and Go (TUG), TUGcog, Dynamic Gait Index (DGI)

● Statistically significant improvements found in:
  ○ Gait speed (+0.19 m/s): tDCS with gait training or dual task conditions
  ○ TUG scores (-1.24 s): tDCS combined with gait training
  ○ TUG and DGI scores when evaluating gait immediately post-tDCS

● No adverse events requiring drop-outs
Conclusions

- There is strong evidence to support the effectiveness of tDCS on improving gait in patients with PD
- tDCS and gait training combined showed both accelerated and prolonged effects of treatment compared to gait training alone
Clinical Relevance

- PD is a common neurological condition that PTs can encounter in various settings
- tDCS is a safe and therapeutic method to improve gait in patients with PD
- Alternative treatment option for patients who are unresponsive to traditional interventions
Limitations

- Small sample sizes
- Lack of follow up on long-term effects
- Treatment occurred during “on” phase of medication only
Future Research

- Placement of electrodes
- Duration of treatment
- Parameters for tDCS
- Long-term effects
- Focus on quality of gait
Take Home Message

- PD primarily affects an individual’s ambulation ability, leading to increased disability
- tDCS proves to be a safe, therapeutic option to improve gait in those with PD
- Explore potential with current patient population
- Consider as an option upon FDA approval
References


Thank you

Dr. Renee Hakim, PT, PhD, NCS
Dr. Tracey Collins, PT, PhD, MBA, GCS
Dr. John Sanko, PT, EdD
Questions?
tDCS Availability