Therapeutic Effect Of Transcranial Direct Current Stimulation On Patients with Parkinson’s Disease

International Parkinson and Movement Disorder Society

Jordan University of Science & Technology
1) Parkinson’s Disease

2) Non-invasive Cortical Stimulation

3) Literature review

4) Our Study
   a. Methodology
   b. Results
1) Parkinson’s Disease

Progressive

Basal Ganglia Degeneration  Dopamine Deficiency

Putamen

Normal

Patient

BASAL GANGLIA

MIDBRAIN

S.N.
1) Parkinson’s Disease

- Motor complications
  - Tremor
  - Rigidity
  - Bradykinesia
  - Gait abnormalities etc.

- Non-motor complications
  - Cognitive impairment
  - Psychiatric dysfunction
  - Autonomic dysfunction
  - Sensory dysfunctions

[Leverenz JB, 2009]
1) Parkinson’s Disease

Pharmacological Therapy

- Dopamine-resistant symptoms
- Freezing of gait
- Cognitive deficits
- Depression
- Dementia and hallucinations

[Weintraub D, 2004]

Limitation & Complications

Deep Brain Stimulation

- Highly cost
- Invasive (surgery) procedure
- Effective against fluctuations & tremor mainly.
- Cognitive & mood complications

[Troche MS, 2013; Skidmore FM, 2006; Dowding CH, 2006]
2) Non-invasive Cortical Stimulation

Transcranial Direct Current Stimulation (tDCS)

- Non-expensive & Non-invasive
- Low amplitude Galvanic Current
- Intensity: 1mA - 2mA (itching sensation)
- Time: 15-20 mins.
- Electrodes:
  - **Anode**: Positive – Excitation
  - **Cathode**: Negative – Inhibition
2) **Non-invasive Cortical Stimulation**

- **tDCS** – Long Term Potentiation – Like effects

![Diagram](image-url)

- Anodal stimulation inhibits GABA
- Long-term potentiation (LDP)-like
- GABA receptors
- Glutamate receptors
- Presynaptic neuron
- Postsynaptic neuron
2) Non-invasive Cortical Stimulation

- tDCS – Long Term Potentiation

Cathode (-ve) Inhibition

Cathodal stimulation inhibits glutamate (Stagg 2011)

Long-term depression (LDP)-like
3) Parkinson’s Disease & tDCS

- Doruk D 2014
- Fregni F 2006
- Leite J 2014
- Boggio PS 2006
- Pereira JB 2013
- Benninger DH 2010
- Wu AD 2008

Literature Review
3) Parkinson’s Disease & tDCS

Participants:
Idiopathic PD patients (n≤20)

Studies Design: RTC
1. tDCS therapy group (Pre tDCS vs. Post tDCS)
2. Control group. (Sham vs. tDCS)

Outcome measures
• Motor Function
  ✓ Unified Parkinson’s Disease Rating Scale III
  ✓ Purdue Peg board test – fine motor
  ✓ Simple Reaction Time

• Cognitive function
  ✓ Working memory (forward and backward Digit Span Tests and 3-back Test)
  ✓ Stroop test
  ✓ Visuospatial ability (Hooper Visual Organization Test)

• Behavioral & Mood
  ✓ Beck Depression Inventory
3) Parkinson’s Disease & tDCS

**tDCS Stimulation**
- Intensity → 1 – 2 mA
- Duration → 10-20 min per session
- # of Session → 10 sessions
- Electrode placement
  - a) Motor cortex (M1)
  - b) Prefrontal cortex (DLPFC)
3) Parkinson’s Disease & tDCS

**tDCS Stimulation**
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3) Parkinson’s Disease & tDCS

**Discussion**

1. Small sample size (n<20)
2. Variable tDCS Electrodes placement.
3. Only one cortical hemisphere is excited.
4. (M1) & (DL-PFC) is excited Separately.

**Results & Conclusion**

- Supported Variable Therapeutic effects of tDCS in patient with PD in terms of
  - Motor Function
  - Cognitive function

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- Leite J 2014
- Doruk D 2014
- Fregni F 2006
- Pereira JB 2013
- Benninger DH 2010
- Wu AD 2008
Previous Studies

1. RTC with Small sample size (n<20)
2. Only one cortical hemisphere is excited
3. (M1) & (DL-PFC) is excited Separately.

Our Study

1. RTC with Large sample size (n=40)
   - Left & Right M1 or DLPFC is involved Bilaterally in PD deficits, not unilaterally [Wu AD, 2008].
2. Both cortical hemisphere is excited simultaneously.
3. Both (M1) & (DL-PFC) is excited simultaneously.

![10-20 EEG Diagram]

10-10 EEG

Simultaneous Bi-Hemispheric Excitation of DL-PFC & M1

![10-10 EEG Diagram]
4) Our Study

**Participants:**
Idiopathic PD patients (n=40)

**Studies Design : RTC**
1. tDCS therapy group (Pre tDCS vs. Post tDCS)
2. Control group. (Sham vs. tDCS)

**Outcome measures**
- **Motor Function**
  - UPDRS (III)
  - Balance outcomes - Mini-BEST
  - Mobility - timed up & go test / 10 meter walk test
- **Cognitive Functions**
  - Montréal cognitive assessment scale (MOCA)
  - STROOP Test
  - California Verbal Learning Test
  - Visuo-spatial Memory Test
- **QOL**
  - WHO – QOL questionnaire
4) Our Study

Results (n=10 out of 40)

- There are noticeable
  - Decrease in tremor (Hand & Trunk)
  - More function ability in ADL
  - Good sleep quality

- Variable improvement in
  - Balance scale
  - Cognitive function
Thank You!