tDCS Augmentation Trials in Neurorehabilitation

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Transcranial Electrical Stimulation (tES): Mechanisms, Technology and Therapeutic Applications
National Institutes of Health
Neurorehabilitation & Neural Repair

Burke Rehabilitation Center, New York
Neurorehabilitation-tDCS original studies

2007-2016

- Total Rehabilitation
- Physical Therapy
- Occupational Therapy
- Speech Therapy

Neurorehabilitation-tDCS registered trials

- Cognitive Behavioral Therapy, 13
- Cognitive Training, 25
- Physical Therapy, 15
- Speech Therapy, 15
- Motor Practice, 8
- Task Training, 29
- Balance, 7
- Rehabilitation, 65

'tDCS and Transcranial direct current stimulation' + key words in chart

Post-stroke aphasia?

How is the network disrupted?
Is NIBS useful?
Can it be effectively combined with SL therapy?
Evidence / Rationale


No evidence for tDCS as useful adjunct some merit in cathodal stimulation?


R hem1 Hz rTMS + SL therapy improves language recovery and favors L hem language network activation
Northstar Trial

- **Infarct**

- **Pars triangularis**

- **Parameters:**
  - 2 runs of 20 minutes of cathodal stimulation
  - Electrode placement
    - Cathode – R pars triangularis
    - Anode – L supraorbital region
  - Real – direct current of 2 mA
  - Sham – direct current of 0.1 mA
  - Worn during speech therapy
tDCS for aphasia rehabilitation
  • primarily studied as a complement to speech therapy

2014-2015 Publications

Motor

- tDCS - No PT/OT 28%
- tDCS During PT/OT 32%
- tDCS Before PT/OT 40%

Aphasia

- tDCS Before ST 8%
- tDCS During ST 92%
Anodal tDCS favors clinical improvement in stroke motor...


Invited Review

Does anodal transcranial direct current stimulation enhance excitability of the motor cortex and motor function in healthy individuals and subjects with stroke: A systematic review and meta-analysis


Transcranial direct current stimulation (tDCS) for improving function and activities of daily living in patients after stroke

Elsner et al (2013)
Corticomotor excitability in stroke
IMPROVED CORTICOMOTOR OUTPUT FROM IPSI-LESIONAL M1 & IMPROVED MOTOR BEHAVIOUR

Boggio et al, 2007
Fregni et al., 2006
Fregni et al., 2005
Mansur et al., 2005
Takeuchi et al., 2005
Boggio, et al., 2006
Werhahn, et al., 2003

Yozbatiran et al, 2009
Malcom et al, 2007
Hummel et al, 2007
Talelli et al., 2007  Kim et al., 2006 Hummel et al, 2006 Khedr et al., 2005 Hummel et al, 2005

Webster et al (2006)
Is coupling tDCS with training good?
If...

Motor Training = improvement in function ‘X’

and...

tDCS = improvement in function ‘X’

does...

Motor Training + tDCS = improvement in function $2X$, $X^2$, or 0??
Anodal tDCS combined with robotic motor training
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Robotics for kinematics assessment & training
NIH funded study 2012-2017 – tDCS and robotic motor training in stroke

- 60 patients, Right hemiparesis
- >6mnths post first ischemic stroke
- Robotic protocol alternates S/E-wrist robot across sessions
- tDCS 2mA, 35cm², 0.9% NaCl soaked sponges
Upper limb robotics at Burke-Cornell, New York

Edwards PI: R01 HD069776

Robotics with brain stimulation in patients with motor dysfunction
Mean clinical (Fugl-Meyer) improvement robot/sham tDCS + robot/real tDCS groups

PRELIM. RESULTS

![Graph showing change in FM Impairment Scale](image)

*Full results in prep*
Summary
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