How, When and What-ifs of Transcranial Direct Current Stimulation for Tinnitus

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Transcranial direct current stimulation (TDCS)

- Weak current can be used to polarise cortex
- Anode: depolarisation
  - Neurons are more likely to fire
- Cathode: hyperpolarisation
  - Neurons are less likely to fire
Is this safe?

- Neurologist screens for contraindications
- Potential adverse effects
  - Skin burns
- Common experiences
  - Mild itching or prickling skin sensation
TDCS

- Typical intensity: 1 – 2 mA
- Typical duration: 10 – 20 minutes
- Advantages over rTMS
  - Fewer contraindications
  - Portable
  - Simple
  - Inexpensive
Contents

- What we know?

- What we don’t know?

- What should be done?
Q1. What do we know?
Real Vs. Sham tDCS
## Publications

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<td>Auditory cortex</td>
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Parameters

- Polarity – Anodal
- Intensity of Stimulation – 1 to 2 mA
- Duration of Stimulation – 10 to 20 Minutes
- Site of Stimulation – LTA/DLPFC
LTA & DLPFC Location

Nasion – point between the forehead and nose, at the junction of the nasal bones

Inion – most prominent point of the occipital bone

LTA – Halfway between C3 and T5

DLPFC – F3 and F4
Physiological basis of anodal tDCS

Effects of anodal tDCS on Neurons

During Stimulation
- Depolarization of resting membrane potential

After Effects
- Activation of NMDA receptors \([\uparrow \text{Duration}]\)
- Reduced GABAergic tone \([\uparrow \text{Magnitude}]\)

Neuromodulators
- Serotonin \([\uparrow \text{Magnitude \& Duration}]\)
- Catecholamines Acetylcholine \([\uparrow \text{Duration}]\)

Q2. What we don’t know?
localization of currents

- Current Flow (Skull, CSF, Subcutaneous fat, Gyri and Sulci)

- Current Orientation (Tangential vs. Radial)
Effect of tDCS on Tinnitus

- No mechanistic explanation
Q3. What should be done?
Electrophysiological measures

- Computational Neurostimulation models
- Rating scales (11) > Questionnaires (3)
- fMRI / EEG
Improve Focality (HD-tDCS)

Different protocols

- Combination of tDCS with others forms of intervention
- Multiple sites of Stimulation
Responders Vs. Nonresponders

- Hearing loss
- Functional connectivity and resting state
- Genetic biomarkers
Conclusion

- Past – Present – Future
- Potential tool for intervention
Suppliers

- NeuroConn, Germany
  http://www.neuroconn.de/profile/

- Soletrix medical, USA
  http://soterixmedical.com/tdcs

- Magstim, UK
  http://www.magstim.com/index

- Inomed, Germany
  http://www.inomed.com/

- Trademe/Online/Home made?
Thank You