

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



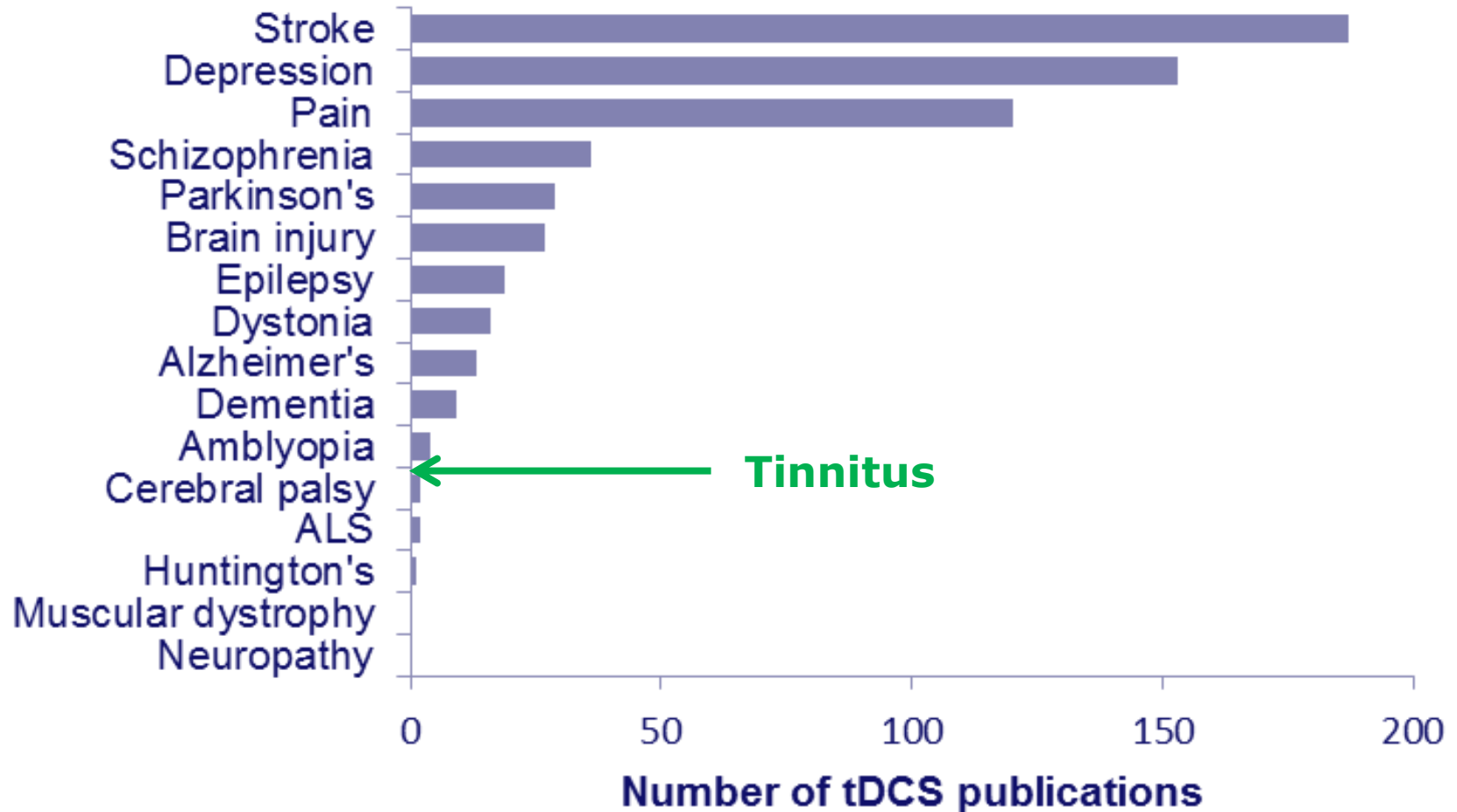
Is this safe?

- 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

Neurology applications

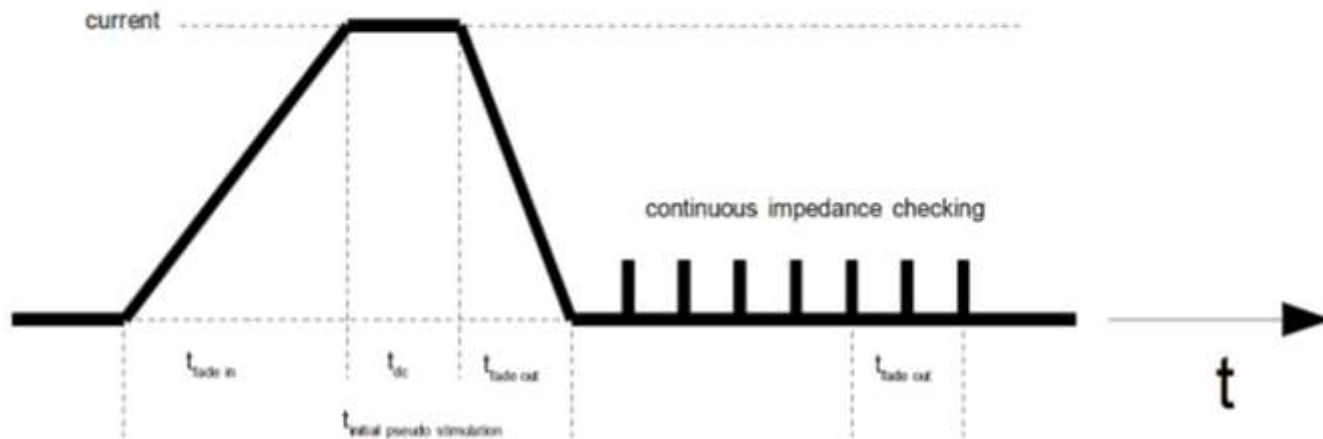
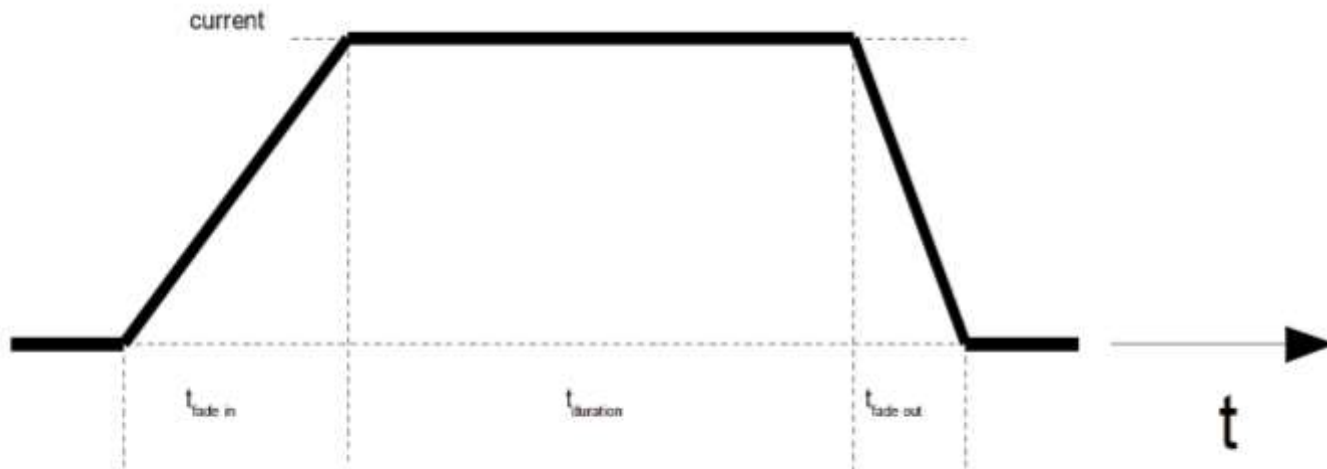


Contents

- What we know ?
- What we don't know ?
- What should be done ?

Q1. What do we know ?

Real Vs. Sham tDCS



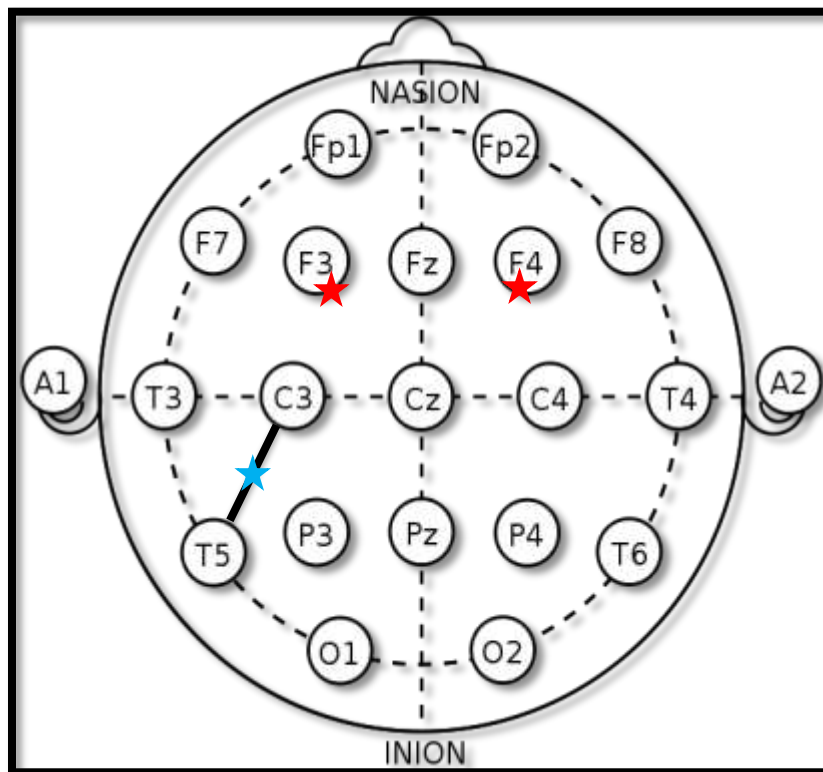
Publications

Studies	Location	Intensity	Duration
Fregni et al 2006	LTA	1 mA	3 Minutes
Vanneste et al 2010	DLPFC	1.5 mA	20 Minutes
Garin et al 2011	LTA	1 mA	20 Minutes
Vanneste et al 2011	DLPFC	1.5 mA	20 Minutes
Vanneste & DDR 2011	DLPFC	1.5 mA	20 Minutes
Frank et al 2012	DLPFC	1.5 mA	30 Minutes
Shekhawat et al 2012	LTA	1 mA and 2 mA	10, 15, 20 Minutes
Faber et al 2012	DLPFC	1.5 mA	20 Minutes
Shekhawat et al 2013	LTA	2 mA	20 Minutes
Vanneste et al 2013	DLPFC	2 mA	20 Minutes
Vanneste et al 2013	Auditory cortex	1.5 mA	20 Minutes

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



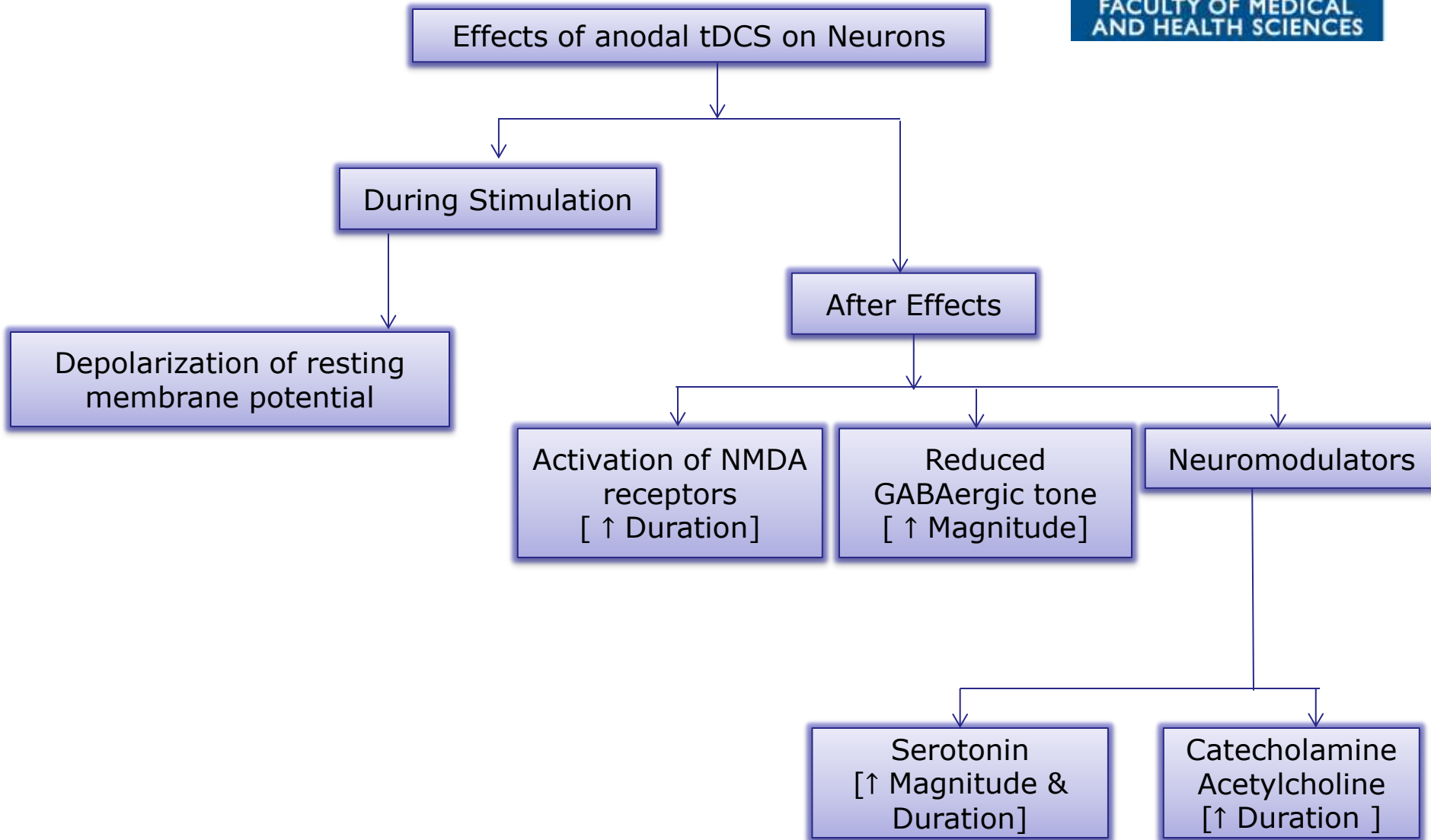
Nasion – point between the forehead and nose, at the junction of the nasal bones

Inion – most prominent point of the occipital bone

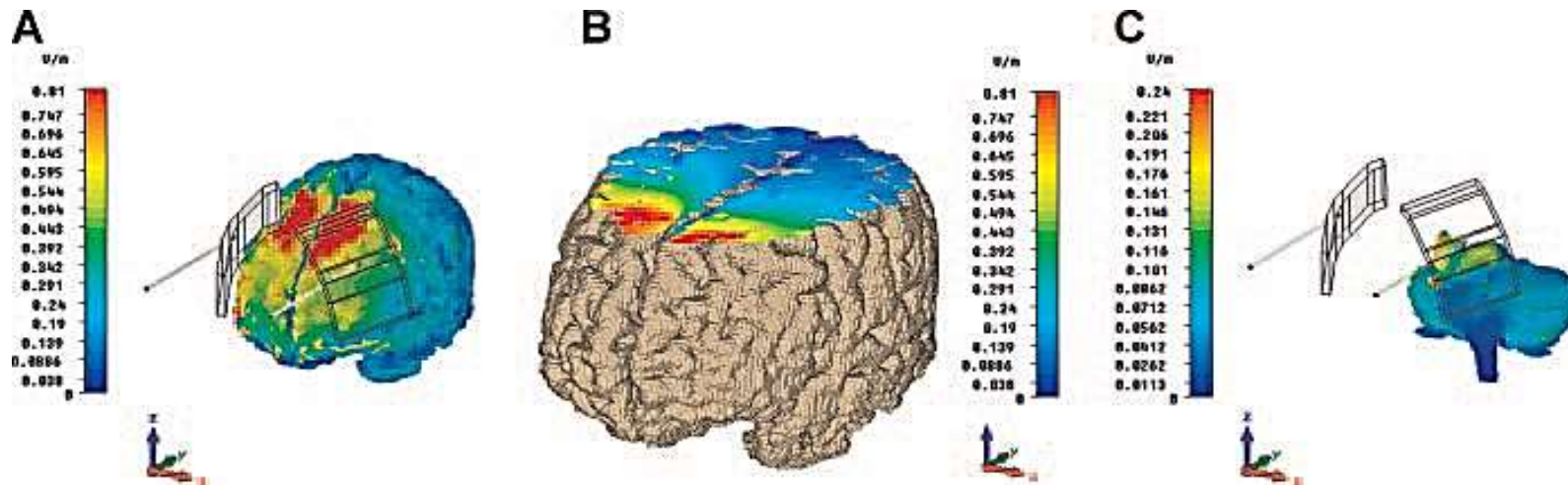
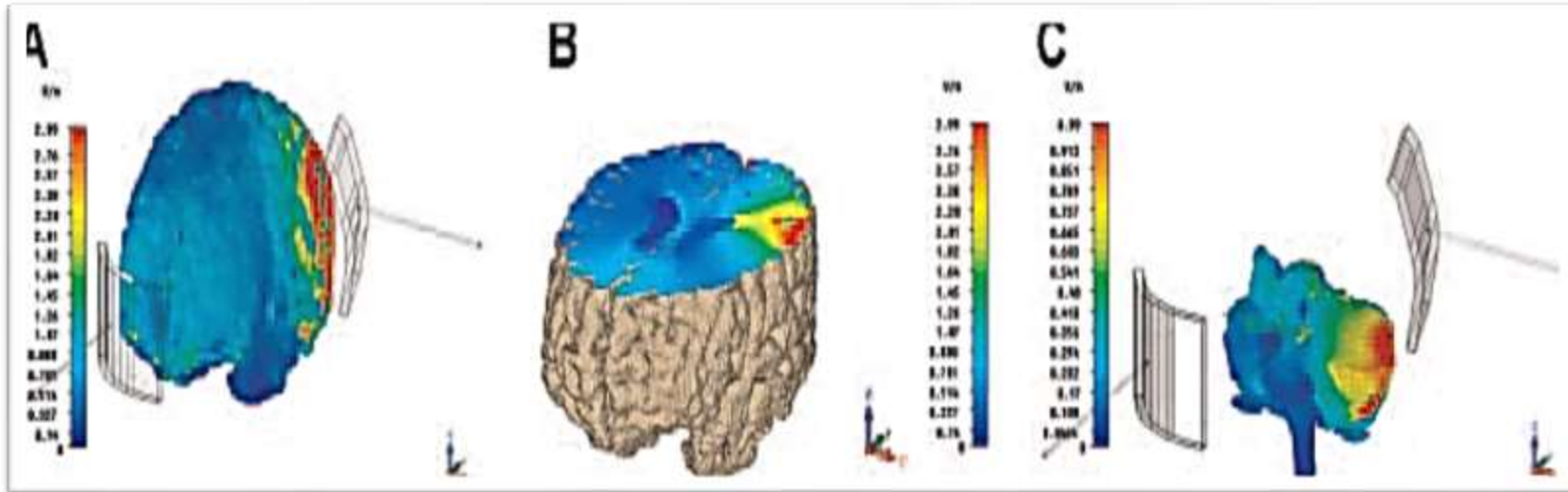
LTA – Halfway between C3 and T5

DLPFC – F3 and F4

Physiological basis of anodal tDCS



LTA Vs. DLPFC



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

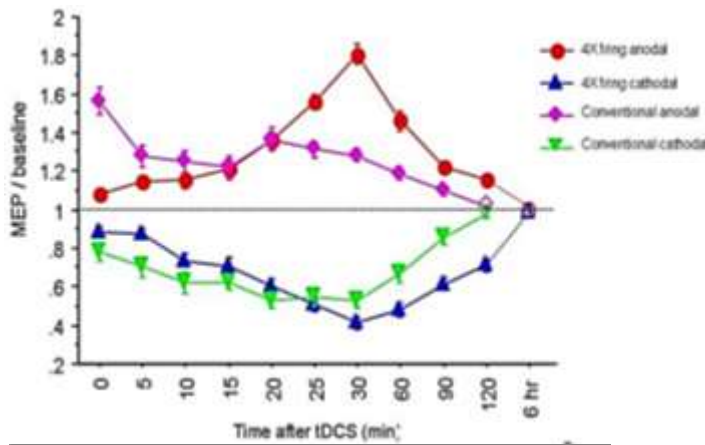
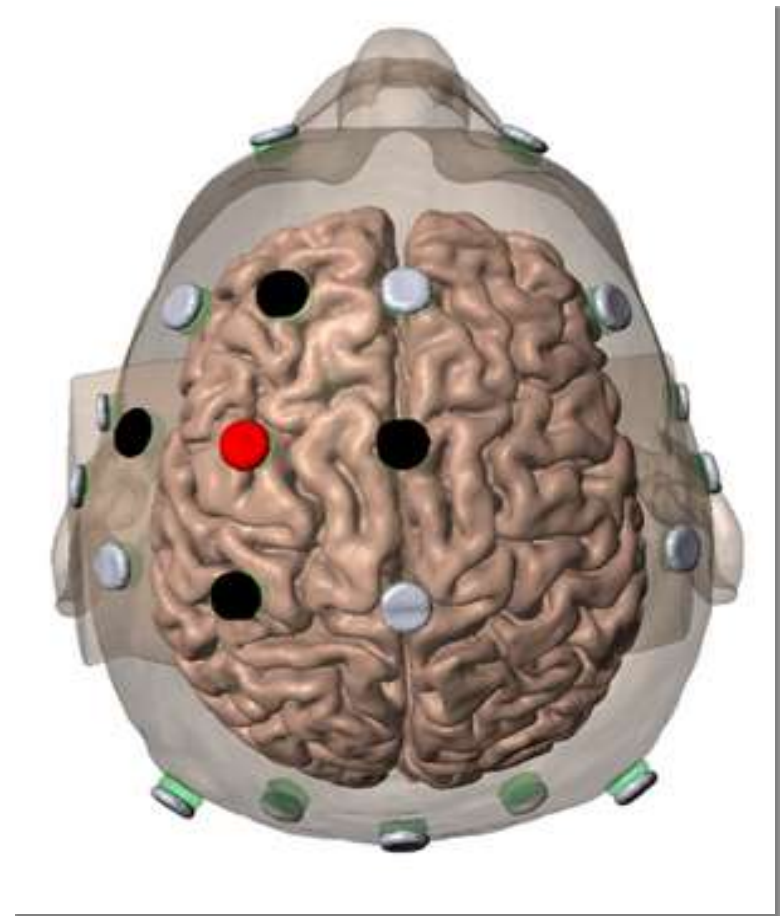
- No mechanistic explanation

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