tDCS safety and Guidelines

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Introduction to Transcranial Electric Stimulation (tES) in Neuropsychiatric Research

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Is tDCS Safe?
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YES!
When applied in accordance with safety guidelines and reviews

Low intensity transcranial electric stimulation: Safety, ethical, legal regulatory and application guidelines


Safety of transcranial Direct Current Stimulation: Evidence Based Update 2016

Is tDCS Safe?

YES!
When applied in accordance with safety guidelines

BUT...
Mild and moderate Adverse Events (AEs) may happen even when following the guidelines
tDCS device

- Current Spiking During Device On/Off
- Automatic Current Ramping
- Current Fluctuation During Stimulation
- Impedance Check
- Display of Actual Current
Cables and sponges

• Broken Electrodes
• Rust and corrosion

• Old/Dried out sponges
• Moisture of Sponges

Be careful, no dripping!
Safe tDCS parameters and montage

Electrodes should make uniform contact with the scalp

Current intensity: 1 – 2 mA (< 4 mA)

Duration: 10 – 20 min/day (up to 60 min/day)

Electrode area: 25 – 35 cm² (1 to 100 cm²)

Abrading the skin before placing the electrode is not recommended (Loo et al. 2011)
Safety limits and animal studies

Current intensity

Duration

Electrode area

Liebetanz et al, 2009
Reports on Adverse Events
A systematic review on reporting and assessment of adverse effects associated with transcranial direct current stimulation

Andre Russowsky Brunoni¹,²,³, João Amadera¹, Bruna Berbel¹, Magdalena Sarah Volz¹, Brenno Gomes Rizziêrio¹ and Felipe Fregni¹,²

• Systematic review of reported AEs in patients and healthy subjects:
  – 172 articles (209 studies) included
  – 117 studies assessed AEs
  – 74 studies reported at least 1 AE
A systematic review on reporting and assessment of adverse effects associated with transcranial direct current stimulation

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Most commonly reported effects are mild

– Itching (39.3%)
– Tingling (22.2%)
– Headache (14.8%)
– Discomfort (10.4%)
– Burning sensation (8.7%)
Skin burn and redness

Wang et al. 2015

Healthy subject
Single session
2 mA
26 min
35 cm²

Skin abrading prior to tDCS?
Uneven current distribution?
Sponges too old?
Skin burn

Palm et al. 2008
- 10 Patients, multiple sessions
  1 mA, 20 min, 35 cm²

Skin redness
- 5 Patients, multiple sessions
  2 mA, 20 min, 35 cm²

Skin burns

Tap water instead of Saline?
Contact dermatitis

Riedel et al. 2008

Healthy subject
Single session
0.75 mA
20 min
Anode 100 cm$^2$
Cathode 9cm$^2$

Skin irritation and pruritus
2 days after the stimulation

Probable allergic reaction
Additional considerations

• Safety in children
  – Reported AEs are the same as in adults
  – Thinner skulls, thus less resistance and greater amount of current

• Safety during pregnancy
  – Research: Questionnaires should ask about pregnancy
  – Clinical practice: Only when benefit is higher than risk

• Safety in older age
  – Reported AEs are the same as in young adults
  – Cortical atrophy in age-related diseases
tDCS modeling in the brain

Mahdavi et al., 2017
Transcranial direct current stimulation in patients with skull defects and skull plates: High-resolution computational FEM study of factors altering cortical current flow.

Abhishek Datta a,⁎, Marom Bikson a, Felipe Fregni b,c,⁎
Safety Recommendations

• Screening for exclusion criteria
• Keep informed of new safety guidelines
• Consider specific device
• Obtain IRB approval
• Consider environment for stimulation (ex. Hospital/University)
• Have emergency procedures prepared