tDCS safety and Guidelines

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Introduction to Transcranial Electric Stimulation (tES) in Neuropsychiatric Research

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Is tDCS Safe?

YES!

When applied in accordance with safety guidelines and reviews

http://www.ifcn.info/
tDCS device

Cables and sponges

Montage and Safe parameters
tDCS device

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

Always use **Saline**.

Possible alternatives:

- Electrode gel or cream

Tap water is **not** recommended
Cables and sponges

• Broken cables
• Rust and corrosion

• Old/Dried out sponges
• Moisture of sponges

Be careful, no dripping!
Montage and Safe parameters

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
Safety limits and animal studies

Current intensity

Duration

Electrode area

Liebetanz et al, 2009

Please do not copy.
Is tDCS Safe?

YES!

When applied in accordance with safety guidelines and reviews

BUT...

Mild and moderate Adverse Events (AEs) may happen
A systematic review on reporting and assessment of adverse effects associated with transcranial direct current stimulation

Andre Russowsky Brunoni¹,²,³, Joao Amadera¹, Bruna Berbel¹, Magdalena Sarah Volz¹, Brenno Gomes Rizzerio¹ and Felipe Fregni¹,²

• Systematic review of reported adverse events (AEs) in patients and healthy subjects:
  – 172 articles (209 studies) included
  – 117 studies assessed AEs
  – 74 studies reported at least 1 AE
Mild AEs are the most commonly reported

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

Wang et al. 2015
Healthy subject
Single session
2 mA, 26 min, 35 cm²

The sponges were too old
Skin abrading prior to tDCS
Uneven current distribution
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 cm²
Cathode 9cm2

Skin irritation and pruritus
2 days after the stimulation

Probable allergic reaction
Additional considerations

• Screening questionnaire:
  – Metal or electronic implants in the brain/skull or elsewhere
  – Brain or spinal cord surgery
  – Head trauma with impairment of consciousness
  – Skin problems (dermatitis, eczema...)
  – History of epilepsy
  – Pregnancy
  – Medications
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

Young healthy controls

 Older healthy controls

 Mild cognitive impairment

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

• Always screen for **exclusion criteria** and AEs

• Follow guidelines recommendations

• Verify **safety montage** and setup parameters

• Consider environment (ex. Hospital/University) and plan **emergency procedures** accordingly

• Keep informed of new **safety guidelines**