Improving transcranial direct current stimulation using model-based optimized electrode configurations.

Published: 02-05-2013
Last updated: 24-04-2024

We aim to show a larger increase in the excitability of the motor cortical representation of the right FDI muscle when using new model-based optimized electrode configurations than when using the commonly used standard configuration. This study can...

Ethical review	Approved WMO
Status	Recruiting
Health condition type	Other condition
Study type	Interventional

Summary

ID

NL-OMON38925

Source
ToetsingOnline

Brief title
Optimizing tDCS configurations

Condition

- Other condition

Synonym
n.a.

Health condition

n.a.

Research involving
Human

Sponsors and support

Primary sponsor: Universitair Medisch Centrum Sint Radboud
Source(s) of monetary or material Support: Ministerie van OC&W,Smartmix consortium BrainGain

Intervention

Keyword: electrode placement, motor evoked potential (MEP), transcranial direct current stimulation (tDCS)

Outcome measures

Primary outcome

This study will examine the changes in motor cortical excitability, defined as

the size of MEPs measured via TMS and EMG, induced by anodal tDCS using

different electrode configurations. Specifically, we predict that the

model-based optimized configurations will lead to a larger increase in MEP size

than the standard configuration from literature.

Secondary outcome

Furthermore, we expect that optimization based on both electric field strength

and direction will lead to a larger increase in MEP size than optimization

based on electric field strength alone.

Study description

Background summary

Transcranial direct current stimulation (tDCS) is a promising tool to study human brain function and improve function in certain tasks in both healthy subjects and patients with neurological diseases. As the effects are currently promising, but small and short-lived, this study aims to improve the technique. Using a highly detailed volume conduction model of the human head, it was found that with the commonly used electrode configurations stimulation is not optimal, and new optimized configurations were determined. The proposed study

aims to test these optimized configurations experimentally and compare the results to the standard configuration.

Study objective

We aim to show a larger increase in the excitability of the motor cortical representation of the right FDI muscle when using new model-based optimized electrode configurations than when using the commonly used standard configuration. This study can lead to new tDCS configurations that have bigger effects and can be used in many other studies and applications. Also, this study can give new insights into the mechanisms behind tDCS.

Study design

Experimental within-subject design with healthy volunteers.

Intervention

tDCS (anodal, 2 mA, 15 minutes, three sessions) will be applied with three different tDCS configurations targeting the motor cortical representation of the right FDI muscle. Excitability is measured via EMG as so-called motor evoked potentials (MEPs) of the FDI muscle (an intrinsic hand muscle) induced by single pulses of transcranial magnetic stimulation (TMS).

Study burden and risks

Participants will not directly benefit from their participation in the study, except for a compensatory (financial) incentive. Transcranial current stimulation (tCS) is a widely used non-invasive brain stimulation technique, applying weak direct/alternating currents (tDCS/tACS) via conductive rubber/sponge electrodes to the scalp. These weak currents can slightly shift the neurons* membrane potential and thereby increase or decrease spontaneous neuronal activity in the stimulated cortex, but (unlike TMS) they do not evoke action potentials. During the stimulation, participants may transiently experience light tingling, itching or burning sensations on the skin underlying the electrodes, which can be unpleasant. The most common side effects are a light transient headache and a feeling of fatigue. In the current study, healthy participants will be stimulated with a protocol that is considered safe with respect to the latest published safety guidelines. Transcranial magnetic stimulation (TMS) is a widely used non-invasive brain stimulation technique, based on the principle of electromagnetic induction. During stimulation, the participant will likely hear the clicks of the TMS pulses and experience stimulation of nerves and muscles of the head. The most common side effect is a light transient headache (2-4% occurrence). A severe headache is uncommon (0.3-0.5% occurrence). In TMS studies of patient populations (e.g. epilepsy) or those exceeding the standard protocols (e.g. in intensity or frequency)

epileptic seizures have been reported in rare cases. In the current study healthy participants will be stimulated with a protocol that falls within the safety guidelines. All subjects are screened for their relevant medical history and other tCS and TMS safety aspects (e.g. metal parts in the head). In summary, because the risk and burden associated with participation can be considered negligible-to-minimal, we do not expect serious adverse events during the project.

Contacts

Public
Universitair Medisch Centrum Sint Radboud

Reinier Postlaan 4
Nijmegen 6525 GC
NL
Scientific
Universitair Medisch Centrum Sint Radboud

Reinier Postlaan 4
Nijmegen 6525 GC
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Age 18-45 years
Righthanded

Exclusion criteria

• Epilepsy, convulsion or seizure (TMS)
• Serious head trauma or brain surgery
• Large or ferromagnetic metal parts in the head (except for a dental wire)
• Implanted cardiac pacemaker or neurostimulator
• Pregnancy
• Skin diseases at intended electrode sites (EMG, tDCS)
• History or current presence of any neurologic or psychiatric disease
• Any prescribed medication that can alter cortical excitability (e.g. antiepileptics, tricyclic anti-depressives or benzodiazepines) or can have an influence on the participant*s vigilance or cognitive performance within two weeks prior to participation

Study design

Design

Study type:	Interventional
Intervention model:	Crossover
Masking:	Open (masking not used)
Control:	Uncontrolled
Primary purpose:	Treatment

Recruitment

NL

Recruitment status:	Recruiting
Start date (anticipated):	03-05-2013
Enrollment:	30
Type:	Actual

Ethics review

Approved WMO

Date:	02-05-2013
Application type:	First submission
Review commission:	CMO regio Arnhem-Nijmegen (Nijmegen)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL43188.091.13