Clinical Trial Protocol
Iranian Registry of Clinical Trials

01 Jul 2026

Comparison of the effectiveness of transcranial electrical stimulation of the cerebellum, parietal, anterior cingulate and primary motor cortex on adaptation to postural perturbations in healthy adults: Linear and nonlinear approaches

Protocol summary

Study aim

Comparison of the effectiveness of transcranial electrical stimulation of the cerebellum, parietal, anterior cingulate and primary motor cortex on adaptation to postural perturbations in healthy adults: Linear and nonlinear approaches

Design

A randomized, double-blinded, sham-controlled clinical trial with a parallel group design of 75 participants. For randomization, the "randomization.com" website algorithm will be used.

Settings and conduct

The study will be conducted in the rehabilitation school of TUMS. The participants will randomly be distributed to any of the intervention or control groups. After getting baseline information on the central pressure with a force plate, the participant will receive the transcranial direct current stimulation. After that, the measurer who is blind to the participant group will measure their response to perturbation (Achill vibration) with a force plate.

Participants/Inclusion and exclusion criteria

Not having a history of epilepsy Not having pacemaker Not having skin infection Not having metal or implant in head Not having sensory disorder Not having wound or scratch on the scalp Not having cognitive disorder (Mini-Mental State Exam (MMSE) score more than or equal to 24) Not having any history of severe neurologic or musculoskeletal disorders based on the participant's claim Age: 18-40 Healthy people

Intervention groups

Intervention groups of this study will receive high-definition transcranial direct current stimulation over the cerebellum, primary motor cortex, posterior parietal cortex, and anterior cingulate cortex. The sham control group will receive the stimulation in a randomly selected montage.

Main outcome variables

The standard deviation of the displacement, the amplitude of displacement, the length of displacement, the Lyapunov exponent, the approximate entropy, and the correlation dimension of the center of pressure.

General information

Reason for update

Acronym

IRCT registration information

IRCT registration number: **IRCT20220819055745N1**
Registration date: **2022-11-15, 1401/08/24**
Registration timing: **prospective**

Last update: **2022-11-15, 1401/08/24**
Update count: **0**

Registration date

2022-11-15, 1401/08/24

Registrant information

Name

Nastaran bahadorani

Name of organization / entity

Country

Iran (Islamic Republic of)

Phone

+98 21 6694 5185

Email address

nbahadorani@razi.tums.ac.ir

Recruitment status

Recruitment complete

Funding source

Expected recruitment start date

2022-11-22, 1401/09/01

Expected recruitment end date
2023-01-21, 1401/11/01
Actual recruitment start date
empty
Actual recruitment end date
empty
Trial completion date
empty

Scientific title
Comparison of the effectiveness of transcranial electrical stimulation of the cerebellum, parietal, anterior cingulate and primary motor cortex on adaptation to postural perturbations in healthy adults: Linear and nonlinear approaches

Public title
Effect of transcranial direct current stimulation of different brain areas on postural adaptation
Purpose
Treatment
Inclusion/Exclusion criteria
Inclusion criteria:
Healthy people Age 18-40 No history of sever neurologic or musculoskeletal disorders based on the participant's clam Not having cognitive disorder (Mini-Mental State Exam (MMSE) ≥24) No wound or scratch on the scalp No sensory disorder No metal or implant in head No skin infection No pacemaker No history of epilepsy
Exclusion criteria:
Taking any medication that influence balance, neural system or brain. Heavy bodily exertion before experiment Not willing to continue the study
Age
From **18 years** old to **40 years** old
Gender
Both

Phase
3
Groups that have been masked

- Participant
- Outcome assessor

Sample size
Target sample size: **75**
Randomization (investigator's opinion)
Randomized
Randomization description
Permuted Block Randomization method from the website randomization.com will be used for allocating participants to different groups. The size of each block will be 10. A secretary will announce the participant group via a sealed envelope for allocation concealment.
Blinding (investigator's opinion)
Double blinded
Blinding description
To blind participants, there will be a sham control group. To blind the assessor, the therapist that will set the device for stimulation will be different from the therapist who will assess and collect data.
Placebo
Not used
Assignment
Parallel
Other design features

Secondary Ids

empty

Ethics committees

1

Ethics committee
Name of ethics committee
Research ethics committees of school of nursing and midwifery and rehabilitation of Tehran universit
Street address
Tehran university of medical science school of rehabilitation, Enghelab street
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Tehran
Postal code
6511111489
Approval date
2022-08-17, 1401/05/26
Ethics committee reference number
IR.TUMS.FNM.REC.1401.066

Health conditions studied

1

Description of health condition studied
Postural adaptation
ICD-10 code
ICD-10 code description

Primary outcomes

1

Description
Standard Deviation of Center of Pressure Displacement: This parameter comes from the second root of the sum of the square of the distance of each center of pressure from the average center of pressure divided by the number of the center of pressure in the anterior-posterior and lateral axis. The scale is in millimeter.
Timepoint
Before and after the intervention
Method of measurement
Force Plate

2

Description
Range of Center of Pressure Displacement: The difference between the maximum and minimum center of pressure displacement in the anterior-posterior and lateral axis. The scale is in millimeters.

Timepoint
Before and after the intervention
Method of measurement
Force Plate

3

Description
Path Length of Center of Pressure Displacement: This parameter comes from the summation of the distance of every center of pressure point from the consecutive point in the anterior-posterior and lateral axis. The scale is in millimeters.
Timepoint
Before and after the intervention
Method of measurement
Force Plate

4

Description
Lyapunov Exponent: Lyapunov Exponent is used to define the system chaos. When consecutive points diverge (divergence) the system will become chaotic, which can be quantified by Lyapunov Exponent.
Timepoint
Before and after the intervention
Method of measurement
To calculate, the Rosenstein algorithm will be used in Chaos Data Analyzer Software.

5

Description
Approximate Entropy: Approximate Entropy is a scale for showing the complexity, regularity, and predictability of the center of pressure time series. In another word, Entropy gives a probability of the existence of a repeatable pattern with the length of m, the similarity of r, and delay of T.
Timepoint
Before and after the intervention
Method of measurement
To calculate, the Pincus algorithm will be used in Matlab Software.

6

Description
Correlation Dimension: Correlation Dimension is a scale that shows degrees of freedom or the dimensions of the time series of the center of pressure.
Timepoint
Before and after the intervention
Method of measurement
To calculate, the Grassberger and Procaccia algorithm will be used in Chaos Data Analyzer Software.

Secondary outcomes

empty

Intervention groups

1

Description
First intervention group: This group will receive Transcranial Direct Current Stimulation on posterior parietal cortex by Star Stim device. The amplitude will be 1 milliampere and the duration of stimulation will be 20 minutes.
Category
Rehabilitation

2

Description
Second intervention group: This group will receive Transcranial Direct Current Stimulation on cerebellum by Star Stim device. The amplitude will be 1 milliampere and the duration of stimulation will be 20 minutes.
Category
Rehabilitation

3

Description
Third intervention group: This group will receive Transcranial Direct Current Stimulation on primary motor cortex by Star Stim device. The amplitude will be 1 milliampere and the duration of stimulation will be 20 minutes.
Category
Rehabilitation

4

Description
Forth intervention group: This group will receive Transcranial Direct Current Stimulation on anterior cingulate cortex by Star Stim device. The amplitude will be 1 milliampere and the duration of stimulation will be 20 minutes.
Category
Rehabilitation

5

Description
Sham control group: Second intervention group: This group will receive Transcranial Direct Current Stimulation on any random cite from the intervention groups by Star Stim device. The amplitude will be 1 milliampere and will stop after ramp-up. The ramp-up time is 10 seconds.
Category
Rehabilitation

Recruitment centers

1

Recruitment center
Name of recruitment center
Tehran university of medical science rehabilitation

school

Full name of responsible person
Nastaran Bahadorani

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Sponsors / Funding sources

1

Sponsor

Name of organization / entity
Tehran University of Medical Sciences

Full name of responsible person
Dr. Akbar Fotohi

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Grant name

Grant code / Reference number

Is the source of funding the same sponsor organization/entity?
Yes

Title of funding source
Tehran University of Medical Sciences

Proportion provided by this source
100

Public or private sector
Public

Domestic or foreign origin
Domestic

Category of foreign source of funding
empty

Country of origin

Type of organization providing the funding
Academic

Person responsible for general inquiries

Contact

Name of organization / entity
Tehran University of Medical Sciences

Full name of responsible person
Nastaran Bahadorani

Position
MSc student

Latest degree
Bachelor

Other areas of specialty/work
Physiotherapy

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Sharing plan

Deidentified Individual Participant Data Set (IPD)
Undecided - It is not yet known if there will be a plan to make this available
Study Protocol
Undecided - It is not yet known if there will be a plan to make this available
Statistical Analysis Plan
Undecided - It is not yet known if there will be a plan to make this available
Informed Consent Form
Undecided - It is not yet known if there will be a plan to make this available
Clinical Study Report
Undecided - It is not yet known if there will be a plan to make this available
Analytic Code
Undecided - It is not yet known if there will be a plan to make this available
Data Dictionary
Undecided - It is not yet known if there will be a plan to make this available