EEG investigation of gait and balance in Parkinson*s disease using immersive virtual reality

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Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Movement disorders (incl parkinsonism)
Study type	Observational non invasive

Summary

ID

NL-OMON40694

Source
ToetsingOnline

Brief title
EEG investigation of gait and balance using VR

Condition

- Movement disorders (incl parkinsonism)

Synonym
Parkinson's disease

Research involving
Human

Sponsors and support

Primary sponsor: Vrije Universiteit Medisch Centrum
Source(s) of monetary or material Support: (Moving Beyond Industrial Academic Initial Training Network towards focused treatment of age-related motor symptoms (FP7-

PEOPLE-2012-ITN)

Intervention

Keyword: Electroencephalography, Gait, Parkinson's disease, Virtual reality

Outcome measures

Primary outcome

Primary study parameters:

- power values of EEG oscillatory activity in different frequency bands

- phase relationship of oscillations with external events

- phase relationship of oscillations at different frequencies (cross-frequency coupling)

- cortical distribution of oscillatory activity

Secondary outcome

Secondary study parameters:

-Gait-coordination parameters i.e. step length, width, symmetry and frequency, relative phase relationship between arms, legs and trunk movements.

Descriptive study parameters:

- Clinical characteristics: Unified Parkinson*s Disease Rating Scale,

- Walking performance: 10 meter walk test; freezing of Gait Questionnaire

- Balance performance: Single leg stance test

- Activities of Daily Living: Nottingham Extended ADL Index

- Quality of life: Short-form-36; Parkinson*s Disease Questionnaire-39

Study description

Background summary

Alterations in balance, posture and gait are among the most important motor symptoms of Parkinson*s disease (PD). With progress of the disease, they may lead to serious impairments of walking mobility, ultimately in the form of freezing of gait and falls. The physiological mechanisms behind the occurrence of FOG are still not clear, but there is compelling evidence for a disturbance in visuomotor processing.
EEG has become an important research tool for the investigation of the motor pathophysiology of PD. This is due to the observation of increased synchronization of brain oscillations in the beta frequency range (13-30 Hz). Since the beta rhythm, recorded from scalp regions overlying the motor cortex, shows strong task-related modulations in motor tasks, it also provides a means to evaluate the effect of experimental interventions on the cortical control of movement in PD, complementing behavioural measures.
The current state of incomplete understanding of parkinsonian gait problems may be improved upon with research methods that allow the study of brain activation patterns during locomotion with high temporal resolution. Recent EEG studies of treadmill walking have demonstrated the feasibility of obtaining EEG data of sufficient quality to assess intra-stride patterns of cortical activation and deactivation, but to date EEG analysis during externally cued gait performance has not been applied in PD. The limitations of treadmill walking with regard to realistic optical patterns of movement, as opposed to walking in a natural environment, can be compensated with virtual reality (VR) methods. VR methods also afford an opportunity for systematically manipulating the walking environment so as to investigate relevant factors affecting gait and gait control.

For a more extensive background, we refer to pp 8-9 of the protocol.

Study objective

The project aim is to optimize existing EEG methods for recording and analyzing EEG data acquired during walking in combination with advanced VR methods for the investigation and rehabilitation of gait and balance impairments. The project aims to deliver a methodological contribution to their combined use. The combined use will be directed at the investigation of visual information processing in the service of gait control. Specifically, the project aims (i) to clarify the effect, and possible benefit of visual cues on gait in PD, and (ii) to elucidate the increased sensitivity of PD patients* gait to visual information.

Primary Objective:
Assess and describe oscillatory EEG characteristics of supraspinal mechanisms

for gait control in Parkinson*s disease

Secondary Objectives:
- Assess the responsiveness of EEG rhythms involved in gait control to visual information provided by visual cues
- Identify EEG correlates of visuospatial and visuomotor processes contributing to visually induced gait impairment

Study design

The design is an observational study investigating electroencephalographic brain activity during walking in patients with PD and healthy controls. EEG activity is measured during walking on a treadmill, whilst the visual environment is manipulated to compare groups under different conditions. Two experiments are planned. The first experiment examines EEG activity during walking with and without external visual cues projected on the ground. The second experiment manipulates optic flow information, projected using a 180 degrees projections screen.

Experiment 1: Effect of visual cues on beta oscillatory activity during walking
Aim: Assess whether beneficial effects of visual cues are mediated by increased reactivity of beta power
PD patients are known to have a reduced reactivity of beta oscillatory activity, with an enhanced beta power that does not attenuate before and during movement in the same way as in healthy controls. That is, the attenuation is delayed in time and of lower amplitude. The experiment will test whether this *sluggishness* of beta activity in PD is partly reverted by visual cues. Such a result would (i) further underpin the pathophysiological significance of abnormal beta activity in PD, and (ii) contribute to the explanation of cueing benefits.

Experiment 2: Effect of optic flow information on oscillatory activity during walking
Aim: Assess whether detrimental effects of visual information on walking are mediated by changes in beta activity
Visual information can help (Experiment 1) as well as hinder movement (Experiment 2). It is known that changing the direction and speed of optic flow has a greater effect on walking velocity in PD patients than in healthy subjects. Here we investigate whether this is expressed in changes in beta reactivity. Of interest is further whether visuomotor processes mediating such effects have an identifiable EEG signature.

For further details, we refer to pp 11-12 of the protocol.

Study burden and risks

There are no risks associated with the EEG measurements. Time burden is ~3 hrs for the actual experiment (including preparation and debriefing). There is no direct benefit for a patient or healthy subject in participating.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

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

Inclusion criteria

- Idiopathic Parkinson's disease
- Age between 45 -70 years
- Moderate disease severity (Hoehn-Yahr 2-3)

Exclusion criteria

- Other neurological or psychiatric conditions, including stroke, traumatic brain injury, epilepsy, depression or anxiety disorder
- Electronic equipment implanted
- Severe visual impairment
- Declining to be informed of medically relevant chance findings in the investigation

Study design

Design

Study type:	Observational non invasive
Intervention model:	Other
Allocation:	Non-randomized controlled trial
Masking:	Open (masking not used)
Control:	Active
Primary purpose:	Basic science

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	25-02-2015
Enrollment:	48
Type:	Actual

Ethics review

Approved WMO

Date:	25-08-2014
Application type:	First submission
Review commission:	METC Amsterdam UMC

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	NL48360.029.14