Protocol of the study with dual-tasks in Parkinson's disease.

Cognitive improvement in Parkinson's disease after dual-task training. A follow-up study.

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Introduction

Background: Neither pharmacological nor non-pharmacological treatments of Parkinson's disease (PD) have any marked effect on the cognitive ability of patients and our study has therefore explored the possible value of dual-task performance training. Compared with other tests of intellectual health, dual-task performance with exergaming is inherently suitable for the detection of cognitive decline in patients with Parkinson's disease (van het Reve and Bruin 2014 doi: 10.1186/1471-2318-14-134, Monteiro-Junior et a. 2016 doi: 10.4103/1673-5374.177709; Costa et al. 2019 doi: 10.2174/1745017901915010015) It is a rapidly performed, objective and sensitive paradigm, which can revealed a deterioration of cognition in early PD ((Eggenberger et al. 2015, Mirelman et al. 2013, Schättin et al. 2016, Swanenburg et al. 2018). We have now examined dual-task ability to detect cognitive deterioration in Hoehn-Yahr stages I and II, when traditional tests are normal. Furthermore, dual task-performance training has gained a great interest in the treatment of patients with PD. The previous studies focused on the motor ability of the PD patients, while this study will focus on the cognitive changes assessed by dual-task tests. The training with dual-task tests is repeated half and one year later to detect the reproducibility of the effect of training.

Goal of the study

The effect of dual-task performances in PD patients with Hoeh-Yahr stages I and II will be compared with age matched healthy controls.

- The effect of training with dual-task tests for short duration will be examined 5 days, half year and one year later. The maintenance and reproducibility of the results are being detected.

Hypothesis

- Deterioration caused by dual-task performances may be significantly higher in the PD patients, than in the age matched healthy controls, in spite of their similar results in other cognitive tests.

- Achievements with different dual-task activities may differ from each other.

- Short term dual-task training for five days may improve the global cognitive ability assessed by dual-task tests.

- It is supposed that there is an age dependency of the effect of dual-task tests and that of training with dual-task activities.

- Besides short-term effect of training, the long-term improvement and reproducibility are studied in the PD patients a half and one year later.

Number of the PD patients and the age matched healthy controls

Fifty patients with Parkinson's disease in their stage of Hoehn-Yahr I and II and 50 controls will be involved in the study.

Inclusion criteria

- Inclusion criteria for the PD patients are based on the UK PD Brain Bank (Reichmann, Neurodegenerative Dis 2010)

- The PD patients with no functional deterioration.in Hoehn-Yahr stage I and II are included.

- Subjects between 30 and 80 years are involved in the study.

- The patients reacted well for levodopa treatment.

- The age matched healthy controls have not any chronic movement disease or joint problems.

Exclusion criteria

- Persons not signing the informed consent will be excluded.

- Subjects with dementia or minimal mental impairment according to different cognitive tests will be excluded.

- No other chronic disease except hypertonia

- If the person can not stand without holding on to a bar.

Drop out

- If the person refuses cooperation.

- Infection disease demanding hospitalization.

The place of examinations

Institute of Neurorehabilitation, Major-köz 3., Sopron, Hungary

Study design

This is an open study. The first part of the present work is a comparative study with age-matched healthy controls. The second part of the follow-up research is a self-controlled experiment with PD patients.

Process of the investigation

- Detailed physical examination with laboratory tests.

- Two neurologists, experts in movement disorders, detect the Parkinsonian symptoms and decide the severity of PD disease (Hoehn-Yahr stages, UPDRS).

- Psychologist administers Mini Mental Rating Scale, Ziehen-Ranschburg word pair test, Clock drawing, Hamilton Depression Scale, Trail Making Test.

- Walking for 6 minutes and walking along 10 m are tested.

- Patients and controls are divided into two groups according to their ages (under 65 years and above 65 years).

- The control subjects are selected from the staff of the Inst. of Neurorehabilitation and from the relatives of the patients.

- A physiotherapist controls the activity of participants. on Dividat-Sensor.

- Five dual-task performances with different difficulties are selected. Every test lasts for one and a half minutes.

- Every participant will perform the tests in the mornings of five consecutive days.

- Patients coming back after a half year and one year later will repeat the same tests on the equipment of Dividat and all of the other tests will be replicated.

Methods

Measurement of the effect of dual-task performances on Dividat Senso

- Dual-tasks performances will be examined using Dividat Senso equipment (HUR, Finland) ((Swinnen et al. 2021; van het Reve and Bruin 2014). The exergaming is a computer assisted equipment, where the virtual world (games) has to be followed by motor activity, and it is suitable for the detection of attention and executive function.

- Participants standing on a glass platform overlying 20 sensors. Sensors are sensitive for foot pressure.

- A cognitive task will be combined with a motor activity task in each test period, with subjects asked to focus on a game presented on a visual monitor. For the motor task, patients will be asked to detect an object appearing at one edge (top, bottom, right or left) of the screen and they will be required to react using leg movements. Five dual-task tests will be applied.

- For cognitive testing, a first ('Bird') task is used in which a bird will have to be selected from different colored figures.

- In a 'Simple' task, red spots will be shown at different positions.

- In the game 'Divided', red spots will be linked to high and low sounds, requiring the patient's movements.

- In the game 'Habitat' four different animals will have to be allocated to their appropriate living area, however steps need, if they are in a wrong living area.

- Dual-task interactions will be quantified by the average reaction times.

- In the game of 'Target', black bullets will move around the monitor, with different speeds, the subject being asked to calculate the speed of the bullets. Correct and incorrect responses will be recorded.

- The tasks will last for one and a half minutes and are repeated each day for five consecutive days.

- Data analysis based on the average reaction times, hits and misses.

Other tests for detecting cognitive function and motor ability

- Mini Mental Rating Scale

- Clock Drawing Test

- Ziehen-Ranschburg Word Pair test

- Trail Making Test

- Hamilton Depression Scale

- Hoehn-Yahr Stages

- Walking ability will be measured as distance walked in 6 mins (in m),

- Unified Parkinsonian Disability Rating Scale (UPDRS)

- 10 m megtételéhez szükséges idő másodpercben

- Time required to walk 10 m (in sec).

- The walking tests will be performed on the first and fifth days of training.

Statistical analysis

Results are expressed as the mean ± standard deviation of mean and sample size for each age group with Parkinson. The normality of data was checked by applying the Shapiro-Wilk's test and the homogeneity of variances was assessed through the Levene's test. For baseline values, we performed the necessary statistical analysis with the nonparametric Mann-Whitney test to determine significant differences for the PD age groups examined (<65,> 65 years), but no significant differences were found. The means of different date (baseline, half year, one year data) were compared by nonparametric Friedman ANOVA, significance values have been adjusted by the Bonferroni correction for multiple tests. The analysis was two sided with a level of significance of $\alpha = 0.05$. All statistical analyses were performed using the SAS 9.4 (SAS Institute Inc., Cary, NC, USA) software package.

Expected results of the study

- Delayed reaction times, increased misses and decreased hits following dual-task performances may be more expressive in Parkinson's disease. The decreased resources of the attention and executive function may be responsible for the limit of dual-task activity in PD.

- Dual- task may be the most sensitive indicator for the cognitive deterioration in the PD patients.

- The training with dual-task performances for a short period may improve the restrictions caused by dual-tasks tests.

- The repetition of short training may preserve the mental health for a long time.

- A short training with dual-task tests may be more useful than a long training for weeks. The rehabilitation is time saving with short training.

References

1. Costa MTS, Vieira LP, Barbosa EO, Oliveira LM, Maillot P, Vaghetti CAO, Carta MG, Machado S, Gatica-Rojas V, Monteiro-Junior RS. Virtual Reality-based exercise with exergames as medicine in different contexts: A short review. Clin Pract Epidemiol Ment Health 2019, 31, 15-20. doi: 10.2174/1745017901915010015

2. Eggenberger P, Schumacher V, Angst M, Theill N, de Bruin E.D. Does multicomponent physical exercise with simultaneous cognitive training, boost cognitive performance in older adults? A 6-month randomized controlled trial with a 1-year follow-up. Clinical Interventions in Aging 2015, 10, 1335-1349. doi: 10.3389/fnagi.2020.00197

3. .Hoehn, M.M., Yahr, M.D., Parkinsonism: onset, progression, and mortality. Neurology 1967, 17, 427-442.

4. Mirelman A, Maidan I, Deutsch J.E. Virtual reality and motor imagery: promising tools for assessment and therapy in Parkinson1s disease. Mov Disord 2013, 28, 1597-1608.

5. Monteiro-Junior RS, Vaghetti CAO, Nascimento OJM, Laks J, Deslandes AC. Exergames: neuroplastic hypothesis about cognitive improvement and biological effects on physical function of institutionalized older persons. Neural Regen Res 2016,11, 201-204. doi: 10.4103/1673-5374.177709.

6. Reichmannn H Clinical criteria for the diagnosis of Parkinson's disease. Neurodegenerative Dis 2010, 7, 284-290. doi: 10.1159/000314478

7. Schättin A, Arner R, Gennaro F, de Bruin E.D. Adaptations of prefrontal brain activity, executive functions, and gait in healthy elderly following exergame and balance training: A randomized-controlled study. Frontiers in Aging Neurosci 2016, 8, 1-12. doi: 10.3389/fnagi.2016.00278

8. Swanenburg J, Wild K, Straumann D, de Bruin E.D. Exergaming in a moving virtual world to train vestibular functions, and gait; a proof-of-concept-study with older adults. Frontiers in Psychology 2018, 9, 1-9. doi: 10.3389/fphys.2018.00988

9. van het Reve E, de Bruin ED. Strength-balance supplemented with computerized cognitive training to improve dual task gait and divided attention in older adults: a multicenter randomized-controlled trial. BMC Geriatrics 2014, 14, 134. doi: 10.1186/1471-2318-14-134

Examiners taking part in the study

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