The onset side of the disease influences the manual dexterity in patients with Parkinson's disease

ORIGINAL ARTICLE

O lado de início da doença influencia a destreza manual de pacientes com doença de Parkinson

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doi: http://dx.doi.org/10.11606/issn.2238-6149.v29i3p223-229

Lahr J, Pereira MP, Pelicioni PHS, Batistela RA, Gobbi LTB. The onset side of the disease influences the manual dexterity in patients with Parkinson's disease. Rev Ter Ocup Univ Sao Paulo. 2018 Sept-Dec;29(3):223-9.

ABSTRACT: Parkinson's disease (PD) is characterized by the asymmetrical onset of motor symptoms and by compromising manual dexterity. It is expected that patients with preferred onset side affected can maintain a good performance with the most affected side (MAS) in the manual dexterity test due to the life-long motor experience. The aim of this study was to verify the interference of coincidence between the onset side of the disease and manual preference in the performance of manual dexterity, MAS and less affected side in patients with PD. Patients were distributed according to the onset side of the disease: the Coincident Group (preferred side affected) and Non-Coincident Group (non-preferred side affected). Manual dexterity was assessed by the adapted Annett Pegboard test. The two-factor statistical analysis ANOVA (group × side), with repeated measurements in the last factor, revealed that the Non-Coincident Group spent more time to complete the test with the MAS (p=0.001), while the Coincident Group spent similar time with both sides, indicating that patients in the initial stages of PD and with disease onset in the preferred side lose manual proficiency. It is suggested that interventions to improve manual skills should be applied from the diagnosis of the disease, especially in patients with the preferred side affected.

Keywords: Hypokinesia; Motor Skills; Hand; Functional laterality.

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RESUMO: A doença de Parkinson (DP) é caracterizada pelo início assimétrico de sintomas motores e compromete a destreza manual. Espera-se que pacientes com o lado de início da doença preferido comprometido consigam manter bom desempenho com o lado mais afetado (LMA) no teste de destreza manual decorrente da experiência motora ao longo da vida. O objetivo do estudo foi verificar a interferência da coincidência entre o lado de início da doença e preferência manual no desempenho da destreza manual, LMA e lado menos afetado, em pacientes com DP. Os pacientes foram distribuídos conforme o lado de início: Grupo Coincidente (lado preferido acometido) e Grupo Não Coincidente (lado não preferido acometido). A destreza manual foi avaliada pelo teste Annett Pegboard adaptado. A análise estatística ANOVA de dois fatores (grupo x lado), medidas repetidas no último fator, revelou que o Grupo Não Coincidente dispendeu maior tempo para completar o teste com o LMA (p=0,001), enquanto, o Grupo Coincidente dispendeu o mesmo tempo com ambos os lados, indicando que pacientes nos estágios iniciais e com início da doença pelo lado preferido perdem a proficiência manual. Sugerese que intervenções para melhorar as habilidades manuais sejam aplicadas desde o diagnóstico da doença, principalmente em pacientes com o lado preferido acometido.

Descritores: Hipocinesia; Destreza motora; Mãos; Lateralidade funcional.

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INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disease characterized by the unilateral onset of the symptoms, resulting from the asymmetrical loss of dopamine in the basal ganglia[1,2]. The asymmetry of motor symptoms persists along the course of the disease; therefore, there will be a more committed side, the one in which the disease started (MAS – most affected side), and one that will later be compromised, which, however, will always be less affected than the first (LAS – less affected side)[1].

The onset side of the motor systems is associated to manual preference[3], and most PD patients have the disease onset in the side of manual preference[2]. Such fact becomes important when we consider that the lateral preference is frequently associated to the advantage of one hemibody in relation to another[4]. The impairment of the preferred side may negatively influence in the development of motor skills[5], such as manual dexterity.

One of the most frequent complaints of PD patients is precisely related to manual dexterity[6], which is impaired from the initial stage of the disease[7]. This impairment generates limitations in work and leisure[8], makes it difficult to perform daily life activities, leading to reduced quality of life and independence[9]; such reasons justify and motivated this study.

Although the onset side of PD is associated to manual preference[3], studies have not investigated how the onset side of the disease may interfere with the performance of manual dexterity[10]. Studies have evaluated the impairment of manual dexterity, the MAS and of the LAS[9,11], without considering if the MAS is the preferred side or not.

Due to the asymmetrical characteristic of PD, a worse performance of the MAS is expected when a manual task is performed[11]. Considering that motor impairment is lower at the beginning of the disease, it is expected that patients with the preferred onset side impaired may keep a good performance of the MAS in the manual dexterity test, despite the limitations imposed by the disease, considering the motor experience throughout life[4] and the less motor impairments (assessed by the Unified Parkinson's Disease Rating Scale (UPDRS) – subscale 3) when compared to patients with onset in the non-preferred hemibody[12]. However, this hypothesis has not been tested yet.

The Annett Pegboard is one of the tests used in clinics to assess manual dexterity. This test is easy to apply and consists in transferring and positioning pins with different fittings and diameters in the corresponding holes[13]. The Annett Pegboard test was adapted, showing as modifications the standardization of the format of the socket and diameter of the pin; such standardizations reduce the cognitive component of the test, prioritizing the assessment of the motor component of manual dexterity[14]. The adapted Annett Pegboard test has already been used in PD, being able to discriminate differences related to the severity and subtype of the disease[15].

Understanding the interference on the onset side of the disease in manual dexterity (assessed by the adapted Annett Pegboard test) could contribute to clarification regarding the impairment of the MAS and LAS in PD patients. This would allow the development of better intervention and prevention procedures in order to mitigate the losses of manual skills and functionality of this population. Thus, the aim of this study was to verify the interference of coincidence between the onset side of the disease and manual preference in the performance of manual dexterity (MAS and LAS) in PD patients.

METHODOLOGY

Participants

The participants of this study were selected by convenience with the Physical Activity Program for patients with Parkinson's disease (PROPARKI – Programa de Atividade Física para Pacientes com Doença de Parkinson) of the Universidade Estadual Paulista – UNESP – Campus Rio Claro. Sixteen patients with idiopathic PD participated of this study, right-handed, being 8 patients with the preferred side affected by the illness (Coincident Group) and 8 patients with the non-preferred side affected (Non-Coincident Group), with similar age, disease duration, gender, stage of the disease and impairment (Table 1). Exclusion criteria were: a) patients who were not in the initial stages of the disease, that is, above 1.5 in the Hoehn and Yahr (H&Y) scale, modified version[16]; b) non-preserved cognitive impairment assessed by the Mini-Mental State Examination (MMSE)[17]; c) musculoskeletal impairments in the upper limbs; and d) visual impairment not corrected by the use of glasses. This study adhered to the ethics principles for research involving human beings, according to Resolution 466/2012 of the National Health Council and was approved by the Ethics Research Committee of the Instituto de Biociências of the Universidade Estadual Paulista – UNESP (Protocol no. 3936, 06/05/2012). All participants agreed to sign the Informed Consent Form.

Table 1. Sample characterization

Variables	Coincident Group	Non-Coincident Group	p-value	Effect size
Side preference	(n=8)	(n=8)	----	----
Onset side	R (n=8)	L (n=8)	----	----
Gender (F/M)	5/3	5/3	----	----
H&Y (1/1.5)	3/5	2/6	----	----
Age (years)	65.88±5.48	66.50±5.07	0.668	d=-0.117
Disease duration (years)	5.25±2.54	7.63±3.15	0.315	d=0.259
UPDRS I (points)	2.13±1.35	3.50±1.77	0.096	r=-0.416
UPDRS II (points)	10.00±4.40	12.63±3.29	0.246	r=-0.290
UPDRS III (points)	20.63±8.87	18.50±7.19	0.793	r=-0.065
Total UPRDS (points)	32.75±12.71	34.63±9.91	1.000	r=0.000
MMSE (points)	26.13±3.04	28.75±1.38	0.054	r=-0.482

R – right; L – left; F – Female; M – male; H&Y – stage of the disease; UPDRS – Unified Parkinson's Disease Rating Scale: UPDRS I – subscale I (cognitive, behavioral and mood components); UPDRS II – subscale II (daily life activities); UPDRS III – subscale III (motor functions); Total UPDRS – (disease severity); MMSE – Mini-Mental State Examination (cognitive screening performance)

Procedures

PD patients were assessed in the Posture and Locomotion Studies Laboratory of the Universidade Estadual Paulista – UNESP – Campus Rio Claro, under the influence of antiparkinson medication (approximately 1 hour after its ingestion), regarding their clinical and cognitive conditions. After, manual dexterity was evaluated.

In the clinical evaluation, patients were assessed regarding the impairment and stage of disease progression through two scales: 1) UPDRS, which assesses the disease impairment and is divided in the following subscales: UPDRS I (cognitive, behavioral and mood components), UPDRS II (daily life activities) and UPDRS III (motor functions). The higher the score in these subscales, the greater is the psychical, functional and motor impairment, respectively[18]. 2) H&Y scale, modified version, which establishes the stage of disease progression. Patients in Stage 1: unilateral impairment and Stage 1.5: axial and unilateral impairments were included in this study[16]. After clinical evaluation, cognitive screening was performed using the MMSE[19], and schooling was considered as a cut-off grade according to Brucki et al.[17].

Patients were classified regarding the onset side of the disease according to the calculation of the score difference between the right and left hemibodies, in items 20 to 23, 25 and 16 of the UPDRS III[20]. These items evaluate the presence and the level of impairment of motor symptoms of tremor, rigidity and bradykinesia of the upper and lower limbs. The hemibody with the highest score was considered as the onset side of the disease. Manual preference was defined as the hand used for writing[21]. The adapted Annett Pegboard test was used to assess manual dexterity[14,15]. The equipment used for this test (Figure 1) consists in a wooden rectangular board with 32 cm long, 18 cm wide and 5 cm thick. Positioned at 1.5 cm from the edge of each side of the rectangle, there are two rows of 15 cm long with 10 holes (with a distance of 12 cm from each other) with 1.2 cm in diameter and 3.5 cm deep. In the row distant from the participant, 10 pins were positioned (1 per hole) with 7 cm of height and 1.0 cm in diameter[13].

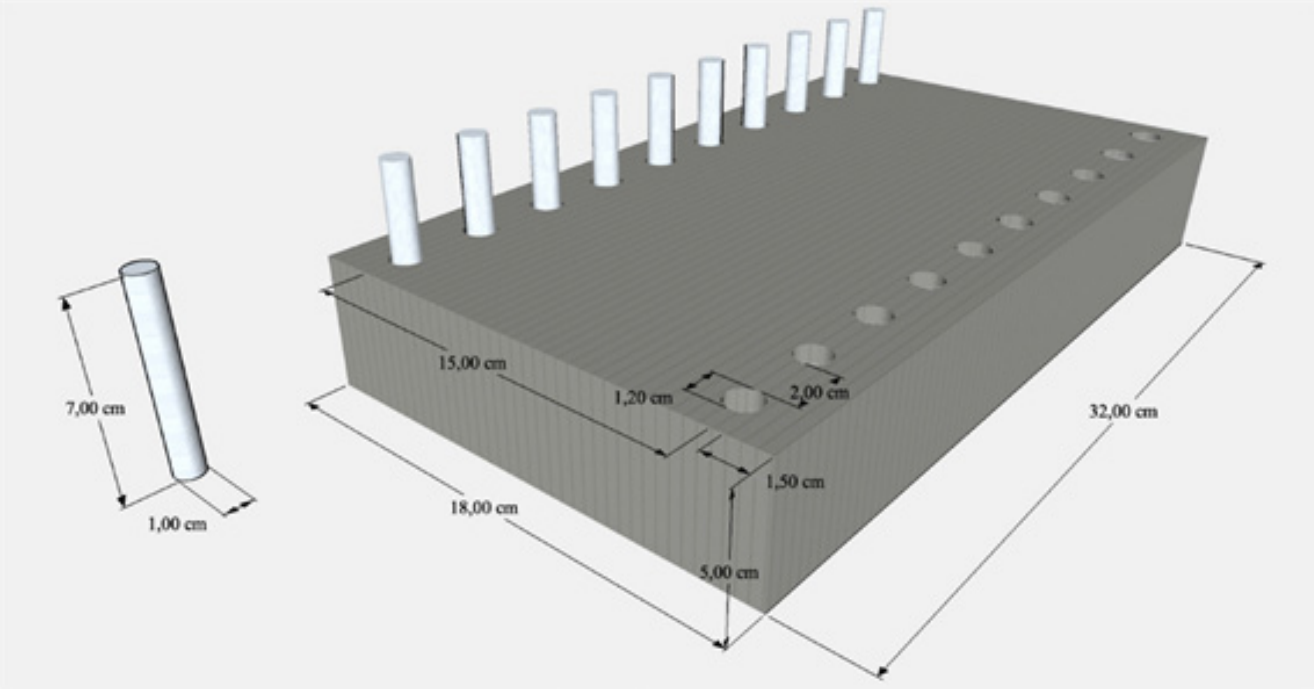


Figure 1 – Illustration of the adapted *Annett Pegboard* test

According to the original description of the test, the equipment was positioned on a table, in such a way that the row with pins was the one farthest ahead of the participant. The participant was sitting and was instructed to move one pin at a time, as fast as possible, by placing them in the corresponding empty holes. The test was timed and completed with the transfer of all the pins. It was performed with both hands: with the right hand, the movement of the pins occurred from right to left, and vice versa. An attempt of familiarization was performed, which preceded three consecutive attempts of each hand, the first three being performed with the right hand and the others with the left. If a pin fell during the attempt, it was repeated[13]. During the test, verbal stimulus was offered in order to optimize the performance. Thus, the shorter the time spent for placing the pins in the holes, the better the manual dexterity is considered[13,22]. The mean time of three attempts (in seconds) was considered for the MAS and LAS.

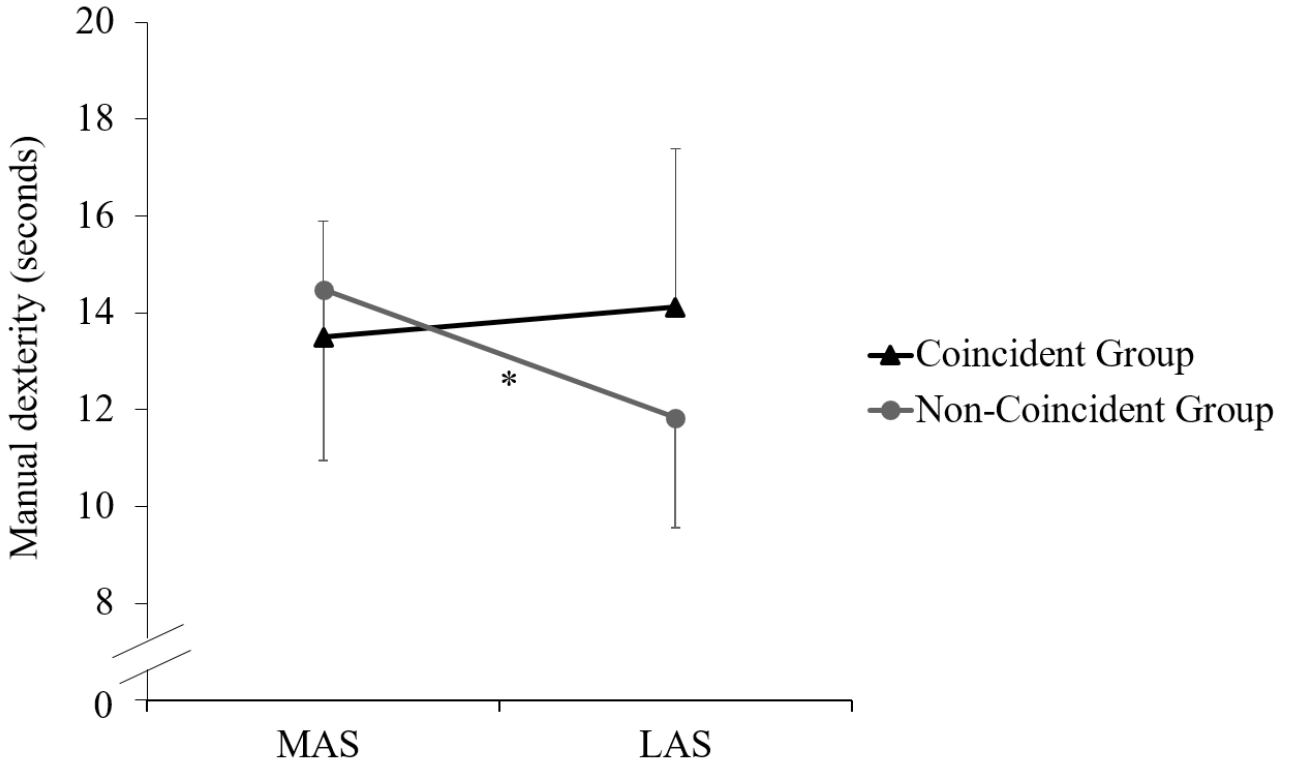
Statistical analysis

Initially, descriptive analysis was used. Then, normal distribution and homogeneity of variances were observed through the ShapiroWilk and Levene tests, respectively. For the comparison between the groups in the characterization variables, the Student's t-test was used for independent samples, and the effect size was estimated through the Cohen's d ($d = \bar{x} - \bar{x} / \sigma$). For the clinical and cognitive variables, the Mann-Whitney U test was used, and the effect sizes were calculated through correlation coefficient ($r=z/\sqrt{N}$). For comparison between groups (Coincident Group × Non-Coincident Group) and assessed side (MAS × LAS) in the performance of the manual dexterity test, two-factor (group × side) analysis of variance (ANOVA) was used with repeated measurements in the last factor, and the effect size was estimated through the *partial eta squared*. The Bonferroni *post hoc* test was employed when interaction was found between factors. SPSS (SPSS for Windows® – version 21.0) was used for the statistical analyses and the significance level was set at ≤0.05.

RESULTS

The Student's t-test and the Mann-Whitney U test did not reveal statistically significant differences in the comparison between groups in the variables of clinical and cognitive characterization (Table 1). ANOVA revealed interaction between group and side ($F_{(2.15)}=11.10$; $p=0.013$; $\eta_p^2=0.613$). The Bonferroni *post hoc* test revealed

significant difference for the Non-Coincident Group, showing greater mean value in the time spent to complete the manual dexterity test for the MAS in comparison with the LAS (p=0.001), (Figure 2). No statistical difference was observed for the Coincident Group (MAS=LAS; p=0.448), which spent similar time to perform the task with both hands.



Caption: MAS – Most affected side; LAS – Less affected side; *Statistically significant difference for the Non-Coincident Group of the *post hoc* test (p=0.001).

Figure 2 – Mean and standard deviation of group performance in the manual dexterity test

DISCUSSION

The aim of this study was to verify the interference of coincidence between the onset side of the disease and the manual preference in the performance of manual dexterity (MAS and LAS) in PD patients. Our initial hypothesis was that patients with the onset of the disease in the preferred side (Coincident Group) would have a good performance of the MAS in the manual dexterity test when compared to patients with the onset in the non-preferred hemibody (Non-Coincident Group), due to the lifelong motor experience and to less motor impairments at the onset of the disease. However, our results do not confirm this hypothesis.

The results demonstrated that patients who do not match the onset side with the preferred side spend more time to complete a manual dexterity test with the MAS in relation to the LAS, while coinciding patients spend similar time to perform the task, regardless of the affected side. These results are discussed regarding neuromotor aspects, the complexity of the task, motor symptoms shown by the patients and the implications of the results for clinical practice.

Ham et al.[12] demonstrated that patients with onset of the disease in the preferred hemibody show less motor impairments (assessed by the UPDRS III) when compared to patients with the non-preferred hemibody affected, although both show the same striatal dopaminergic reduction. These authors suggest that patients with onset of the disease in the preferred hemibody show more efficient motor networks with greater neural reserve in the preferred cerebral hemisphere, thus allowing a good motor performance and more intact cognition to better overcome

the clinical impairments related do PD. In this study, the superiority of preferred MAS performance in manual dexterity was not observed.

Previous studies have not investigated the effect of coincidence in the onset side of the disease and manual preference in the performance of manual dexterity. In this way, it can be speculated that the lack of superiority in manual dexterity of the MAS of coinciding patients is due to the complexity of the task. The manual dexterity task requires coordinated control of fine finger movements and demands a complex neural processing[23], a complexity that would not be supplied by the more efficient motor networks[12]. Therefore, manual dexterity impairment seems to be more important than other impairments in PD patients, especially when the preferred side is affected.

Other authors demonstrated that the preferred upper limb is predominantly susceptible to the emergence of several motor symptoms of the disease, such as bradykinesia and tremor[3,24]. The progression of the disease also affects the learning of compensatory strategies to adjust to motor impairments[25]. This learning disability can justify the results found, since no compensatory strategy was observed for the MAS in coinciding patients, even in the initial stages of the disease. The non-observance of compensatory strategies indicated the loss of proficiency in the preferred hand.

Our results highlight the importance of considering the onset side of the disease, preferred or not, in the evaluation between hemibodies in manual tasks. It is known that, in the more advanced stages of the disease, patients tend to change their manual preference[10]. However, this study showed that, from the initial stages of the disease, patients with onset of the disease in the preferred hemibody do not show advantages in the performance of the preferred hemibody. Given these results, interventions aimed at improving/maintaining manual skills from the initial diagnosis of the disease become important, especially in patients with the preferred hemibody affected. In addition, the fact that manual dexterity is not responsive the dopaminergic supplementation and its relationship with the performance in carrying out daily life activities reinforce the need of specific interventions aimed at those manual skills[6].

Among the non-pharmacological interventions, to recover and maintain manual skills, interventions of physical therapy and Occupational Therapy stand out. These interventions must mainly address tasks that involve manual dexterity using adaptive techniques to minimize the limitations resulting from the disease progression, and, consequently, to promote improvement and maintenance of the quality of life in this population[7]. Thus, for such interventions, it is essential to consider the performance in the manual dexterity test as an important metric of daily life activities[9].

The limitations of this study were the small sample size and the lack of validation of the instrument used. It is suggested that future studies should assess a larger sample size, in addition to investigating the other stages of the disease, moderate and advanced, in order to understand how the onset side of the disease influences the performance of manual dexterity throughout the progression of the disease.

CONCLUSIONS

The onset side of the disease influenced the performance of manual dexterity of the MAS and LAS in PD patients. Patients who had the onset of the disease in the preferred hemibody showed proficiency deficits in the preferred hand, while patients with the non-preferred hemibody affected maintained good performance with the preferred hand. Therefore, it is suggested that intervention procedures aimed at improving and maintaining manual skills should be performed from the initial diagnosis of the disease, especially in patients with the preferred hemibody affected, in order to maintain functional independence.

Acknowledgments: the authors thank *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* – Brazil (CAPES) – Financing Code 001, and *Conselho Nacional de Desenvolviment Científico e Tecnológico* (CNPq) – Processes 306389/2013-4 and 142057/2017-7.

This article is part of the research project "Effects of a physical activity program on clinical condition, mental state, functional capacity and postural and locomotor behavior of elderly people with Parkinson's disease", which followed the ethical procedures in force. Institutional Ethics Committee opinion: approved CEP June 05, 2012. Shown as poster "Onset side of the disease and performance in the manual dexterity test in individuals with Parkinson's disease" in the VII International Congress of Physical Education and Human Motricity – XIV São Paulo Symposium of Physical Education, Rio Claro, 2013.

Authors' participation Juliana Lahr – data organization and analysis, text conception and writing; Paulo Henrique Silva Pelicioni and Rosangela Alice Batistela – data collection and text revision; Marcelo Pinto Pereira – data processing and text conception and revision; Lilian Teresa Bucken Gobbi – advisor and responsible for the project conception and text revision.

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Submitted: 16.06.18
Accepted: 22.10.18