ISB 2013 BRAZIL
XXIV CONGRESS OF THE INTERNATIONAL SOCIETY OF BIOMECHANICS
XV BRAZILIAN CONGRESS OF BIOMECHANICS

GAIT PROFILE SCORE AND MOVEMENT ANALYSIS PROFILE IN PATIENTS WITH PARKINSON'S DISEASE DURING COGNITIVE TASK

[1]Danielli Souza Speciali, [2]Elaine Menezes de Oliveira, [3]Jefferson R Cardoso,[1]João Carlos Ferrari Correa, [4]Richard Baker and [1]Paulo Roberto Garcia Lucareli
[1]Universidade Nove de Julho; [2] Universidade Federal de São Paulo [3]Universidade Estadual de Londrina; [4]University of Salford; e-mail: danispeciali@ig.com.br

SUMMARY
Gait disorders are common in individuals with Parkinson's disease (PD) and the concurrent performance of motor and cognitive tasks can have marked effects on gait. The Gait Profile Score (GPS) and the Movement Analysis Profile (MAP) were developed in order to summarize the data of kinematics and facilitate understanding of the results of gait analysis. The aim of the present study was to investigate the effectiveness of the GPS/MAP in the quantification of changes in gait during a concurrent cognitive load while walking in adults with and without PD. Fourteen patients with PD and nine healthy subjects participated in the study. All subjects performed single and dual walking tasks. The GPS/MAP was computed from three-dimensional gait analysis data. Differences were found between tasks for GPS ($P < 0.05$) and GVS (pelvic rotation, knee flexion-extension and ankle dorsiflexion-plantarflexion) ($P < 0.05$) in PD group. The results evidenced gait impairment during the dual task and suggest that GPS/MAP may be used to evaluate the effects of concurrent cognitive load while walking on patients with PD.

INTRODUCTION
Walking is one of the tasks most affected by idiopathic PD. The ability to perform such concurrent tasks is particularly limited in patients with PD, especially when one of the tasks is walking, leading to the impairment of one or both tasks, with a negative impact on activities of daily living. The potential consequences of gait impairment in PD are significant and include increased disability, a greater risk of falls and reduced quality of life [1].

The GPS was developed to summarize data on kinematics and facilitate the understanding of the results of gait analysis. The GPS can be broken down to provide the Gait Variable Score (GVS), based on nine kinematic variables and establish a Movement Analysis Profile (MAP), which describes the magnitude of the deviation of those nine variables across the gait cycle [2,3].

The aim of the present study was to investigate the effectiveness of the GPS and the MAP regarding the quantification of changes in gait during a dual task performed by healthy adults and individuals with Parkinson's disease.

METHODS
After approval by the local ethics committee, fourteen patients (7 female and 7 male) with diagnosis of idiopathic PD (PDG) and nine healthy subjects (CG) (5 female and 4 male) participated in the study. All subjects had to have scores on the Mini Mental State Examination (MMSE) ≥ 24. All subjects performed single (walking free) and dual walking tasks (arithmetic subtraction regressive test).

The kinematics data were collected using three-dimensional gait analysis (Motion Analysis Corporation, Santa Rosa, CA, USA) from a minimum of six trials per subject. Kinematic variables for analysis were based on the Helen Hayes biomechanical model used in the Orthotrack® 6.2 software (Motion Analysis Corporation, Santa Rosa, CA, USA). The GPS/MAP was computed from three-dimensional gait analysis data for each group (Parkinson's disease and control) under the simple task and dual task conditions.

Analysis of variance (ANOVA) was used for comparisons between groups. Interactions between variables were also analyzed. If the F test was significant, multiple comparisons were performed using the Bonferroni test. Cohen's _*d* was used to measure the effect size for both the CG (single versus dual task) and PDG (single versus dual task) for power analysis purposes. Statistical significance in all tests was 5% ($P < 0.05$).

RESULTS AND DISCUSSION
The PDG exhibited different movement patterns when compared to healthy individuals, as demonstrated by comparison of the MAP in Figure 1 (1a/1b and 1c/1d). When the cognitive task was added, the PDG changed the gait pattern.

Statistically significant differences were found between groups for GPS and GVS variables (pelvic tilt, pelvic obliquity, pelvic rotation, hip flexion-extension, hip internal-external rotation, knee flexion-extension and ankle dorsiflexion-plantarflexion). Differences were found between tasks regarding the GPS and GVS (tilt pelvic,

pelvic obliquity, pelvic rotation, hip flexion-extension, hip adduction-abduction, knee flexion-extension and ankle dorsiflexion-plantarflexion) in PDG.

An interaction between task and group was observed in GPS and almost all GVS variables, except for hip internal-external rotation and foot internal-external rotation in PDG during dual task. The effect size observed between PD group and task interaction was high for GPS: right side (Cohen's ¯d=0.99), left side (Cohen's ¯d=0.91) and overall (Cohen's ¯d=0.88). The effect size for GVS was medium in all variables.

The dual tasks lead to a significant increase in multi-joint and multi-plane lower limb joint range of motion in patients with PD. Using this approach it has been possible to verify different compensation strategies adopted by PD and health subjects during DT interference [4].

When two tasks requiring a high degree of information processing are performed simultaneously, the performance of one or both is diminished. This impairment in the primary task and/or secondary task results from the fact that the two tasks compete for similar processing demands [5].

Dual tasking has also been used to identify the risk of falls in patients with PD due to the secondary relationship to postural strategies stemming from the loss of attention and a reduction in gait performance during dual task [1,5].

CONCLUSIONS

Our results showed that the GPS/MAP were efficient to quantify changes in gait in patients with PD during a cognitive task.

REFERENCES

[1] O'Shea S, Morris M, Iansek R. Dual task interference during gait in people with Parkinson's disease: effects of motor versus cognitive secondary tasks. *Physcal Therapy* 2002; **82**:888-97.

[2] Baker R, McGinley JL, Schwartz MH, Beynon S, Rozumalski A, Graham HK, et al. The Gait Profile Score and Movement Analysis Profile. *Gait&Posture* 2009; **30**: 265–9.

[3] Beynon S, McGinley L, Dobson F, Baker R. Correlations of the Gait Profile Score and the Movement Analysis Profile relative to clinical judgments. *Gait&Posture* 2010; **32**: 129-32.

[4] Morris, M., Iansek, R., McGinley, J., Matyas, T., & Huxham, F. Three- dimensional gait biomechanics in Parkinson's disease: evidence for a centrally mediated amplitude regulation disorder. *Movement Disorders* 2005; **20**, 40–50.

[5] Canning, C.G. The effect of directing attention during walking under dual-task conditions in Parkinson's disease. *Parkinsonism & Related Disorders* 2005; **11**, 95-99.

Figure 1: Gait profile score and movement analysis profile in control and Parkinson's disease group during single task and concurrent cognitive load.