

Effect of a cognitive task on standing balance ability of the elderly using Wii balance board

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Abstract – *The purpose of this study was to evaluate standing balance ability using Wii balance board, and to identify the difference between single task and dual task. Ninety five subjects participated in this experiment. The Subjects performed single task (2-leg standing posture on a Wii balance board for 60 seconds and performed dual task included counting backward starting from 50. The center of pressure (COP) values were calculated from the data obtained using Wii balance board, and medial-lateral (ML) & anterior-posterior (AP) directional components of root mean square (RMS) and mean velocity (MV) and 95% confidence ellipse area (CEA) of COP were calculated. The results showed that all directional movements of COP of dual task were higher than single task except AP_RMS. The results of this study showed that considering the cognitive ability while balancing ability evaluation can provide much more information.*

Keywords: Wii balance board, the Elderly, Balance, Dual Task, Cognitive function

1 Introduction

Mild Cognitive Impairment (MCI) is transitional stage between normal aging and dementia [1]. The progression rate to dementia is higher for patients with MCI compared with healthy controls. Since the elderly population is increasing globally, the problem caused by MCI is expected to increase further. Therefore, it is important to check MCI early to prevent dementia. Recently, various studies on the interaction between motor function and cognitive function have been conducted. The dual task method, which requires participants to perform multiple tasks simultaneously, has been used to investigate the effect of cognitive tasks on postural control and vice versa [2]. Dual task is conducted in various methods such as memorized word or backward counting [3, 4]. In previous studies, it was found that the activities of lower extremity muscles were decreased when balancing ability was adjusted while performing cognitive tasks, especially in the elderly people [5]. Therefore, it is expected that there will be variables that show difference according to cognitive function through balance ability. Traditionally, expensive specialized equipment such as force plates has been used for quantitative measurements of body

sway, but more economic and user-friendly equipment such as Wii balance board (Nintendo, Japan) has been gaining popularity in recent years [6]. In this study, we used the Wii Balance Board to evaluate standing balance ability, and to identify the difference between single task and dual task.

2 Method

2.1 Subjects

Ninety five subjects (age: 78.3 ± 4.9 years), who have a normal cognitive level, participated in this experiment. The inclusion criteria were as follows: those capable of walking 10 meters without assistive devices and those with no visual impairment or lower motor neuron disease. The local Ethics Committee approved the study and all participants provided informed consent.

2.2 Experiments

The Subjects performed single task (2-leg standing posture on Wii balance board) for 60 seconds and performed dual task included counting backward starting from 50.

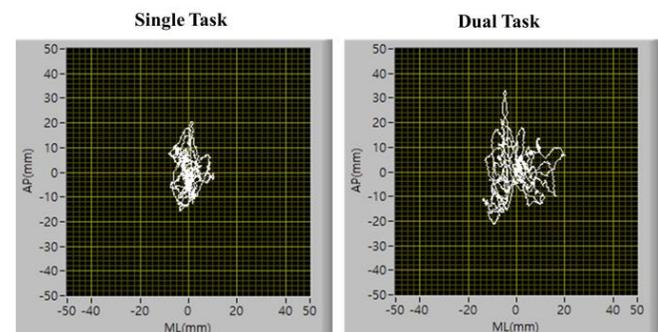


Figure 1. The example of center of pressure trajectories

2.3 Analysis & Variables

COP values were calculated from the data obtained using Wii balance board. In order to reduce the bias of the measurement data, only 11 ~ 50 seconds interval data except 10 seconds before and after were used. Wii balance board data were obtained via LABVIEW (National Instrument Co., USA) with a sampling frequency of 60 Hz. Medial-lateral (ML) & anterior-posterior (AP) directional components of

root mean square(RMS) and mean velocity (MV) and 95% confidence ellipse area (CEA) of COP were calculated. Matlab 2014a (MathWorks, Inc., USA) was used for all data calculation. All statistical tests were performed with use of SPSS vision 24.0 (SPSS Inc, Chicago, USA).

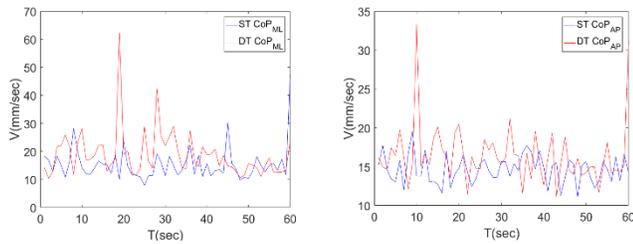


Figure 2. Graph of velocity change of each task

3 Result

Table 1 showed the comparison between single task (ST) and dual task (DT) using Wii balance board. Results by two task showed that the data of DT were bigger than those of ST.

Table 1 Root mean square, mean velocity, and 95% confidence ellipse area value of each task from Wii balance board

	ML_RMS (mm)	AP_RMS (mm)	ML_MV (mm/s)	AP_MV (mm/s)	95% CEA (mm ²)
ST	3.1 ±1.9	5.4 ±1.7	14.6 ±2.4	17.1 ±5.8	267 ±246.2
DT	4.8 ±4.3	5.8 ±2.1	17.1 ±5.8	18.3 ±5.8	500.7 ±529.5
p-value	.00	.05	.00	.00	.00

ST: Single Task, DT: Dual Task, ML: Medial-Lateral, AP: Anterior-Posterior.

P value: paired t-test (ST vs DT) p-value, $\alpha=0.05$

4 Discussion

As shown in Table 1, the results from Wii balance board showed that all directional movements of COP of dual task were higher than single task, which means the decreased balance ability in dual task compared with single task. A statistically significant difference between two tasks was found at all variables except AP_RMS. This is because the central nervous system processing mechanism was being used to perform backward counting tasks, and therefore the ability to standing posture is deteriorated due to decreases in lower extremity muscle activity [5]. Also, AP_RMS did not show any statistical difference, which the evidence is shown that older age seems to be associated with an increased COP sway particularly in the ML direction [7]. The results of this study showed that considering the cognitive ability in balancing ability evaluation can provide much information during the evaluation process. Hopefully future studies will find a unique index of the elderly with MCI through the evaluation of standing balance ability.

5 Acknowledgement

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6 References

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