

The Effect of Ankle Balance Dual Task Including Motor Training on Static Balance and Dynamic Balance in the Elderly

Seoung-Uk Park, PT, MS · Yong-Ho Cho, PT, PhD[†] · Yoon-Tae Hwang, PT, PhD¹

Dept. of Physical Therapy, Daegu Haany University

¹Dept. of Physical Therapy, Gangneung Yeongdong University

Received: July 21, 2017 / Revised: July 23, 2017 / Accepted: August 3, 2017

© 2017 J Korean Soc Phys Med

| Abstract |

PURPOSE: The purpose of this study was to investigate the effect of ankle dual task including motor training on the static balance, dynamic balance in the elderly.

METHODS: 30 elderly people were randomly divided into 3 groups: 10 people in the single motor task group, 10 people in the double motor dual task group and 10 people in the motor-cognitive dual task group. In the double motor dual tasks group was performed ankle balance motor task additional motor task. Motor-cognitive dual task group was performed ankle balance motor task additional cognitive task. Single motor task group was performed ankle balance motor task. It was performed three times intervention a week for six weeks. Statistical analysis method was performed using one way ANOVA for comparison between groups, and the paired t-test was used for comparison pre and post intervention.

RESULTS: Static and dynamic balance were significant differences between pre and post intervention by three groups ($p < .05$). In static balance, there was a significant difference

among groups ($p < .05$), but there was not a significant difference between groups in dynamic balance ($p > .05$).

CONCLUSION: The results of the research, the ankle balance dual task including motor or cognitive task was more effective than single motor task on static balance in the elderly.

Key Words: Dual task, Dynamic balance, Elderly people, Static balance

I. Introduction

Falling is a major cause of mortality and morbidity in the elderly and a health problem caused by the physical activities of the elderly (Schuchat and Wenger, 1994). The frequency of falls is increasing due to the growing elderly population, and falling is emerging as a social problem because of the high risk of recurrence (Close et al., 1999; Lee and Bea, 2007). In elderly people, physical abilities are weakened by aging and health conditions are deteriorated by diseases. Musculoskeletal regression due to aging leads to muscle atrophy, low muscular function, and muscle weakness, which make balancing difficult (Schlicht et al., 2001).

Balance is the ability to keep within the base of support

[†] Corresponding Author : ptyongho@daum.net

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

and to maintain the body parallel while moving the body (Nashner and McCollum, 1985). Balance is divided into static balance and dynamic balance. Static balance refers to the ability to stand still on a static basis, and dynamic balance refers to the ability to maintain balance while performing motions on a dynamic basis (Ragnarsdóttir, 1996).

Especially for the elderly, the decline of balance acts as a cause of increasing the falling risk in daily living and interfering with motor recovery (Tyson et al., 2006). Interventions to prevent falling include muscular strength training, gait training, and medication. Among them, muscular strength and balance training have been mainly used for exercise methods. Balance training tools include balance pad, aero-step, and balance balls, which are used for the balance training of stroke patients and the elderly as well as for sports rehabilitation and training (Eser et al., 2008; Kim et al., 2011). Balance training through dual tasks is being applied to the elderly and stroke patients. Studies on dual tasks have been conducted on motor-cognitive dual task and double motor dual task. For double motor dual tasks, the changes in body balance, spatial balance index and walking ability were investigated while adding exercise interventions such as ball exercise while maintaining balance (Yang et al., 2007). The cognitive task balance training has been reported to be effective for fall prevention by improving the vision, perception, and balance in the elderly (MacRae et al., 1994; Resch et al., 2011). These preceding studies conducted fragmentary comparison through single task and dual task training (Melzer et al., 2009; Yang et al., 2007), and research on the balance ability of the elderly according to the dual task type is still insufficient.

Therefore, this study investigated the effects of balance training including an ankle balance exercise task according to the type of double motor dual task and motor-cognitive dual task on balance in the elderly in comparison to single motor tasks.

II. Methods

1. Subjects

The subjects of this study were 30 elderly persons aged 65 or older who had no big problems in daily living because they had no special diseases of the nervous system and the musculoskeletal system. Furthermore, the subjects were given sufficient explanation about the purpose of this study, the experimental process, and the experiment method. The subjects who consented to participate in this study were randomized into three groups: double motor dual task group, motor-cognitive dual task group, and single motor task group.

2. Measurement Instruments

In this study, a balance measuring instrument (Biorescue, RM Ingenierie Rodez, France) was used to measure the static and dynamic balance of subjects. For the static balance, the body center movement area was measured while the subjects were standing still for 30 seconds. For the dynamic balance, limit of stability (LOS) was measured with a tool for measuring the maximum limit of stability while the subjects moved their body spontaneously while maintaining stability in standing position. They moved their weight to the front, back, left, right, and diagonal directions as directed on the monitor. For data collection, the average values were determined after three measurements. The effect on muscle fatigue was minimized by giving a three-minute rest between measurements.

3. Procedure

The intervention methods of this study are as follows:

- 1) Double motor dual tasks group
- 2) Motor-cognitive dual tasks group
- 3) Single motor task group

The double motor dual task group kept holding a cup with water additionally while performing single motor task balance training. The motor-cognitive dual task group performed calculation by subtracting seven from a random

three-digit number additionally while performing single motor task balance training. The single motor task group stood straight with both feet on an air cushion. They performed five sets of two-minute training three times a week for six weeks, and took a rest for two minutes between sets.

4. Statistical Processing

In this study, the average and standard deviation of each item were calculated using SPSS 18.0. Matched pair t-test was conducted to compare the static and dynamic balances of each group between before and after the intervention according to the dual task type. In addition, one-way ANOVA was performed for inter-group comparison. The statistical significance level was set at .05.

III. Results

In the inter group comparison, there is not significant difference between group in pre intervention ($p > .05$). The body center movement area of the double motor dual task group and the motor-cognitive dual task group showed significant differences with those of the single motor task group in post intervention ($p < .05$) (Table 1).

In 3 groups, significant differences were observed in the body center movement area between pre and post the intervention ($p < .05$). The movement distances of LOS for dynamic balance showed a significant difference between pre and post intervention ($p < .05$). However, no significant differences in LOS were found between groups ($p > .05$) (Table 2, 3).

Table 1. Comparison balance ability between groups in post intervention (unit : mm²)

	DMDTG	MCDTG	STG	<i>p</i>
	Mean ± SD	Mean ± SD	Mean ± SD	
Static balance	23.90 ± 6.62	32.10 ± 12.65 [†]	51.40 ± 24.16 [†]	.002*
Dynamic balance	2228.90 ± 735.68	2010.60 ± 682.42	2356.90 ± 1049.87	.651

DMTG: Double motor dual Task Group, MCTG: Motor-Cognitive Dual Task Group, STG: Single Motor Task Group

[†] significant difference compared to STG

* $p < .05$

Table 2. Surface area in each groups for static balance (unit : mm²)

	Pre	Post	<i>t</i>	<i>p</i>
	Mean ± SD	Mean ± SD		
DMDTG	92.70 ± 62.55	23.90 ± 6.62	3.58	.006*
MCDTG	86.90 ± 44.09	32.10 ± 12.65	4.41	.002*
STG	83.10 ± 40.80	51.40 ± 24.16	3.87	.004*

DMTG: Double motor dual Task Group, MCTG: Motor-Cognitive Dual Task Group, STG: Single Motor Task Group

* $p < .05$

Table 3. Limit of stability following on standing for dynamic balance (unit : mm²)

	Pre	Post	<i>t</i>	<i>p</i>
	Mean ± SD	Mean ± SD		
DMDTG	1778.50 ± 955.08	2228.90 ± 735.68	-4.18	.002*
MCDTG	1621.80 ± 900.79	2010.60 ± 682.42	-3.78	.004*
STG	1946.80 ± 1186.93	2356.90 ± 1049.87	-3.60	.006*

DMTG: Double motor dual Task Group, MCTG: Motor-Cognitive Dual Task Group, STG: Single Motor Task Group

* $p < .05$

IV. Discussion

This study was conducted to investigate the effects of dual task balance training including ankle balance motor task on the balance of the elderly according to the type.

In this study, the body center movement area, which represent static balance, was measured while the subjects were in standing position. The body center movement area in standing position decreased significantly for all the three groups.

The intergroup comparison results showed significant differences in the body center movement area between the double motor dual task group and the single motor task group, as well as between the motor-cognitive dual task group and the single motor task group. Hiyamizu et al. (2012) reported that cognitive task balance training for three months improved the muscular strength, balance, and cognitive abilities. Lindemann et al. (2004) found that visual cognitive task balance training improved balance ability by reducing the postural sway in the elderly subjects. Other studies also found improved postural stability as a result of reduced postural sway through the performance of dual tasks (Pellecchia, 2005; Riley et al., 2005; Verhoeff et al., 2009). The results of this study also showed that double motor dual task training improved balance ability. When single motor task group and double motor dual task group were compared, the dual task training showed more effective results in balance training as in other previous studies.

In addition, the dynamic balance was measured in this study. When movement areas in the front, back, left, and right directions were compared, all the three groups of double motor dual task group, motor-cognitive dual task group, and single motor task group showed statistically significant improvements. In the study of Gouglidis et al. (2010), balance training with added cognitive task in the female elderly produced significant differences in LOS, which agreed with the dynamic balance improvement in this study.

Therefore, the results of this study confirmed that dual task training was a better intervention method for enhancing the static and dynamic balance of the elderly than the single motor task training, and the double motor dual task was more effective in static balance.

V. Conclusion

The results of this study will contribute to the improvement of balance in the elderly through various programs to improve the balance of the elderly through dual task training with daily tasks, which are expected to be used actively to prevent falls.

References

- Close J, Ellis M, Hooper R, et al. Prevention of falls in the elderly trial (PROFET): a randomised controlled trial. *The Lancet*. 1999;353(9147):93-7.
- Eser F, Yavuzer G, Karakus D, et al. The effect of balance training on motor recovery and ambulation after stroke: a randomized controlled trial. *Eur J Phys Rehabil Med*. 2008;44(1):19-25.
- Gouglidis V, Nikodelis T, Hatzitaki V, et al. Changes in the limits of stability induced by weight-shifting training in elderly women. *Exp Aging Res*. 2010;37(1):46-62.
- Hiyamizu M, Morioka S, Shomoto K, et al. Effects of dual task balance training on dual task performance in elderly people: a randomized controlled trial. *Clin Rehabil*. 2012;26(1):58-67.
- Kim YJ, Son HH, Oh JL, et al. Effects of dual task balance training on balance and activities of daily living in stroke patient. *J Korean Soc Phys Med*. 2011;6(1): 19-29.
- Lee YK, Bae SS. Risk factors and methods in balance assessment associated with fall in older adults. *J Korean*

- Soc Phys Med. 2007;2(1):73-84.
- Lindemann U, Rupp K, Muche R, et al. Improving balance by improving motor skills. *Z Gerontol Geriatr.* 2004;37(1):20-6.
- MacRae PG, Feltner ME, Reinsch S. A 1-year exercise program for older women: Effects on falls, injuries, and physical performance. *J Aging Phys Act.* 1994;2(2):127-42.
- Melzer I, Tzedek I, Or M, et al. Speed of voluntary stepping in chronic stroke survivors under single-and dual-task conditions: a case-control study. *Arch Phys Med Rehabil.* 2009; 90(6):927-33.
- Nashner LM, McCollum, G. The organization of human postural movements: a formal basis and experimental synthesis. *Behav Brain Sci.* 1985;8(1):135-50.
- Pellecchia GL. Dual-task training reduces impact of cognitive task on postural sway. *J Mot Behav.* 2005;37(3): 239-46.
- Ragnarsdóttir M. The concept of balance. *Physiotherapy.* 1996;82(6):368-75.
- Resch JE, May B, Tomporowski PD, et al. Balance performance with a cognitive task: a continuation of the dual-task testing paradigm. *J Athl Train.* 2011;46(2):170-5.
- Riley MA, Baker AA, Schmit JM, et al. Effects of visual and auditory short-term memory tasks on the spatiotemporal dynamics and variability of postural sway. *J Mot Behav.* 2005;37(4): 311-24.
- Schlicht J, Camaione DN, Owen SV. Effect of intense strength training on standing balance, walking speed, and sit-to-stand performance in older adults. *J Gerontol A Biol Sci Med Sci.* 2001;56(5):M281-6.
- Schuchat A, Wenger JD. Epidemiology of group B streptococcal disease: risk factors, prevention strategies, and vaccine development. *Epidemiol Rev.* 1994;16(2):374-402.
- Tyson SF, Hanley M, Chillala J, et al. Balance disability after stroke. *Phys Ther.* 2006;86(1):30-8.
- Verhoeff LL, Horlings CG, Janssen LJ, et al. Effects of biofeedback on trunk sway during dual tasking in the healthy young and elderly. *Gait Posture.* 2009; 30(1):76-81.
- Yang YR, Chen YC, Lee CS, et al. Dual-task-related gait changes in individuals with stroke. *Gait Posture.* 2007;25(2):185-90.