

Effect of Core Strengthening Exercise Programs on Symmetric Double Limb Support and Balance Ability for the Elderly

The purpose of this study effectiveness of core strengthening exercise programs on symmetric double limb support and balance ability for elderly. The subjects that 30 persons between the ages of 65~80 elderly participated were divided into two groups randomly for 8 weeks. Tetrax interactive balance system and Berg's balance scale were used to assess support and stability. Paired t-tests were used to evaluate the changes before and after intervention. The difference between the groups was compared using an independent t-test. The experimental group showed significantly increase weight support, stability, balance($p<.05$). However, the control group not showed significantly increase weight support, stability, balance($p>.05$). In a variation, experimental and control groups showed significantly increased rate of weight support, stability, balance($p<.05$). Consequently, core strengthening exercise program should be considered as a therapeutic method for the elderly to improve the balance ability and effectiveness on falls.

Key words: *Core Strengthening Exercise; Balance; Stability; Weight Support; Elderly*

Kwon Young Kang^a, Jung Hyun Choi^b, Sang Bin Lee^b

^aSeonam University, Namwon; ^bNamseoul University, Cheonan, Korea

Received : 27 October 2011
Accepted : 30 January 2012

Address for correspondence

Sang Bin Lee, PT, Ph.D
Department of Physical Therapy,
Namseoul University, 21 Maeju-ri,
Sunghwan-eup, Cheonan, Korea
Tel: 82-41-580-2532
E-mail: sblee@nsu.ac.kr

INTRODUCTION

As human body gets older, proprioceptive senses and muscle strength grow weak and the reflex to react to a sudden change declines due to physiological changes following aging. These phenomenon affects the balance ability of body and causes one to obtain a bruise from a fall(1). Balogun et al, stated that a person's balance ability is well-maintained until he or she reaches 40, but the ability continues to decline after 40(2).

According to Woollacott and Shumaway, when a young person falls, a muscle contraction occurs from the direction of distal to proximal in order to keep the balance. However for an elderly, the muscle contraction occurs from the direction of proximal to distal, which makes it difficult for the person to keep the balance(3). Due to the decline in the balance control ability, the incidence of getting a bruise from a fall increases(4), and secondarily, a fear grows inside a person and the person loses confidence, which

makes them to become inactive, and this causes a significant change in the independent daily living(5). Therefore, in order to maintain or increase muscle strength and improve balance and gait velocity in an elderly, various forms of exercise are used such as muscle strengthening exercise, stretching exercise, aerobic exercise and walking(6).

Among these, the core strengthening exercise, one of rehabilitation exercises, is used for athletes. In Europe, it is use as an intervention to prevent and treat stroke, spine and posture revision, and lumbar and cervical pain. Michael and Andre reported that the core strengthening exercise is helpful for muscle strengthening exercises, joint exercises, and equilibrium training and can develop flexibility and stability(7).

Through a stabilization exercise utilizing the core strengthening exercise, muscle control and mobility control abilities are recovered, and recently, it is becoming an essential approach to treat a backpain patient(8, 9, 10). Also, the core strengthening exercise is effective in lumbar stabilization and motor control

training, so it is widely used as a main exercise to maintain body balance(11, 12).

For elderly, a bruise from a fall is a factor that increases the death rate related to fracture, immobility, and injury. The death rate a bruise from a fall for elderly is 8 times higher compared to the rate for children and the hospitalization rate is 10 times higher(13).

In Korea, the medical insurance rate for accidents or injuries of elderly is increasing every year. Among bruised elderly, 56.7% were aged over 65. The average period bruised elderly spend in the hospital ranged from 8 to 15 days(14). Risk factors for getting a bruise from a fall can be categorized into two parts: intrinsic factors and extrinsic factors. Causes for getting a bruise from a fall are age, sex, the level of disability, disease, and the type of drug used(15). From an experiment targeting elderly living in a nursing home, it was shown that decreased flexibility, low extremity strength and visual function, lower tension of muscle, and weakened knee joint were found as repetitive risk factors for bruises.

The issue of elderly getting bruises from a fall has been an objective of interest for many researchers and there needs studies conducted from various perspectives on exercises to prevent it. This study will apply the core strengthening exercise to elderly aged over 65 and observe the effect.

METHODS

Subjects

The subjects for this study were elderly in Gyeonggido J Hospital aged between 65 and 80. The study period lasted for 8 weeks from June 2011 to September 2011. Below criteria was used in selecting a sample, and a total of 30 people were selected(15 in each sample)(Table 1). The experiment was conducted after the objective and method of this study was explained to the subjects and after they signed an agreement to participate. Below is the criteria.

- 1) Can follow direction
- 2) Can walk for 10m or more
- 3) Does not have a central nerve system disorder
- 4) Does not have a vision or hearing disability
- 5) Does not have an orthopedic issue
- 6) Does not use drug
- 7) Does not have a limitation regarding range of motion

Table 1. Characteristics of subjects

		Treatment group(n=15)	Control group (n=15)
Sex	M	7	4
	F	8	11
Age	65~70	7	5
	71~75	4	8
	76~80	4	2

Measurement Instruments

Tetrax

For weight bearing and balance examination, we used Tetrax(Sunlight Inc, Israel), an interactive balance testing and biofeedback system. This device was invented to measure to accurately diagnose stability and test body balance. Force plates are installed in upper and lower part of each foot to examine weight support and balance by section. Using the monitor, the device can execute a biofeedback training.

Berg's balance scale(BBS)

Berg's balance scale evaluates functional performance and is used to measure balance of elderly whose balance ability was damaged. It is a useful device used to express functional aspects during clinical training or studies in numerical values and to evaluate the treatment effect. It consists of 14 questions and takes 15 to 20 minutes to complete(16).

Procedure

The procedure is as follows. First, in hooklying position, co-contract transversus abdominis, multifidus, and pelvic floor muscle to make the bridging position. Maintain the position as cross extending knee joint. Second, lie face down and maintain the crawling position while co-contracting transversus abdominis, multifidus, and pelvic floor muscle, and stretch one arm and the opposite leg, and then repeat the same with the opposite arm and leg. Practice these two positions sequentially. Practice each position for 5 minutes a set for 3 sets. The total exercise time is 30 minutes, and the group was given a break in between so they can stay focused.

Data Analysis

In this study, SPSS(v.17.0) was used to observe the difference between the treatment group that completed the core strengthening exercise and the control group. Values from before and after the treatment was analyzed using the paired t-test, and the difference in the value between the two groups were analyzed with the independent t-test. The statistically significant level was .05.

RESULTS

Comparing before and after of Treatment Group and Control Group

For the treatment group, the weight support improved from 44.13 ± 2.40 to 49.04 ± 1.92 , the stability improved from 17.15 ± 4.10 to 21.77 ± 3.78 , and Berg's balance improved from 46.87 ± 2.05 to 49.54 ± 1.68 ($p < .05$) (Table 2). For the control group, the weight support increased from 49.58 ± 3.17 to 50.68 ± 1.89 , the stability decreased from 19.89 ± 3.35 to 19.69 ± 5.58 , and Berg's balance decreased from 49.25 ± 3.19 to 48.90 ± 4.11 , showing no statistical significance ($p > .05$) (Table 3).

Table 2. Before and after for the treatment group

	Before	After	t	p
Weight support	44.13 ± 2.40	49.04 ± 1.92	-3.812	.014*
Stability	17.15 ± 4.10	21.77 ± 3.78	-4.435	.003*
Berg's balance	46.87 ± 2.05	49.54 ± 1.68	-2.865	.021*

*: $p < .05$

Table 3. Before and after for the control group

	Before	After	t	p
Weight support	49.58 ± 3.17	50.68 ± 1.89	-1.864	.195
Stability	19.89 ± 3.35	19.69 ± 5.58	-.352	.412
Berg's balance	49.25 ± 3.19	48.90 ± 4.11	.805	.214

Comparing the Result between the Treatment Group and Control Group

The change in the weight support was 3.80 ± 2.77 for the treatment group and 1.49 ± 1.29 for the control group. The change in the stability for the treat-

ment group was 5.82 ± 2.65 and for the control group was $.24 \pm 2.11$. And the change in Berg's balance was 3.05 ± 3.29 for the treatment group and $-.31 \pm 2.21$ for the control group. Statistically significant differences were shown ($p < .05$) (Table 4).

Table 4. Amount of changes between the groups

	Treatment group	Control group	t	p
Change in weight support	-3.80 ± 2.77	-1.49 ± 1.29	-2.394	.041*
Change in stability	5.82 ± 2.65	$.24 \pm 2.11$	3.654	.012*
Change in balance	3.05 ± 3.29	$-.31 \pm 2.21$	3.193	.010*

*: $p < .05$

DISCUSSION

The decrease in weight support ability and balance ability in elderly following aging causes independent functional activities to decline and increases the risk of falling(17). Aging also decreases the ability to ready oneself, making it difficult for a person to prepare for unexpected situations. A decrease in the ability to walk also increases the risk of getting injured(18).

Kligman & Pepin conducted a study on the effect of exercises for improving changes in body due to aging and concluded that it is effective to consider elderly's physical condition and ability and assign appropriate exercises(19). Also, they reported that regular exercises, lumbar muscle strengthening exercises, and balance exercises are effective in preventing injury of elderly(20) and they enhances functions of the sensory motor system needed to maintain the body safety(21).

In order for elderly to enjoy a healthy and happy life without worrying about getting a bruise, they need both muscle strength and balance ability. In the past, there has been many researches on posture and balance control and related disorders(3). Among many exercises, the core strengthening exercise recovers posture control function of the body and increases the range of motion, therefore they may be considered as appropriate exercises for elderlies. A research of Skleton & Dinan on muscle strength and dynamic balance training reported that among exercises that prevent bruising, posture training and dynamic balance training were the most effective in decreasing the incident of bruising(22). In this study, it was found that the weight support and balance of the treatment group who went through the core strengthening exercise showed a statistically significant increase($p < .05$).

This agrees with the result of a study where thirty elderly were randomly selected for a 6 week long balance exercise through the biofeedback training and compared to the control group, and the balance performance ability of the treatment group showed that the exercise was effective and showed a statistically significant increase($p < .05$)(23). Hwang & Lee's an 8 week long study was conducted where 15 female elderly who live in a nursing home(7 in the treatment group and 8 in the control group) were selected as a sample, and the treatment group received a dynamic balance stability training using a ball 5 times a week. As a result, there was a statistically significant difference($p < .05$) between the average value for the

treatment group and the control group for the Time Up and Go Test. Also, there was a statistically significant difference($p < .05$) between the two groups value for Berg's balance scale. The outcome of our research agrees with Hwang & Lee's as well(24).

Lumbar muscle is crucial in daily life to allow body to maintain various positions, therefore maintaining enough lumbar muscle strength and stamina is very important. It has been reported that lack of co-contraction in lumbar muscles is deeply related to the instability in lumbar(25). Koumantakis, et al said, to prevent dysfunction in trunk muscle, which causes lumbar instability, one needs to practice the core strengthening exercise(26). Motor learning improves muscle reflex and accelerates proprioceptive sensation that affects balance control, so the core strengthening exercise is an exercise that helps improving balance ability. In this study, the elderly practiced the core strengthening exercise and experienced a statistically significant amount of improvement in balance ability. Thus, the core strengthening exercise can be said that it is an effective exercise in improving balance ability.

CONCLUSION

This study sought to apply the core strengthening exercises to improve the balance ability for elderly in a bid to study an effective exercise method to prevent getting a bruise from a fall. In conclusion, the core strengthening exercise was proven that it was effective in improving balance ability of elderly and in preventing getting a bruise from a fall. The subjects for this group was comparatively healthy. For a better research, it is considered that a study with elderly who have experience of getting a bruise from a fall is necessary.

REFERENCES

1. Steinweg KK. The changing approach to falls in the elderly. *Am Fam Physician* 1997; 56(7): 1815–1823.
2. Balogun JA, Akindele KA, Nihinlola JO, Marzouk DK. Age related changes in balance performance. *Disabil Rehabil* 1994; 16(2): 58–62.
3. Woollacott MH, Shumway-Cook A. Changes in posture control across the life span: a systems approach. *Phys Ther* 1990; 70(12): 799–807.
4. Patla AE, Prentice SD, Robinson C, Neufeld J. Visual control of locomotion: strategies for changing direction and for going over obstacles. *J Exp Psychol Hum Percept Perform* 1991; 17(3): 603–634.
5. Studenski S, Duncan PW, Chandler J. Postural responses and effector factors in persons with unexplained falls: results and methodologic issues. *J Am Geriatr Soc* 1991; 39(3): 229–234.
6. Duncan PW, Studenski S, Chandler J, Prescott B. Functional reach: predictive validity in a sample of elderly male veterans. *J Gerontol* 1992; 47(3): M93–98.
7. Andre NP, Mike J. *The Great body ball handbook*. productive fitness publishing 2007.
8. MacDonald DA, Moseley GL, Hodges PW. The lumbar multifidus: does the evidence support clinical beliefs?. *Man Ther* 2006; 11(4): 254–263.
9. Richardson CA, Snijders CJ, Hides JA, Damen L, Pas MS, Storm J. The relation between the trans-versus abdominis muscles, sacroiliac joint mechanics, and low back pain. *Spine* 2002; 27(4): 399–405.
10. Handa N, Tani T, Kawakami T. The effect of trunk muscle exercise in patients over 40 years of age with chronic low back pain. *J Orthop Sci* 2000; 5(3): 210–216.
11. Nadler SF, Malanga GA, Feinberg JH, Prybicien M, Stitik TP, DePrince M. Relationship between hip muscle imbalance and occurrence of low back pain in collegiate athletes: a prospective study. *Am J Phys Med Rehabil* 2001; 80(8): 572–577.
12. Nadler SF, Malaga GA, Bartoli LA, Feinberg JH. Hip muscle imbalance and low back pain in athletes: influence of core strengthening. *Med Sci Sports Exerc* 2002; 34: 9–16.
13. Tibbitts GM. Patients who fall: how to predict and prevent injuries. *Geriatrics* 1996; 51(9): 24–28, 31.
14. Bayne CG. Falling: why and what to do about it. *Nurs Manage* 1997; 28(12): 22–23.
15. Ryyanen OP. Health, functional capacity, health behaviour, psychosocial factors and falling in old age. *Public Health* 1994; 108(2): 99–110.
16. Berg K, Wood-Dauphinee S, Williams JI, Maki B. Measuring balance in the elderly: validation of an instrument. *Can J Pub Health* 1992; 2: S7–11.
17. Province MA, Hadley EC, Hornbrook MC, Lipsitz LA, Miller JP, Mulrow CD, Ory MG, Sattin RW, Tinetti ME, Wolf SL. The effects of exercise on falls in elderly patients. A preplanned meta-analysis of the FICSIT Trials. Frailty and Injuries: Cooperative Studies of Intervention Techniques. *JAMA* 1995; 273(17): 1341–1347.
18. Lord SR, Castell S. Physical activity program for older persons: effect on balance, strength, neuromuscular control, and reaction time. *Arch Phys Med Rehabil* 1994; 75(6): 648–52.
19. Kligman EW, Pepin E. Prescribing physical activity for older patients. *Geriatrics* 1992; 47(8): 33–4, 37–44, 47.
20. Wolfson L, Whipple R, Judge J, Amerman P, Derby C, King M. Training balance and strength in the elderly to improve function. *J Am Geriatr Soc* 1993; 41(3): 341–343.
21. Lord SR, Caplan GA, Colagiuri R, Colagiuri S, Ward JA. Sensori-motor function in older persons with diabetes. *Diabet Med* 1993; 10(7): 614–618.
22. Skelton DA, Dinan SM. Exercise for falls management: Rationale for an exercise programme aimed at reducing postural instability. *Physiother Theory and Pract* 1999; 15(2): 105–120(16)
23. Kang KY, Lee SB. Effect of Biofeedback Training for Pervention of Falling in Elderly Persons. *J Kor Acad of Phys Ther Sci* 2009; 16(2): 19–26.
24. Hwang SJ, Lee SY. Effects of Balance Control and Functional Activities During Gym Ball Exercises in Elderly People. *J Kor Acad Univ Trained Phys Ther* 2004; 11(3): 25–32.
25. Paul S, Sung. Multifidi muscles median frequency before and after spinal stabilization exercises. *Arch Phys Med Rehabil* 2003; 84(9): 1313–1318
26. Koumantakis GA, Watson PJ, Oldham JA. Trunk muscle stabilization training plus general exercise versus general exercise only: randomized controlled trial of patients with recurrent low back pain. *Phys Ther* 2005; 85(3): 209–225.