



Original Article

## The effects of horse-riding simulator exercise on balance in elderly with knee osteoarthritis

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**Abstract.** [Purpose] The aim of this study was to examine the effects of horse-riding simulator exercise on balance in elderly with knee osteoarthritis. [Subjects and Methods] Fifty elderly patients with knee osteoarthritis were recruited, a horse-riding simulator group performed exercise three times a week for eight weeks. And each exercise was performed for 30 minutes. [Results] The horse-riding simulator group showed significant differences after the intervention in Short Form Berg Balance Scale, Functional reaching test. [Conclusion] The results of this study indicate that horse-riding simulator exercise is effective on knee osteoarthritis. Therefore, horse-riding simulator exercise can be used balance training for knee osteoarthritis.

**Key words:** Knee osteoarthritis, Balance, Horse-riding simulator

(This article was submitted Oct. 21, 2016, and was accepted Nov. 18, 2016)

### INTRODUCTION

Balance is very important in daily activities of the elderly and greatly affects their quality of life. Due to age-related changes, balance ability deteriorates. Osteoarthritis is a degenerative disease that causes severe pain in elderly patients with low pain thresholds. Research has shown that it results in a high disability score, low quality of life, and limited range of motion, in addition to weak muscle strength, poor balance ability, and high risk of falls<sup>1-5</sup>). As osteoarthritis causes severe pain and functional disorders, in general, the clinical treatment is focused on pain management and amelioration of related disorders. The treatments include muscle strength training, electrical stimulation, manual therapy, aquatic therapy, balance therapy, and pharmacotherapy<sup>6</sup>).

As balance ability and falls are closely related in the elderly, exercise therapies need to focus on the maintenance of such ability<sup>7</sup>). Horseback riding exercise is one such therapy. In research conducted by Araújo et al.<sup>8</sup>) where elderly individuals performed horseback riding exercise for eight weeks, the researchers reported that the exercise significantly improved the participants' balance and muscle strength. Unlike other interventions, horseback riding exercise can arouse the interest of patients and motivate them while improving their balance, bone density, muscle strength, and mental state<sup>9-11</sup>). According to some studies, horseback riding exercise increased the static muscular contraction of the rider against the movement of the horse and improved the muscle strength in the quadriceps femoris and knee flexors of young riders<sup>12, 13</sup>).

Most people do not indulge in horse riding because of where they live (i.e., urban rather than rural areas) or the costs and risks involved in horse riding. Hence, simulator horseback riding exercise equipment using virtual reality has been developed for use at home and in small spaces. Previous studies reported that horseback riding exercise significantly increased oxygen intake, minute ventilation, MET, calorie consumption, and muscle<sup>14, 15</sup>). Although various therapeutic approaches have made with horseback riding exercise in the previous studies there is a lack of research on the effects of horseback riding exercise equipment on the balance and gait abilities of elderly patients with osteoarthritis.

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## SUBJECTS AND METHODS

Experimental procedures were performed in accordance with the protocols established by the Institution of Animal Care and Use Committee (IACUC) at the Daegu University.

Include criteria was aged 65 years or over (Table 1), and with a history of none falls in previous year, lower pain for perform experiment, and visual or auditory damage, nervous system or of the vestibular organ problems, who can't understand the contents of the experiment were excluded. After providing information study all subjects received a participation agreement.

In this study, the subjects, while providing conventional physical therapy, 8 weeks three times a week the movement of the horse riding equipment, was carried out for 30 minutes. Before performing horse riding simulation exercise, subjects were educated about exercise program through a research assistant's demonstration. In this study, used the SlimRider (Shinhwa, MX-0004SE, Korea), which is a horse riding simulator. While performing a horse riding equipment exercise, subjects were effort to maintain the correct posture. Exercise intensity was increased gradually according to the state of the subjects while performing the exercise, the research assistant were always observed to prevent falling.

In order to evaluate the balance of the elderly, it was using the FRT (Functional reach test) and SBBSF (Short form berg balance scale). All of the measurement results were expressed as mean  $\pm$  standard deviation.

The SPSS for Windows (version 18.0) was used for data analysis of the study. In order to compare the differences between before and after, it was analyzed using the paired t-test. Statistical significance level was set at  $\alpha=0.05$ .

## RESULTS

In this study, SFBBS scores and range of FRT increased significantly after Horse riding simulator exercise (Table 2).

## DISCUSSION

Osteoarthritis causes severe pain in elderly patients who have a low threshold for pain and high disability scores, thereby resulting in a low quality of life, increased risk of falls, and poor balance ability<sup>1, 2, 6)</sup>. In the present study, the static, dynamic, and functional balance abilities of osteoarthritis patients who undertook horseback riding exercises on exercise equipment were measured using a FRT and SFBBS. The SFBBS score increased significantly after the intervention. The findings are in accordance with those of study that stroke patients performed horseback riding exercise for 35 min five times a week for eight weeks and Araújo<sup>8)</sup> in which elderly patients performed horseback riding exercise for eight weeks. They are also in accordance with the results of Han Jun-young<sup>16)</sup> in a study of stroke patients who performed horseback riding exercise for 12 weeks that an eight-week-long horseback riding exercise significantly improved the BBS scores of osteoarthritis patients. In general elderly, the average BBS score is  $20.60 \pm 4.08$ <sup>17)</sup>. In the present study, the scores of the elderly participants were lower than average before the exercise. After eight weeks of the exercise, the average score was  $22.3 \pm 4.4$ , higher than the average. The results suggest that horseback riding exercise equipment can improve dynamic and functional balance abilities.

Furthermore, according to the FRT results, the static balance ability of the participants improved. These results are in line with the research findings of Yasuhiro et al.<sup>18)</sup> and Kim Sung-gil<sup>11)</sup> where the FRT scores improved significantly after 12-week-long and 8-week-long horseback riding exercise, respectively. An increase in the FRT score is considered an improvement in static balance ability. Based on the findings of the present study, horseback riding exercise equipment seems to improve the static balance ability of the elderly.

## ACKNOWLEDGEMENT

This research was supported by Daegu University Research Grants in 2015.

**Table 1.** General characteristics of the subjects

Variables	Subjects (n=15)
Gender (M/F)	6/9
Age (years)	$76.5 \pm 7.7$
Height (cm)	$160.6 \pm 9.7$
Weight (kg)	$54.7 \pm 9.8$
Mean $\pm$ SD	

**Table 2.** Comparison of measurement values at pre-test and post-test

Variables	Pre	Post
SFBBS (score)	$18.6 \pm 5.8$	$22.3 \pm 4.4^{**}$
FRT (cm)	$19.7 \pm 9.5$	$26.3 \pm 7.5^{*}$

Mean  $\pm$  SD

\* $p < 0.05$ , \*\* $p < 0.01$

SFBBS: short form berg balance scale; FRT: functional reach test

## REFERENCES

- 1) Imamura M, Imamura ST, Kaziya HH, et al.: Impact of nervous system hyperalgesia on pain, disability, and quality of life in patients with knee osteoarthritis: a controlled analysis. *Arthritis Rheum*, 2008, 59: 1424–1431. [\[Medline\]](#) [\[CrossRef\]](#)
- 2) Alkan BM, Fidan F, Tosun A, et al.: Quality of life and self-reported disability in patients with knee osteoarthritis. *Mod Rheumatol*, 2014, 24: 166–171. [\[Medline\]](#) [\[CrossRef\]](#)
- 3) Ettinger WH Jr, Afbale RF: Physical disability from knee osteoarthritis: the role of exercise as an intervention. *Med Sci Sports Exerc*, 1994, 26: 1435–1440. [\[Medline\]](#) [\[CrossRef\]](#)
- 4) Duffell LD, Southgate DF, Gulati V, et al.: Balance and gait adaptations in patients with early knee osteoarthritis. *Gait Posture*, 2014, 39: 1057–1061. [\[Medline\]](#) [\[CrossRef\]](#)
- 5) Khalaj N, Abu Osman NA, Mokhtar AH, et al.: Balance and risk of fall in individuals with bilateral mild and moderate knee osteoarthritis. *PLoS One*, 2014, 9: e92270. [\[Medline\]](#) [\[CrossRef\]](#)
- 6) Brakke R, Singh J, Sullivan W: Physical therapy in persons with osteoarthritis. *PM R*, 2012, 4: S53–S58. [\[Medline\]](#) [\[CrossRef\]](#)
- 7) Skelton D, Dinan S, Campbell M, et al.: Tailored group exercise (Falls Management Exercise—FaME) reduces falls in community-dwelling older frequent fallers (an RCT). *Age Ageing*, 2005, 34: 636–639. [\[Medline\]](#) [\[CrossRef\]](#)
- 8) de Araújo TB, de Oliveira RJ, Martins WR, et al.: Effects of hippotherapy on mobility, strength and balance in elderly. *Arch Gerontol Geriatr*, 2013, 56: 478–481. [\[Medline\]](#) [\[CrossRef\]](#)
- 9) Cho GH, Kim EJ, Jung JM: The study on the effect of horseback riding. *J Rehabil Sci Res*, 2010, 28: 1–8.
- 10) Park J, Lee S, Lee J, et al.: The effects of horseback riding simulator exercise on postural balance of chronic stroke patients. *J Phys Ther Sci*, 2013, 25: 1169–1172. [\[Medline\]](#) [\[CrossRef\]](#)
- 11) Kim S, Yuk GC, Gak H: Effects of the horse riding simulator and ball exercises on balance of the elderly. *J Phys Ther Sci*, 2013, 25: 1425–1428. [\[Medline\]](#) [\[CrossRef\]](#)
- 12) Westerling D: A study of physical demands in riding. *Eur J Appl Physiol Occup Physiol*, 1983, 50: 373–382. [\[Medline\]](#) [\[CrossRef\]](#)
- 13) Alfredson H, Hedberg G, Bergström E, et al.: High thigh muscle strength but not bone mass in young horseback-riding females. *Calcif Tissue Int*, 1998, 62: 497–501. [\[Medline\]](#) [\[CrossRef\]](#)
- 14) Sung BJ, Chung DS, Kim BH, et al.: The change of HR, VO<sub>2</sub>, VE, MET and Calory expenditure in Horseback-Riding Simulator's Walking Types. *Korean J Sport Sci*, 2004, 15: 1–13.
- 15) Kim SG, Lee JH: The effects of horse riding simulation exercise on muscle activation and limits of stability in the elderly. *Arch Gerontol Geriatr*, 2015, 60: 62–65. [\[Medline\]](#) [\[CrossRef\]](#)
- 16) Han JY, Kim JM, Kim SK, et al.: Therapeutic effects of mechanical horseback riding on gait and balance ability in stroke patients. *Ann Rehabil Med*, 2012, 36: 762–769. [\[Medline\]](#) [\[CrossRef\]](#)
- 17) Karthikeyan G, Sheikh SG, Chippala P: Test-retest reliability of short form of berg balance scale in elderly people. *Glob Adv Res J Med Med Sci*, 2012, 1: 139–144.
- 18) Mitani Y, Doi K, Yano T, et al.: Effect of exercise using a horse-riding simulator on physical ability of frail seniors. *J Phys Ther Sci*, 2008, 20: 177–183. [\[Cross-Ref\]](#)