

Comparison between the Effects of Horseback Riding Exercise and Trunk Stability Exercise on the Balance of Normal Adults

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Abstract. [Purpose] The aim of this study was to compare the effects of horseback riding exercise and trunk stability exercise on static and dynamic balance in normal adults. [Subjects and Methods] Twenty-two normal adults residing in communities were randomly divided into a horseback riding exercise group and a trunk stability exercise group, and they conducted exercise for eight weeks. [Results] Sway times of the COG (center of gravity) decreased significantly, and the A-P (anterior-posterior) and M-L (medial-lateral) velocities significantly decreased in both groups. A comparison of sway times of the COG after the intervention between the two groups revealed that the horseback riding exercise group showed larger decreases than the trunk stability exercise group. [Conclusion] In terms of the musculoskeletal factor, horseback riding may result in functional improvement and increased stability, and it may stimulate proprioceptive sense input in neurological terms. It is therefore considered a composite exercise method that may strengthen the two factors simultaneously.

Key words: Static balance, Dynamic balance, Horseback riding exercise

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INTRODUCTION

Balance is a complex function in which the neurological system and the musculoskeletal system, in combination, maintain posture through diverse functional elements¹⁾. Adjustment of balance is a composite process that requires the integration of sensory information and the execution of appropriate postural response. In order to maintain an erect posture, visual information and sensory information of joints and muscles are integrated by the visual and somatic senses and vestibular system through the central nervous system. This information differs according to task performance functions²⁾. In addition, balance adjustment demands well-adjusted voluntary movements and reflex muscle responses³⁾. In general, interaction among different sensory motor nerves actively adjusts physical stability and tension against gravity (the base of support), vision, and the external environment, enabling stabilization of the center of the body⁴⁾.

Various programs to improve balance have been developed, and these programs in the clinical field include exercises to enhance muscle strength of the lower extremities and proprioceptive sense exercises using biofeedback train-

ing⁵⁾.

Studies have verified the usefulness of trunk stability exercises in improving balance. Hodges and Richardson⁶⁾ observed that trunk muscle strength was related to balance and functional activities. Tyson⁷⁾ noted that balance in a standing or sitting posture was an essential element in performing all physical functions and that balance and functional activities were closely related. Hsieh⁸⁾ asserted that trunk muscles played an important role in enhancing balance and functions, and Verheyden⁹⁾ reported that trunk muscle activities maintained balance against gravity, adjusting posture and preparing for movements of the extremities for activities of daily living.

Recently, horseback riding exercises have been studied with the aim of improving balance. A horseback riding exercise is an exercise to prevent falls and develops vestibular and proprioceptive senses, balance ability in which visual feedback senses the center of gravity, and motor functions¹⁰⁾.

This study compares the effects of trunk stabilization and horseback riding exercises that increase stability of the trunk on improvement of static and dynamic balance.

SUBJECTS AND METHODS

The subjects of this study were 24 undergraduates at K University located in Gyeongsangbuk-do, Republic of Korea. They had no history of neurological and musculoskeletal system diseases, did not have functional disorders of these systems, had no dizziness or other balance disorders,

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Table 1. General characteristics of subjects

	Horseback riding	Trunk stability
Gender (M/F)	6/5	7/4
Age (years)	21.8±2.4	22.3±2.1
Height (cm)	166.8±7.3	169.0±8.1
Weight (kg)	61.0±10.5	63.1±10.9
Mean±SD		

and had not performed regular or systematic exercise. Information about this study was provided to all the subjects, and written consent to participate was obtained from each (Table 1). All the participants understood the purpose of this study and provided written informed consent prior to participation in the study in accordance with the ethical standards of the Declaration of Helsinki.

Subjects were equally divided into a horseback riding exercise group and a trunk stability exercise group. Exercise was conducted three times per week, 40 minutes per time, for six weeks. The horseback riding exercise comprised riding while the horse walked (10 minutes), riding while the horse trotted (20 minutes), and then while the horse walked again (10 minutes). The trunk stability exercise consisted of bridge exercise (20 minutes) and crunch exercise (20 minutes).

In order to test the balance ability of the subjects, a Good Balance System (Metitur Ltd., Finland, AP1135) (GBS), a balance measurement and training system, was used. For measurement of static balance, the subjects stood on a foothold and looked straight ahead with their eyes open. Forward and backward average movement velocity and left and right average movement velocity from the center of pressure were measured for 30 seconds. For measurement of dynamic balance ability, the time from when the subjects moved along the zigzag route displayed on the computer screen without lifting their feet off the ground to when they returned after reaching the target was measured. All measurement results were expressed as means ± standard deviation.

SPSS for Windows (version 18.0) was used to analyze the data. Paired t-tests were used to examine pre- and post-intervention differences, and were analyzed using independent t-tests to examine differences between the groups. The statistical significance level was set to $\alpha = 0.05$.

RESULTS

After the intervention, the sway times of the COG decreased significantly ($p < 0.05$) and A-P velocities (anterior-posterior velocities) and M-L velocities (medial-lateral velocities) significantly decreased ($p < 0.05$) in both groups. A comparison of sway time of the COG after the intervention between the two groups revealed that the horseback riding exercise group showed larger decreases than the trunk stability exercise group ($p < 0.05$) (Table 2).

Table 2. Comparison of pre- and post- intervention measurement values

Variable	Group	Pre	Post
A-P velocity (mm/s)	Horseback riding	5.5±0.3	4.4±0.2 ^a
	Trunk stability	5.6±0.7	4.8±0.7 ^a
M-L velocity (mm/s)	Horseback riding	3.8±0.2	2.8±0.2 ^a
	Trunk stability	3.7±0.2	3.3±0.2 ^a
Sway time of the COG (sec)	Horseback riding	19.0±5.3	12.2±1.6 ^{ab}
	Trunk stability	18.1±2.2	13.3±0.7 ^{ab}

^a Significant difference between pre and post, ^b Significant difference between horseback riding and trunk stability after the intervention.

DISCUSSION

Balance generally refers to an ability to maintain the center of gravity on a base of support in a straight posture and to adjust a posture without falling while moving¹¹. Inappropriate postural adjustment related to such balance triggers problems, such as decreased ability to adjust balance, and reduced stability limits increased postural sway in a standing position. Therefore, balance is essential in all functional actions and an indispensable element in sitting, standing, and walking¹².

Trunk stability exercise is known to be effective in improving balance by increasing balance and stability of the body; as an exercise for the pelvis, it activates the abdominal muscle and multifidus muscle, a small muscle of the vertebrae, concurrently and in harmony¹³.

In the current study, a one leg bridging exercise introduced by Stevens et al.¹⁴ was employed along with a crunch exercise introduced by Marshall and Murphy¹⁵. The results showed that in a static balance test, forward and backward average movement velocity and left and right average movement velocity of the center of the body significantly increased after the trunk stability exercise, and there was also a significant decrease in time during the dynamic balance test.

However, the regular and active assistive movements of the trunk and pelvis made during horseback riding to obtain stability resulted in more positive outcomes compared with the static trunk stability exercise.

During horseback riding, a horse rider's pelvic movements while the horse walks are similar to a non-riding person's pelvic movements during the gait cycle. Therefore, when an individual rides a horse, his or her balance and postural adjustment are stimulated. Basically, the horse rider's pelvic movements caused by the horse trigger automatic physical responses involving static and dynamic movements of the trunk and pelvis, movement of the center of gravity, and rotational movements¹⁶, which is consistent with the present study's results.

Encheff¹⁷ asserted that horseback riding exercise improved postural adjustment of the proximal area, thus bringing about functional improvement of the extremities. Enhanced balance of the trunk leads to stabilization and effective movements of the extremities, evidence that horse-

back riding is an exercise method applicable to patients with neurological system disorders.

Together with a trunk stability exercise, which is an existing method to improve balance, horseback riding was found to be effective in enhancing balance. In fact, horseback riding is considered more effective in improving balance than other exercises in that it leads to a more significant increase in movement velocity and decrease in time taken.

Horseback riding is an exercise that may enhance both static and dynamic balance but has the disadvantages of high cost and a lack of accessibility. Nonetheless, the exercise may simultaneously strengthen musculoskeletal and neurological factors, two factors that improve balance. In terms of the musculoskeletal factor, horseback riding may result in functional improvement and increased stability, and it may stimulate proprioceptive sense input in neurological terms. It is therefore considered a composite exercise method that may strengthen the two factors simultaneously.

This study has some limitations. Because the subjects were healthy individuals, not patients, and the study period was short, results cannot be generalized across different populations. Nevertheless, the balance ability of healthy people converted into numerical values can be utilized as reliable data for research on patients. Clinical experimental research using horseback riding exercises on patients who have problems with balance is warranted.

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