Abstract. [Purpose] The study was conducted to determine the effect of horse riding simulation combined with blindfolding on healthy individuals’ balance and gait. [Subjects and Methods] Thirty subjects were randomly divided into an experimental group (n=15) and a control group (n=15). The subjects in the experimental group covered their eyes using a blindfold, climbed onto a horse riding simulator, and performed the horse riding simulation exercise. The control group took part in the horse riding exercises without a blindfold. All of the subjects performed the 20 minutes long exercise once a day, five times a week, over a four-week period. [Results] The experimental group showed significant improvement in static balance, dynamic balance, velocity, and cadence compared to pre-intervention measurements. In addition, the control group showed significant improvement in static balance, dynamic balance, single support, and cadence compared to pre-intervention measurements. Significant differences in post-training gains in static balance, dynamic balance, and cadence were observed between the experimental group and the control group. [Conclusion] Subjects that performed horse riding simulation exercise after blindfolding showed significant improvements in balance and cadence compared to the control group.

Key words: Balance, Gait, Horse riding simulation

INTRODUCTION

Walking is the most common form of human motion, and is composed of cyclically switching single-support phases. Moreover, the trunk’s ability to balance load is a very important element in this switching motion. The trunk needs to maintain the body’s center of gravity within the base of support, and is an important part of motor control required for individuals to perform various tasks in daily life. Normal sensory feedback and an ability for integrated higher center control are required to continuously maintain the body’s center of gravity within the base of support in the body. Overall, balance is divided into static and dynamic abilities. Maintenance of balance requires a complex process requiring visual and vestibular organs and proper somatosensory response. Among the sensory organs necessary for maintaining balance, vision plays a significant role in maintaining gait and balance. When vision is blocked, there is an increased reliance on the vestibular, proprioceptive, and tactile senses. Hence blindfolding can facilitate these senses and improve balance and gait abilities.

In recent years, exercises such as the Swiss ball exercise, proprioceptive neuromuscular facilitation, virtual reality training, and horse riding simulation have been conducted to improve balance and gait for stroke or polio patients. Horse riding simulation exercise is a feedback exercise designed to correct postural changes following the movements of a mechanical horse. This differs from most other exercises performed for balance improvement because it is a feed forward exercise that can predict movements. The horse riding simulation is an exercise of the whole body, which is performed using muscles and
joints. It can recover the ability to walk and can improve joint range of movements, sense of balance, coordination, muscular strength, and endurance for patients with reduced physical functions.

A number of studies have been conducted to examine the effects of horse riding simulation exercise on trunk muscle activity. However, studies on the effect of this treatment on balance and gait are limited. Therefore, this study was conducted to identify the effects of horse riding simulation with blindfolding on the balance and gait of healthy individuals.

SUBJECTS AND METHODS

Thirty subjects who participated in our experiment were randomly divided into an experimental group (n=15) and a control group (n=15). Those subjects were included who had not undergone orthopedic surgery in the lower limbs, not taken medicine due to neurological problems, and did not have any musculoskeletal back injury. Their average ages, heights, and weights were 21.32 ± 1.04 and 20.13 ± 1.57 years, 169.32 ± 10.01 and 171.24 ± 9.64 cm, and 67.45 ± 12.31 and 66.61 ± 16.32 kg in the experimental and control groups, respectively. Information on the study was provided to all of the subjects prior to their participation and written informed consent was obtained according to the ethical standards of the Declaration of Helsinki.

The subjects in the experimental group covered their eyes using a blindfold, climbed onto a horse riding simulator, and performed the horse riding simulation exercise. The subjects in the control group performed the horse riding simulator exercise in the same manner without wearing a blindfold. All of the subjects performed the 20 minutes long exercise once a day, five times a week, over a four-week period. The horse riding exercise machine (JOBA, EU7805, Panasonic, Japan) creates a figure-eight movement using five axes, and creates three-dimensional movements (front and back, left and right, up and down) similar to the movements of a live horse. The machine is designed to enable the rider to experience various movements similar to the movements of a real horse based on a built-in program in the JOBA simulator. The subjects were instructed to maintain a correct sitting posture after seating themselves, and to hold on to the handle to prevent a fall. They were also continuously instructed by the therapist to make postural corrections while sitting for the correct alignment of the trunk. The speed of the horse riding exercise machine was gradually increased up to Phase 3, according to the adaptability of each subject. A balance measuring device (Good Balance, Metitur, Finland) was used for the quantitative measurement of the ability to balance after the horse riding simulation exercise treatment. In order to measure balance, the subjects were instructed to step onto a triangular platform and maintain a symmetrical standing posture by placing their legs apart at shoulder width. The participants’ head movements were minimized by guiding them to gaze at a fixed forward point. The center of pressure (COP) was measured for 30 seconds while each subject was standing, eyes open, with each arm placed comfortably by the hip joint. After three repeated measurements, their average was calculated.

A gait measuring analyzer (Gait Rite, Technologies Ltd., UK) was used in this study to measure spatiotemporal gait characteristics. It can measure the velocity, step length, stride length, single support, double support, cadence, functional ambulation profile (FAP), step time, and cycle time. Each subject was verbally instructed to walk as usual, while starting from a point 2 m away from an ambulatory mat to help measure the natural gait. The subjects were instructed to lift their heads and look straight forward, and then walk barefoot while naturally moving their upper limbs. Each subject performed this task three times, and the corresponding data were collected. The subject’s dominant leg was used for the gait measurements. The rater reliability was r=0.90, and the interclass correlation coefficient for all of the gait measurements at comfortable gait speeds was substantially high at r=0.96. Data analysis was performed using the SPSS software package version 18.0 (SPSS Inc., Chicago, IL, USA). Mean and SD were calculated for each variable. Before the intervention, differences in the general characteristics of the experimental and control groups were compared using independent t-tests and χ² tests. Comparisons of variables before and after training within each group were made using paired sample t-tests. Comparisons of pre- and post-test differences in variables between the experimental and control groups were performed using the independent t-test. Intergroup effect sizes were calculated using Cohen’s d coefficient. An effect size <0.2 reflects a negligible mean difference; 0.2–0.5, a small difference; 0.5–0.8, a moderate mean difference; and >0.8, a large difference. Statistical analysis was performed at a 95% confidence level, and p values<0.05 were considered statistically significant.

RESULTS

Thirty subjects completed this experiment. Balance and gait were measured for the experimental and control groups before and after intervention (Table 1). The experimental group showed significant improvement in static balance, dynamic balance, velocity, and cadence compared to the pre-intervention results (p<0.05). In addition, the control group showed significant improvement in static and dynamic balance, single support, and cadence compared to the pre-intervention results (p<0.05). Significant differences in the post-training gains in static and dynamic balance and cadence were observed between experimental and control groups (p<0.05). Both the experimental and control groups showed a big gain in static balance (effect size=0.87) and cadence (effect size=1.31).

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This study was undertaken to determine the effects of horse riding simulation exercise with blindfolding on balance and gait of healthy individuals. The experimental group and control group performed horse riding simulation exercise. The experimental group, which was additionally blindfolded, showed statistically significant improvements in balance and cadence compared to the control group.

A previous study reported that horse riding simulator treatment improved symmetrical weight-bearing in a standing posture, and improved balance through the maintenance of correct posture. A horse riding simulation exercise generates 50 to 100 three-dimensional physical movements (front and back, left and right, up and down) due to the movements of the horse riding exercise machine. This exercise can produce effects similar to walking, activate the trunk muscles to continuously maintain balance, and help correct posture. Another study reported that the horse riding simulator normalized the trunk muscle activity and developed equilibrium reactions, to help improve balance in the trunk. This concurs with the present study, in which we found that the horse riding simulation exercise improved balance and gait.

The present study showed improvements in both static and dynamic balance following horse riding simulation exercise with blindfolding. This may be because the subjects have an increased reliance on the vestibular organs and somatosensory system. This then improves the subjects’ motor control, enabling proper maintenance of physical alignment and the spontaneous control of movement. In addition, the improvement in gait found in the study may be from the improved stability and coordination in the trunk. This may have occurred through motor learning of the trunk according to the changes in the base of support. This result suggests that a horse riding simulator can improve balance and gait.

As the horse riding simulation exercise generates higher levels of self-motivation and interest when compared to other exercises, we recommend the clinical application of this exercise for patients with impaired balance.

This study has some limitations in terms of interpreting its results. First, as healthy individuals were used, additional studies should be conducted involving patients with functional disorders. Second, the intervention period was short and no long term follow-up was performed. In addition, the subjects were not properly controlled after the experiment.

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