

Original Article

# The Effects of Hippotherapy and a Horse Riding Simulator on the Balance of Children with Cerebral Palsy

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**Abstract.** [Purpose] We with respect to their effects on the compared hippotherapy with a horseback riding simulator (JOBA, Panasonic Inc. JP) static and dynamic balance of children with cerebral palsy (CP). [Subjects and Methods] Twenty-six children were randomly divided into two groups: a hippotherapy group that included 13 children, and a horseback riding simulator (JOBA, Panasonic Inc., Japan) group, which was also composed of 13 children. The two groups participated in 1 hour of exercise per day, 3 times a week, for 12 weeks. The subjects' static balance ability was measured using BPM (software 5.3, SMS Healthcare Inc., UK) as the center of pressure sway length while standing for 30 seconds with their eyes open and looking to the front. Dynamic balance ability was measured using the PBS (Pediatric Balance Scale). [Results] Both groups showed significant improvements in static and dynamic balance but significant differences between the two groups were not found. [Conclusion] The horseback riding simulator could be a useful alternative to hippotherapy for the improvement of static and dynamic balance of children with CP.

**Key words:** Cerebral palsy, Balance, Hippotherapy

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## INTRODUCTION

Cerebral palsy (CP) is a non-progressive disease with symptoms that include neurological disorders or developmental disabilities. Children with CP have spasticity, musculoskeletal problems, mobility disturbances, and decreased pelvic movements that lead to awkward movement and sitting posture<sup>1, 2)</sup>. Symptoms also induce unstable posture control, imbalance, and aberrant control of movement.

Postural control is the ability to control the body position in space, and it has a relationship with the sense of balance<sup>3)</sup>. Hippotherapy and horseback riding have been suggested as interventions for correcting the balance problems of children with CP<sup>4)</sup>. Two types of horseback riding are available: hippotherapy and therapeutic horseback riding (THR). Hippotherapy provides better pelvic, hip, and trunk movement and influences children's posture, balance, and coordination<sup>5)</sup>. Hippotherapy has short-term beneficial effects on the muscle symmetry of the trunk and hip, whereas THR has no effect on muscle tone<sup>6)</sup>. The effects of these two types of horseback riding have been studied in children with CP, and both types have been demonstrated to improve

gross motor function and promote better standing and bipedal balance<sup>7, 8)</sup>.

A horseback riding simulator (JOBA, Panasonic Inc., Japan) imitates the passive movement of horseback riding. It was developed to overcome the primary limitations of hippotherapy, such as unavailability and high cost. This device offers an indoor experience of horseback riding and mimics the rhythmic movement of horseback riding, thereby promoting muscular strength and improving sense of balance.

The objective of this study was to compare hippotherapy to the use of a horseback riding simulator (JOBA, Panasonic Inc., Japan) with respect to their effects on the static and dynamic balance of children with CP. Our results indicate that a horseback riding simulator has beneficial effects as an intervention for children with CP.

## SUBJECTS AND METHODS

This study included 26 children with CP who were receiving physical therapy at the H horseback riding center and the N horseback riding center in Kyung-Ki in Korea. The selection criteria for the subjects were a Modified Ashworth Scale (MAS) grade less than +1. Children who could perform more than 10 m independent walking and were available for more than 30 min training per day were selected. The parents or guardians of all the participants provided their written informed consent in accordance with the ethical principles of the Declaration of Helsinki (Table 1).

The children were randomly divided into two groups: a

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hippotherapy group that included 13 children, and a horseback riding simulator (JOBA, Panasonic Inc., Japan) group, which also had 13 children. The two groups participated in 1 hour of exercise per day, 3 times a week, for 12 weeks. The hippotherapy group carried out anterior-sitting, posterior-sitting, and side-sitting exercises for 10 min each while horseback riding at a walking pace (6 km/h). The course leader held the reins of the horse and two side-walkers held the child's legs to assist the child in sitting in the saddle in order to prevent the child from falling and to help the child to exercise during the horseback riding walk. The horseback riding simulator group exercised with the same protective equipment and were assisted by the same leader and side-walkers.

Both groups received 20 min of conventional physical therapy before hippotherapy and performed stretching on the horse or horseback riding simulator for 5 min before and after the exercise. Three physical therapists, who had more than 3 years of experience in pediatric physical therapy and had received education in the experimental method, participated in this study.

The subjects' static balance ability was measured using BPM (software 5.3, SMS Healthcare Inc., UK) as the center of pressure sway length while standing for 30 seconds with the eyes open and looking to the front. Dynamic balance ability was measured using the PBS (Pediatric Balance Scale).

All data are presented as mean  $\pm$  standard deviation. SPSS for Windows (version 18.0) was used for the statistical analysis. Statistically significant differences between the measurements obtained before and after the intervention in each group were determined using the independent t-test. Statistical significance was chosen as  $\alpha=0.05$ .

## RESULTS

We evaluated the static and dynamic balance of 26 children with CP. The children were divided into two groups and evaluated pre- and post-test using BPM (software 5.3, SMS Healthcare Inc., UK) and the PBS (Pediatric Balance Scale) (Table 2).

The hippotherapy and horseback riding simulator groups showed significantly decreased sway lengths in the static balance test. Comparison of the pre- and post-test sway lengths showed that the hippotherapy group and the horseback riding simulator group showed significant decreases in sway length of 85 mm and 80 mm, respectively ( $p<0.05$ ). Both groups showed improved static balance, but no significant difference was found between the two groups.

Dynamic balance was also evaluated pre- and post-test using the PBS (Pediatric Balance Scale). The hippotherapy group showed an increase in score of about 4 points, while the horseback riding simulator group showed an increase of 3 points. Both groups showed significant improvements in dynamic balance, but no significant difference was found between the two groups ( $p<0.05$ ).

## DISCUSSION

Balance control is very important for children with CP, and maintaining balance requires three distinct sensory system inputs: visual, somatosensory, and vestibular<sup>9</sup>. Generally, the dynamic sense of balance depends primarily on vestibular input on unstable surfaces; however, static balance primarily depends on somatosensory input. Many studies have investigated balance and clinical tools for children with CP. A systematic review identified 22 tools that can assess balance<sup>10</sup>.

Hippotherapy and THR are types of exercises that affect balance, coordination, and posture, contributing to the development of sensory and perceptual motor skills<sup>6, 11</sup>. A horse's rhythmic movement, velocity, and variations can facilitate righting and equilibrium actions. During hippotherapy and THR, these facilitations improve muscular co-contraction and postural balance resulting in improvements in the gross motor function of children with CP<sup>12-15</sup>.

Many studies of hippotherapy and THR in children with CP have demonstrated they have positive effects on postural control and balance. The horseback riding simulator has also been reported to be beneficial for children with CP, improving their postural control and global function, and providing enjoyment<sup>16</sup>. Haehl et al. found no significant improvement of in hippotherapy and THR but indicated that hippotherapy had positive effects on the postural control and balance of children with CP<sup>17</sup>. Other studies confirmed that hippotherapy and THR are suitable interventions for children with CP.

The horseback riding simulator used in the present study

**Table 1.** General characteristics of subjects

	Hippotherapy	HRS
Gender (M/F)	8/5	9/4
Age (year)	10.8 $\pm$ 1.6	10.0 $\pm$ 2.2
Height (cm)	125.8 $\pm$ 12.6	122.6 $\pm$ 14.3
Weight (kg)	25.2 $\pm$ 6.4	25.5 $\pm$ 5.7

Mean $\pm$ SD, HRS: horseback riding simulator

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

Variable	Group	Pre	Post
PBS (score)	Hippotherapy	35.6 $\pm$ 3.8	41.2 $\pm$ 4.7*
	HRS	35.8 $\pm$ 4.7	38.5 $\pm$ 5.3*
Sway Length (mm)	Hippotherapy	220.1 $\pm$ 27.6	135.0 $\pm$ 14.3*
	HRS	219.9 $\pm$ 31.7	142.8 $\pm$ 18.8*

\* $p<0.05$  Mean $\pm$ SD, PBS: Pediatric Balance Scale, HRS: horseback riding simulator

offers several advantages over hippotherapy. The simulator is free from space limitations, has a low price, is easy to handle, and is non-affected by weather conditions<sup>16)</sup>. Use of the horseback riding simulator resulted in improved muscle strength and contraction in elderly people<sup>18)</sup>. A previous study of children with CP reported that use of a horseback riding simulator significantly improved their postural control and balance<sup>16)</sup>.

Our data indicate that both hippotherapy and use of the horseback riding simulator improved the static and dynamic balance of children with CP. However, due to the fast learning characteristics of children, the long-term 12-week exercise program might have been responsible for the similar results seen in balance improvement. Many factors remain to be considered regarding exercise for children with CP. Therefore, if other tools or exercises were utilized, the results might not match the results presented here. Overall, our results indicate that children with CP may respond equally well to the use of a horseback riding simulator as they do to hippotherapy in terms of balance improvement.

This study had several limitations. First, the number of subjects was small, and second, only static and dynamic balance were evaluated. In spite of these limitations, our results show that the use of a horseback riding simulator can be a good intervention for children with CP. Further studies incorporating larger sample sizes, various CP types, and full utilization of the programs of the horseback riding simulator might be needed.

In conclusion, the horseback riding simulator could be a useful alternative to hippotherapy for improving of static and dynamic balance of children with CP.

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