

# Effects of Hippotherapy on Functional Ability for The Children with Cerebral Palsy

The purpose of this study was to effects of hippotherapy on functional ability of children with cerebral palsy (CP). Fifty–seven children with CP participated were randomly divided into two groups. All of the groups received thirty minutes of conventional physical therapy program for three times a week per twelve weeks, however experimental group received additional fifteen minutes of the hippotherapy. Gross Motor Function Measure(GMFM) was used to compare the effects of hippotherapy. The results were as followings: GMFM score in dimensions A and B significantly increased in the control group after intervention. All dimensions of GMFM was significantly increased in experimental group after intervention. All dimensions of GMFM were significantly different between experimental group and control group. These results suggest that hippotherapy can be considered as a therapeutic method for physical therapy for the children with CP to improve the functional movements.

Key words: *Cerebral Palsy; Functional Ability; Hippotherapy*

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## INTRODUCTION

Hippotherapy has been used with children who have disabilities since the 1950s when it was used primarily for children who had polio. Recently, it has become increasingly popular to use with children who have CP<sup>1)</sup>. CP is a blanket term used to describe a group of neurological disorders that are related, but have different causes, and can usually be recognized within the first years of birth. In contradiction to what many people think, the muscle and nerves of the peripheral nervous system are not responsible for CP symptoms. CP is caused by abnormal neurological signals sent by the brain to the muscles and joints, which in turn respond their environment. In order words, it is the cerebral motor centers that dictate how the body will maintain posture and control movement. So the damage to the brain does not become worse over time. But if muscles and nerves are not taught to respond to external stimuli with normal movement patterns, then dysfunctional neuromo-

tor patterns of the nervous and muscular systems would continue to impede normal function, it is necessary for consistent and accurate input by therapists and other facilitators, to influence cognitive interpretation and motor response of the patient. The main purpose of hippotherapy is the enhancement of sensory processing and neurological and musculoskeletal function, with the purpose of using the horse movements to provide sensory stimulation to the rider. The intension is to promote a normal neural influence that will override the abnormal neural signals. One reason this approach works is because the children are actually having fun in the process.

Theoretically, riding on a horse can improve posture, balance, and overall function by mobilizing the pelvis, lumbar spine, and hip joints, decreasing muscle tone, improving head and trunk postural control, and developing equilibrium reactions in the trunk<sup>1)</sup>. Horseback riding therapy is the use of the rhythmic movement of a horse to provide input to multiple systems in the body to

effect therapeutic gains and automatic reflex mechanisms for postural control and trunk equilibrium reactions can often be achieved more easily on the horse than in a clinic <sup>2)</sup>.

Generally, hippotherapy is a physical therapy treatment strategy in which the movement of a horse is used to improve posture, balance, and overall function. Its inclusion as part of a comprehensive treatment plan to enhance physical therapy outcomes has the added benefit of engaging and motivating the child. Hippotherapy has been used for decades in the treatment of children with CP, as well as for such conditions as multiple sclerosis, traumatic brain injury, developmental delay, muscular dystrophy, and sensory impairments <sup>3)</sup>. However, little objective research has been offered to document the widespread clinical impression of benefit reported by therapists, parents, and pediatricians, particularly for children with CP <sup>4)</sup>. One methodological dilemma is that each child presents with unique impairments and functional limitations, creating difficulties in gathering a homogeneous sample of the population being tested <sup>5)</sup>. Another is that the effect of hippotherapy is potentially multifactorial, making specific cause and effect relations difficult to discern. A few studies have reported improved posture <sup>6,7)</sup> or postural reactions related to balance and posture <sup>8)</sup>.

Heine <sup>2)</sup> theorizes that hippotherapy is successful as a therapeutic modality based on the principle that the three-dimensional swinging motions of the horseback at the walk provide rhythmical movement that stimulates and challenges the rider's sensory receptors body-wide. As a horse walks, his center of gravity is displaced with up and down, side to side, and rotational components of movement, which happen to be similar to the

normal trunk and pelvis patterns humans experience when walking.

In fact, it is difficult to have a horseback riding therapy still in Korea. When we look at the statistics for effectiveness of hippotherapy, the result shows that it is effective. However, there is a controversial points about the effectiveness of hippotherapy. Therefore, the purpose of this study is to find out the effectiveness of hippotherapy using horseback riding on the gross motor function for the children with CP. Horseback riding to simulate how effective the treatment is a CP. Here in this study we used GMFM to evaluate the improvement of functional ability for CP children.

## METHODS

### Subjects

Fifty-seven CP participants were recruited from the rehabilitation center of Bundang Jesaeng general hospital. Participants in the study were fifty-seven children ranging from 6 to 15 years of age diagnosed with CP, who met the following inclusion criteria: <sup>1)</sup> ability to sit independently without back support, <sup>2)</sup> ability to stand and walk independently with or without an assistive device, <sup>3)</sup> ability to cooperate with and follow verbal directions, <sup>4)</sup> sufficient hip abduction to sit astride a horseback simulation machine. Exclusion criteria were: <sup>1)</sup> grand mal seizures uncontrolled by medication, <sup>2)</sup> surgical procedures or lower extremity casting within the 12 months prior to testing, <sup>3)</sup> vision impairment not corrected by lenses, <sup>4)</sup> moderate to severe mental retardation. Table 1 shows demographic and general characteristics of subjects (36 male, 21 female).

Table 1. Characteristics of subjects

Variable			control group	experimental group	total
Age(yrs)			9.08±2.32	10.42±2.91a	
Sex(%)	male		16(28.1)	20(35.1)	36(63.2)
	female		8(14.0)	13(22.8)	21(36.8)
Type(%)	spastic	diplegia	17(29.8)	25(43.9)	42(73.7)
		hemiplegia	2(3.5)	5(8.8)	7(12.3)
		quadriplegia	4(7.0)	1(1.8)	5(8.8)
	athetoid	1(1.8)	2(3.5)	3(5.3)	

<sup>a</sup>Mean±SD

## Exercise Methods

Benda <sup>4)</sup> reported that it was a 12-week period, in this study of subjects will participate in an individualized 12-week horseback riding program (3 time/week for 15 minutes). We separate two groups. All subject treatment plans will be 30 minutes on a conventional physical therapy program. Add to the horseback riding program for 15 minutes in experimental group. They may also ride facing forward sit on the horseback simulation machine. Some will kneel or weight bear on upper extremities or ride in a quadruped position. For safety set up a harness in decreased trunk stability children. Outcome assessment testing will occur prior to the intervention, after completing the intervention, and after an additional 12 weeks assess any carryover effects. Control the assessment testing will use GMFM for functional motor performance measured. GMFM was performed according to the user's manual by physiotherapist with extensive experience in the application of this test 12 weeks after the treatment with hippotherapy. The same examiner performed pre-

and post-treatment GMFM.

## Analysis Methods

Measured data were analyzed by using SPSS and normalized GMFM scores were compared using independent t-test and then paired t-test was used to pretest and posttest. A statistical significance level was set at .05.

## RESULTS

### Changes of evaluation using the GMFM in CP

The functional motor performance during horseback riding training was increased. It was significant in all dimensions experimental group. But change from control group was significant dimension A and B, a functional motor performance is shown in table 2. Table 3 shows the GMFM score on control and experimental group, all dimension showed greatest significant.

**Table 2.** Results of evaluation using the GMFM pretest and posttest

Dimension	control group		p	control group		p
	pre	post		pre	post	
A	86.16±26.45a	85.28±22.15	.044 *	84.50±19.48	86.83±19.65	.049 *
B	69.75±33.61	68.65±32.55	.043 *	67.14±30.17	73.39±29.34	.045 *
C	43.43±33.64	42.59±33.84	.089	43.58±33.13	49.85±34.66	.038 *
D	19.71±12.87	18.71±12.45	.087	18.47±25.18	21.65±25.96	.021 *
E	14.86±24.01	13.86±23.58	.079	16.62±25.22	19.88±27.45	.013 *

<sup>a</sup>Mean±SD \* p<.05

**Table 3.** Results of evaluation using the GMFM control and experimental group

Dimension	control group	experimental group	p
A	-.88±3.41a	2.66±2.77	.001 *
B	-1.10±3.47	2.32±2.30	.001 *
C	-.84±5.14	6.92±9.69	.003 *
D	-1.58±5.98	3.58±3.80	.002 *
E	-1.00±7.02	3.88±5.29	.015 *

<sup>a</sup>Mean±SD \* p<.05

## DISCUSSION

Hippotherapy provides physical, cognitive, emotional, and social stimulation as well as nurturing and developing capabilities that may be untapped through conventional treatment. Despite the unusual nature of hippotherapy, its rationale is based in current theories of motor development and control and established neurophysiologic treatment principles. Dynamic systems theory maintains that the complex human system continuously interacts, adapts, and modifies relative to the dynamic, interrelated and changing factors within the person, task, and environment<sup>12)</sup>. This study performed to investigate the changes of the functional performance with hippotherapy than without hippotherapy. Consistent with the findings of Hammer et al.<sup>13)</sup> the group receiving hippotherapy had statistically significant improvement in scores on standard balance tests following intervention. The result hippotherapy showed statistically significant improvement from pretest to posttest (14-week) on the Berg balance scale and performance-oriented mobility assessment scores. Hippotherapy treatments not only allowed the subjects an opportunity to develop, refine, and practice motor patterns, but also permitted concurrent practice in the integration of sensory information in a controlled environment as a whole task activity<sup>14-16)</sup>. Some disabled children, after a series of hippotherapy sessions, walk with greater ease and demonstrate improved motor function<sup>17)</sup>. Previous investigations of hippotherapy have demonstrated improvements in children with CP with walking, running, jumping along with decreased energy expenditure and increased efficiency while walking<sup>17, 18)</sup>. A recently published study demonstrated that ten weeks of hippotherapy created significant improvements in young children with CP for functional motor performance measured by the GMFM and Pediatric Evaluation of Disability Inventory<sup>19)</sup>. Therefore, therapeutic horseback riding training was thought to be able to effectively functional performance level. For this reason, we suggest that a additional therapy program with a conventional physical therapy program should increase functional performance more effectively than without a additional therapy program, and inclusive the care of patients should be based, to the greatest extent possible, on evidence, whether or not the therapy is considered to be complementary. Haehl et al.<sup>7)</sup> Therapists use hippotherapy to improve postural

control in children with neuromotor dysfunction. Understanding the influence of the horse's movement on the child may clarify mechanisms, which influence posture during hippotherapy. This study was conducted in two phases. First measures of the kinematic relationship between the rider and the horse were developed. A kinematic analysis of the rider's trunk and the horse's back was used to describe postural orientation, postural stability, and temporal phase relations of a novice and an experienced rider. Both riders exhibited biphasic movement patterns in response to the horse's movement. The experienced rider had a more vertical orientation of the trunk and delayed postural response to the movement of the horse. Next we examined the influence of 12 weekly hippotherapy sessions on the postural control, coordination, and function of two children with CP. Both children with CP approximated the biphasic movement patterns exhibited by the two children developing typically. Both also demonstrated improved coordination between the upper and lower trunk, and between the lower trunk and the back of the horse. One child's functional mobility improved. Meregillano<sup>20)</sup> reported that a hippotherapy refers to the use of the movement of the horse as a treatment strategy by physical therapists, occupational therapists, and speech-language therapists to address impairments, functional limitations, and disabilities in clients with neuromusculoskeletal dysfunction, such as CP. Hippotherapy is used as part of an integrated treatment program to achieve functional outcomes. Hippotherapy engages the client in activities on the horse that are enjoyable and challenging. In the controlled hippotherapy environment, the therapist modifies the horse's movement and carefully grades sensory input, establishing a foundation for improved neurologic function and sensory processing. This foundation can be generalized to a wide range of daily activities, making the horse a valuable therapeutic tool for rehabilitation. McGibbon et al.<sup>17)</sup> study was to evaluate the effects of an 8-week program of hippotherapy on energy expenditure during walking; on the gait dimensions of stride length, velocity, and cadence; and on performance on the GMFM in five children with spastic CP.

After hippotherapy, all five children showed a significant decrease in energy expenditure during walking and a significant increase in scores on Dimension E of the GMFM. A trend toward increased stride length and decreased cadence was

observed. This study suggests that hippotherapy may improve energy expenditure during walking and gross motor function in children with CP.

In another study, After hippotherapy, significant improvement in symmetry of muscle activity was noted in those muscle groups displaying the highest asymmetry prior to hippotherapy. No significant change was noted after sitting astride a barrel<sup>4)</sup>. Lechner et al.<sup>21)</sup> in primary rehabilitation patients Ashworth values after hippotherapy were significantly lower than before. Highest improvements were observed in spinal cord injuries with very high spasticity. No significant difference between short-term effect in paraplegic and short-term effect in tetraplegic subjects was found. hippotherapy significantly reduces spasticity of lower extremities in spinal cord injuries. Sokolov et al.<sup>22)</sup> Influence and therapeutic efficacy of horseback riding as a method for complex rehabilitation of patients with late residual stage of infantile CP were studied. Significant increase of a range of active and passive movements in large joints of lower extremities, higher, indices of hand dynamometry on the left, of vital lung capacity as well as a relief of reactive and personality anxiety and depression, higher motivation for rehabilitation treatment, etc., were registered. Neurophysiological study revealed significant changes of afferentation at stem and thalamus cortical levels and of spectral components of cortical rhythmic. The data obtained allow us to consider hippotherapy as an effective method of complex rehabilitation of patients with late residual stage of infantile CP. A combination of sensory stimulation and motor rehabilitation components may be a key mechanism of positive effect.

This study has limitations. Subjects were not randomly assigned to groups. The small number of subjects necessitated the use of analysis and makes it difficult to generalize this information to individuals with different type of CP. Variables that may have affected outcome between the groups, such as cognitive impairments that might affect motor learning, fatigue, or level of motor and sensory impairments, were not controlled.

## CONCLUSIONS

The results of this study demonstrated a statistically significant improvement in functional per-

formance as measured by GMFM and following 12-weeks of hippotherapy intervention. The control group had no improvement in functional performance. The intervention also produced a between group difference in the GMFM scores by 12-weeks, suggesting that improvements in the intervention group may have been caused by the hippotherapy treatments. The small number of participants and the use of parametric analysis of the data make it difficult to state with confidence that hippotherapy would improve functional performance for children with CP. Further studies are needed to determine the scientific evidence and foundation for the use of hippotherapy.

## REFERENCES

1. Liptak,GS. Complementary and alternative therapies for cerebral palsy. *Ment Retard Dev Disabil Res Rev* 2005; 11: 156-63.
2. Heine B. An introduction to hippotherapy. *J Strides* 1997 Apr;10-13.
3. Strauss I. *Hippotherapy: Neurophysiological Therapy on the Horse*. Ontario, Ontario Therapeutic Riding Association, 1995
4. Benda W, McGibbon NH, Grant KL. Improvements in muscle symmetry in children with cerebral palsy after equine assisted therapy(hippotherapy). *J Altern Complement Med* 2003; 9: 817-25.
5. Martin JE, Epstein LH. Evaluating treatment effectiveness in cerebral palsy. single-subject design. *Phys Ther* 1976; 56: 285-94.
6. Bertoti DB. Effect of therapeutic horseback riding on posture in children with cerebral palsy. *Phys Ther* 1988; 68: 1505-12.
7. Haehl V, Giuliani C, Lewis C. Influence of hippotherapy on the kinematics and functional performance of two children with cerebral palsy. *Pediatr Phys Ther* 1999; 11: 89-101
8. MacPhail HEA, Edwards J, Golding J, et al., Trunk postural reactions in children with and without cerebral palsy during therapeutic horseback riding. *Ped Phys Ther* 1998; 10: 143-7.
9. Russell DJ, Rosenbaum PL, Cadman DT, et al., The Gross Motor Function Measure: A means to evaluate the effects of physical therapy. *Dev Med Child Neurol* 1989; 31: 341-52.



10. Russell DJ, Rosenbaum PL, Gowland C, et al., Manual for the Gross Motor Function Measure. 2nd ed. 1993.
11. Russell DJ, Avery LM, Rosenbaum PL, et al., Improved scaling of the Gross Motor Function Measure for children with cerebral palsy: Evidence of reliability and validity. *Phys Ther* 2000; 80: 873–85.
12. Thelen E, Smith LB. *A Dynamic Systems Approach to the Development of Cognition and Action*. Cambridge, MA, The MIT Press, 1995.
13. Hammer A, Nilsagard Y, Forsberg A, et al., Evaluation of therapeutic riding(Sweden)/hippotherapy(United Stated). A single–subject experimental design study replicated in eleven patients with multiple sclerosis. *Physiother Theory Pract* 2005; 21: 51–77.
14. Horak FB. Assumptions underlying motor control for neurological rehabilitation. In: Lister M; eds. *Contemporary Management of Motor Control Problems: Proceedings of the II step conference*. Alexandria, Foundation for Physical Therapy, 1991: 11–27.
15. Nicholson DE. Motor learning. In: Fredericks CM, Saladin LK, eds. *Pathophysiology of Motor Systems: Principles and clinical presentations*. Philadelphia, F.A. Davis Co., 1996: 238–51.
16. Schmidt RA. Motor learning principles for physical therapists. In: Lister M; eds. *Contemporary Management of Motor Control Problems: Proceedings of the II step conference*. Alexandria, Foundation for Physical Therapy, 1991: 49–63.
17. McGibbon NH, Andrade CK, Widener G, et al., Effect of an equine movement therapy program on gait, energy expenditure, and motor function in children with spastic cerebral palsy: A pilot study. *Dev Med Child Neurol* 1998; 40: 754–62.
18. Sterba JA, Rogers BT, France AP, et al., Horseback riding in children with cerebral palsy: Effect on gross motor function. *Dev Med Child Neurol* 2002; 44: 301–8.
19. Casady RL, Nichols–Larsen DS. The effect of hippotherapy on ten children with cerebral palsy. *Pediatr Phys Ther* 2004; 16: 165–72.
20. Meregillano G. Hippotherapy. *Phys Med Rehabil Clin N Am* 2004; 15: 843–54.
21. Lechner HE, Feldhaus S, Gudmundsen L, et al., The short–term effect of hippotherapy on spasticity in patients with spinal cord injury. *Spinal Cord* 2003; 41: 502–5.
22. Sokolov PL, Dremova GV, Samsonova SV. Hippotherapy as a method for complex rehabilitation of patients with late residual stage of infantile cerebral palsy. *Zh Nevrol Psikhiatr Im S S Korsakova* 2002.; 102: 42–5.