

The Effect of Hippotherapy on Ten Children with Cerebral Palsy

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Purpose: The purpose of this study was to determine whether hippotherapy has an effect on the general functional development of children with cerebral palsy. **Methods:** The study employed a repeated-measures design with two pre-tests and two post-tests conducted 10 weeks apart using the Pediatric Evaluation of Disability Inventory (PEDI) and the Gross Motor Function Measure (GMFM) as outcome measures. A convenience sample of 10 children with cerebral palsy participated whose ages were 2.3 to 6.8 years at baseline (mean \pm SD 4.1 \pm 1.7). Subjects received hippotherapy once weekly for 10 weeks between pre-test 2 and post-test 1. Test scores on the GMFM and PEDI were compared before and after hippotherapy. **Results:** One-way analysis of variance of group mean scores with repeated measures was significant ($p < 0.05$) for all PEDI subscales and all GMFM dimensions except lying/rolling. Post hoc analyses with the Tukey test for honest significant differences on the PEDI and GMFM total measures as well as GMFM crawling/kneeling and PEDI social skills subtests were statistically significant between pre-test 2 and post-test 1. **Conclusions:** The results of this study suggest that hippotherapy has a positive effect on the functional motor performance of children with cerebral palsy. Hippotherapy appears to be a viable treatment strategy for therapists with experience and training in this form of treatment and a means of improving functional outcomes in children with cerebral palsy, although specific functional skills were not investigated. (*Pediatr Phys Ther* 2004;16:165–172) **Key words:** cerebral palsy/rehabilitation, child, physical therapy techniques/methods, horses, treatment outcome

INTRODUCTION

Hippotherapy is a treatment strategy using the movement of the horse.¹ Hippotherapy has been used by therapists in Europe since the 1960s for increasing strength, balance, posture, and function. However, only since the 1970s have therapists in the United States been using hippotherapy integrated with traditional treatment strategies.² Therapists who use hippotherapy are experiencing an increased demand for their services in spite of limited clinical research evidence.³ Empirical research that measures functional outcomes is necessary to substantiate effectiveness and the efficacy of hippotherapy as a treatment strategy.^{4,5}

The development of modern-day horseback riding for persons with disabilities was sparked by the 1952 Olympic Grand Prix Dressage victory of Liz Hartel who claimed that riding helped her recover from polio.⁶ In the 1960s, therapeutic riding centers emerged throughout Europe, Canada, and the United States. Therapists in Germany, Switzerland, and Austria popularized the term hippotherapy when they began to use the horse as a treatment tool. In 1969, the North American Riding for the Handicapped Association (NARHA) was formed.² In 1987, a group of 18 American and Canadian therapists went to Germany to study classic hippotherapy and developed a curriculum to train therapists. In 1992, the American Hippotherapy Association (AHA) was formed and became the first section of NARHA to offer continuing education workshops and materials for physical therapists (PTs), physical therapist assistants (PTAs), occupational therapists (OTs), occupational therapist assistants (OTAs), and speech-language pathologists (SLPs). In 2004, AHA became an affiliate partner of NARHA as AHA, Inc., with a mission concentrating on continuing education, materials, and research.⁷

The recreational use of therapeutic horseback riding has been shown to improve coordination,⁸ gross motor

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skills,⁹ midline postural control,¹⁰ head control,¹¹ and coordination.¹² However, hippotherapy is distinctly different from therapeutic horseback riding lessons that teach equestrian skills and provide a recreational activity for persons with special needs.^{12,13} The purpose of hippotherapy is not to teach riding skills or to provide a recreational experience. PTs, PTAs, OTs, OTAs, and SLPs who have a working knowledge of the movement of the horse and its influence on a rider may use hippotherapy to address impairments, functional limitations, and disabilities in children or adults with neuromusculoskeletal dysfunction.²

Haehl et al¹⁴ demonstrated in two subjects that hippotherapy improved postural stability using a kinematic analysis of the rider's trunk and the horse's back in relationship with each other. They also used the Pediatric Evaluation of Disability Inventory (PEDI) to measure functional skill change after 12 weeks of hippotherapy. There was no specific analysis of which skills were most influenced by hippotherapy. McGibbon et al¹⁵ attributed the mean increase in walk/run/jump scores for five subjects on dimension E of the Gross Motor Function Measure (GMFM) to eight weeks of hippotherapy. As evidenced in these studies, the goal of hippotherapy is not that a patient/client be able to do something better while on the horse but that he or she is able to move better when off the horse. Any motor skill or active postural control achieved while on the horse has the potential to influence functional tasks off of the horse. It is hypothesized that the stretching, facilitation, mobilization, spatial orientation, and tactile reactions that are required of the child during hippotherapy will improve posture, balance, mobility, or function in daily living.²

The conceptual framework of hippotherapy may be explained using dynamic systems theory along with theories of motor learning and sensory integration. Through the repetitive, rhythmical movement of the horse in hippotherapy, a child experiences and begins to anticipate movement with each step of the walking horse. The child learns to produce compensatory movements that reduce the displacement of his or her center of gravity and keep him- or herself on the moving horse. Practice and experience are believed to lead to the modification and reorganization of the central nervous system.¹⁶ By affecting multiple systems simultaneously such as the sensory, muscular, skeletal, limbic, vestibular, and ocular systems, hippotherapy may promote modification and reorganization of the central nervous system and increase the likelihood that the learning will be evidenced in movement patterns used in other environments. Hippotherapy is postulated to influence disability and function through the impairment level of the health condition, positively alter activity limitation, and eliminate barrier to participation in contextual situations.¹⁷

Patients are active participants in hippotherapy. They are continually responding to a changing environment that encourages adaptive behaviors or movement strategies to maintain postural control on a dynamic surface.¹³ The development of postural control is postulated to be the foundation for normal gross motor activities,¹⁶ and the acquisition of motor skills is proposed to be dependent on the

development of postural control.¹⁸ If hippotherapy influences postural control in functional patterns, it may also influence the acquisition of motor skills in everyday functional tasks.

In addition to the automatic postural reactions necessary for balance and control, active postural adjustments occur just before voluntary movements such as reaching or stepping. These postural adjustments are considered feedforward, anticipatory strategies.¹⁹ For example, muscle activation of the trunk before reaching for a toy while sitting is a form of feedforward, planned postural adjustment. Successful feedforward postural control is proposed to be dependent on practice and experience with the task and the environment. Insufficient control is believed to create a lack of stability on the base of support and abnormal postural adjustment when reacting to a weight shift independent of the functional activity. One of the consequences of cerebral palsy (CP) is the inability to maintain postural control due to abnormal muscle activation and ineffective movement strategies.¹⁸ In children with CP, the development of automatic postural reactions of righting, equilibrium and protection may be delayed or never develop.²⁰ The responses of those with CP to external disturbances or perturbations are adversely affected. Subsequently, there is a delay in or absence of development of anticipatory control.¹⁹ Therefore, goals of therapy for children with CP commonly include improving the variety of movement patterns, developing more advanced motor skills, and improving postural control and balance, both reactive and anticipatory.^{19,20}

Typically, therapists use handling and verbal cues to stimulate feedforward anticipatory control in a functional task. Therapy balls are commonly used as a dynamic surface to develop postural control in lying or sitting positions. Therapists move the ball and thus provide the direction, speed, and magnitude of postural displacement.¹⁹ Similarly, the horse can be used as a dynamic treatment surface because a therapist can modify the direction, speed, and magnitude of postural displacement of a client on a walking horse. With its proposed effect on postural control, hippotherapy has the potential to be an effective treatment intervention for children with CP with an expectation of carryover into functional activities.

PURPOSE

The purpose of this study was to measure the effect of hippotherapy on children with CP using the PEDI and GMFM as outcome measures. Subjects served as their own controls in a repeated-measures, time-series design to satisfy internal validity and to permit a trend analysis of the development of functional skills.

METHODS

Subjects

A convenience sample of 11 children with CP participated. The researcher contacted physicians and therapists to recruit subjects. Subjects were required to have a primary diagnosis of CP and to never have had hippotherapy. The subjects were between the ages of 2.3 and 6.8 years old

(mean \pm SD 4.1 \pm 1.7) at the start of the study (Table 1). Parental consent was obtained. The study was approved by the Institutional Review Board at The Ohio State University. Medical clearance to ride a horse and a referral for physical therapy were obtained from the children's primary physicians.

Design

A time-series, quasiexperimental research design was selected to show pretreatment, treatment, and posttreatment trends in development. There were four test dates, ie, pre-test 1, pre-test 2, post-test 1, and post-test 2. The time interval between test dates was held constant at 10 weeks. Hippotherapy treatment was provided once weekly for 10 weeks. The implementer of hippotherapy (the primary researcher) was a physical therapist with 18 years of practice experience, certified in hippotherapy, and a NARHA-registered therapeutic riding instructor. All subjects received treatment. Parents were advised to continue therapies at schools or clinics throughout the 30-week study. Any concurrent events that may have affected development such as medical procedures or therapies were reported to the researcher by the parent.

Instrumentation

The GMFM and PEDI were selected as outcome measures because they are quantitative measures responsive to change in function across time. The GMFM is sensitive to changes in gross motor performance irrespective of the type of CP or the direction of change.²¹ The GMFM was constructed specifically to determine whether treatment approaches are effective for children with CP^{22,23} and has been used by researchers as an outcome measure for treatment interventions such as hyperbaric oxygen,²⁴ selective dorsal rhizotomy,²⁵ treadmill training,²⁶ Botox injections,²⁷ conventional versus intensive physical therapy,²² and hippotherapy.¹⁵ The original 88-item GMFM was used in this study.

The PEDI is a comprehensive clinical assessment tool for the evaluation of functional performance of children six months to 7.5 years old. The PEDI can be used to detect significant change in function across repeated measures earlier than the GMFM.²⁸ The GMFM measures gross mo-

tor ability in a clinical testing situation, whereas the PEDI identifies functional performance in the home and community in three areas: functional skills, mobility, and social function. The PEDI is administered by parental/caregiver report through a structured interview.²⁹

Testing Procedure

Parents brought their children to the test location on each test date. Test location was in a preschool building. The researcher administered the PEDI through a structured interview with the parent. Part I (Functional Skills) of the PEDI has 197 items that were answered by the parent and recorded by the researcher. All items were checked as either capable = 1 or unable = 0. No items were left blank.

Subjects were videotaped on each test date while performing the items on the GMFM appropriate to their current skill level. A camcorder was set up on a tripod base in the room on each test date. Subjects were encouraged to attempt as many items as possible to obtain a score for each GMFM dimension.

The GMFM videotapes were later watched and rated by two scorers who had no contact with one another during the study. One scorer was a PT with 26 years of pediatric experience. The other scorer was an OT with 20 years of pediatric experience. The PT received formal training in the use of the GMFM before this study in 1996 and had used the GMFM in practice. The OT was familiar with the GMFM but had no formal training. The researcher used the GMFM manual to train the OT scorer. The OT scorer reviewed the contents of the manual, discussed the scoring procedure with the researcher, and practiced with three nonparticipating subjects before the start of the study.

Interrater Reliability

Reliability was established between the two scorers using videotapes of three children who did not participate in this study performing the GMFM test items. Interrater reliability has been reported as 0.77 and 0.88 using videotaped assessments viewed by therapists with no previous experience using the GMFM.³⁰ The two scorers in this study independently viewed the tapes and scored the performances. The absolute agreement ranged from 79.4% to 96%. The average absolute agreement on the GMFM total was 94.6%. With the exception of 79.4% agreement on the standing dimension D, scorer agreement was very good (>88%) (Table 2). Interrater reliability on the GMFM dimensions and total scores was excellent ($ICC_{[3,1]} = 0.990-0.999$).

Pretreatment Phase

Eleven subjects were tested at baseline Pre-test 1 (PreT₁). Parents were given the opportunity to ask questions about the study or hippotherapy and were presented with a calendar illustrating the 30-week study, including test dates and treatment phase. Videotape, photographs, and literature were available to explain hippotherapy. Several weeks before Pre-test 2 (PreT₂), a letter was mailed to

TABLE 1

Subject Demographics Including Age at Start of the Study

Subject	Age (yr)	Gender	Type of CP	Ambulatory
1	2.25	F	Spastic quadriplegia	No
2	2.33	F	Right hemiparesis	Yes
3	2.58	F	Spastic quadriplegia	No
5	2.75	M	Unspecified	No
6	3.83	M	Spastic diplegia	No
7	4.00	F	Unspecified	No
8	4.33	M	Left hemiparesis	Yes
9	5.83	M	Unspecified	Yes
10	5.97	M	Right hemiparesis	Yes
11	6.83	M	Athetoid	No

TABLE 2

The Average Absolute Rater Agreement on GMFM Dimensions and Total

A	B	C	D	E	Total
Lying/ Rolling	Sitting	Crawling/ Kneeling	Standing	Walk/Run/ Jump	GMFM
92.5%	96.0%	92.2%	79.4%	89.3%	94.6%

GMFM = Gross Motor Function Measure.

the parents allowing them to select a day/time for the second pre-test. All 11 parents responded and were scheduled for the second GMFM/PEDI measurement. However, subject 4 did not show up for the PreT₂ appointment and was therefore dropped from the study.

Treatment Phase

Hippotherapy once weekly for 10 consecutive weeks was conducted in an enclosed 60 × 120-ft riding arena or outdoors in a fenced 60 × 80-ft area. The horses were owned by a NARHA therapeutic riding center that operated at a family farm. The three horses were trained by volunteers or staff of the riding center. Individual hippotherapy appointments were 45 minutes, but the actual amount of time on the horse was typically 20 to 30 minutes. Each subject wore a helmet and safety belt. Although there were no a priori criteria set for attendance, overall attendance was excellent, ie, 98 of 100 scheduled hippotherapy sessions were conducted. Nine subjects attended all 10 of their treatment sessions. One subject missed two sessions.

The researcher, a physical therapist with extensive training and experience in hippotherapy, selected the appropriate horse and tack for each subject. The selection was not part of a protocol. The horse and equipment used in each treatment session were documented in the treatment note. The horses worked during sessions with a trained, experienced horse handler walking behind the horse holding two leather lines connected to a bit in the horse's mouth. This technique is called long lining or ground driving. Occasionally, the horses worked by being led from the front with the horse handler holding a cotton lead rope clipped to the ring under the chin on a horse halter. The PT and a volunteer side walker walked along either side of the horse. The horse's movement was modified during treatment sessions depending on the needs and responses of the subject. The therapist directed the horse handler to walk, halt, alter tempo, or change the pattern of the horse's movement. The subjects were positioned according to their postural ability: forward facing, rear facing, side facing, modified side sitting, prone, or quadruped. Periodic halts were standard for repositioning.

While the horse walked, subjects were encouraged to maintain postural alignment with symmetry of head, trunk, and lower extremities and to sit independently with little or no assistance from the PT and side walker. At the start of hippotherapy, subjects 1 and 3 were unable to maintain a sitting position on a moving horse with the typical assistance from the therapist and side walker. For a

few sessions, it was necessary for the therapist to ride in tandem, seated on the horse behind these subjects, to facilitate postural control. Later, these subjects developed sufficient postural control to maintain alignment on the dynamic surface with assistance provided by the therapist and side walker from the ground. A U-shaped pillow placed around the waist of subjects 1, 3 and 5 was occasionally used during treatment sessions when they needed external support to maintain postural alignment or midline orientation in a sitting position.

Posttreatment Phase

Post-test 1 (PostT₁) was conducted during the week after the final hippotherapy session. Post-test 2 (PostT₂) was 10 weeks later. GMFM and PEDI assessments were repeated during the post-tests. To examine confounding variables, parents were asked to report the frequency of physical therapy, occupational therapy, and/or speech therapy received at school, home or clinic during the treatment phase (Table 3). Concurrent events that may have affected the outcome measure were recorded in Table 4.

Data Analysis

Subtest and total PEDI Functional Skills Part I and GMFM percent scores were entered into the software Statistical Package for the Social Sciences. Correlation of the outcome measures was done as well as a one-way analysis of variance with repeated measures ($\alpha = 0.05$). To determine the effect of the treatment phase, a post hoc analysis of multiple comparisons was done with the Tukey test for honest significant difference (HSD).

RESULTS

The PEDI and GMFM were strongly and significantly related to each other on each test date ($r = 0.729-0.836$). Significant differences were found between the groups on a repeated-measure analysis of variance for all the PEDI and GMFM subscales except GMFM lying/rolling (Tables 5 and 6).

To examine the difference between the three time periods and particularly to determine whether the change that occurred during hippotherapy was significant, a

TABLE 3

Frequency of PT/OT/SLT During the Hippotherapy Treatment Phase

Subject	Therapy During Treatment Phase
1	One PT treatment in 10 weeks
2	PT once weekly for 10 weeks
3	Four PT treatments in 10 weeks
5	PT once weekly for 10 weeks
6	OT/PT/SLP once weekly for 10 weeks
7	None
8	None
9	None
10	PT once weekly for 10 weeks
11	None

PT = physical therapy; OT = occupational therapy; SLP = speech-language therapy.

TABLE 4
Concurrent Events

Subject	Concurrent Event
2	Failure to wear the newly issued right ankle-foot orthosis
3	Started oral baclofen during the pretreatment phase
6	Bilateral otitis media during the treatment phase treated with antibiotic
7	Hyperbaric oxygen treatment for one week during the posttreatment phase
11	Hyperbaric oxygen treatment for one week during the pretreatment phase and one week during the posttreatment phase

Tukey HSD value was calculated for the mean PEDI and GMFM scores on the four test dates. If the mean score change across a time period was greater than the Tukey HSD, then statistical significance existed for that time period. To accept the research hypothesis, a statistically significant change in the mean score during the hippotherapy treatment phase from PreT₂ to PostT₁ must exist with no significant change during the pretreatment and posttreatment phases (Table 7). Statistically significant change was found in the mean of the PEDI total score, GMFM total score, PEDI social score, and GMFM crawling/kneeling scores.

The magnitude of individual subject GMFM total percent score change varied between 1% and 10% during hippotherapy. Seven of the 10 subjects had greater change in the GMFM total percent score between PreT₂ and PostT₁ (Fig. 1). The mean change in GMFM total scores was 3.6% ± 2.7% between PreT₁ and PreT₂; 4.5% ± 2.8% between PreT₂ and PostT₁; and 3.4% ± 1.9% from PostT₁ to PostT₂.

DISCUSSION

General Findings

The purpose of this study was to evaluate the effect of hippotherapy on children with CP. The primary objective was to determine whether hippotherapy had a positive effect on functional performance of young subjects with CP. The results demonstrate a statistically significant treatment effect after the hippotherapy treatment phase and no statistically significant change in function during the non-treatment phase. The post hoc mean score analysis was statistically significant for the PEDI social scores, PEDI total scores, GMFM crawling/kneeling scores, and GMFM

TABLE 5
PEDI Part I Functional Skills Analysis of Variance

	df	SS	MS	F	p
Self-care	1.222	296.300	242.430	13.03	0.003*
Mobility	1.675	170.600	101.939	10.67	0.002*
Social	1.415	228.675	161.591	15.82	0.001*
Total	1.454	2038.875	1402.011	22.37	0.000*

PEDI = Pediatric Evaluation of Disability Inventory.

Within-subjects effect.

* $p < 0.05$.

TABLE 6

Gross Motor Function Measure Analysis of Variance

	df	SS	MS	F	p
Lying/rolling	1.26	368.500	291.780	3.47	0.082
Sitting	1.34	872.075	648.754	10.99	0.004*
Crawling/kneeling	1.75	1469.000	838.892	18.21	0.000*
Standing	1.36	631.475	465.114	12.05	0.003*
Walk/run/jump	1.07	641.475	601.408	6.69	0.027*
Total	1.26	846.675	670.900	32.62	0.000*

Within-subjects effect.

* $p < 0.05$.

total scores. Four other subscales (PEDI self-care, PEDI mobility, GMFM sitting, and GMFM standing) missed the mark of significance by a small margin in the analysis using the Tukey procedure (Table 7). This finding may have been due to the small sample size or may have been influenced by commonality in gross motor goal areas among participants.

Lying/rolling was a goal area for four of 10 participants. Insufficient data were available for statistical significance ($p > 0.05$). Crawling/kneeling was an appropriate skill area for nine of 10 participants. Crawling/kneeling reached statistical significance. Crawling and kneeling may have been practiced more frequently outside of hippotherapy.

The PEDI social function statistical significance during hippotherapy may have been influenced by the opportunities to use or practice communication, listening, and language skills.

There were many walk to halt to walk transitions per session allowing subjects to use verbal “walk” or nonverbal (hand pat on the horse) communication to ask the horse to walk. Subject 9 learned to activate a switch on a preprogrammed communication device to command his horse to move from halt to walk. Singing by side walkers and the therapist in rhythm with the walking horse was a common occurrence. Most of the children also listened and followed simple commands such as moving from forward sitting astride the horse to sitting sideways on the horse or selecting an activity by gesturing or speaking.

Three of four ambulatory subjects had more change in the total GMFM score from PreT₂ to PostT₁ (Fig. 1). Four of six nonambulatory subjects had more change in the total GMFM score between PreT₂ and PostT₁. The magnitude of improvement was greatest from PreT₂ to PostT₁ for seven subjects. Subjects 2, 5, and 6 had less or no change between PreT₂ and PostT₁. Subject 2 had the same amount of change in the total GMFM score in both the pretreatment (baseline) and the intervention phases. A concurrent event for subject 2 was a new right ankle-foot orthosis (AFO) that did not fit correctly, requiring her to walk with compensatory patterns due to unsupported foot drop. Her parents reported that she walked less and crawled more at home when she did not have her AFO. Subject 6 was treated for acute otitis media during hippotherapy, and his treatment sessions were shortened when the movement experience became excessively stimulating. Subject 5 had weak trunk

TABLE 7

Results of the Tukey Test for Post Hoc Multiple Comparisons

	Tukey HSD	PreT ₁ -PreT ₂	PreT ₂ -PostT ₁	PostT ₁ -PostT ₂
PEDI self-care	3.37	1.80	3.20	2.00
PEDI mobility	2.83	1.90	2.80	0.30
PEDI social	2.69	1.70	2.70*	1.80
PEDI total	6.75	5.40	8.70*	4.10
GMFM lying/rolling (<i>p</i> > 0.05)	—	—	—	—
GMFM sitting	3.76	2.85	3.20	1.15
GMFM crawling/kneeling	2.64	2.35	2.85*	1.55
GMFM standing	1.99	1.20	1.65	1.25
GMFM walk/run/jump	4.98	1.95	2.80	2.90
GMFM total	9.34	9.00	12.35*	8.25

PEDI = Pediatric Evaluation of Disability Index; GMFM = Gross Motor Function Measure; PreT₁ = pre-test 1; PreT₂ = pre-test 2; PostT₁ = post-test 1; PostT₂ = post-test 2.

The Tukey honest significant difference (HSD) value in the first column indicates the magnitude required for significance. The actual mean score change in the three time periods is listed in the following columns.

* Denotes a statistically significant difference in the mean score change.

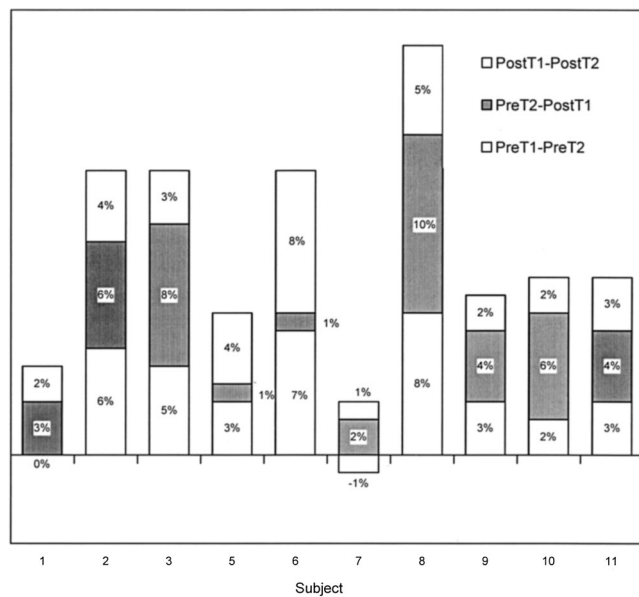


Fig. 1. GMFM total score change for the ten subjects across the three time periods before, during and after hippotherapy.

control in all upright positions requiring moderate assistance from the side walker and therapist. Treatment sessions were shortened when his active, anticipatory head on trunk postural control weakened. The withdrawal of hippotherapy from PostT₁ to PostT₂ decreased the magnitude of the GMFM total score change for eight of the 10 subjects. Subjects 5 and 6 had a greater increase in GMFM total scores between PostT₁ and PostT₂ than between PreT₂ and PostT₁.

The variation in GMFM total percent score change across time can be favorably compared with other studies that used the GMFM as an outcome measure. There was between 1.0% and 10.0% change in the total percent scores (mean 4.5% ± 2.8%) from PreT₂ to PostT₁ during the 10 weeks of hippotherapy in this study. Trahan and Malouin²¹ reported 4.2% to 6.2% total GMFM score change after intensive physical therapy for eight months. Yang et al²⁷ reported 2.3% to 5.1% change after three months of Botox

injection treatments. Richards et al²⁶ reported between 5.0% and 14% change after four months of treadmill training. Nordmark et al²⁵ reported 2.0% to 17% change 12 months after selective posterior rhizotomy.

Limitations

The extraneous variable of other therapies was inconsistent. The treatment phase of hippotherapy occurred during the summer months (June to August) when school therapy services are typically less frequent. Four of the subjects did not attend any therapy other than hippotherapy during summer. There was also no contact between the therapist providing hippotherapy and the primary therapists at schools or clinics for most of the subjects. Hippotherapy treatment intervention might have been more effective if there were coordination of services between therapists.

The GMFM scorers were not blind to the order of test date. They watched and scored a box of tapes from test dates in chronological order. The scorers returned the box of tapes to the researcher but retained the score sheets for the individual subjects until the completion of the study. Permitting the scorers to keep the score sheets potentially biased the scorers because they reported that they did check their scores occasionally on previous test dates. However, after reviewing the score sheets and observing that the scores went up or down depending on performance of the test item, it appears that the scorers were not noticeably biased by previous test scores. Scorers were unaware of when hippotherapy occurred in relation to the test dates. There was no contact between scorers during the study. Two of these limitations could have been eliminated by blinding the scorers to the order of test date and collecting the score sheets after the scorers watched and scored the tapes.

One PEDI score sheet per individual was used to record change. Respondents had the opportunity to view their responses to the PEDI items on the previous test date. Although parents did score in the negative direction when they believed their child had regressed on that skill or item,

they may have been biased by the use of the same score sheet on each test date.

Hippotherapy is a treatment strategy with multiple options for the treating therapist. From selection of horse, equipment, movement patterns of the horse during treatment, and positional changes of the client, the researcher used her knowledge base and experience to choose the best combination for each individual. With this individualized approach to treatment, there is no protocol that would allow replication of this study.

Clinical Implications

Hippotherapy may create nonspecific functional change in a relatively short period of time. Haehl et al¹⁴ and McGibbon et al¹⁵ recorded functional change after eight and 10 weeks of hippotherapy. In this study, functional change was recorded after 10 weeks of hippotherapy.

Hippotherapy is functionally relevant for children with CP. The movement of the horse can be used to physically challenge patients in a way that is similar to, and at the same time different from, other clinical tools. The surface of the horse is moving repetitively in three planes of movement. During hippotherapy, children learn to make postural adjustments that reduce the amount of sway created by the moving horse and maintain their position or midline orientation.¹⁴ Postural control is an impairment common to children with CP. Dysfunctional motor recruitment and impaired coactivation affect the quality of postural adjustments in children with CP.³¹ Postural adjustments made by children in hippotherapy occur as a response to unexpected external perturbations as well as to expected self-generated movement. Anticipatory postural adjustments mediated by feedforward and feedback motor control processes generated by the central nervous system are used to counteract any expected perturbing force. Repetition and practice make postural adjustment more appropriate and efficient.³² The three-dimensional, rhythmic movement of the horse at a steady walk is a repetitive external perturbation that gives a rider approximately 100 impulses per minute to practice anticipatory postural control.³³ When postural control improves, motor skills may also improve.^{34,35}

Hippotherapy has the potential to be a valuable treatment strategy in light of recent recommendations that therapists use strategies that enhance a child's motivation. The motivation of a child to be a willing participant in an activity will most likely improve the outcome of therapy.³⁶ Riding a horse in hippotherapy is an excellent motivator. Therapists have also been advised to provide young clients with environmental conditions that encourage self-initiated activity with natural restraints.³⁷ In hippotherapy, children are active participants engaged in a movement activity that can be fun and therapeutic.

Research Implications

If treatment with the movement of the horse primarily influences function by improving postural control and balance, then research that uses an impairment level outcome

measure for balance reactions or posture may determine more precise effects of hippotherapy. A correlational study that examines the relationship between postural control changes, functional change, and hippotherapy would be valuable. The specific areas of function affected most by hippotherapy were difficult to determine in this study because of the age range, ability levels, and types of CP represented. Future studies should use more homogeneous subject populations in terms of age and type of CP to determine precise areas of function affected most by hippotherapy. The implementer of treatment in this study was a physical therapist with certification in hippotherapy, which denotes a high level of knowledge and experience. Further study is needed with therapists or assistants who have similar or less expertise. The treatment approach and outcomes in occupational or speech therapy should also be explored. This pilot study could be expanded to a multicenter trial after establishing a treatment protocol to improve control of the independent variable.

CONCLUSIONS

From the results of this study, the use of hippotherapy could be a viable treatment strategy for a physical therapist with special training, clinical experience, and expertise to achieve functional outcomes for young children with CP, although the specific functional areas that might improve were not studied. Because treatment intervention for CP typically focuses on maximizing potential through improving functional ability, hippotherapy has the potential to be a valuable treatment intervention that maximizes function through actively engaging children in a motivating setting. The positive results of this study support the use of hippotherapy as a treatment strategy within the limitations described.

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