

The Effects of Hippotherapy on Motor Performance and Function in an Individual with Bilateral Developmental Dysplasia of the Hip (DDH)

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INTRODUCTION

Hippotherapy is a specialized therapy treatment strategy that uses the horse's movement to influence the patient/client in a various number of ways.¹ Hippo is derived from the Greek word "hippos" which means horse. Hippotherapy is conducted by a physical therapist, occupational therapist, or speech language pathologist as part of a patient/client's intervention. During hippotherapy, functional riding skills are not taught. The client sits on the horse's back and physically accommodates to the three-dimensional movements of the horse's walk. The client does not influence the horse; rather the horse's movement influences the rider.² Through the repetitive, rhythmical movement of the horse, the client experiences and begins to anticipate movement with each step of the walking horse. The client learns to produce compensatory movements that reduce the displacement of his or her center of gravity and keep the client on the moving horse.³ Hippotherapy is shown to

ABSTRACT

Study Design: A-B Single-Subject Repeated Measures Design, A case report on the effects of hippotherapy on a child with ADD, DDH, and developmental delay.

Objective: To investigate if any differences are found in motor functioning with a child with Bilateral Developmental Dysplasia of the Hip, Attention Deficient Disorder, and developmental delay when adding hippotherapy to a traditional physical therapy program.

Methods: The subject included in this study was a seven year-old child. The child was medically diagnosed with Bilateral Developmental Dysplasia of the Hip. Treatment A consisted of a traditional physical therapy program for 7 weeks. Treatment B consisted of the traditional physical therapy program with the addition of hippotherapy for 7 weeks. The instrumentation used was components taken from the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP). The components from the BOTMP were standing on one leg eyes open, standing on one leg eyes closed, shuttle run, one leg hop, catching with two hands, catching with one hand, and throwing.

Results: The results of this study showed that there were significant differences found when adding hippotherapy as an adjunct therapy to a traditional physical therapy program. With all seven components used from the BOTMP, five of the seven tests showed significance.

Conclusion: The addition of hippotherapy to a traditional physical therapy program seems to improve motor functioning in a child with DDH. Further research needs to be done to investigate further the effects of hippotherapy on children with DDH.

Key words: : Hippotherapy, Developmental Dysplasia of the Hip (DDH), Bruininks-Oseretsky Test of Motor Proficiency (BOTMP).

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motivate the child to engage in therapy, maintain the child's willingness to participate, and provide a playful environment while facilitating pain free movement.⁴ Research has

shown that hippotherapy has effects on posture, balance, and muscle tone, as well as other aspects.

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Haehl et al⁵ conducted a study to examine "the kinematic relationship of the horse and the client before, during, and after a hippotherapy intervention." The researchers used the Pediatric Evaluation of Disability Inventory (PEDI) to examine the effects of hippotherapy on postural control and coordination in two children with cerebral palsy. The study consisted of two phases. Phase one consisted of five trials. Each trial used markers on the sagittal plane of both the child and the horse. They each were recorded on a camcorder to measure postural control and coordination. Postural control showed little change for the amateur and experienced riders. Smooth biphasic movement patterns of the upper and lower trunk of both children were shown. However, temporal phasing with the reversal of movement was somewhat different between the two children. Phase two used the same form of study. Postural control, coordination, and functional performance were measured to see the effect of a 12 week hippotherapy program. Each child exhibited improved postural stability during the final session.⁵

Hippotherapy as well as other sources of alternative therapies have shown to be effective in past studies. The literature that has been shown on the effects of hippotherapy and children with cerebral palsy, Down syndrome, and spinal cord injuries has had positive results. The majority of research has been focused on children with cerebral

palsy. Positive results have been found in these studies. However, research has yet to provide any data for hippotherapy and clients with orthopedic diagnosis such as developmental dysplasia of the hip.

Developmental

Dysplasia of the hip involves abnormal formation of the hip joint in which the ball at the top of the femoral head is not stable in the acetabulum. Dysplasia can refer to a hip that is subluxatable, dislocatable, or currently dislocated. DDH may occur during fetal development, at delivery, or after birth. Individuals with DDH typically have signs and symptoms such hip instabilities, asymmetrical thigh and buttock skin folds or creases, legs may appear to be at different lengths, decreased hip range of motion, and abnormal gait or limp.⁶

The purpose of this study is to investigate the use of hippotherapy and it's effects on a child with a diagnosis of Bilateral Developmental Dysplasia of the Hip (DDH), Attention Deficit Disorder (ADD), and developmental delay. There is much needed research for the prospective advancements hippotherapy could make for children with DDH. Another aspect of this study is the outcome measurement tools. The research on the use of the Bruininks-Oseretsky Test of Motor Proficiency is very sparse. These outcome measurement tools have been used often to test motor impairments, but not necessarily with a child with

DDH and the effects of hippotherapy on that child. The more research in the area of hippotherapy is needed and it's effects with different populations.

The following hypothesis was tested:

- 1) The addition of hippotherapy in a traditional physical therapy program will not result in any significant change or difference in gross motor performance measured by the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP).

METHODS

Design of the Study

This study used an A-B single subject repeated measures design. Two different treatment protocols were used on the same subject. The measurement tool used was the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP).

Subject

The subject included in this study was a seven year-old female from Northeast Arkansas. The child was medically diagnosed by a developmental pediatrician with Developmental Dysplasia of the Hip and during the time of research study she was also diagnosed with Attention Deficit Disorder (ADD). Secondary to the child's diagnosis of DDH, the child presented with gross motor development delays. Upon initiating the study, initial testing using the BOTMP revealed the following age equivalency of the child in the following categories. Fine

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motor precision, fine motor integration, manual dexterity, balance, running speed and agility all scores below four years old. Bilateral coordination strength, and upper limb coordination scored four years to four years and one month. The exclusion criteria for this study were any type of horse/barn related allergies, atlanto-axial instability, or any other medical problem restricting the child from participation. The population sample was a sample of convenience. The subject presented with no true or apparent leg length deficit.

Instrumentation

The instrument used was the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP). The Bruininks-Oseretsky Test of Motor Proficiency is an individually administered test that assesses the motor functioning of children from 4.5 to 14.5 years of age. The test is composed of a battery which consists of eight subtests with 46 separate items. The subtests are: running speed and agility, balance, bilateral coordination, strength, upper-limb coordination, response speed, visual-motor control, and upper-limb speed and dexterity. These items measure both gross and fine motor skills. The BOTMP was developed to provide educators as well as health care clinicians, information on developing and evaluating motor training programs. The test also helped in assessing motor dysfunctions and developmental delays in children.⁷

The components from the BOTMP that were used included: standing on one leg

eyes open, standing on one leg eyes closed, shuttle run, one leg hop, catching with two hands, catching with one hand, and throwing. Each of these components was measured individually by number of catches, number of jumps, number of target hits, or seconds. These measurements were taken so that changes could be measured over the 14 week period.

Data Collection

The subject was seen for a one-hour session once a week for 14 weeks. To test the hypothesis using an exact binomial scale fourteen data points in each phase of treatment is appropriate.⁸ The subject received Treatment A for the first seven weeks and Treatment B for the second seven weeks. All testing was preformed immediately after treatment for both A and B. The repeated measures design takes into account attrition, for this reason a wash out period was not required between Treatment A and Treatment B. The subject was measured with the BOMPT once a week for 14 weeks. Treatment A consisted of a traditional physical therapy program. The traditional physical therapy protocol included, ball catching, ball bouncing, target throwing, kicking, balance beam activities, gait on stairs and unlevel terrain, running and jumping, as well as sensory integration activities including swiss ball, vestibular swing tasks, and scooter board. Treatment B consisted of a traditional physical therapy program with the addition of hippotherapy. Protocol for hippotherapy included riding in

a forward, backward, and side saddle position while the horse walked in a four beat gait moving in a serpentine and figure eight patterns. Ball throwing and catching on the horse while stationary as well as ring tossing and placing while the horse was stationary were also preformed. Sessions would end with the horse trotting while the subject faced forward working on advanced balance and core control.

Data Analysis

Each of the 14 data points were plotted in the individual charts for the seven Bruininks-Oseretsky tests. Then a split middle line was drawn between Treatment A and Treatment B with seven data points in each treatment. The line was determined by Treatment A and was extended into Treatment B. An exact binomial was then calculated for each test to determine if the test was significant. The Alpha level was set at .05.

RESULTS

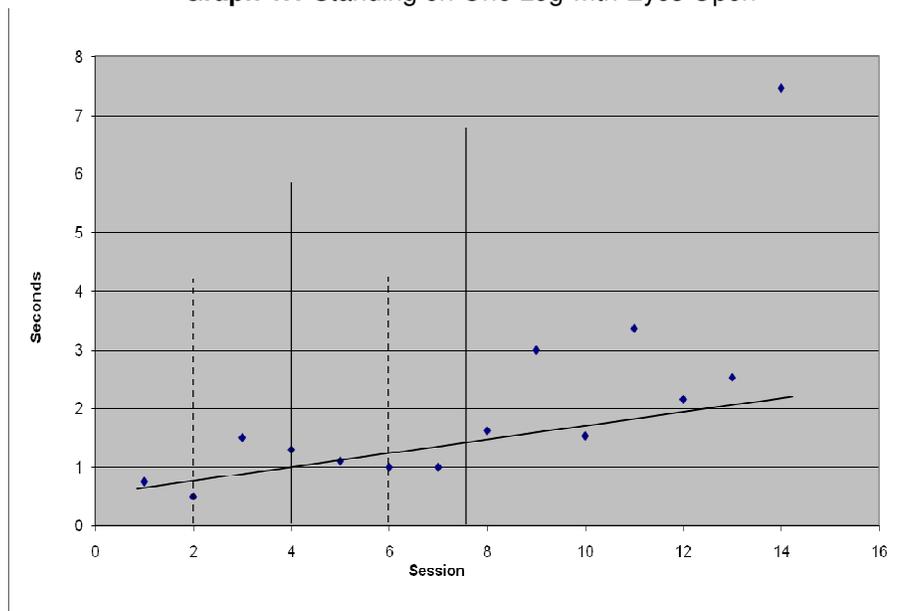
The subject was seen for 14 consecutive weeks in which Treatment A was applied for 7 weeks and Treatment B was applied for 7 weeks. Following each session the subject was tested using the BOTMP. The 7 test that were used include the following: standing on one leg with eyes open, standing on one leg with eyes closed, shuttle run, hop on one leg, catch a ball with one hand, catch a ball with two hands, and throw a ball at a target at eye level. The data points were then plotted in individual charts in which the split middle lines were drawn to see the

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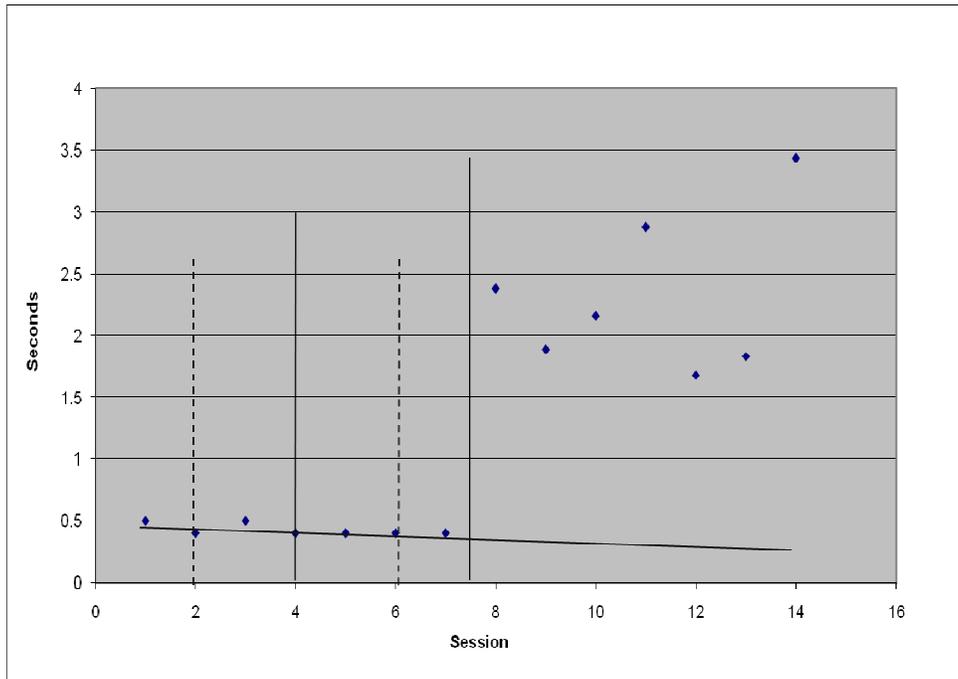
TABLE-1

Test	P-Value	Null Hypothesis	Significant
Stand on One Leg With Eyes Open	.109	Null Not Rejected	No
Stand on One Leg with Eyes Closed	.008	Null Rejected	Yes
Shuttle Run	.500	Null Not Rejected	No
Hop on One Leg	.008	Null Rejected	Yes
Catch a Ball with Two Hands	.008	Null Rejected	Yes
Catch a Ball with One Hand	.008	Null Rejected	Yes
Throw a Ball at a Target	.008	Null Rejected	Yes

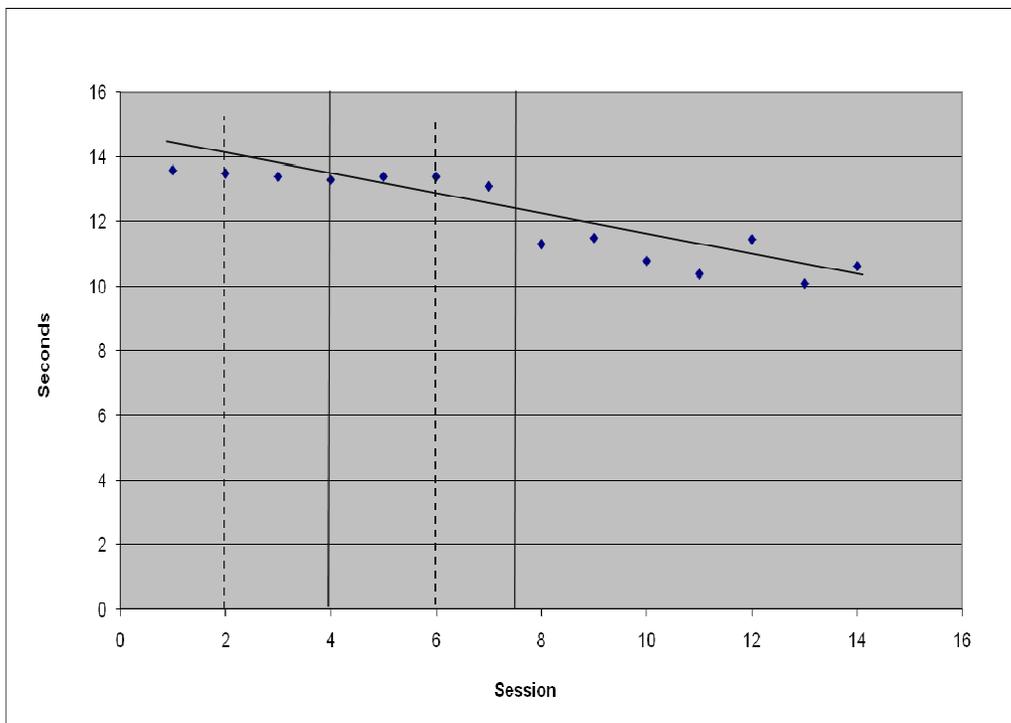
Graph 1.1 Standing on One Leg with Eyes Open



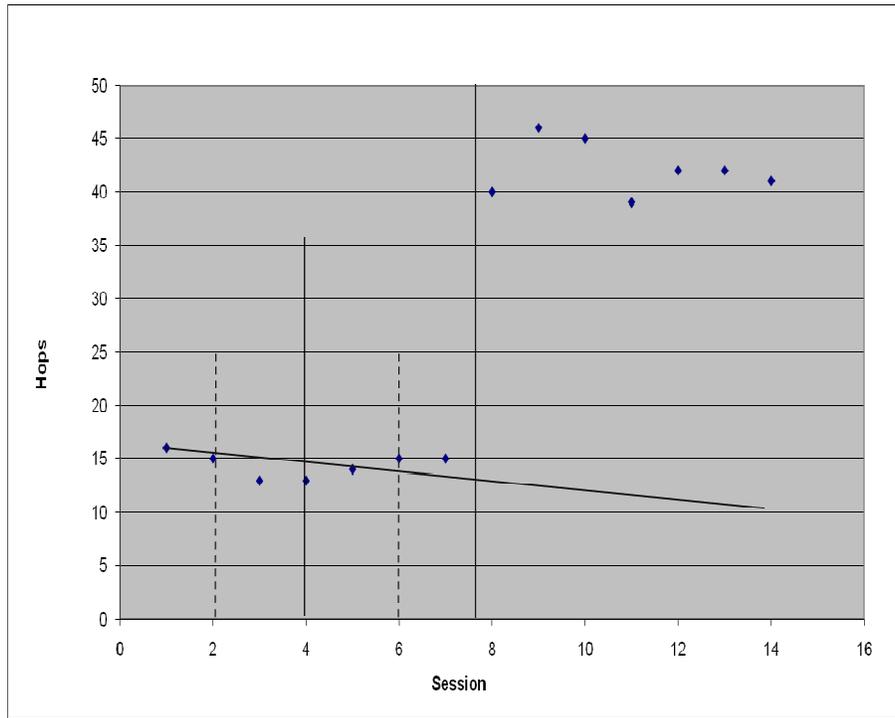
Graph 1.2 Standing on One Leg with Eyes Closed



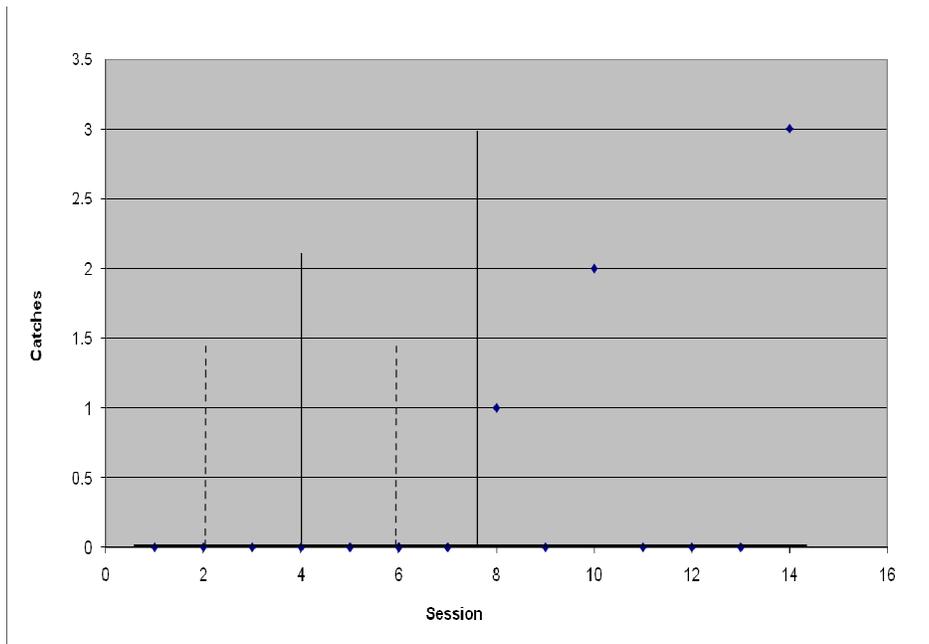
Graph 1.3 Shuttle Run



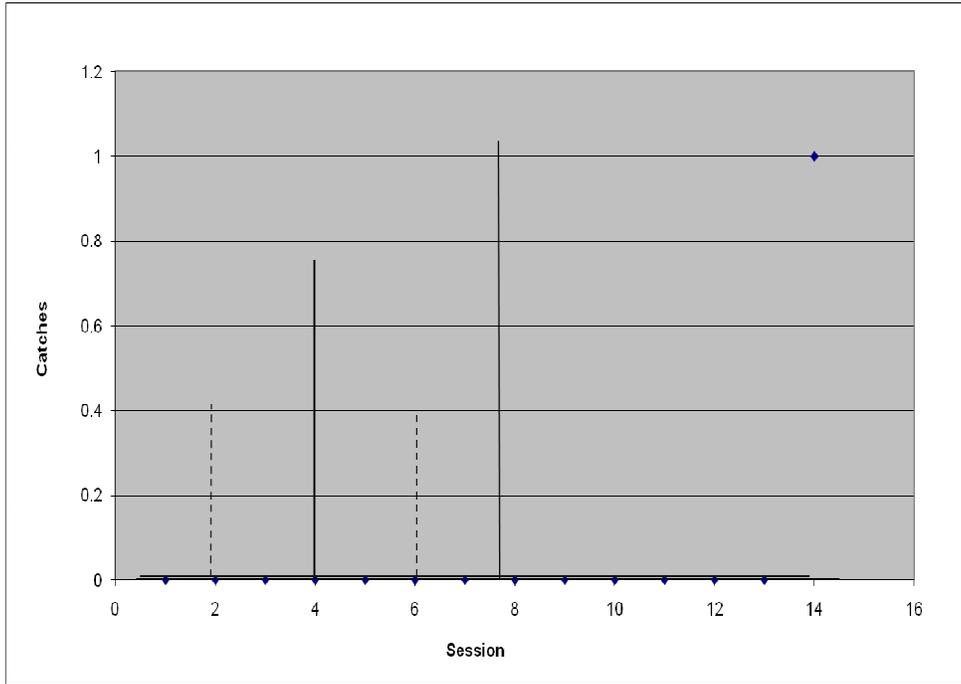
Graph 1.4 Hop on One Leg



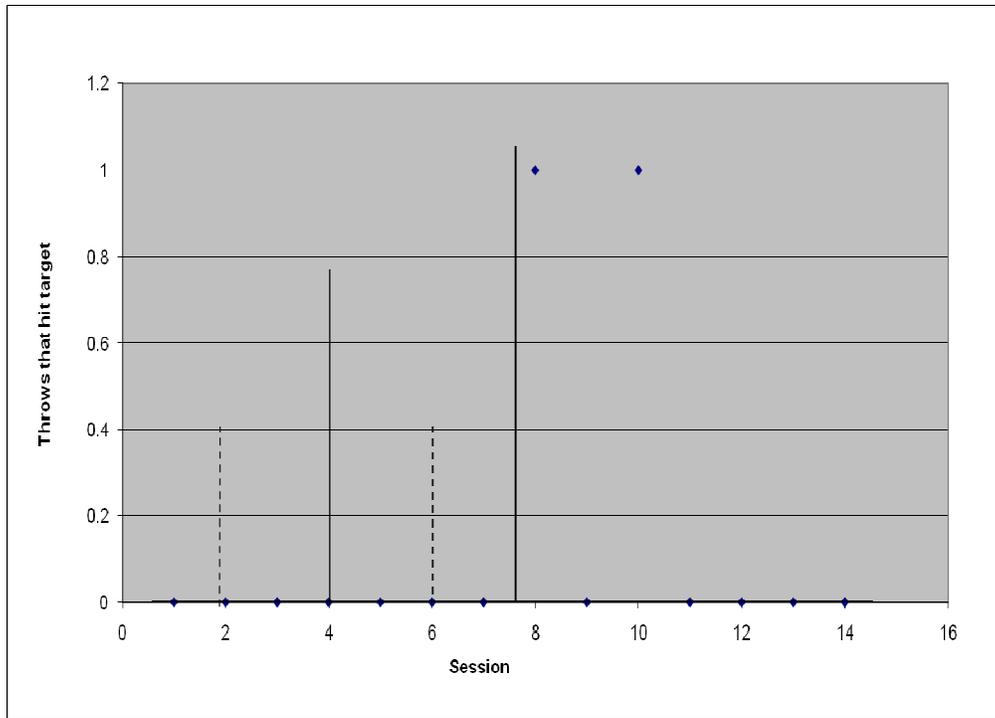
Graph 1.5 Catch a Ball with Two Hands



Graph 1.6 Catch a Ball with One Hand



Graph 1.7 Throw a Ball at a Target



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trends. A summary of all findings are in Chart 1.1.

Standing on one leg with eyes open varied throughout the 14 weeks of the study. However, the time was increased in Treatment B. With the split middle line drawn into Treatment B, six of the data points were above the line and only one was below the line. The exact binomial test revealed a p-value of .109. Since the p-value was above the alpha value set, the null was not rejected and the test was not significant. Results are shown in Chart 1.1

Standing on one leg with eyes closed was consistent throughout Treatment A but fluctuated throughout Treatment B. During Treatment B times were higher than Treatment A. With the split middle line extended into Treatment B, all 7 data points were above the line. The exact binomial test revealed a p-value of .008. Therefore, the null hypothesis was rejected and the test was significant. Results are shown on Chart 1.2.

The Shuttle Run was consistent throughout both Treatment A and B. However, Treatment B times were less than Treatment A. With the split middle line extended into Treatment B, five of the data points are below the line and only two data points are above the line. The exact binomial test revealed a p-value of .500. Therefore, the null hypothesis was not rejected. The test did not show to be significant. Results are shown in Chart 1.3

Hop on one leg was also consistent within each treatment. In Treatment A, the scores were lower than in

Treatment B but did not fluctuate much. With the split middle line extended into Treatment B, all data points were above the line. The exact binomial test revealed a p-value of .008. The null hypothesis was therefore rejected. The test also proved to be significant. Results are shown in Chart 1.4.

Catch a ball with two hands did improve with the addition of hippotherapy. With the split middle line extended into Treatment B, only three of the data points were above the line. All other data points were directly on the split middle line. The exact binomial revealed a p-value of .008. The null hypothesis was therefore rejected and the test proved to be significant. Results are shown on Chart 1.5.

Catch a ball with one hand only showed a change from Treatment A to Treatment B. With the split middle line extended into Treatment B, only one data point is above the line. All other data points are directly on the line. The exact binomial test revealed a p-value of .008. The null hypothesis was therefore rejected and the test proved to be significant. Results are shown in Chart 1.6.

Throwing a ball at a target at eye level improved some in Treatment B as compared to Treatment A. With the split middle line extended into Treatment B only two of the seven data points were above the line. All other data points were directly on the line. The exact binomial test revealed a p-value of .008. The null hypothesis was therefore

rejected and the test was proved significant. Results are shown in Chart 1.7.

After the completion of Treatment A the complete battery of the BOTMP was performed the subject revealed an increase in a few areas. Fine motor precision, fine motor integration, manual dexterity, balance, running speed and agility all scored the same below four years. Bilateral coordination strength, and upper limb coordination scored four years three months to four years four months.

Upon completing the study the complete battery of the BOTMP was performed the subject revealed an increase in all areas. Fine motor precision, fine motor integration, manual dexterity, all scored four years to four years and one month after the study. Balance, running speed and agility scored for years four months to four years five months. Bilateral coordination, strength, and upper limb coordination scored five years two months to five years four months.

DISCUSSION

A single-subject design helps to provide a clinically viable, controlled experimental approach to the study of a single case or several subjects, and the flexibility to observe change under ongoing treatment conditions. The A-B design has an independent variable and a dependent variable. The independent variable is the treatment or intervention, where the dependent variable is the patient response or the

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target behavior. The target behavior is defined as observable, quantifiable, and a valid indicator of treatment effectiveness. This particular research experiment used a single-subject design to compare treatment and no-treatment conditions.⁸

With the addition of hippotherapy to a traditional physical therapy program significant improvements were measured by the BOTMP. When Treatment B began, the first session the subject was apprehensive about the horse. To increase comfort the subject was allowed to assist in grooming, tacking, and allowed to lead the horse around the arena. By the next session, she began to relax and become more comfortable with the horse and environment. Week by week during physical therapy, the subject seemed to relax more on the horse and began to try different activities while riding. The subject would lean forward and pet the horse, lean back, wave to her mother, clap over her head, and do numerous other activities if asked to. Additionally, the subject improved on placing the rings on the pole in the middle of the riding arena. She would use both upper extremities and would cross her opposite arm across her body to place rings. She was also able to place the rings on the pole while moving and weaving through a series of poles. She learned to really reach in all directions and felt more comfortable doing this as the weeks progressed. Although, these aspects are hard to measure technically and show significance, the child enjoyed coming to therapy and riding the horse.

There were limitations of this study that could have affected the outcomes. During Treatment B, the subject's sibling were there, which could have served as a distraction. The sibling was often at the neighbor's house while the traditional physical therapy protocol was performed. Variables such as external distractions such as cats, horses, or people around the subject when trying to test her was a factor in her ability to focus and try her best in each activity. Since testing occurred immediately after treatment, dealing with the external distractions were unavoidable. In the future perhaps testing after treatment but in a quieter environment may be useful. The person administering the components of BOTMP was different in Treatment A compared to Treatment B. This could have affected the reliability of the scores and tests. The initial tester in treatment A was a male while in treatment B a female was used. Even though the standard testing instructions were used, the pitch of the commands may have influenced the results. The testing was also completed at different locations. Testing during Treatment A also took place at the subject's home and not at a neutral place such as the riding arena during Treatment B. Another factor was that some weeks she wanted to participate in the activities and other weeks she did not. Motivation and willingness was also a factor in how well she did each week. Additional tests perhaps the Gross Motor Functional Measure test and the Browns ADD Scale for Children may

have given additional data into the subject's performance and participation.

Further studies should try to acquire a larger sample size to increase the power of the research. The design of the study could be changed from an A-B to an A-B-A. This research does show significant positive outcomes on motor function as measured by components of the BOTMP. More research needs to be focused on children with DDH and the use of hippotherapy. This study will serve as additional support to the benefits of including hippotherapy in current physical therapy treatment.

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ACKNOWLEDGMENT

A special thanks is given to Susan Hanrahan, Dean of the College of Nursing and Health Professions, at Arkansas State University for funding this project. Special thanks to Nathan Wells and the Arkansas State University College of Agriculture for use of the horse and facilities.

CONFLICTS OF INTEREST

None identified or declared.