

## Combination of Hippotherapy with Technical Bobath Method in Body Extensor Control of a Patient with Tetraplegia due to Cerebral Palsy

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### Abstract

The hippotherapy is a therapeutic method based on the practice of horsemanship activities that uses the horse as main kinesiotherapeutic agent. Already the Neuroevolutive concept of Bobath consecrated there are years, it is used of specific techniques of inhibition, facilitation and neuromuscular stimulation, objectifying to modify standard postural tonus and abnormal movements, facilitating standard motors of more appropriate movements. Therefore, this study has as objective to verify the evolution of an experimental protocol through exercises, associating the hippotherapy treatment to Bobath's techniques. It was used as study object an individual of the seven year-old masculine sex, with spastic tetraplegic diagnosis due to cerebral paralysis. The apprentice presented thoracic hyperkyfosis, hypertonic flexor reaction associated to the extending hypotonic thoracic reaction of the musculature, time delay in the recovery and rectification side, deficit of lateral balance, without capacity of executing March. The procedures were accomplished in the section of hippotherapy of Unisep, in two neighbors, PR, Brazil. The apprentice accomplished fifteen sessions with maximum duration of 30 minutes on the horse. The activities were structured seeking to stimulate motive coordination, proprioception, vestibular and motor-sensory system, they provided alterations of 20% in the thoracic cifosis, it improves in the time of the lateral reactions of protection in up to 700%, it improves of the muscular force of upper extremities passing of the degree 3 for 4 according to the scale of Oxford and it improves of the muscular tonus of upper extremities of the degree 3 for 1, according to the modified scale of Ashworth

**Keywords:** Hippotherapy; Bobath method; Cerebral paralysis; Postural correction

### Introduction

Cerebral palsy is a chronic non-progressive encephalopathy, frequent and changeable of motor impairment (tone and posture) secondary to damage the developing brain [1,2]. The harmful event may occur in pre, peri or post-natal care, taking into account the semiology which is divided into quadriplegia, diplegia, paraplegia, triplegia, hemiplegia or monoplegia. As for the type of involvement it can be divided into spastic, ataxic, and mixed atetotic [3].

Neuro-Bobath treatment concept uses inhibition of specific techniques, facilitating and stimulating which can be adapted to all types of neuromotor dysfunction [4]. Since adjusted to the individual needs of each patient, aiming to modify patterns of postural tone and abnormal movements, facilitating more appropriate motor patterns of movement, prepare the child for a variety of motor skills, having the possibility of live experiences that are favorable for brain plasticity [5].

In rehabilitation, mounting means help individuals develop normal activities, and its purposes are: improvement in balance, adjustments, tonics, alignment and body awareness, spatial and temporal organization and coordination. Objectives are similar to those of the Bobath method [4] which aims to facilitate the reaction balance, correction and protection.

Thus this study aims to apply an experimental treatment in equine therapy techniques involving the Bobath method with exercises performed on the horse to a patient diagnosed with spastic quadriplegia from cerebral palsy.

### Material and Methods

This case study on the effect of techniques combination of Bobath Method and hippotherapy through an experimental protocol was performed on a seven year old male patient diagnosed with spastic

quadriplegia due to cerebral palsy, which has hypertonia in upper and lower limbs, extensor hypotonia of the trunk, legs crossed, thoracic kyphosis, generalized muscle weakness, body asymmetry, impaired protection in side reactions and preserved cognitive inability to perform gait, and presents level III by Gross Motor Function Classification System (GMFCS). The patient has a history of perinatal distress in cesarean section, where it received a score of 4 in APGAR bulletin, both in the first minute of life, and in the second and fifth minute after birth. During pregnancy there were no relevant events through information provided by the mother. The patient performs some kind of treatment through traditional physical therapy since birth.

### Assessment tools

For this work we had a permission form signed by the parents, informed intervention protocols and the accompanying norms of Resolution 196/96 of the National Health Council on research involving humans. We used an evaluation form adapted to the physical therapy patient used by Hippotherapy industry, a platform with 1.85 m long and 1.38 m wide, the ISP brand, a digital Sony camera, model Cyber-shot DSC-W30, 6.0 mega pixels, manufactured by Sony Corporation, the mobile stopwatch model 125 Mg LG brand, neurological reflex hammer brand ISP, warm heating pad, ice, tape

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brand ISP, black marker Faber Castell Kraft paper, Pentium 4 PC, Windows Vista and AutoCAD software.

Then the patient's physical evaluation was performed at the Unisep Therapeutic Hippotherapy Center using a platform and a horse, prior to the first and after the last session, with the purpose of identifying and characterizing it as well as its acquisitions and motor deficits. The upper limb muscle tone was assessed according to the modified Ashworth Scale based on the study of Shurtleff et al. [6]. This scale has a minimum degree of 0 and a maximum of 5. Zero is considered normal tone and 5 severe hypertonia, the passive motion is impossible. The degree of upper limb muscle strength was evaluated according to the Oxford Scale. This scale classifies muscle strength and ranges from 0 to 5, where 0 is the absence of muscle contraction and 5 normal strength.

### Ratings

The evaluation took place on the platform as follows: The patient sat on the platform was shifted to the right to rest on his own forearm, then received a verbal stimulus to return to the starting position. The time the patient took to return to the starting position was recorded. The procedure was repeated systematically to the left.

After that, the patient in the initial cat position on the stage received a verbal stimulus to raise the right arm and was kept on three supports. The stay in this posture was timed and performed consistently with the left side. On the horse the evaluation was as follows: The student was put in the cat position on the horse and the stay in this posture was recorded. All reaction time and maintenance of posture was timed three times each. Time were added and divided by three to obtain the average of each.

The images were standardized with actual measurements to be analyzed by AutoCAD Software. To take the photos we used a wall lined with kraft paper and this was marked forming a bounded numerical scale of ten centimeters. The horse was positioned on the side of this scale and the patient was placed in a sitting position on the horse without support. The procedures for all images were the same, being bounded a fixed distance of two meters and photographic records were made before the first, after the eighth and after the last session.

### Procedures

Procedures were as follows: the patient held fifteen sessions of hippotherapy exercises associated with the Bobath method for at most 30 minutes on the horse, three times a week in a row. The activities were structured to stimulate tonic and postural adjustments, to increase resistance of the extensor muscles of the trunk and upper limbs, as hypotonia and muscle weakness are considered characteristic of cerebral palsy.

We used an 800 m<sup>2</sup> oval shape sand track, a creole breed horse with buckskin single coat, 1.15 m tall, gentle and trained for hippotherapy, basic saddlery - a saddle type Chincha, blanket with stirrups and pommel, halter and bridle, and protective riding helmet. Auxiliary devices used: cone, crisp ball, hula hoop.

The patient performed all the exercises in simple riding. The treatment program execution is as follows:

**1<sup>st</sup> exercise:** The patient in the sitting position without support, while the horse was led to perform movements of "coil" with use of six cones arranged in a linear distance of 2 m between each cone, in a

total of twenty repetitions, leaving from the first cone and returning to the same.

**2<sup>nd</sup> exercise:** The patient in the sitting position without support, the horse was led to perform moves in a circle, clockwise and counterclockwise. Ten turns to each side.

**3<sup>rd</sup> exercise:** The student sat on the motionless horse performed bimanual movements associated with rotational movements of the trunk for both sides and threw the ball into the basket. Ten repetitions for each side.

**4<sup>th</sup> exercise:** patient in inverted mount, bimanual supported on the horse's back with elbows extended for four laps on the track. Two turns clockwise and two turns in the counterclockwise direction.

**5<sup>th</sup> exercise:** The student maintained a sitting posture with good alignment of trunk while were performed output movements and stop of the horse turn. For this exercise there were ten shifts of about five meters on a straight line.

**6<sup>th</sup> exercise:** The patient sat on the motionless horse, without support, holding the crisp ball of 15 cm with both hands, and held the position maintained flexion of both shoulders passing the ball into the hoop, handing it to the therapist (therapist holds the hoop). Fifteen repetitions. In order to the patient not lose interest in the session due to the repetitions during the exercise, the last five sessions of the hula hoop was replaced by a cone for the patient to fit the ball inside, just as a change of reference.

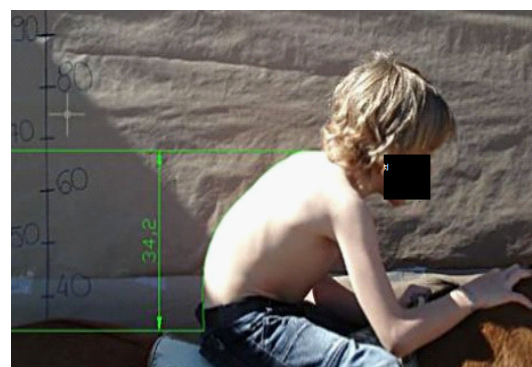
### Results and Discussion

Over the patient physical examination before the equine therapy treatment it was observed that when the patient was sitting he kept the trunk forward flexioned due to mild hypertonia of this region and the anterior extension associated with hypotonia of the trunk, characterizing a marked thoracic kyphosis. The patient had no associated motor impairment, the upper and lower limbs showed a mild degree of bending stiffness with distribution in flexion.

He had no ability to perform gait, did not show any associated disorder relate to vision, hearing, speech or respiratory system.

In neurological examination was found that the patient did not show any abnormal primitive or pathological reflex activity, only a delay in time recovery and side recovery. Data analysis of the initial and final assessments was through comparative charts and photographs with the aid of AutoCAD software, shown below.

In Figure 1 the patient is in sitting position on the horse at the end of the outlined scale, with bilateral support of the forearms and hands,



**Figure 1:** Initial evaluation.

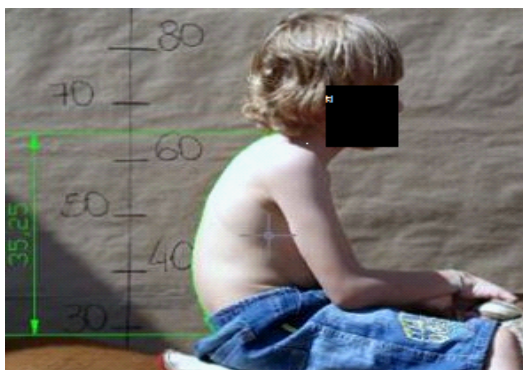


Figure 2: After the eighth session.

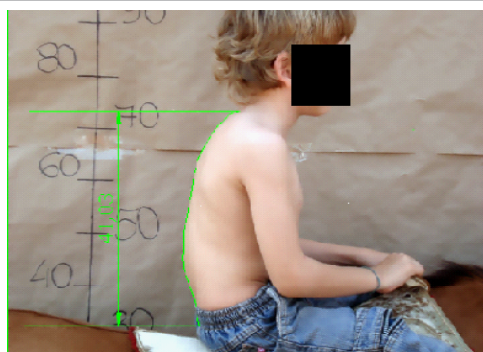


Figure 3: After the fifteenth session.

severe thoracic kyphosis and cervical protrusion. The real value of column initial height measured by AutoCAD is 34.2 cm (marked in green).

As noted above, in Figure 2 after the eighth session the patient has the value of the column height increased to 35.25 cm, which gives an improvement rate of 3% compared to the initial value in Figure 1.

There was improvement in thoracic kyphosis and cervical protrusion, the support became only the pommel hand and forearm is not supported on the horse. From the eighth session the patient did not require consecutive verbal and sensory stimulation to keep the trunk posture in the midline and the head high, even without the continued support of the pommel he could use the arms to hold the ball, which agrees with a study by Duarte Barbosa [7], which reports improved trunk control, balance and postural adjustments from the eighth hippotherapeutic session for an individual with spastic cerebral palsy.

Figure 3 illustrates the final treatment after the fifteen sessions. Analyzing the thoracic kyphosis before and after execution of the protocol it is evident a spine gain extension, ie, the decrease of the thoracic kyphosis and improved cervical protrusion, increasing the value of the patient column height to 41.03 cm, which compared to the amount of Figure 2 we have an improvement rate of 16%.

Comparing Figure 1 (before treatment) as shown above (after fifteen sessions), there was a total improvement of 20%. Support remains only on the manual pommel and his forearm is not supported on the horse, showing improvement in thoracic kyphosis and the resistance of the trunk extensor muscles and improves static balance in a seated position, which is consistent with Meregillano

[8] who reports improved posture and static balance in practicing hippotherapy.

Figure 3 shows positive resistance gain of the trunk extensor muscle by repositioning along the vertebral column at the end of fifteen sessions and through therapeutic exercises on the horse leading to an increase of 6.83 cm in the patient height position, which gives us an improvement rate of 20%, which in fact seems to agree with the findings of Silkwood-Sherer and Warmbier [9], who observed significant improvements promoted by hippotherapy in spine imbalances in patients with cerebral palsy.

Chart 1 compares in seconds the time of reactions recovery for left and right side, for cat position on the platform with four and later with three supports, before the first and after the fifteenth session. The average reaction time of recovery for right side went from 5.66 to 3.33 seconds, thus having a better percentage of 41.17%.

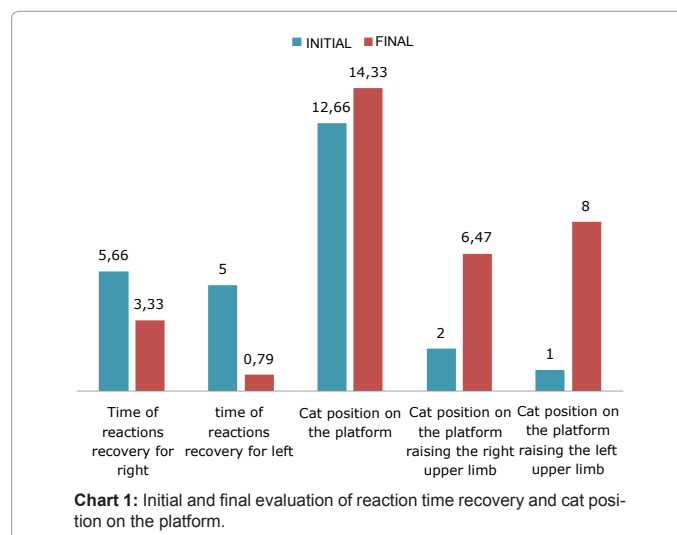
According to the analysis of the cat position on the platform there was an improvement of 13.19% by comparing the initial value which was 12.66 seconds with the final value that resulted in 14.33 seconds keeping the position. According to the results obtained in the initial and final cat position on the platform raising the right arm, an increase in time from 2 to 6.47 seconds with an improvement rate of 223.5% can be observed.

However the left side as well as the left side reaction time there was a higher percentage of improvement than on the contralateral side, the initial value of permanence increased from one to eight seconds, which gives us a percentage of 700% improvement in time.

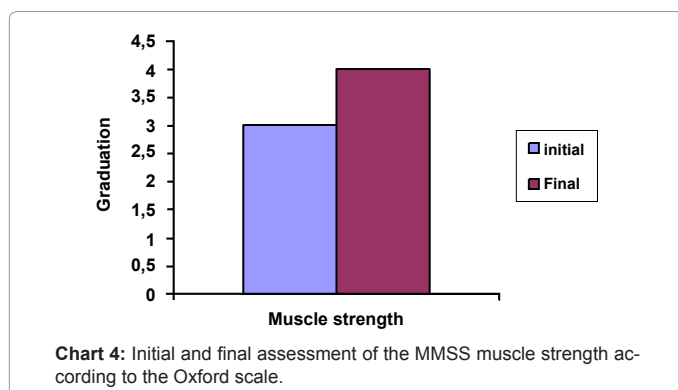
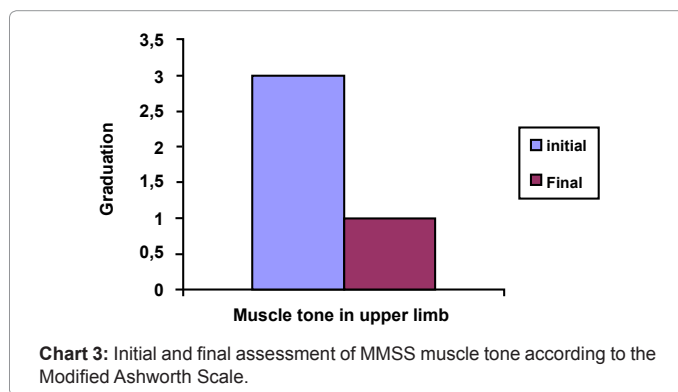
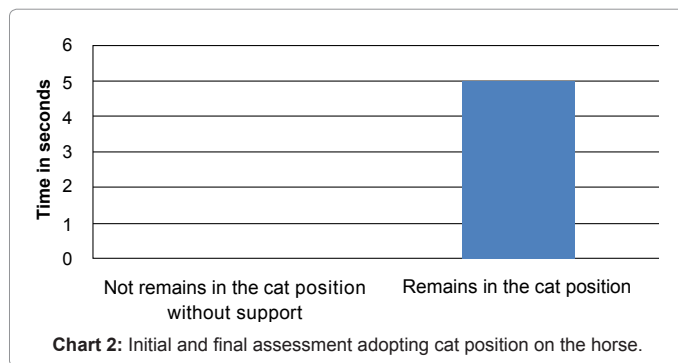
Chart 2 compares the time in seconds referring to the initial and final assessment of the patient's permanence in cat position on the horse. After fifteen sessions his stay in the same position was increased to 5 seconds, obtaining an improvement of 500% compared to the average time.

Chart 3 shows initial and final evaluation of the MMSS muscle tone according to the Ashworth scale. Before the first session his tone was graduated in three and after the last session, was graduated in 1, thus obtaining an improvement of 40% over the MMSS muscle tone.

Chart 4 shows the initial and final assessment of the patient's MMSS muscle strength. It's possible to note that before the treatment







start the degree of force was 3 and after fifteen sessions it went to 4, with a 20% improvement in MMSS strength muscle.

Given that the sample participant had at the beginning of the experimental protocol improper placement of trunk anterior flexion, severe thoracic kyphosis and anterior head protrusion due to the hypotonia extensor and flexor hypertonia of the trunk, he did not remain in a sitting position without the support of the hands and forearms by global muscle weakness, and deficit of static balance due to spastic quadriplegia framework deriving from cerebral palsy [10-12], during the first visits it was noted moderate difficulty for the patient to remain sitting unsupported on the horse without missing balance and falling down. Another factor was about the difficulty in extending the trunk and keep his head up, due to trunk anterior flexor hypertonia and deficit of trunk extensor control.

From the fourth visit it was possible to observe improvement in thoracic kyphosis due to postural adjustments, improved trunk control to the imbalance even with the horse in motion [12]. It also

showed better quality in the movement of raising the arms above the head. These same positions became spontaneous and without difficulty, because the patient held his head up so that the trunk remained extended longer. In this sense, the therapist has the function to lead and facilitate the achievement of normal movements, inhibit the realization of abnormal movements and encourage normal patterns of movement during the session [13,14].

These functions mentioned above were the basis for the treatment techniques association, which were held until the seventh session, i.e., beyond the protocol activities performed by the patient associated with the movements provided by the horse, the therapist had a sensory feedback through tappings on the dorsal region of the spine and forehead, besides verbal stimulation to the patient during treatment.

From the eighth session the patient did not require consecutive verbal and sensory encouragement to keep trunk posture in the midline and the head up, even without the continued support of the pommel and could use his arms to hold the ball, what is in accordance with the study by Zadnikar and Kastrin [7], which reports improved trunk control, balance and postural adjustments from the eighth quoterapeutic session for patients with spastic cerebral palsy.

According to Hamill et al. [15] the horse's oscillations and movements stimulates balance reactions and a better control of the patient's trunk and head position, a fact observed in Figure 2. The improvement in patient's static balance in the sitting position, according to Santos [16] it is from an improving balance of the patient that the control can progress to cervical trunk control. It is also evident in Figure 2, the improvement thoracic kyphosis due to occurred muscular tonic adjustments and increasing of the column extended extension muscle resistance.

Figure 3 shows positive gain in resistance of the trunk extensor muscle by extending repositioning along the vertebral column at the end of fifteen sessions as well as through therapeutic exercises on the horse leading to an increase of 6.83 cm in the patient's height position, which gives us an improvement rate of 20%, which actually seems to work according to observed significant improvements promoted by hippotherapy's spine imbalances in patients with cerebral palsy [17].

With trunk organization it may perform its functions more easily. The trunk should be able to align the vertebral segments and stabilize them in static position as well as in weight bearing, perform flexion, extension, side inclinations and rotations according to Silva e Borges et al. [18] it can be combined thanks to spine mobility.

This dual purpose handling/stability is ensured by the trunk muscles. Fact observed at the end of treatment, greater control on the mobility of the shoulder girdle while performing bilateral shoulder flexion, trunk rotation when throwing the ball, reduction in time reaction of right and left side recovery and correction in the increase of the MMSS muscle strength to stay longer in cat position on three supports on the platform and cat position on the horse. According to the Oxford power scale, before the treatment start its graduation was 3, after the treatment the graduation went to 4, thereby obtaining an improvement rate of 20% after the treatment.

In his experience with hippotherapy Lisinski and Stryla [19] report that the walk was always described as the gait for excellence in activities that use the horse as a therapeutic means, which together with the work of Frank et al. [1] where the hippotherapy through the three-dimensional motion of the horse's back and synergistic action of agonist and antagonist muscles will rescue the global postural mechanism reflex, maintaining posture and balance.

Neuromotor techniques used in the treatment associated with equine therapy, according to Klimont [20] help to stabilize the postural tone in the head organization, torso and limbs. We have observed that spastic muscle groups through the effect of movement of the horse received alternately the resulting posterior antero-lateral impulse with spasticity reduction under the effect of inhibition techniques, facilitating and gradual and symmetrical stimulation. According to Kwon et al. [21] spasticity is one of the causes of movements limitations in neurological patients, a fact observed in the patient during the first sessions, who had difficulties in performing movements such as raising his arms above the head to hold and play the ball, presented by spasticity in his MMSS, and was evaluated based on Lechner et al. [22] by the Ashworth modified scale in step 3.

From the eighth session these difficulties were reduced by adjusting tonic and postural correction. It was obtained a 40% improvement in the MMSS spasticity degree when the modified Ashworth scale went from the first level to level 3 at the end of one treatment using the gait as inhibiting pathological patterns and encouraging normal adding to the dissociation of the shoulder girdle through bilateral exercises with trunk rotation, shoulder flexion and making changes in position on the horse.

Lisiński and Stryla [19] reported that avoiding abrupt motions and resistance is important to encourage the application of selective movement with the maximum symmetry on both sides. This fact is in agreement with the experimental protocol performed in our work where bilateral exercises were performed avoiding sudden movements that could increase MMSS spasticity degree.

Shurtleff et al. [6] reported that the central nervous system uses automatic postural responses to provide quick reactions, but despite moves go quickly, Benda et al. [23] reported that they are not so quick to the point of not being understood by the human brain, and their repetition, symmetry, rhythm and cadence in making their responses arise very quickly, what makes this a great advantage of horse using.

For balance disorders equine therapy provides a better balance in the patient by the constant stimulation of the horse three-dimensional motion that is performed on the vestibular system, cerebellum and reticular patient [24]. This fact can be observed by decreasing recovery time and side rectification and maintenance of the cat posture on the horse on the platform shown in Charts 1 and 2.

In this sense, the techniques associated with hippotherapy Bobath method becomes a method of rehabilitation and mental motor, acting as a facilitator of teaching and learning [4,20,23,25], making the central nervous system to react at stimulations that converge from the outside and inside the body, inhibiting the uncoordinated activity and facilitating utility functions simultaneously promoting capacity of motor learning.

Therefore, according to the findings of this study, we observed that at the end of fifteen sessions, the patient showed significant improvement in thoracic kyphosis by quantifying torso alignment, improvement of static balance at sitting position adopted because of the taken position without support on the horse, improvement in time recovery and side recovery, improvement of MMSS muscle strength through increased time in the cat position on the horse and on the platform, and tonic adjustments enabled by the benefits favored by the Bobath method techniques combination and hippotherapy.

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