

Use of hippotherapy in gait training for hemiparetic post-stroke

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ABSTRACT

Objective: To evaluate the hippotherapy influence on gait training in post-stroke hemiparetic individuals. **Method:** The study was constituted of 20 individuals divided into two groups. Group A performed the conventional treatment while group B the conventional treatment along with hippotherapy during 16 weeks. The patients were evaluated by using the Functional Ambulation Category Scale, Fugl-Meyer Scale, only the lower limbs and balance sub items, Berg Balance Scale, and functional assessment of gait (cadence) in the beginning and end of the treatment. **Results:** Significant improvements were observed in the experimental group including motor impairment in lower limbs ($p=0.004$), balance, over time ($p=0.007$) but a significant trend between groups ($p=0.056$). The gait independence, cadence and speed were not significantly in both groups ($p=0.93$, 0.69 and 0.44). **Conclusion:** Hippotherapy associated with conventional physical therapy demonstrates a positive influence in gait training, besides bringing the patients' gait standard closer to normality than the control group.

Key words: stroke, hemiplegia, hippotherapy, gait and horseback riding therapy.

Utilização da hipoterapia no treino de marcha em indivíduos hemiparéticos pós-acidente vascular cerebral

RESUMO

Objetivo: Avaliar a influência da hipoterapia no treino de marcha em indivíduos hemiparético pós-AVC. **Método:** O estudo constou de 20 indivíduos divididos em dois grupos (A e B); o grupo A realizou tratamento convencional e o grupo B, tratamento convencional e hipoterapia, durante 16 semanas. Os pacientes foram avaliados pela Escala de Fugl-Meyer, Escala de Equilíbrio de Berg, Escala de Deambulação Funcional e a Cadênci, no início e no final do tratamento. **Resultados:** Melhoras significativas foram observadas no grupo experimental incluindo comprometimento motor em membros inferiores ($p\text{-valor}=0,004$), o equilíbrio, em relação ao tempo ($p\text{-valor}=0,007$) porém uma tendência significância entre os grupos ($p=0,056$). A independência na marcha, cadênci e a velocidade não apresentaram relevância estatística em ambos os grupos ($p\text{-valor}=0,93$, $0,69$ e $0,44$). **Conclusão:** A Hipoterapia associada ao tratamento convencional mostra ter influência no treino de marcha, além de tornar o padrão de marcha dos pacientes mais próximo da normalidade em relação ao grupo controle.

Palavras-chave: acidente vascular cerebral, hemiplegia, hipoterapia, marcha e equoterapia.

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The loss of the ability of independent walking is one of the most common consequences of stroke¹. As a result of the alterations demonstrated by hemiparetic individuals, disabilities were shown which af-

flect their activities of daily living (ADLs) and walking, for this reason researchers consider improving the ability of gait as the main goal in the rehabilitation process^{2,3}.

The motor recovery of the hemiparet-

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ic patients lower limbs represents one of the great challenges of the rehabilitation process. When beginning the bipedalism and exchanging steps, the movements performed by the patients with stroke keep a different hemiparetic standard from the adult gait considered normal².

This gait features reduced speed and poorly coordinated movements, shorter steps, longer support time and shorter swing phase on the side affected. The residual motor weakness, abnormal synergistic movements, and the spasticity result in an altered gait standard and contribute for a weak balance, risk of falls and increased energy consumption while walking^{1,4}.

The gait recovery requires different techniques which demand physical therapist's ability to help patients bear their own body weight and control the balance⁴. In several patients with stroke there is an asymmetric gait pattern with a difficult intervention during conventional training causing an unsatisfactory rehabilitation⁵.

Over the years, the conventional physical therapy has been receiving support from other techniques used for gait training, including the therapeutic riding.

The therapy with horses, known as horseback riding therapy is a therapeutic and educational method that uses the horse within an interdisciplinary approach in the areas of health, education and riding aiming at the psychosocial development of people with motor impairment and/or special needs. In Brazil, it is divided into programs, in which hippotherapy is a program used when the patient is not able to conduct the horse by himself and needs a guide to lead the animal and one or two people, on the sides of the horse, to give protection and help with the exercises⁶.

The horseback riding therapy, which uses the horse as a kinesiotherapeutic tool requires the participation of the patient as a whole, helping to improve muscle strength, relaxation, awareness of the body, developing balance and coordination, essential to bipedalism⁷.

Woods, apud Uzun⁸, said that when the horse walks, its center of gravity moves in three-dimensional movements similarly to humans when walking. The adaptation to the pace rhythm is one of the key pieces of hippotherapy. The tonic rhythmic adjustment osteo-articular mobilization, which facilitates a great deal of proprioceptive information. This new information, determined by the horse, allows the creation of new motor schemes. It is, in this case, a particularly neuromuscular reeducation technique⁹.

In studies with children, the results were beneficial due to the improvement of spasticity, the balance, functional capacity, control of posture and improved gait after training with horse^{7,10-12}.

Therapeutic riding is one of the few methods, or rather, perhaps the only, which allows the patient to experi-

ence many events at the same time and in which the actions, reactions and information are very numerous¹³.

Such technique is not intended to replace conventional physical therapy, but to add resources to the best possible recovery of the patient. Researches in this area are scarce and often are most performed in childhood. With regard to technique for adult patients, especially in the benefits in gait training, knowledge of statistical significance is primary.

Some studies in children^{7,9,11,13} have attempted to quantify improvements in walking after the intervention of hippotherapy, however, more statistics are needed to link the improvement of postural control and, ultimately, gait improvements to horseback riding therapy.

Because of this, the present study tries to determine in more detail the influence of hippotherapy on gait after stroke and the influence levels of motor impairment, balance, rhythm and dynamics of gait in patients after treatment. Thus, it is expected a breakthrough especially in the neurological area, therefore improving the attitudes and techniques in the future.

METHOD

This is an experimental study with intervention and analyzes pre and post test, in 20 subjects diagnosed with stroke, during the period of four months.

In order to select and invite patients and/or caregivers to participate in this research all the information about the objectives and procedures of the study were reported. The concordance of the study was confirmed by signing the consent form.

The project was approved by the Ethics and Research Committee of the Faculty of Medical Sciences (443/2006).

The subjects were selected at the Clinical Hospital (HC), at the State University of Campinas (UNICAMP) and at the Municipal Hospital Dr. Mario Gatti because they are two reference hospitals in the city of Campinas and present a large number of cases of stroke.

Only those with a diagnosis of single stroke, unilateral, of both genres who are in the chronic phase of the disease (>365 days), aged 30 to 85, with sequelae of hemiparesis and significant impaired gait and a score of at least two in Functional Ambulation Category Scale¹⁴; they had to understand simple instructions, not have apraxia or hemineglect; have the ability to stand with or without assistance and walk, one or more steps with or without assistance and stable medical condition. Besides, they need favorable medical opinion to the practice of hippotherapy for patients who did do it.

Not participated in the study patients who present neurological pathologies associated with stroke or any other clinical entity resulting in co-morbidity such as

heart disease, uncontrolled diabetes, cognitive deficits or psychiatric problems or had bilateral stroke or degenerative distal disease of other types that might interfere with gait training.

At first, patients were evaluated by a medical history and scientific scales: Functional Ambulation Category Scale (FAC)¹⁴, Fugl-Meyer Scale¹⁵, only the lower limbs and balance sub items, Berg Balance Scale¹⁶, and functional assessment of gait (cadence)¹⁷ aiming to score the level of impairment in each of them. The scales were conducted by a physiotherapist, oriented as to the rules and procedures of each of them, having no bonds with the research.

Initially, the patients underwent initial evaluation and were divided into two groups according to the availability of time and displacement to the hippotherapy. Group A (control) performed conventional treatment three times a week for a period of 16 weeks, totaling 48 sessions each, and group B (experimental) performed conventional therapy twice a week and the horse therapy (hippotherapy), once a week for 16 weeks, totaling 48 sessions. After the end of the therapy patients were reassessed by the same scales applied in the initial evaluation.

Hippotherapy sessions occurred at the Center for Therapeutic Riding Harmony, a sand arena, and conventional therapy in the Physical Therapy and Occupational Therapy Clinic, Clinics is Hospital, UNICAMP.

A horse, Quarter-Mile breed, gelding, 20 years old, 500 kg and 1.52 m in height, properly trained for hippotherapy was used.

For the mount an American saddle (drum saddle) was used in the first 5 sessions, to give greater balance and stability to the adult and in the other sessions, a suitable blanket for hippotherapy.

In statistical analysis for comparison of proportions, the Fisher exact test was used and to compare continuous or orderable data between two groups we used the Mann-Whitney test.

In the longitudinal study to compare the evolution of continuous variables and the groups described above, analysis of variance (ANOVA) was used for repeated measures with a processing station. The level of significance was set at 5%, p-value≤0.05 and the software used was the SAS

System for Windows (Statistical Analysis System), version 9.1.3. (SAS Institute Inc, 2002-2003, Cary, NC, USA).

RESULTS

The experimental and control groups showed no significant differences in the proportions: gender, motor impairment, diagnosis, mean age and length of injury showing homogeneity between them (Table 1).

The Fugl-Meyer assessment showed significant improvement in symptoms of motor impairment in the lower limbs in the total (p=0.01) and significant difference between groups (p=0.01). The average of the experimental group ranged from 14.7 points in the first to 18.5 points in the last assessment, and the control group did not present variation in 13.1 points. When compared the groups, the experimental group showed significant improvement (p=0.004), the control did not (p=1.000) (Fig 1).

On balance subscale there was significant improvement in both groups (p-value=0.19).

In Berg Balance Scale the average of the experimental group ranged from 46.1 points in the first assessment

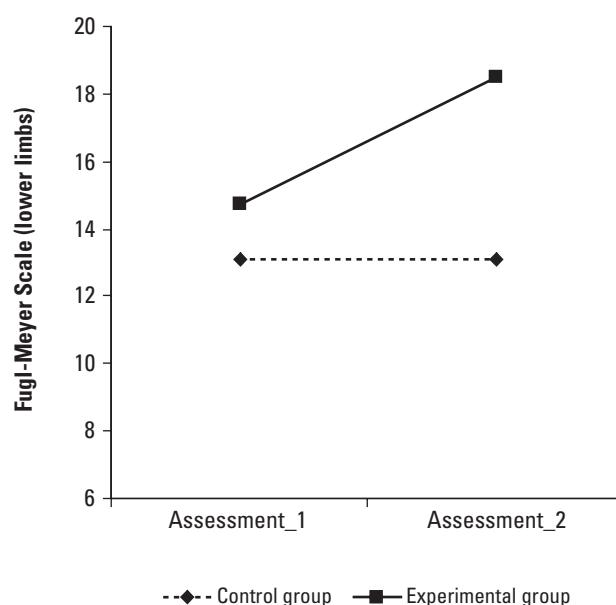


Fig 1. Average value of each group in relation to the Fugl-Meyer Scale sub item lower limbs.

Table 1. Descriptive table of variables and comparation between groups.

Groups	Gender		Motor impairment		Diagnosis		Mean age (years)	Length of injure (months)
	M	F	R	L	I	H		
Control	6	4	4	6	8	2	52	60
Experimental	8	2	5	5	9	1	59	78
p-value	0.62		1		1		0.67	0.47

M: male; F: female; R: right; L: Left; I: ischemic; H: hemorrhagic.

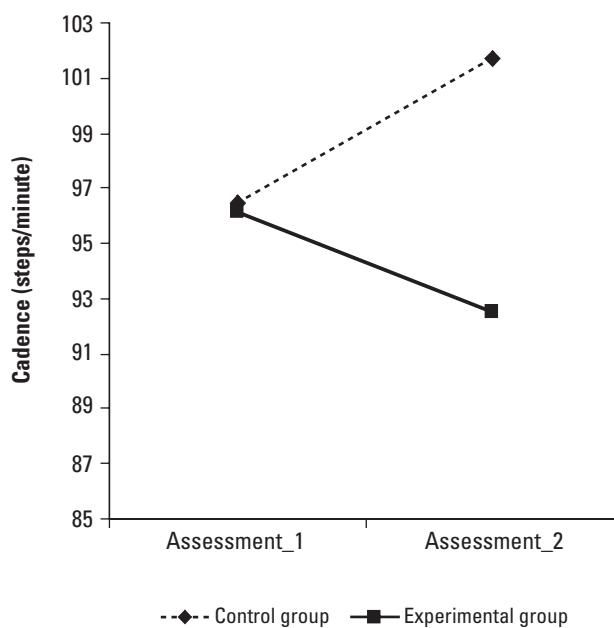


Fig 2. Average value of each group in relation to the cadence (steps/minute).

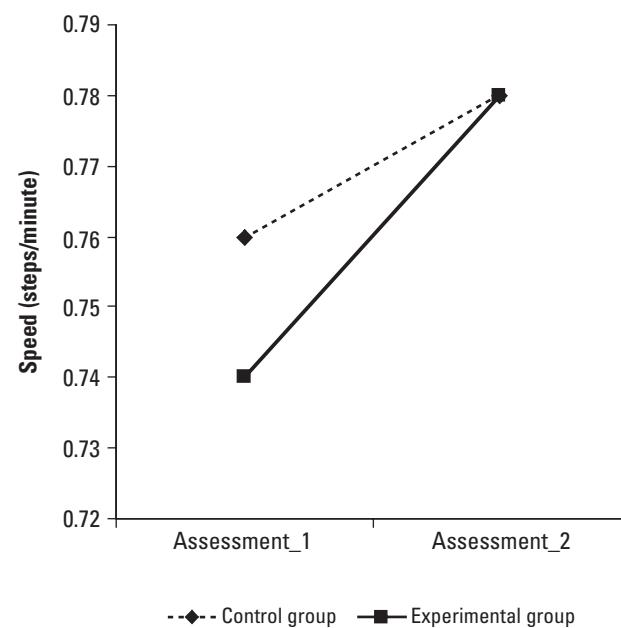


Fig 3. Average value of each group in relation to speed (meters/second).

Table 2. Average value of each group in first and second assessment and its p-values.

Scale	Assessment 1		Assessment 2		Time p-value	Total group p-value
	Control	Experimental	Control	Experimental		
Fugl-Meyer lower limbs	13.1±6.2	14.7±3.8	13.1±7.3	18.5±3.6	0.0169	0.0169
Fugl-Meyer Balance	11.1±0.9	11.4±1.6	11.2±1.8	11.6±1.3	0.1932	0.4609
Berg Balance Scale	44.3±12.3	46.1±12.9	45.1±14.2	49.0±13.0	0.0007	0.0564
FAC	3.2±1.0	3.6±0.8	3.4±1.0	3.8±0.9	0.0519	0.9318
Cadence	96.5±25.8	96.1±24.7	100.9±17.9	92.5±21.0	0.6993	0.1987
Speed	0.8±0.4	0.7±0.2	0.8±0.3	0.8±0.2	0.4484	0.4690

FAC: functional ambulatory category scale; Analysis of variance (ANOVA) was used. P values show significant differences or not over time. In Fugl-Meyer Scale (lower limbs), the Experimental group showed $p=0.004$ and Control=1.000.

to 49 points to the last one, and the control group ranged from 44.3 points to 45.1 points. There was a significant improvement in the total study subjects ($p=0.007$) and there was also a trend to significance in the difference between the groups ($p=0.056$). The experimental group achieved improvement of 2.9 points on the scale while the control group increased only 0.8 points. Thus demonstrating that the experimental group showed a greater tendency of improvement than the control group.

The Functional Ambulation Scale showed improvement on average in the experimental group ranged from 3.6 points in the first to 3.8 points in the second assessment and the control group ranged from 3.2 points in the first for 3.4 points in the last evaluation, there was also a trend to significance in the time ($p=0.0519$), and when compared between the groups was not different ($p=0.93$).

The average cadence in the experimental group ranged from 96.1 steps / minute in the first to 92.5 steps / min-

ute in the last assessment, and the control group ranged from 96.5 points to 101.7 steps / minute. There was a significant improvement in total ($p=0.69$), no difference between groups ($p=0.19$) (Fig 2).

The average speed in the experimental group ranged from 0.74 m/s in the first to 0.78 m/s in the last assessment, and the control group ranged from 0.76 m/s to 0.78 m/s. There was no a significant improvement in total ($p=0.44$) and no difference between groups ($p=0.46$) (Fig 3).

The average values of the scales used, the p-values of time and the total p-values groups are described in Table 2.

DISCUSSION

By forming a partnership with a horse, the patient with physical disabilities, eliminates the need to concentrate on foot. Thus, the practitioner can devote their attention to refining the balance, coordination and improve functional capacity in a more rhythmic way¹². This can

be evidenced on the subjects who participated in the experimental group, obtaining a significant improvement in motor impairment, while the control group did not (p -value=0.004).

Tarnow, apud Lechner et al.¹⁸, found in his study that children and adolescents with spastic quadriplegia showed a clear improvement in trunk flexibility and functional capacity after treatment with the horseback riding therapy.

Casady and Nichols-Larsen¹¹ examined the effects of hippotherapy in the gross motor function of ten children with chronic non-progressive encephalopathy of childhood, noting a significant improvement due to the intervention.

Encheff¹³ reported in his study that the impact of hippotherapy may have in promoting the improvement of proximal postural control can also mean distal improvement during functional movement, such as walking.

On the horse back, the rider is placed in a position that inhibits the extensor spasticity of the legs and applies a long stretch of the hip adductors. They can be useful in reducing muscle tone that is usually high^{12,19}, in trunk control and in postural improvement²⁰.

Heine²¹ reports that the movements of the horse generate continuous vestibular inputs causing the practitioner to constantly adjust to these movements. Reactions of correction and balance are stimulated and thus may lead to increased postural control, aiding the muscles of the trunk and extremities.

In one study, Would, apud Debuse et al.²² was able to demonstrate statistically significant improvement in weight shifting and balance in eight children who underwent therapeutic riding program. In this survey, the balance of both groups did not obtain significant improvements, although there was a trend to significance in the difference between the groups (p =0.056). The experimental group showed an improvement of 2.9 points while the control group improved only 0.8, showing a greater improvement for the experimental than the control group.

Bobath²³ mentioned that the facilitation of balance reactions contributes to the necessary basis of normal movement and functional abilities. As noted in the study, there was significant improvement in both groups in terms of independent walking (p =0.05), however there was no statistical difference between the groups, demonstrating that both treatments had a positive improvement in the gait independence.

Would, apud Debuse et al.²², found evidence in his study that the walking ability of the subjects investigated had improved after a period of therapeutic riding, compared with the same period in the control group. The aspects of walking ability investigated were specific object and included the transfer of weight, ability to stand with-

out support, ability to walk without the use of a walking aid, and the ability to stop and turn successfully.

The human locomotion is a series of repetitive cyclical standard of the lower extremities, and is produced by coordinated rhythmic movements of body segments¹⁴. In addition, Cromwell et al.²⁴ propose that the lower extremity movements provide the propulsion and retropulsion necessary for locomotion. The role of the trunk and upper body is to keep balanced and act as a stable system in parallel dynamic balance. Therefore, subtle movements and reactions of the trunk muscles are necessary in response to movement of the limbs. These subtle movements are required to avoid excessive movement and to provide stability and to balance the pelvic rotation.

People with stroke often have decreased postural control, so this is one of many factors that contribute to the abnormal gait standard. The body ability to recognize and prepare for voluntary movement is due to the close interaction of the sensory-motor, visual and hearing systems that are used when the body encounters an unexpected disruption. When preparing for an early movement or in response to unexpected movement, postural adjustments are necessary before initiating voluntary movement²⁴.

As mentioned by Bream and Sprangler, once the patient is on a horse, it acts as a substitute of the cerebellum, providing patients different inputs that are near to those that are experienced during normal human walking¹².

McGibbon et al.¹⁰ and Low et al., apud Silva²⁵, report that the use of the horse as treatment can result in an improvement in walking and in improved skills. But in his studies, they found no statistically significant differences in cadence after hippotherapy. These researchers also had small sampling sizes, of five and fourteen, which supports the notion that larger sampling can produce statistically significant changes in the participation of cadence after hippotherapy.

These results are similar to the findings of this research, where the average of cadence in the experimental group improved from 96.1 steps/minute to 92.5 steps/minute in the last assessment, and the control group worsened his average of 96.5 steps/minute to 101.7 steps/minute, but this difference was not statistical (p -value=0.19). Moreover, the improved speed in both groups showed no significance (p =0.44). But the experimental group had a decrease in steps per minute and an increase in speed, so it is possible to conclude that there was an improvement in gait standard in the experimental group, whereas in the control group that was not observed.

Copetti et al.²⁶ examined the gait of three boys with Down syndrome after therapeutic riding, noting improvement in the gait quality. He suggested that activities in the therapeutic riding can generate a combination of incentives in favor of greater control of movement, promot-

ing a greater approximation of the gait of the child with Down syndrome with the normal standard described in the literature.

Britton noted the amount of benefits that an individual with a disability obtains in hippotherapy is dependent on the combination of factors such as type of disability, severity of dysfunction and type of therapy offered²⁷.

In conclusion, the hippotherapy associated with conventional physical therapy has proved to be a good resource in the treatment of gait training for hemiparetic patients after stroke. The improvements in motor impairment of lower limbs, the independence of ambulation, of cadence and speed confirm this finding. Thus the patients in the experimental group showed a greater approximation of the normal gait standard than the control group.

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