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The Effect of the Combination of Physical Therapies on Functional Mobility and Balance for Hemiparetic Patients who had a Cerebrovascular Accident

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Abstract

Introduction: Physical therapy has a range of features that can be used to promote motor recovery after stroke individuals.

Objective: To evaluate the effect of combined treatment forming, Neural Mobilization and Vibration Stimulation on functional mobility and balance after stroke.

Method: A sample of 30 individuals was arranged in two groups: the intervention group (IG-15 subjects) and control group (CG-15 subjects). Balance assessments were performed by BSE and Functional mobility through the TUG before and immediately after the neural mobilization, stretching and vibration platform in GI and self-stretching on the GC.

Results: In the control group there was an increase in the average BSE (p=0.013) and reduced average TUG (p=0.001).

Conclusion: Comprehensive protocol is presented as a possible valid form of treatment for post stroke patients.

Keywords: Balance; Stretching; Neural mobilization; Vibration platform

Introduction

The Cerebrovascular Accident (CVA) is defined as an acute neurological dysfunction, with sudden development and clinical signs showing disorder in brain function that last over 24 hours. This pathology may present varied clinical conditions, depending on the type of injury, location and the size of the portion affected, as well as the nature of the motor functions that were compromised [1].

Spasticity is a common complication of neurological conditions, such as cerebrovascular accidents and spinal cord injuries. It is characterized by reduced articular mobility and increased resistance to passive articular movement. Spasticity may lead to deformities, pain and limited functionality. For this reason, treatment and prevention of spasticity are the foremost therapeutic goals for people with neurological conditions [2].

Physical therapy plays an important role in the treatment of such patients and has an array of resources which can be used to reduce muscle tone. Resources like muscular stretching, neural mobilization and the vibrating platform aim to promote motor rehabilitation and to prevent minor complications [3].

Muscular stretching is commonly applied in order to increase the movement amplitude (MA) both in healthy individuals and those undergoing rehabilitation. It has been noticed that stretching exercises increase MA, decrease passive stiffness of the muscle-tendon unit and in tone reflex activity, indicating an increase in length and extensibility of the muscles [4].

Both contractile tissues (muscles) and noncontractile tissues (fasciae, tendons and ligaments) have elastic and plastic properties. The elastic properties allow tissues to resume their original length once the stretching stimuli are halted, whereas the plastic properties allow the tissues to deform permanently, never regaining their original length or state [5].

In order to achieve such effective increase in flexibility a plastic deformation of the muscle-tendon collagen is necessary. This deformation will leave gaps in the tissues, inflammation, repair and remodeling by means of fibroblasts. It is necessary to cause rupture of inter and intramolecular bonds in collagen so these deformations can be permanent [6].

The neural mobilization technique promotes comfort when performing movement and elasticity of the nervous system, recovering and improving its normal functions. This mobility intervention is based on the assumption that an alteration in the mechanics or physiology of the neural system may lead to dysfunction in the nervous system or its structures [5].

Neural mobilization poses as an excellent form of therapy for incomplete nerve injuries. This kind of therapy aims to restore mobility and proper length, thus increasing the blood flow and the dynamics of

axonal transport. Neural mobilization is effective in the reduction of adherence and in the increase of neural [7].

Mobilization of the nervous system is a therapeutic resource used in order to achieve the reestablishment of the dynamic balance, circulation of neural fluids and mechanical harmony, promoting normal physiological functioning. By means of such hypotheses, it is believed that mobilization of the peripheral nerve can be effective in sliding the neural tissue, reducing neural compression and adherence, thus improving vascularization [8].

The vibration platform is a device which transmits mechanical vibration throughout the body or only part of it activating the myotatic reflex. The benefits of the vibratory treatment are predicted through the knowledge of neurophysiological systems. It is known that vibrations promote normal patterns of motor activity through modulation of excitability of motor neurons and the spinal cord. Thus, this kind of therapy is recommended to cause the inhibition of spasticity and improve the motor skills of individuals with after effects of a CVA [9].

The myotatic reflex is the monosynaptic activation of sensory receptors in the muscles and tendons. The myotatic reflex is very sensitive and it is determined by the speed of stretching, in a way that under slow stimulus, the motor response will be very weak, whereas the fast and abrupt stimulus will result in fast and explosive muscular response. Therefore, in the vibratory training there is an increase of neuromuscular activation and an improvement in muscular performance [10].

Because of the impact spasticity causes in the quality of life of the patients, there is a growing interest in alternative treatments that can bring more independence and restoration of functional mobility. Recovery through physical therapy comprehends several techniques, among which stretching, neural mobilization and vibratory stimulation are the highlights.

In fact, the application of these techniques combined seems to have an effect on variables of functional mobility and postural balance. However, we lack evidence to prove that such techniques would be effective changing the aforementioned variables for hemiparetic patients who had a CVA. This way the study observed that the academic and scientific areas had a need for the development of a research approaching this theme so as to contribute with the creation of protocols of physical therapies for spastic patients.

Given the importance of the matter and existing doubts, this research aimed to assess the acute effect of muscular stretching, neural mobilization and the vibration platform on functional mobility and balance for patients who have had a CVA.

Materials and Method

This study is quantitative, analytical, longitudinal, randomized and controlled. The randomization of the patients was done after screening and including them in the study, without their awareness, by means of sorting their names at random, not allowing the characteristics of the sample to influence the selection.

It was approved by the Committee of Ethics and Research of Faculdade Santo Agostinho, under the number 1.016.811, in accordance with Resolution 466/22 of the national health council, following all the necessary ethical precepts. It was carried out at the Carolina Freitas Lira Integrated Teaching Clinic, located on Barão de Gurguéia Avenue in Teresina-PI, Brazil.

The sample was composed of 30 individuals, aging between 35 and 85 years old. The criteria for inclusion were: to be at least 35 years old; to have been diagnosed with cerebrovascular accident verified by means of MRI scan or CT scan, regardless of its etiology; to show mild to moderate spasticity according to the Ashworth scale, being able to respond to simple verbal commands, such as “lift the foot”, “maximum strength”, “relax and rest”; absence of bone degeneration or orthopedic damage. The criteria for exclusion were: patients with unstable neurological condition; uncontrolled blood pressure; presence of cardiorespiratory alterations, hyperalgia and aphasia; patients who use medication to treat spasticity. Two groups were randomly formed and they were composed of 15 subjects each-the intervention and the control groups, then the type of intervention proposed for each group was chosen. The intervention group (IG) underwent the combination of therapies: stretching, neural mobilization the vibration platform, whereas the control group (CG) was instructed through self-stretching.

Before the beginning of the interventions, the sample was assessed by using the Berg Balance Scale, Timed Up and Go test. Such tests were also applied immediately after the interventions.

The Berg Balance Scale (BBS) is an instrument used to assess balance. The Scale is composed of 14 tasks which involve static and dynamic balance. The assessment is done through observation and the score ranges from 0 to 4, which may reach a total of 56 points. In the amplitude between 56 and 54, each negative point is associated with an increase between 3 and 4% in the risk of tumbles; between 54 and 46, the alteration of one point is associated to an increase between 6 and 8% of chances; below 36 points, the risk is almost 100% [6].

The Timed Up and Go test (TUG) is used to assess mobility and balance, in which it counts how many seconds of functional mobility it takes to stand up from a standardized 46 cm-tall chair with support for the back and arms, walk a linear 3-meter course, turn around and sit on the chair again [7].

The IG underwent static stretching of the spastic gastrocnemius muscle for 30 seconds, repeating it five times with a 10-second break between repetitions, and then Neural Mobilization was applied to the Anterior Tibial muscle and Gastrocnemius (Neural Mobilization of the Sciatic Nerve), with oscillatory movements of plantar flexion and dorsiflexion for one minute, which corresponds to 20 oscillations, repeating it five times with a 10-second break between repetitions. Finally, the subjects were put through 10 uninterrupted minutes of vibration, at a 50 Hz frequency and 2 mm amplitude.

In the CG, the patients received guidance as for self-stretching of the Gastrocnemius. Self-stretching was performed for 30 seconds and was repeated five times with a 10-second break between repetitions.

The study used analytical statistics, where the data were processed with the Statistical Package for the Social Sciences software (SPSS®, 17.0) for Windows by using Student’s T-test for pairing samples and evaluating them before and after the intervention, and for independent samples for comparisons between the groups, considering statistically significant values of $p<0.05$ (5% error, 95% reliability). The results are shown in graphs arranged and designed with Microsoft Office Excel® 2013, presenting absolute values and percentages.

Results

The average age of the participants was 58.50 ± 1.05, where the youngest was 36 years old and the oldest was 84 years old. The average BMI was 23.71 ± 3.24, where the lowest value was 18.95 and the highest 33.33. (Table 1) describes the sample.

Characteristics	N (%)
Gender	-
Male	20 (66.70)
Female	10 (33.10)
Etiology of the CVA	-
Ischemic	18 (60.00)
Haemorrhagic	12 (40.00)
Duration of After Effects	-
6 months – 1 year	9 (30,00)
1 – 3 years	11 (36.70)
3 – 5 years	8 (26.70)
More than 5 Years	2 (6.70)
Hemiparetic Pattern	-
Right	11 (36.70)
Left	19 (63.30)
Level of Spasticity	-
Slight	17 (56.70)
Moderate	13 (43.30)
Severe	-
Medication for Spasticity	-
Yes	-
No	30 (100.00)
Orthopedic Damage	-
Yes	-
No	30 (100.00)
Presence of Systemic Blood Pressure	-
Yes	-
No	30 (100.00)
Cardiorespiratory Alterations	-
Yes	-
No	30 (100.00)
Source: Faculdade Santo Agostinho-FSA; Teresina-Piauí 2015	

Table 1: Description of the sample (N=30).

Figures 1 and 2, respectively, show the average values obtained from the assessment tests-Berg Balance Scale, Timed Up and Go (TUG)-before and after the application of the combined techniques and the comparison between the average values obtained from the assessment tests-Berg Balance Scale, Timed Up and Go (TUG)-after the

application of the combined techniques in both Control and Intervention Groups.

Figure 1 shows clinical improvement as there was significant statistical difference between the average values of the tests done before and after the application of the combined techniques. The Berg Balance Scale showed an increase in the average value, with p=0.013, whereas TUG had a reduction in its average, with p=0.001.

Figure 2 show that the intervention group had the highest average value in the Berg Balance Scale and lowest average in TUG in comparison to the control group. It was possible to observe that the control group achieved an average of 39.53 in the Berg scale and the intervention group achieved an average of 42 after the intervention. When comparing the TUG between the groups, the control group averaged 34.4 seconds to complete the test while the intervention group achieved 31.4 seconds. However there was no statistically significant difference between the average results of the tests applied in both groups.

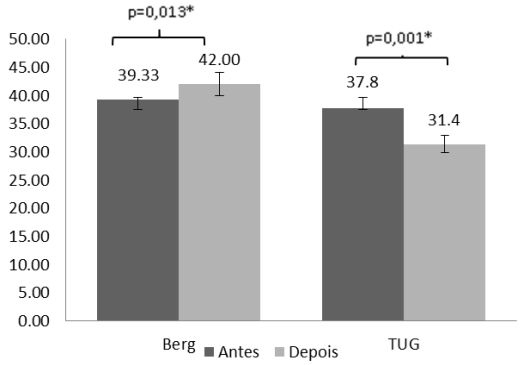

Figure 1: Average values obtained from the assessment tests: Berg Balance Scale, Timed Up and Go (TUG), before and after the application of combined techniques (N=30).

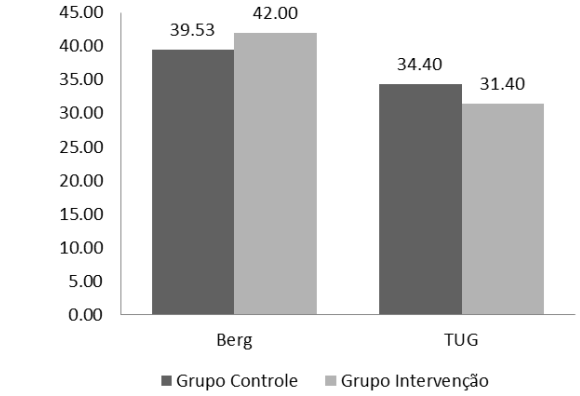

Figure 2: Comparison* between the average values obtained from the assessment tests: Berg Balance Scale, Timed Up and Go (TUG), after the application of combined techniques in the Control and Intervention groups (N=30).

Discussion

Up to the present moment there are no studies evaluating the efficacy of the combined use of the therapies shown in this paper. There are only a few studies on separate therapies. This fact differentiates this study from others in terms of the interventions that were assessed, whereas it makes it difficult to compare with results from other studies that might have been published on this subject matter.

Deficiencies in the sensory and motor systems are very common after a CVA, compromising the patients' balance [11], which may have contributed for the low scores in the Berg Balance Scale (BBS) before the intervention (average 39.33 points).

The Berg Balance Scale is the most commonly used tool in medical literature for assessing balance control in hemiparetic patients, thus it is considered gold standard. According to Figure 1, after the intervention there was a significant improvement in the BBS. It is important to point out that three of the subjects had an increase of four points in the BBS, which implies in significant clinical improvement in terms of functional balance assessment. The fact that some participants had an increase of only two points in the scale can be explained by the extensive damage to the patients' functional balance. Although the results were positive, we can't ignore the effects of learning during the application of BBS [12].

Although the BBS is commonly used for identifying the probability of a tumble and assess balance in individuals with neurological disorders [13-15], we haven't been able to find any studies assessing balance after the combination of techniques used in this research.

The vibration platform transmits micro vibrations to the body, unbalancing the body axis, this information is received and processed by the brain, which returns the necessary information so the muscles can retrieve the sensory-motor reflex balance [16]. Training on the vibration platform has shown to be beneficial, improving balance and being attractive to individuals who have limited mobility [17].

The vibration platform is associated to other routines (stretching, exercising and relaxing with or without the use of accessories) for treating a number of pathologies [18]. The vibration platform was used as a means of treatment for all the subjects, at 30 Hz frequency and 3 mm amplitude, for a period of 15 minutes, 3 times a week on alternate days. As a result, patients had improvements in balance.

Muscle stretching is a therapeutic maneuver applied in order to increase the length of shortened soft tissues. It can also be used to increase the extensibility of muscles, tendons and periarticular connective tissue, thus contributing to the improvement of articular flexibility [19]. Studies have shown that flexible individuals are able to maintain good posture and, consequently, good balance [20,21].

Similarly, some studies also claim that stretching promotes neuro-musculo-skeletal adaptations, improving balance [22,23].

As for the mobilization of the nervous system, various studies show that it is a therapeutic resource used to restore dynamic balance [24].

Concerning the TUG test, according to Figure 1, when the comparison was made between the pre-test of the first assessment and the post-test of the last assessment, it was possible to observe that all the patients from the intervention group reduced their respective response times, thus reducing the risk of tumbles improving their functional mobility.

The diminishment of balance, muscle weakness and spasticity after a CVA justify the longer time spent on TUG before the intervention [25].

The Timed Up and Go test showed great importance because it is related to balance, speed of pace and functional capability. The time spent on the test is directly associated to the level of functional mobility. Patients who had a CVA and take more than 20 seconds to perform the TUG are considered to have compromised functional capability, with higher risk of tumbles when compared with healthy individuals and functional elderly people. Patients who took more than 20 seconds to perform it tend to be more dependent for daily life activities and are more likely to take tumbles [26,27].

Just like our study, another experiment applied the TUG test to healthy individuals, who could perform the test in about 10 seconds, whereas compromised individuals took 30 seconds or more. Such study is parallel to our results, where it was possible to observe that the TUG expresses values that reflect the impact of a CVA in dynamic balance [28].

It was impossible to find any studies assessing the Timed Up and Go test after the combination of techniques described in this research, which turned to be a limitation when it came to comparing the results of our research.

In accordance to the results found in this research, one study observed significant improvement in the TUG scores after the use of the vibration platform [29].

In Figure 2, the studies that relate self-stretching to balance and functional mobility are scarce, so we searched for explanation in physiological bases and in mechanisms of self-stretching.

Self-stretching allows patients to maintain and increase the Movement Amplitude obtained with treatment. The principles of intensity and duration of stretching exercises applied to self-stretching are the same used for passive stretching [30].

In active stretching, the patient uses their own body to stretch a certain area of the body. For instance, stretching of the calf can be done while standing upright, the body weight and force produced by the patient lead to movement amplitude. This muscle group is more easily stretched with the use of the active technique than it is with the passive one [31].

Active stretching prompts a better response from Golgi tendon organs and can mitigate the response from this neural component, promoting more tension on muscles that underwent active stretching [32].

There are no studies evaluating the combination of therapies before and after active stretching, thus we suggest new studies on this theme so as to have their results compared and verified.

This study was limited by the small sample of individuals who had CVA and were diagnosed by MRI or CT scans and who showed slight to moderate spasticity.

Up to the present moment there are no studies proposing the application of combined techniques. Finally, this study proposes additional research involving the use of combined therapies for spastic hemiparetic patients who had a CVA, now with a significant number of individuals.

Conclusion

The broad and comprehensive protocol poses as a valid form of treatment for patients after a CVA. The study observed that the combination of techniques shows statistically significant clinical results when pre and post application data were compared. The intervention group showed to have more positive results in functional capability and balance than the control group.

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