

# Evaluation of the effect of spinal manipulation in upper limb spasticity post stroke.

Avaliação do efeito da manipulação da coluna vertebral nas espasticidade dos membros superiores após um acidente vascular cerebral.

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## Abstract

**Introduction:** Cerebral Vascular Accident is the third leading cause of death and the leading cause of neurological disability in adults with hemiplegic and spasticity is the most prevalent motor dysfunction, with consequent impairment of muscle strength and joint range of motion. **Objective:** To evaluate the immediate effect techniques of spinal manipulation in upper limb spasticity after cerebral vascular accident. **Method:** Participants were six patients included in both groups: group A, submitted to the application of the techniques of spinal manipulation and group B, control. The order of participation of patients was randomized and performed on alternate weeks. In both groups, participants were evaluated for spasticity by Modified Ashworth Scale, immediately before and after a given intervention. **Results:** The results did not permit an inference about the acute effects of spinal manipulation on spasticity, however, can be observed in the study group was reduced in 50% of cases with increased tone, while in the control group, 30% cases had increased tone reduction, and if increased. There was increased tone in two cases which were previously normal. **Conclusion:** The immediate evaluation of the effect of spinal manipulation in patients with spasticity got reduced muscle tone, however, on the number of participants and changes in reducing and also from increased tone in the control group, it is not possible assignment of the obtained effects only the techniques applied, thus being further studies with larger samples and other methods of assessment needed.

**Key-words:** Muscle spasticity, Cerebrovascular accident, Spinal Manipulation.

## Resumo

**Introdução:** O Acidente Vascular Cerebral constitui a terceira causa de morte e a principal causa de incapacidade neurológica em adultos, sendo a espasticidade hemiplérgica a disfunção motora mais prevalente, com consequente comprometimento da força muscular e da amplitude de movimento articular. **Objetivo:** Avaliar o efeito imediato de técnicas de manipulação vertebral na espasticidade de membro superior pós acidente vascular encefálico. **Método:** Participaram da pesquisa 6 pacientes, incluídos em ambos os grupos: grupo A, submetido à aplicação das técnicas de manipulação vertebral, e grupo B, controle. A ordem de participação dos pacientes foi randomizada e realizada em semanas alternadas. Em ambos os grupos os participantes foram avaliados quanto à espasticidade pela Escala Modificada de Ashworth, imediatamente antes e após a intervenção determinada. **Resultados:** Os resultados não permitiram uma inferência acerca do efeito agudo da manipulação vertebral sobre a espasticidade, porém, pode-se observar que no grupo de estudo houve redução em 50% dos casos que apresentavam aumento de tônus, enquanto no grupo controle, 30% dos casos de tônus aumentado tiveram redução, e um caso sofreu aumento. Observou-se aumento do tônus em dois casos que, anteriormente, estavam normais. **Conclusão:** A avaliação imediata do efeito da manipulação vertebral em portadores de espasticidade obteve redução do tônus muscular, porém, diante do número de participantes e das alterações de redução e também do aumento do tônus no grupo controle, não é possível a atribuição dos efeitos obtidos apenas às técnicas utilizadas, sendo, portanto, necessários estudos futuros com amostra maior e outros métodos de avaliação.

**Palavras-chave:** Espasticidade muscular, Acidente cerebrovascular, Manipulação da coluna.

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## INTRODUCTION

Stroke is defined by the World Health Organization (WHO), as the syndrome of vascular origin characterized by the rapid development of signs and symptoms of a focal or global disturbance of cerebral function, with over 24 hours of duration and that can lead to death.<sup>(1-3)</sup>

Stroke has a major impact on public health worldwide, being the third cause of death and the leading cause of neurological disability in adults, and consumes enormous resources of society to treatment in the short and long term.<sup>(4)</sup> In the U.S., the costs associated with stroke in 2009 were estimated at \$ 68.9 billion.<sup>(5)</sup>

In Brazil, the latest statistics released by the Ministério da Saúde indicate that the disease was responsible for the deaths of 90,930 people in 2004, while the first three months of 2006, there were 30,392 hospitalizations for stroke by the Unified Sistema Único de Saúde (SUS).<sup>(6-8)</sup> The incidence rate is 156 cases per 100,000 population, with a prevalence of 6.2% and a mortality rate of 111 cases per 100,000 inhabitants.<sup>(9)</sup>

The most common cause of injury, which occurs in about 85% of cases, is the obstruction of a (middle, anterior or posterior, in descending order of frequency) cerebral artery or its smaller perforating branches that go to the deeper parts brain and characterize ischemic stroke the accident. In other cases, the accident is caused by the rupture of a vessel with consequent cerebral hemorrhage - Hemorrhagic stroke.<sup>(1,2)</sup>

In both situations, the stroke can result in impairment motor, sensory, mental, perceptual or language functions, depending on the location of the brain damage, the extent of injury and the possibility of revascularization. In general, the hemiplegia is the most obvious sign of a stroke, although other disabling symptoms, also including sensory impairment, aphasia or dysarthria, visual field defects and mental and intellectual disabilities.<sup>(3,10)</sup>

The most common symptom is the hemiplegic spasticity, defined as a motor disorder characterized by hyperexcitability of the stretch reflex, with exacerbation of deep tendon reflexes and increased muscle tone.<sup>(11)</sup> This muscle hypertonia is manifested by an increased resistance to muscle stretch, with predominant distribution in the antigravity muscles.<sup>(7,11)</sup>

The functionality of individuals with spastic muscles may be severely compromised due to muscle strength decreased, range of motion and increased of stiffness, besides causing pain, sleep disorders and impair ambulation.<sup>(12)</sup> Thus, spasticity limits the function normal motor and prejudice the tasks of daily life and work.<sup>(13)</sup>

Thus, treatment of spasticity aims to inhibition of pathological reflex activity to adjust muscle tone and facilitate normal movement. For this, the treatment is multifactorial, including pharmacological agents, the application of neurotoxin and physical therapy rehabilitation.<sup>(11,14)</sup>

Physical therapy includes the use of orthosis to assist the movement and positioning of the body, the neuroevolutionary method (Bobath), application of heat and cold, and functional electrical stimulation, indicated for mild to moderate spasticity, regardless of the time of injury.<sup>(11,14)</sup> However, as there is no definitive cure treatment of spasticity, other therapeutic resources have been investigated, such as hydrotherapy and hippotherapy.<sup>(11)</sup>

Thus, this study aims to evaluate the effect of spinal manipulation, therapeutic modality that aims to reduce the frequency range of the system discharge, responsible for chronic intrafusal contraction in order to restore joint mobility, spasticity of the upper limb patients after stroke.<sup>(15-17)</sup>

Muscle spasticity is responsible for increased tone and resistance to stretching of the muscle. Thus, the application of spinal manipulation, which is combines techniques for high speed causes the stretching of joint capsules (Ruffini corpuscles) and mono-articular muscles (Golgi tendon organs) cause a reflex response in the spinal cord, inhibiting alpha and gamma motoneurons.<sup>(15,18,19)</sup>

Another justification for handling the control of spasticity spinal cord is that produces vasospastic facilitating changes ortossimpatic source, providing a vascular effect its metamer that can be standardized through manipulation.<sup>(15,18,20,21)</sup>

## METHOD

After approval by the Research Ethics Committee by the Faculdade de Medicina de São José do Rio Preto, patients with upper limb spasticity after stroke, who received treatment at the Clinic of Neurology, Universidade Paulista, regardless of age and gender, were invited to participate in this study.

For this, patients were informed that this was an investigation into the possible effects of manipulation to control spasticity, and consulted his interest and consent (Appendix 1) to participate as a volunteer, so that regardless of your choice, not would prejudice about treatments that were already underway.

The study included six patients included in the two groups: group A, subject to the application of techniques of spinal manipulation, and group B, control, received no therapeutic procedure during the period in which the group A received treatment. The contribution of each patient in Group A or Group B was determined randomly, and carried out on alternate weeks.

In both groups spasticity was assessed immediately before and after the study protocol of the Modified Ashworth Scale, which is the most widely used scale, acceptance of which is due to its reliability and interobserver reproducibility.<sup>(7)</sup>

The evaluations were performed by the same person, and that he had no knowledge of which group the

participant belonged. After the initial assessment of spasticity, the participant was directed to another physical environment, where it received the application of manipulative techniques (group A) or was at rest (group B) about 50 minutes and then was reassessed. Antes de receber técnicas de manipulação, os participantes do grupo A foram avaliados pelo teste DeKleyn Nieuwenhuysse, com o objetivo de avaliar a compressão de raízes nervosas da coluna cervical e artérias vertebrais.<sup>(22,23)</sup>

Physical examination to determine the techniques to be used include static and dynamic inspection, including tests of mobility of the spine and activates the Mitchell test<sup>(15,23)</sup> Specific tests were applied in the following vertebral segments: Fourth thoracic vertebra (T4), fifth (T5) and sixth (T6).<sup>(18)</sup>

In the case of the presence of somatic dysfunction in vertebral segments during the evaluation techniques of low amplitude and high speed (trust) were conducted, aimed at stimulating the parasympathetic or sympathetic centers to break the arc autonomic reflex pathological. The pulse was applied parallel or perpendicular to the joint, causing a sensory response. The vicious circle that keeps the monoarticular muscle spasm is thus broken and can therefore tailor muscular tone.<sup>(15,18,19,24)</sup>

**RESULTS**

The study included six patients, four men and two women; five had hemiplegia on the right and one left. Among those, four were included in both groups, study and control, and only two were included in a single group, and one was included in the study group and the control group.

In the evaluation of osteopathic dysfunction in the thoracic segments, four of the participants had dysfunction: Extension-rotation-side slope (ERS) on the right side and 2 had on left side. Regarding the assessment of cervical spine dysfunction was identified in five participants ERS on right side and ERS on the left side in one participant.

The results of the evaluation by the Modified Ashworth Scale, before and after manipulation in the study group and control group are shown in Tables 1 and 2, respectively.

The results obtained by the Modified Ashworth Scale showed reduced spasticity in two patients for the movement of shoulder extension and unchanged in three participants. For the movement of shoulder abduction, one patient had hypotonia and two had normal muscle tone. There was also a reduction of tone in

**Table 1.** Assessment of spasticity by Modified Ashworth Scale, pre and post application of manipulative technique in 4-6 vertebrae of the thoracic segment (study group).

n	Spastic limb	Modified Ashworth Scale													
		Shoulder Extensors		Shoulder Aductors		Shoulder Abductors		Elbow Flexors		Elbow Extensors		Wrist Flexors		Wrist Extensors	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	right	1+	0	1	0	0	0	1	1	1	1	1	1	1	1
2	left	1	1	H	H	H	H	1+	1	0	0	1	1	0	0
3	right	1	1	0	0	0	0	0	0	0	0	1+	1+	1	0
4	right	2	1+	2	1+	2	1+	2	1+	2	1+	2	2	2	2
5	right	0	0	0	0	0	0	1	1	0	0	1+	1	1+	1
6	NP														

H: hypotonia; NP: not participated; NO: not obtained.

**Table 2.** Assessment of spasticity by Modified Ashworth Scale, pre and post rest (control group).

n	Spastic limb	Modified Ashworth Scale													
		Shoulder Extensors		Shoulder Aductors		Shoulder Abductors		Elbow Flexors		Elbow Extensors		Wrist Flexors		Wrist Extensors	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	right	0	1	0	1	0	0	2	1+	1	1	1	1	1	1
2	NP														
3	right	0	0	0	0	0	0	1+	1+	1+	0	1+	1	0	0
4	right	2	2	1+	1+	0	0	1+	1+	1	1	1+	1	1	1
5	right	NO	NO	1+	1	0	0	1+	1	1	1+	1	1	1	1
6	right	H	H	H	H	H	H	H	H	1+	1+	1+	1+	H	H

H: hypotonia; NP: not participated; NO: not obtained.

the other two patients underwent the technique. Likewise, the abductor muscles of the shoulder showed normal tone in three participants and hypotonia in a participant, in the only case in which the initial assessment had spasticity, the tone decreased. Regarding the flexor muscles of the elbow, 4 patients had increased tone, two remained unchanged and two showed a reduction; regarding the extensor muscles of the elbow, the two participants who had spasticity in the initial evaluation, his tone had decreased. Already in the flexor muscles of the wrist, in which all participants had increased tone in the initial evaluation, only one participant had tone reduced. As for the wrist extensor muscles, four had increased tone in the initial assessment, two had reduced their tone and two remained unchanged. In the control group, the extensor muscles of the shoulder were not evaluated in two participants, because one had hypotonia and the other, by complaints of pain.

The only participant who had hypertension, had no change of tone, however, was reported by the evaluator, increased tone in a participant who had normal tone before the rest period. A similar effect was observed in the same patients to the shoulder flexors. In the analysis of the abductor muscles of the shoulder was not observed the tone increase in participants, both at initial and final assessment. The elbow flexor muscles showed increased tone in 4 participants and, after rest, two had reduced tone. The tone of the extensor muscles of the elbow was increased in all participants and postoperative evaluation, three were unchanged, in one a decreased, and in another there was tone increased.

Spasticity was also detected in all patients for the flexor muscles of the wrist, and 3 showed no difference between the initial and final evaluation, and in two other cases, it appeared diminished. For the extensor muscles of the wrist, three participants with increased tone showed no change between the initial and final assessment.

## DISCUSSION

The neurological rehabilitation and contribution of physical therapy have changed considerably in recent decades, since the scientific and technological developments have enabled a greater understanding of the mechanisms of brain reorganization and the mechanisms involved in the control settings of the engine performance.<sup>(25)</sup>

The hemiplegia treatment is quite controversial, due to the different methods and techniques are not very specific for this commitment.<sup>(26)</sup> Early in the history of physiotherapy treatment, had orthopedic approach. Only in the 50 new rehabilitation methods have been developed, based on neurophysiological and neurofacilitat6rias techniques. These methods focus on facilitating movement by afferent stimulation, especially in muscles, joints and tactile and proprioceptive receptors.<sup>(25,27)</sup>

In the '80s, manual therapy began to be inserted as a form of treatment for spastic children, using joint mobilization in the scapula and ankle, and following the line of neuroevolutive method that aimed to better alignment and balance of the patient.<sup>(28)</sup>

Despite clinical evidence for the benefits of spinal manipulation, biological effects of spinal manipulation are not known. Although they do not deny the clinical effects of spinal manipulation, they hinder the acceptance by the scientific community health and wider communities, and hinder rational strategies for better implementation of spinal manipulation.<sup>(19)</sup>

In this study, the results do not allow any inference about the acute effects of spinal manipulation in spasticity. The reasons for this relate to the small number of participants and assessments as well as the participation of a single evaluator, in view of modified Ashworth scale is a subjective analysis and thus susceptible to the expectations of the reviewer, although unaware of the same group in which the patient is inserted. The muscle tone in the control group was expanded by 65% compared to the initial rating, remained unchanged in 30% of cases and decreased in one patient (5%).

These results corroborate other studies supporting the theory that manipulative therapy and joint mobilization can lead to inhibitory effects in the short term the human motor system, producing a transient attenuation of the excitation of alpha motor neurons.<sup>(19,29)</sup>

It is also important to consider that during the application of osteopathic techniques for stimulation of proprioceptive afferents (activation of muscle spindles, Golgi tendon organs and joint receptors) and exteroceptive (activation of mechanoreceptors of the skin) all these stimuli may contribute to the formation of new cortical, cortical reorganization and promote links these patients.<sup>(30)</sup>

In a comprehensive review of the neurophysiological effects of manipulation, were found evidences supporting the following mechanisms contribution for the effects of manipulation: Changes in the firing of mechanoreceptors type Ia and type II, facilitation of spinal cord reflexes and control of skeletal muscle.<sup>(31)</sup> Moreover, it was hypothesized that the noradrenergic and serotonergic pathways used an inhibitory effect on descending spinal response to mediate the response of the manipulation.<sup>(32)</sup>

Electromyographic studies have suggested that spinal manipulation can induce activation of adjacent muscles was manipulated,<sup>(32,33)</sup> with muscle activation, possibly from the type II mechanoreceptors in the spinal cord.<sup>(33,34)</sup>

In a later study, Herzog *et al* (1999) did not mention the origin of reflex responses but the authors reported electromyographic responses specific to different areas of the body in response to manipulation.<sup>(34)</sup>

Despite reports of the neurophysiological effects that occur after a spinal manipulation, the placebo effect should also be considered. Information relating to the participant about the potential benefits of the application of technical manipulation and therefore their expectations, may contribute to the response expected by the called placebo effect, highlighting what has been reported for patients only information relevant to the technical procedure used, minimizing the bias expectation. In this study, the assessment method used was not sufficient to demonstrate the effectiveness of treatment used, taking into account the changes in control group. In this sense, it becomes evident the need for other assessment methods in the future, however, with similar proposals.

In the past, the risk of adverse events of manipulative therapy has restricted its use among physical therapists.<sup>(36)</sup> However, it can be assumed that, due to increased scientific research, manipulation has been used more frequently, and complications and failures are associated indication or application of techniques.<sup>(37,38)</sup> A detailed history and physical examination, combined with specific tests, such as DeKleyn - Nieuwenhuys

used in this study contribute to the detection and evaluation of risks that contraindicate manipulation and thus minimize complications from the chosen technique.<sup>(15,22)</sup>

The present study aimed to evaluate the acute effect of the application of the technique, since the manipulation has an advantage over other treatments is that the effect is immediate.<sup>(18,39,40)</sup> Although the results of this work have not been conclusive, manipulative approach deserves further investigation in neurological patients, due to the current therapeutic approach to these patients require prolonged accompaniments for minimal changes in muscle tone, range of motion and pain symptoms.<sup>(41)</sup>

## CONCLUSION

In the immediate assessment of muscle tone by modified Ashworth scale, a reduction in muscle tone was detected in patients who had her spine manipulated. However, due to the small sample and the responses also displayed in the control group, it is not possible to award the effects obtained only the techniques used. Therefore, future studies with a larger sample size and inclusion of other assessment methods are needed.

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