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FOCAL VIBRATION ON THE SPASTICITY OF PATIENTS WITH NEUROLOGICAL INJURIES

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ABSTRACT

Introduction*:* Neurological injuries present movement disorders that impair the independence of these patients. Spasticity is one of the most frequent disorders and results in secondary complications with negative interference with physical and motor functions performed in daily life. The aim of this study was to review evidence in the literature that exposes the effect of focal vibration on spasticity in patients with neurological injuries. **Methodology***:* A search was performed in the databases Pubmed, PEDro, Scopus and Web of Science using the descriptors "focal vibration" AND "spasticity" stipulating inclusion criteria AND methodological qualities. In total, 5 articles were included and made up the review analysis. **Results***:* The results showed significant improvements in the reduction of spasticity and in functional parameters that influence the quality of life of these patients. **Conclusion***:* We concluded that the focal vibration is an effective intervention in reducing spasticity in patients with neurological injuries.

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INTRODUCTION

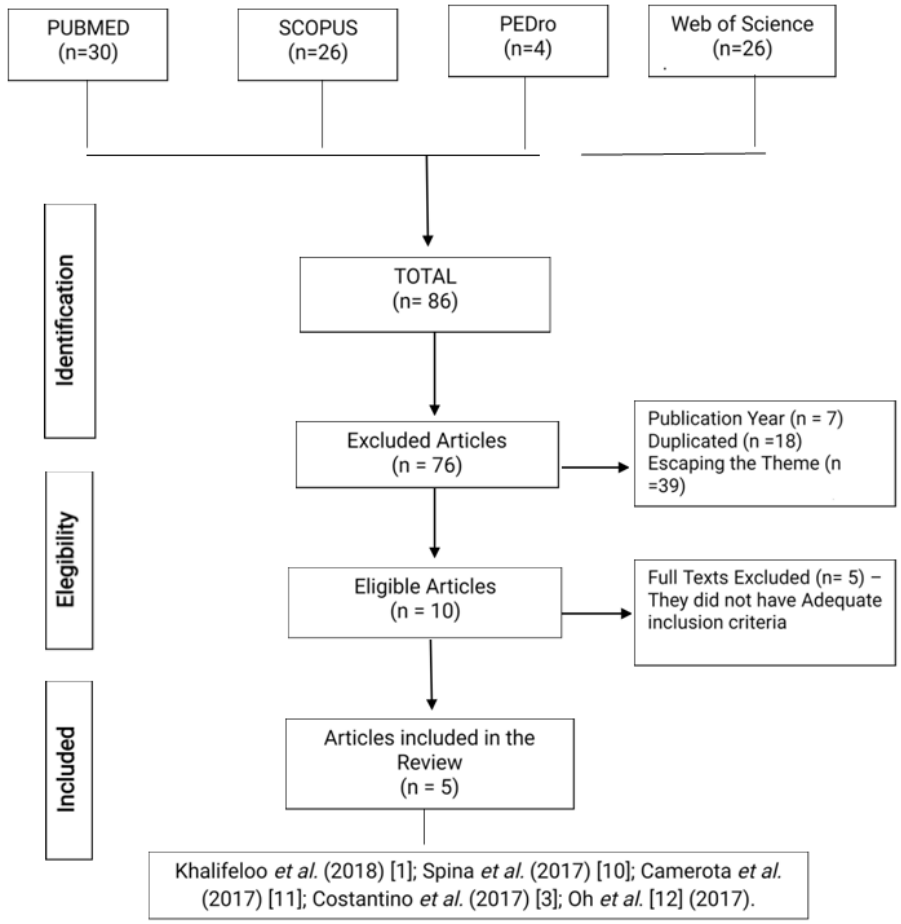
Neurological injuries are one of the main causes of functional disability in the world, this is due to changes resulting from brain damage that mainly affect the motor area, causing important deficits that impair the independence and functionality of these patients. Movement disorders, spasticity, weakness, deficits in balance, gait and sensitivity are common in these injuries [1-3]. Among these, the spasticity stands out as a motor disorder originating from the upper motor neuron syndrome resulting from proximal lesions of the alpha motor neurons, which causes a speed-dependent increase in muscle tone and stretching reflexes. This condition hinders the quality of life of these patients by restricting and / or reducing movements and adding to future complications [4-7]. In this perspective, the focal vibration (FV) appears as a therapeutic intervention used lately in the treatment of spasticity in order to promote a reorganization and sensorimotor learning.

It is a technique that applies vibratory stimuli to a specific muscle or tendon, stimulating the neurological terminations and consequently activating the muscle spindles that lead to changes in the corticospinal pathways. These changes can promote the excitability of the primary motor cortex, which can promote improvements in functional parameters contributing to rehabilitation [2,8,9]. Considering the difficulties presented due to spasticity, it is necessary to investigate the effectiveness of methods of treatment aimed at reducing these disorders. Thus, the aim of this study was to review in the literature evidence that exposes the effect of focal vibration on spasticity of patients with neurological injuries.

METHODS

This study was a literature review by searching PubMed, PEDro, Scopus and Web of Science databases based on the

PICO strategy (P- population: adults with spasticity due to neurological impairments; I-Intervention: vibration focal; C-Comparation: does not apply to this study; O: Outcomes: Reduction of spasticity) for the formulation of the guided research question "Does focal vibration reduce the spasticity of patients with neurological impairments?" and elaboration of the descriptors “focal vibration” AND “spasticity”. Articles with primary studies, published in the last five years in English, were selected, which used focal vibration in patients with neurological impairments. Duplicate articles, which escaped the theme, which had an inappropriate publication year and research designs, and which used another type of vibration (whole body vibration), or which associated focal vibration with another therapy were excluded.



The search and selection were carried out by two independent reviewers initially by reading the title and then reading the abstracts to identify the type of study and inclusion criteria used. Disagreements between reviewers during the analysis were decided by consensus. To evaluate the methodological quality of the selected articles, the PEDro scale was used, which qualifies randomized controlled clinical trials according to 11 criteria with scores from 1 to 10, the first criteria was not scored.

RESULTS

We selected 86 articles through the databases, 76 were excluded for escaping the theme, presenting inappropriate designs and year of publication or being duplicated. Thus, 13 studies were included for a careful evaluation, of these five contemplated the appropriate inclusion criteria (Figure 1). Ninety patients aged 18 to 65 years with a clinical diagnosis of Multiple Sclerosis (MS) and Cerebral Vascular Accident (CVA) were analyzed, evaluating muscle tone (modified Ashworth Scale), gait, balance in walking (Dynamic Gait Index), balance performance (TUGtest), speed and gait resistance (25-foot timed walk - T25FW), quality of life, lower limb kinematics (ROM) and fatigue (Modified Fatigue Impact Scale - MFIS) (Chart 1).

DISCUSSION

This study exposed evidence about the effect of FV on the spasticity of patients with neurological injuries. Studies have shown significant improvements in muscle tone [1,3,12], which leads to a reduction in the spasticity of these patients.

This reduction may be related to the decrease in the volume of the cortical map of the treated muscle, together with the increase in the volume of the cortical map of the antagonist muscle, which can guarantee that the treatment of spastic muscles has more results when applying the vibration to the antagonistic muscles, which generates a reciprocal inhibition, these responses being induced by the excitability of the primary motor cortex, through the tonic vibration reflex [1,3,13,14]. Studies report that the mechanism that promotes improvement in motor recovery through FV may be related to direct action on the ipsilesional motor cortex, with the motor cortex reaching directly via the afferent entry of fibers that is associated with the intrinsic mechanism involving plasticity, generating improvement functional capacity of the affected limb [9,15]. Dynamic balance, spatio-temporal parameters, gait and kinematic aspects of the joints of the involved limbs showed statistically positive improvements in the use of vibration [1,3,10-12] which are associated with the effects arising from this intervention in which it allows changes in

Chart 1. Summary of the included studies showing the sample size, the method of application of the intervention, the outcomes and results obtained in the studied population

Study	Sample	Intervention	Outcome	Results
Khalifeloo *et al.* (2018) [1]	18 patients with CVA	1 focal vibration session in the plantar region of the most affected foot with a frequency of 100 Hz for 5 minutes.	Dynamic balance, spasticity and kinematics of the ankle.	Plantar vibration significantly improved the TUG test (P = 0.03), ankle plantar flexor muscle spasticity (P = 0.008) and passive ankle range of motion (P <0.001).
Spina *et al.* (2017) [10]	20 patients with MS IG (n=10) CG(n=10)	IG: vibration for 1 hour, 5 days a week as an interruption during the fourth and seventh days for 3 weeks. CG: vibration simulation.	PO: Stabilometry and gait parameters; SO: Balance, spasticity and severity of fatigue.	Significant improvements during FRS (p = 0.007), ASL (p = 0.012), DSRT (p = 0.016) and DSLT (p = 0.003) Significant improvements in FRT (p = 0.018); BBS (p = 0.037) and FSS scales, with no significant differences in MAS.
Camerota *et al.* (2017) [11]	14 patients with MS	1 session of focal vibration in the quadriceps and lumbar paraspinal muscles for 30 minutes divided into 3 sessions of 10 min each, repeated for 3 consecutive days.	PO: Gait and spasticity; SO: Kinematics of the lower limbs, quality of life and fatigue.	They showed that after r-fMV, especially after one month, space-time parameters improve, SAI and TAI (which seem to be altered in MS) showed a significant decrease that can be directly linked to reduced muscle stiffness.
Costantino *et al.* (2017) [3]	32 patients with CVA IG (n=16) CG (n=16)	IG: focal vibration in the triceps brachi and carpal extensors with a frequency of 300 Hz, 3 times a week for 12 sessions. CG: vibration simulation;	Handgrip strength, spasticity, quality of life, functional independence, hand functionality and pain.	Statistically significant improvements in muscle strength, pain, quality of life and reduced spasticity.
Oh *et al.* (2017) [12]	6 patients with CVA	Focal vibration at the calf with a frequency of 80 Hz	Lower limb kinematics and spasticity.	Significant improvements in lower limb kinematics and reduced spasticity.

FRS = first right step; ASL = average stride length; DSRT = double support right test; DSLT = double support left test; FRT = functional reach test; BBS = Berg Balance Scale; FSS = Fatigue Severity Scale; SAI = spatial asymmetry index; TAI = temporal asymmetry index; MAS TUG test (Timed Up Go test)

motor performance, because it stimulates the proprioceptive and motor system to obtain an efficient motor control [13]. Neurological injuries modify the quality of life of these patients by limiting their daily activities and reducing social interaction, in view of the mobility difficulties. Studies have found that the use of focal vibration improved the scores on the quality of life scale scores [3,11], which may indicate that the benefits from reducing spasticity and improving of motor performance ensures the overall well-being of these patients [3,11,55]. The limitations of this study are related to the heterogeneity of the protocols and the number of studies related exclusively to focal vibration in the rehabilitation of patients with neurological injuries without the association of other techniques.

Conclusion

In view of the exposed evidence, it was possible to observe the focal vibration can reduce the spasticity of patients with neurological injuries, consequently improving the functional performance of these patients.

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