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Case Report

# EFFECT OF A FOCAL MUSCLE VIBRATION ABOVE TRICEPS BRACHII MUSCLE ON UPPER LIMB SPASTICITY IN A PATIENT WITH A CHRONIC SPINAL CORD INJURY: A CASE REPORT

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## ABSTRACT

**Aim:** To estimate the effect of focal muscle vibration on the spasticity of antagonist muscle group (biceps brachii) and upper extremity muscles when we apply it to agonist muscle group (triceps brachii).

**Methodology:** Our case study is a male patient who suffered from hemiparesis spastic due to spinal cord injury. He was initially evaluated using the modified ashworth scale (MAS). He received 10 sessions of 100 Hz focal muscle superficially to triceps brachii muscle, at the elbow joint.

**Major finding:** We found that the spasticity for both the elbow joint and the non-vibrated wrist joint muscles has reduced. No effect was found on the tone of the shoulder joint.

**Conclusion:** The applied focal muscle vibration on triceps brachii muscle can reduce the spasticity for both elbow and wrist joint muscles.

**KEY WORDS:** Focal Muscle Vibration, Spasticity, Spinal Cord Injury.

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## INTRODUCTION

Spasticity is one of the most invalidation conditions of the upper motor neuron syndrome [1]. A variety of antispasticity interventions, including traditional physiotherapy, oral medication, neurolytic blocking agents, orthopaedic surgery, intrthealbaclopen pumps and selectivedorsal rhiztomy have been used to improve function in patients with spasticity [2]. However,spasticity management is still a challenge for both patients and clinicians who are cautiously in search of less invasive and more effective treatments.

Vibration has been studied and used in medicine for different purposes. It has been used to evoke the Tonic Vibratory Reflex (TVR) in laboratories to study spinal reflex activity [3]. Two major categories of vibrating devices have been used in the rehabilitation field: one is a whole-body vibration device and, the second is a single muscle and locally applied device. Both types are based on a mechanical stimulation characterised by oscillation frequency (in Hz) and amplitude [4].

Regarding the locally applied device, some evidence has demonstrated that a repetitive focal muscle vibration (rMV) that is with a low amplitude and a 100 HZ fixed frequency, and that is used for 90 minutes over 3 consecutive days, induces long-term changes in motor performance, both in healthy subjects and stroke patients. Moreover, recent studies have also suggested that a new form of mechanical stimulation that is at low amplitude, high frequency and prolonged application time, when applied on single muscle, could enhance joint motor control by acting directly on neural circuits [5, 6]. In other words, muscle vibration is a strongly proprioceptive stimulus, which at low amplitude, preferentially produces the afferent input that is able to reach the somatosensory and motor cortex [7].

In addition, classical neurophysiological experiments have demonstrated that upper limb agonists and antagonists show reciprocal inhibition, that is, the activation of one group induces inhibition of the other [8]. It has been demonstrated that this reciprocal inhibition is also induced by vibration [9, 10]. In this study, we discussed the effect of the applied focal muscle vibration on an antagonist muscle, and how it effects the spasticity of the agonistic muscle and non-vibrated muscles.

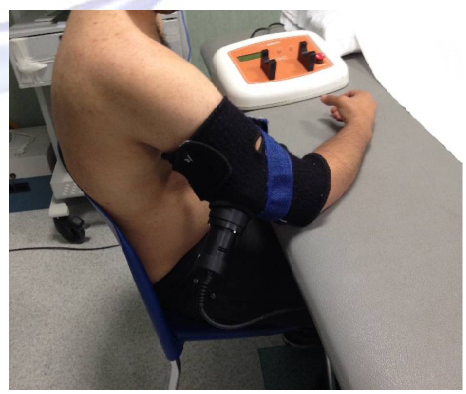
## METHODS AND PARTICIPANT

The participant is a 35 years male patient. He was diagnosed with chronic spastic hemiparesis due to an incomplete Spinal Cord Injury at C5 level (brown- Séquard syndrome) which happened 12 years ago. The procedure of treatment was explained to the patient. Then, the treatment and the assessment in the rehabilitation unit took place in Tor Vergata Hospital “POLICLINICO TOR VERGATA”, Rome, Italy.

The modified ashworth scale was used to assess the spasticity. It was applied to the patient during the normal clinical rotation of doctors, each doctor did not know anything about the aim and the details of our study. The modified Ashworth scale (MAS) is a six-category ordinal scale used to assess the resistance encountered during passive muscle stretching that does not require instrumentation and is quick to perform [11]. The MAS is the current standard for clinical assessment of extremities spasticity, and the most commonly used tool to evaluate the efficacy of pharmacologic and rehabilitation interventions for treatment of spasticit. The MAS is the gold standard against which new assessment tools are evaluated [12]. We found the value of the spasticity for the joint muscles by changing the position of the muscle from the shortening position to the lengthening position while the patient is lying in a supine position.

A pneumatic vibrator powered by compressed air (BOSCO SYSTEM ®, Italy) was utilized. A 100 Hz vibration was applied over the belly of the triceps brachii muscle of the spastic sideby means of a cup-shaped transducer. The contact surface was of 2 $cm^2$. The amplitude of vibration was approximately 2 mm and, the mean pressure was of 250 m Barr. The transducer was kept in place by a non-elastic band wrapped around the arm with a constant contact force of 20-25 Newton (Figure 1). The patient received 10 sessions of vibration, divided into approximately 3 sessions per week. Each session consisted of 10 applications of 30 seconds vibration. Following each vibration, we included 1 minute of full patient rest.

**Fig. 1:** Focal vibratory device and application setting superficially to the triceps muscle.



## RESULTS

Table 1, shows that the muscle tone did not show any change in spastic upper extremity joint muscles after 5 sessions of treatment. At the end of treatment, the muscle tone reduced by one degree on the MAS for both elbow and wrist joints. No change was found in the muscle tone from the end of the treatment to the following follow-up, which came after a month. The reduction in muscles tone in elbow and wrist joints retained after one month follow up.

**Table 1:** The values of muscle tone in upper extremity spastic side according to modifie ashworth scale (MAS).

| Joint | Baseline | After 5 sessions | At end of treatment | 1-month follow up |
|---|---|---|---|---|
| Shoulder joint | 2 | 2 | 2 | 2 |
| Elbow joint | 3 | 3 | 2 | 2 |
| Wrist joint | 4 | 4 | 3 | 3 |

## DISCUSSION

In this case study, we evaluated the possible benefits of the focal muscle vibration on spasticity of the upper limb for a patient, which has a chronic spinal cord injury. The patient started to benefit from the muscle vibration therapy after 10 sessions. We highly recommend adding the vibration intervention device to get more benefits on spasticity and to improve the daily function activity of the patient. Also, we found that applying vibration on antagonist muscle group can reduce the spasticity in agonist muscle group and non-vibrated muscle groups.

We applied the vibration over the triceps muscle to reduce flexion spasticity on elbow flexion spasticity. Muscle agonists and antagonists are linked by so-called reciprocal inhibition and therefore increased motor excitability of a given muscle group can lead to decreased motor excitability in its antagonistic muscle group. A combined clinical consequence of this reciprocal inhibition and of the decreased motor excitability of the non-vibrated antagonistic muscle group could be a reduction in flexion spasticity in the upper limb of patients affected by spastic hemiplegic [13, 14,15].

In addition, muscle vibration is able to increase the excitability of motor cortical projection to vibrated muscle, reducing, at same time, the excitability of projections to non-vibrated muscle [16]. One clinical trial [17] with 19 participants suffer from spinal cord injury was receiving 50 Hz focal vibration above rectus femoris muscle recorded significant reduce in number of cycles and duration of clonus. The authors refereed to explain it; Mechanical spread of vibration, causing activation of spindle primary ending in the soleus muscle cannot be entry ruled out [18]. In our case report, although the vibration was applied on the triceps at elbow joint, the tone in wrist joint shows reduction.

This case study is considered as an example on how muscle vibration can affect spasticity.

This effect needs more investigation and this work needs to be extended to cover more cases in the future studies. Also, other parameters such as the use of higher vibration frequencies can be investigated too.

## CONCLUSION

Focal muscle vibration may reduce the spastic muscle tone to the antagonist muscle when applied at agonist muscle and for non-vibrated muscle. It has a good retention, not only at the end of vibration.

**Conflicts of interest:** None

**Source of funding:** None

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