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The effectiveness of neural mobilization of brachial plexus in patients with chronic unilateral cervical radiculopathy: A single-blinded randomized clinical trial

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Neural tissue mobilization techniques are passive or active movements aiming for restoring the ability of the nervous system to tolerate the normal compressive, friction and tensile forces associated with daily activities. The effectiveness of neural mobilization (NM) for neuromuscular conditions still unclear and limited evidence. To determine the efficacy of tensioning neural mobilization (NM) on handgrip strength and pain intensity in patients with unilateral chronic cervical radiculopathy. The study was conducted at outpatient clinic in AL-Badrashin and AL-Nozha central hospitals, Cairo, Egypt. A single-blinded randomized trial. Forty participants with chronic unilateral CR were randomly assigned either to group-A (conventional physical therapy group, n =20), that received a conventional physical therapy in the form of manual traction, stretching exercise and infra-red irradiation, and group–B (neural mobilization group, n = 20) that received conventional physical therapy in addition to tensioning neural mobilization of brachial plexus. Handgrip strength and neck and arm pain were evaluated at baseline and at the end of a 3-week program. Paired and unpaired t-test, Wilcoxon singed rank test and Wilcoxon rank sum test (Mann-Whitney) were used to analyze data. There were significant within-group differences in both groups regarding both hand grip strength and pain intensity; for hand grip strength, for group (A): (P-value =0.001), and for group (B): (P-value=0.001). Regarding pain, P-value is less than (0.01) for group (A), and P-value is less than (0.01) for group (B). There was no statistically significant difference between both groups regarding both hand grip strength (p-value: 0.374), and pain intensity (p-value: 0.838).The addition of tensioning neural mobilization to conventional physical therapy yielded no significant additional benefits, although both groups showed post-treatment increased handgrip strength and decreased pain intensity.

Keywords: chronic cervical radiculopathy, tensioning neural mobilization, hand grip strength.

INTRODUCTION

Cervical radiculopathy is a common problem for upper quadrant, resulting from compression on cervical nerve roots by space-occupying lesions in the cervical spine; (such as spondylosis, osteophytosis, or cervical disc herniation). Which stimulate the pain receptors of bony and ligamentous structures, producing radicular symptoms (i.e pain, diminished reflexes, sensory deficits, motor deficits, or any combination of these symptoms) in the upper extremity of subject (Boyles et al., 2011, Kim and Iyer, 2016).

Motor function of the hand mainly handgrip strength may be affected by alteration in nerve physiology (Belcher, 2017).

Faisal et al., 2012 demonstrated that hand functions and handgrip strength of the affected limb were significantly reduced in patients suffered from cervical radiculopathy when compared with the unaffected limb. They concluded that assessment of handgrip strength and hand function should be included in the evaluation of patients with cervical radiculopathy.

Effectiveness of neural mobilization (NM) for neuromusculo skeletal conditions still unclear and sound clinical reasoning remains important when using NM in treatment of nerve-related conditions. Due to the limited evidence and often small study samples, conclusions may change over time (Basson et al., 2017). Also, few studies focused on the effect of tensioning neural mobilization (NM) on handgrip strength in patients with cervical radiculopathy. The purpose of this study was to investigate if there were any benefits from adding NM to conventional physical therapy program in the treatment of patients with chronic unilateral cervical radiculopathy regarding handgrip strength and pain intensity.

MATERIALS AND METHODS

Participants:

Forty (male and female) patients with unilateral chronic cervical radiculopathy, referred by physicians for physiotherapy, participated in the study and were randomly assigned to group-A (conventional physical therapy group, n =20), That received a conventional physical therapy in the form of manual traction, stretching exercise and infra-red irradiation, and group–B (neural mobilization group, n = 20) that received conventional physical therapy in addition to tensioning neural mobilization of brachial plexus. All participants were informed about the study procedures and signed informed consent forms. This study was conducted in physiotherapy clinics at two central hospitals. The study was approved by the Research Ethical Committee of the Faculty of Physical Therapy, Cairo University, Egypt. NO:P.T.REC/012/001656.

The study sample included patients with 20-40 years of age who had a history of pain for more than 3 months, and had radiating pain only in one upper limb and also those who met the Wainner et al., 2003 criteria. Patients were excluded if they had traumatic injuries of upper limb and cervical spine, dizziness, circulatory disturbances of upper extremity, known history of high level Spinal cord injury and malignancy or any of the medical "red flags" (e.g., tumor, fracture, rheumatoid arthritis, osteoporosis, prolonged steroid use (Sambyal and Kumar, 2013).

Randomization

After the initial evaluation, the subjects were assigned to 2 groups randomly using opaque, sealed envelopes, each containing the name of one of the groups (conventional physical therapy or neural mobilization). Before the first treatment session, the envelope was picked by the investigator not participated in the study.

Sample-size calculation

The sample size calculation was based on a previously reported difference of handgrip strength in the study by Goyal et al., (2012), 2 tailed an alpha level of .05, and 80% power. A sample size of 20 patients per group was determined.

Assessment procedures:

A single investigator was responsible for the assessment before starting the treatment (baseline) and at 3 weeks after intervention. The investigator was blind to the group assignment of the patients and was not involved in the intervention.

All patients had a full explanation of the objectives of the study and its procedures, and after assigning the consent form for the study ;(,) the demographic data of the subject including name, age, height, and weight were recorded.

Modified sphygmomanometer test was used to assess handgrip strength by using sphygmomanometer (KBM, model: ST-800, CODE: A127880-9 JAPAN) (Beebe and Lang, 2009). The Modified Sphygmomanometer Test (MST) is an objective and adequate measure of handgrip strength with low-cost (Martins et al., 2015).

The participants seated on a chair with supported feet and trunk, shoulder adducted, elbow flexed at 90°, forearm in the neutral position, and wrist with 0 to 30 º extension, the subjects were asked to perform a maximum isometric contraction for 5 s, and the peak force was recorded. The patient received a verbal stimulus to start the movement and maintain contraction (Amaral et al., 2012). Only one trial was performed after the familiarization according to CDCdeM et al., 2013. The force exerted on the modified sphygmomanometer was determined by pressure gauge reading with increments of 20 mmHg before each measurement, as the equipment was pre-inflated at 20 mmHg (Kaegi et al., 1998).

Visual analogue scale (VAS) was used to assess neck and arm pain, the patients were asked to mark any point on the continuum that expressed his/her pain intensity along the neck and the affected arm. Measurement of the length was then recorded as pain intensity (Kannabiran et al., 2015).

Treatment procedures:

Both groups received conventional physical therapy consisted of infrared radiation, flexion stretching exercise, and manual traction, in addition to neural mobilization for group B (Neural mobilization group). All the patients performed the rehabilitation program three sessions per week under the supervision of the principal investigator for nine sessions.

Application of infrared radiation:

The patient seated with the back of his/her neck exposed and his/ her head supported comfortably over a pillow on a top of the table. The position of the infrared was adjusted with the center of the emission coil was directly above and behind the spinous process of the fourth cervical vertebra. The distance between the patient and the lamp was adjusted and the patient reported mild comfortable warmth over the back of his/her neck. The irradiation time was 20 minutes (Chiu et al., 2005).

Manual traction of the cervical spine:

Manual traction of the cervical spine was applied with the subjects in supine position, by placing the right hand on the subject's chin and left hand on the occiput then the distraction force was applied for 15 seconds for 3 sets of ten repetitions, with 30 and 60 seconds rest between repetitions and sets respectively (Goyal et al., 2012).

Flexion Stretching exercise for the neck extensors:

Stretching exercise comprising of neck flexion was applied for 15 seconds for 3sets of ten repetitions, with 30 and 60 seconds rest between repetitions and sets respectively (Goyal et al., 2012).

Neural mobilization:

Group B received the same program as mentioned in addition to tensioning neural mobilization of brachial plexus. The NM tensioning technique consisted of 2 exercises (Butler and Jones, 1991; Beneciuk et al., 2009):

The participant arm was passively positioned in the neurodynamic testing position; while the participant in the supine position, the cervical spine positioned in approximately 25° of contralateral lateral flexion or when the first sense of increased resistance perceived by the investigator, whichever occurred first. This was followed by the following consecutive positioning procedures:

(1) Passive scapular depression until a sense of resistance perceived by the investigator.

(2) Combined shoulder abduction and external rotation 90°; combined forearm supination, wrist extension, finger extension until a sense of resistance perceived by the participant.

The first exercise involved passively positioning the participant in the previous neurodynamic testing position, As the position assumed;10 cycles of passive elbow flexion/ extension, at a rate of approximately 6 seconds per cycle (3 seconds into extension and 3 seconds into flexion), was provided. Upon moving from elbow flexion to extension, an initial sense of resistance perceived by the investigator was used as a sign to alternate directions. Following the 10th cycle, a static hold was maintained while in elbow extension for 10 seconds (Butler and Jones, 1991; Beneciuk et al., 2009).

The second exercise involved the same initial neurodynamic test positioning, except any cervical components (i.e., the cervical spine positioned in a neutral position). Instead of mobilizing the elbow, the participant was asked to perform active movements, consisting of cervical lateral flexion away from the tested extremity, to and from a neutral position. The participant was asked to only encounter an initial sense of resistance when moving into the direction of lateral flexion. This was repeated for a total of 10 cycles. Following the 10^{th} cycle, a static hold maintained while in lateral flexion for 10 seconds (Butler and Jones, 1991; Beneciuk et al., 2009).

Statistical analysis:

The data were analyzed according to their statistical distribution using the Shapiro Wilks W test. Data were analyzed with SPSS Version 22.0 (SPSS Inc, Chicago, IL). Descriptive statistics were conducted for variables (age, height, weight, handgrip strength) as means and standard deviations, unpaired "t" test was used for within and between groups' data analysis of samples background (age, height, and weight) and handgrip strength. Mann-Whitney test& Wilcoxon signed rank test was used for within and between groups data analysis of pain intensity. The alpha level was set at 0.05.

RESULTS

Of 76 patients, 26 did not have meet inclusion criteria and, 10 refused to participate in the study. While 40 participants were allocated into two groups (figure1).

There was no statistically significant difference (P>.05) for age, height, and weight for the patients in the A and B groups as p-value was o.455,o.343, 0.752 for each of them respectively.

Regarding hand grip strength, there was no statistically significant difference between "groups A, B" (P- Value :0.374), but for within-group data; there was a statistically significant difference between "treatments (Pre, Post)" for group (A), and for group (B), as shown in table (1).

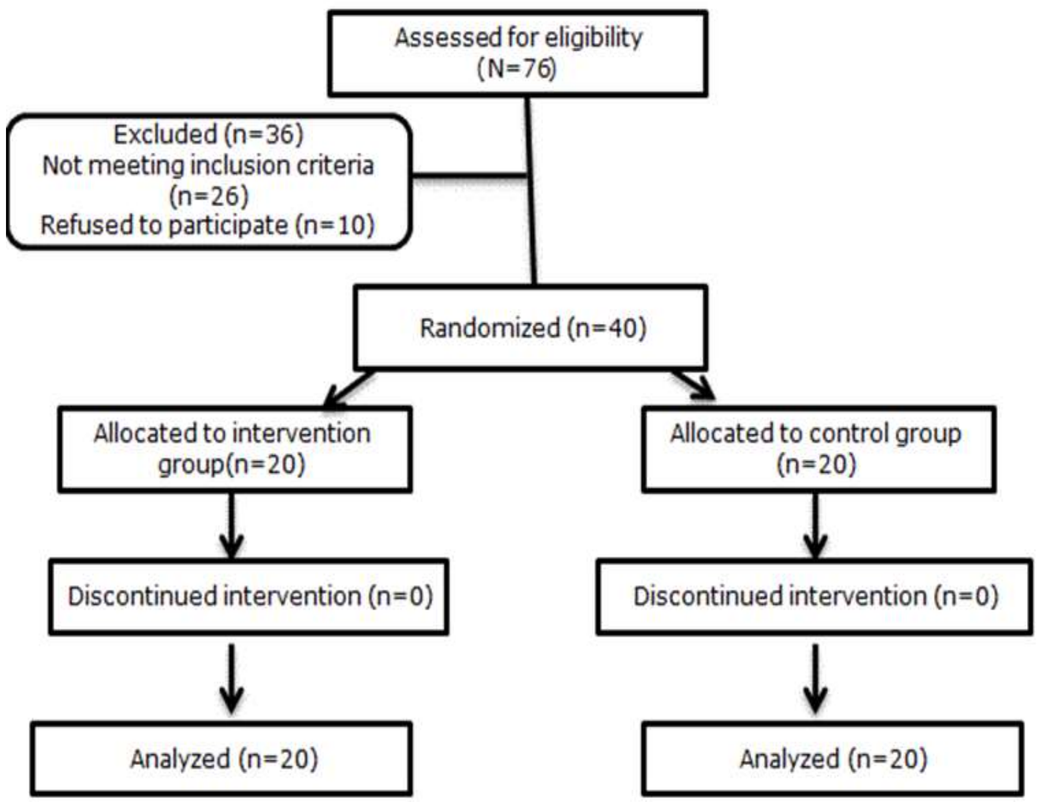

Figure.1: Flow diagram.

Table 1: within and between groups' differences for "Handgrip strength (mmgh)"

		Pre Treatment		Post Treatment		Within Groups	
Handgrip strength (mmgh)		Mean	(±SD)	Mean	(±SD)	t-value	P-value
Group A(n=20)		36.25	(±15.29)	63.75	(±22.76)	-8.297	0.001**
Group B(n=20)		39.5	(±23.28)	72	(±34.08)	-6.706	0.001**
Between Groups	t-value	-0.522		-0.9			
	P-value	0.605		0.374			

*SD: standard deviation, P: probability, S: significant, N.S: Not significant, HS: Highly significant.
**Significant at level (P< 0.01)

DISCUSSION:

This study was conducted to investigate the effects of adding tensioning neural mobilization of brachial plexus to conventional physical therapy in the treatment of patients with chronic unilateral cervical radiculopathy. It was investigated the effects of tensioning neural mobilization on Handgrip strength of the affected upper limb (measured by modified sphygmomanometer test) and neck and arm pain intensity (measured by VAS) and compared the results to those achieved by patients who had received only a conventional physical therapy program.

The results of this study revealed that there was an improvement in handgrip strength and decrease of pain intensity in both groups. Adding tensioning neural mobilization to conventional physical therapy program did not significantly improve handgrip strength or decrease pain intensity in comparison to the control group which received conventional program without neural mobilization**.**

Neural mobilization became important in the management of cervical radiculopathy. This approach is based on many studies that have demonstrated its effectiveness in several musculoskeletal disorders (Kavlak and Uygur, 2011, Jain et al., 2012, Nee et al., 2012, Abbott and Schmitt, 2014 and Saban et al., 2014).

Regarding the benefits of adding neural mobilization to a multimodal treatment program in management of cervical radiculopathy, our results were agree with results of study by (Langevin et al., 2015) who reported that manual therapy and exercises are effective in reducing pain and functional limitations related to cervical radiculopathy and NM yielded no significant additional benefits. This study is similar to the present one in the multimodal approach adopted; also the relatively long duration of the study and they were comparable in including manual therapy in both groups.

Also, in a systematic review with Meta-analysis, 20 studies assessed the effect of NM on a nerve-related chronic musculoskeletal pain conditions and concluded that NM is not superior to other interventions regarding decrease in pain and disability but it may be superior to minimal intervention in these regards (Su and Lim, 2016).

In contrast to our results, some studies (Anwar et al., 2015; Gupta and Sharma, 2012) showed significance of adding neural mobilization to a multi-modal program in management of cervical radiculopathy; a study conducted by (Anwar et al., 2015) concluded that the addition of neurodynamics to a multimodal program (moist heat, mobilization, and isometric exercises) resulted in a significant improvement in disability. This study may indicate the benefit of adding NM to a multimodal program but both the NM technique and treatment duration were not identified.

Gupta and Sharma (2012) demonstrated that the intervention group receiving NM (Median slider applied 3 sets of 10 repetitions) showed better improvement compared to the conventional group B (isometric Exercise, posture, and advice to move regularly) regarding NDI, CBSQ, VAS and Pain-free elbow extension. However; these results are not conclusive as it compared NM to minimal intervention (only isometric exercise and advice) which may explain the superiority of NM.

Regarding the effect of neural mobilization on improving handgrip strength; our study agrees with a crossover study conducted by (Araujo et al., 2012) which concluded that neural mobilization (for the radial, median and ulnar nerves) was not efficient in producing an increase in handgrip strength in healthy individuals. The study was conducted on a 20 healthy participants for only one session.

Also in a prospective, parallel-group, single-blinded randomized controlled trial by Likhite et al. (2017), it was concluded that there was no immediate or short-term effect of neural mobilization (median and ulnar nerve mobilization techniques) on grip strength in asymptomatic subjects. However; this study was conducted on healthy participants and for a short duration (5 sessions on alternate days).

Neural mobilization exercises did not show any additional effect on hand grip strength in cervical radiculopathy in spite of its proven effect on hand grip strength in other cases like carpal tunnel syndrome (Baysal et al., 2006 and Pinar et al., 2005) (30, 31) and lateral epicondylalgia (Dabholkar et al., 2013). This might be due to the relatively short duration which may have limited our capacity to show a significant between-group difference. Also absence of follow up, which might have shown significant difference at long term.

Neural mobilization of brachial plexus might have a significant effect on other hand functions which need more motor control like tool usage, manipulations, dexterity, grasp and release of objects, unilateral and bilateral hand use and sensibility.

This study was included mobilization for the entire brachial plexus, and it might be more suitable to conduct neural mobilization specific to the nerve roots supplying hand grip musculatures.

Other causes rather than changed nerve physiology might have caused the decrease in hand grip strength like chronic neck pain and isometric muscle fatigue, life stresses, emotional status, and culture which are known to affect pain coping strategy and muscle contraction.

Further studies are recommended on specific groups of radiculopathy, with similar or at least comparable symptoms durations, also a third group of no treatment as a real control group is recommended, and with a long term follow up. Also, further studies could be conducted on other types of neural mobilization exercises or with comparison to mechanical traction.

CONCLUSION

The addition of tensioning neural mobilization to conventional physical therapy yielded no significant additional benefits, although both groups showed post-treatment reduced pain intensity and increased handgrip strength.

Clinical implications:

Conventional physical therapy alone is effective in the management of chronic unilateral cervical radiculopathy.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

All authors contributed equally in all parts of this study.

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