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Research Report

Effect of Neural Tissue Mobilization on Grip Strength in Patients with Cervical Radiculopathy

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Abstract

Background and Purpose: There is some evidence to support the influence of neural mobilization on reduction of pain, improvement in range of motion and grip strength. An immediate improvement in grip strength has been established in individuals with a positive neural provocative test. However, its ability to cause an immediate change in grip strength, on individuals with cervical radiculopathy (CR) is unknown. Hence, the purpose of this study was to evaluate the immediate effects of neural mobilization on grip strength in patients with cervical radiculopathy. **Methods and Materials:** A cohort study was conducted and forty participants with cervical pain radiating to unilateral upper limb, were assessed and selected through convenience sampling. Baseline handgrip strength of the affected limb was measured using a hand-held dynamometer. All patients received a single session of neural tissue mobilization in accordance with the affected nerve (median/ulnar). The handgrip strength was assessed immediately post intervention. **Statistical Analysis:** The pre-test and post-test data of handgrip strength were analysed using a Paired t-test following which, the p value was obtained for measuring statistical significance. Further the effect size was calculated using Cohen's d by comparing the means. **Results:** Statistically significant improvement was observed in the handgrip strength ($p<0.001$) after neural mobilization. The effect size value obtained was 0.68, which suggests a medium effect size. **Conclusion:** Neural mobilization may be useful in providing an immediate change in hand grip strength in patients with cervical radiculopathy.

Keywords: Grip, Muscle strength dynamometer, Musculoskeletal manipulations, Radiculopathy, Neurophysiology, Cervical spine

Introduction

Cervical radiculopathy (CR) is a pathological condition of the cervical nerve roots, which often results in pain and sensory and motor deficits namely, numbness, muscle weakness and potential loss of movement.[1] This condition is commonly caused by cervical disc herniation or growing osteophytes from the posterior vertebral bodies. Nerve roots of the lower cervical spine are most affected.[2] Patients with CR often present symptoms of muscle weakness. According to the kinetic chain principles the upper limb is a system of linked segments working together to perform daily activities. In other words, muscle weakness produced in one segment of the affected upper limb, would contribute to a generalized muscle weakness and consequently reduced grip strength.[3]

Maintenance of grip strength of the upper extremity is essential for various functional activities in daily life.[4] However, the integrity of the nervous tissue is required to be well intact to attain a maximum outcome of grip strength.[5,6] That is to say, its physical and physiological properties need to function at an optimum level. Since weakness of grip strength is often presented in patients with CR, it becomes a necessity to implement an effective treatment technique to restore its strength.[3,7] The neural mobilization techniques developed by David Butler are one such example of an effective intervention.[8,9]

According to David Butler, neural mobilization plays an important role in restoring movement and elasticity of the nervous system, promoting return to normal functions. The technique involves movement and/or tension of the nervous system, which results in reduced intrinsic pressure of the neural tissue. It is hypothesized that these therapeutic movements can re-establish the neural biomechanics such as elasticity and axoplasmatic flow, to tolerate normal compressive, tensile and friction forces associated with daily and sport activities.[7,10] This also allows for an improvement in the motor unit recruitment, thereby improving muscle strength. In addition, mobilization of the nervous system has long been known to reduce pain intensity and improve related symptoms in neural disorders.[5,7,11]

Authors have determined that patients with CR have a high disability and low physical function in measures such as hand-grip strength and neck range of motion.[4] Literature is available to support the influence of neural mobilization on reduction of pain, improvement in range of motion and grip strength.[5,8,11] However, its ability to cause an immediate change in grip strength on patients with CR is unknown. Taking into account the number of people affected by CR and the lack of study of non-invasive interventions to achieve symptom relief, more research in this field is necessary.[1] This aspect relating to the effect of neural mobilization on grip strength in CR warrants further investigation, forming the basis for this study.

Methods

A one-group pretest-posttest design was used. This study was approved by the M.S.Ramaiah Medical College Ethics Committee. Neural tissue management involved a single session program and the outcome was measured at baseline and immediately after completion of treatment. All data were collected at a tertiary academic institution and a blinded rater measured and recorded all the patient's scores. The rater was a qualified physiotherapist with an experience in the field of neuro-musculoskeletal physiotherapy. During data collection, the rater was not aware of the purpose of the study or the treatment performed on each of them, to minimize recorder bias.

40 patients [26 women and 14 men; mean age 38.8 (7.42) years] in the age group of 30 to 50 years, diagnosed with CR were recruited from the out-patient departments of M.S.Ramaiah Hospitals. All recruited patients had previously been diagnosed with CR by their respective orthopaedic or neurological consultants and referred for physical therapy management. They were assessed and included in the study if they fulfilled the following criteria: (1) cervical pain radiating to the upper limb (below deltoid tuberosity), (2) subacute phase of CR (2 weeks to 6 months), (3) a unilateral involvement of upper limb, (4) a decreased grip strength (by comparing grip strength values between the affected and unaffected hand), (5) a positive upper limb neural tension (ULNT) test and spurling's compression test, (6) a unilateral diminished deep tendon reflex,[12] (7) sensory changes in dermatome distribution.[12]

To obtain a positive neurodynamic test, the symptoms should be reproducible, should increase/decrease once structural differentiation is used and there should be differences between the two sides. Literature suggests that ULNT demonstrates a high sensitivity (0.97) thereby making it the most reliable way to identify patients with CR.[13] Patients were excluded if they had any pathology preventing neural tissue testing (eg: restriction of joint range of motion), cervical myelopathy/fracture/instability, previous history of cervical surgery, gross neurological deficits, thoracic outlet syndrome, inflammatory arthritis, medical red flags (eg: dizziness caused by vertebro-basilar insufficiency) and severe psychiatric disorder or cognitive deficits.

Before participating in the study, all patients were provided with an information sheet and required to sign an informed consent form, approved by the M.S.Ramaiah Medical Ethics Committee.

Outcome measure

The baseline dynamometer, an isometric, hydraulic hand-held dynamometer (Manufacturer – Intek Electronics 2002. 248 Ashley road, Parkstone, Poole, Dorset BH14 9BZ, England, U.K) was used to measure hand-grip strength of the participants. The dynamometer has been confirmed to be a valid tool for determiming grip strength[14] and has excellent test-retest reliability[15] with an obtained intra-class correlation coefficient (ICC) ranging between values 0.85 - 0.98.

Procedure

All subjects were familiarized with the working of the hand dynamometer (Baseline - hydraulic) by performing 3 sub maximal trial repetitions. Following this, subjects were made to rest for 15 minutes to account for factors of pain or fatigue of the muscle. The patient had to be seated on a straight back chair with their feet flat on the floor. The affected shoulder was to be maintained at 0^o of flexion, abduction and rotation, elbow flexed to 90^o, forearm rested in a neutral position with the wrist in minimal extension and ulnar deviation.

On achieving the standardized arm position, the dynamometer set at the second handle space was given to subjects who were then advised to perform 3 maximum gripping efforts for 5 seconds. A 15 second rest period was given to prevent fatigue effects. While performing each trial, each patient was instructed by the assessor as follows: "squeeze the handle as hard as possible". The mean value of the 3 efforts (measured in pounds) was evaluated for the analysis of grip strength. The patients were not allowed to see their score in each trial. No visual and verbal encouragement was given for achieving the maximum capable grip strength.

Neural tissue mobilization

With the participant in supine lying position and the therapist on the treatment side, neural mobilization was performed (individualized for each participant) for a maximum of five sets at a slow speed. Further, each progression set lasted 30 seconds to two minutes with 15 to 30 repetitions for each set.[7] A one minute rest period was allowed between the sets or till the pain comes to pre-treatment stage. Treatment was performed manually by the therapist. Details are as follows:[7]

Technique One – In supine, the participant's neck was placed in flexion and contralateral lateral flexion with the support of two cushions, for one to two minutes. The aim of this technique was to reduce distal symptoms such as over forearm and hand.

Technique Two – The participant was in supine position. Contralateral lateral flexion of the neck was performed by the therapist within the available range. This technique aims to reduce the symptoms further following technique one.

Technique Three – With the participant in supine position, an ipsilateral lateral flexion of the neck was performed at a slow speed within the available range. This change in direction of movement (from contralateral to ipsilateral) is required as the nerve's physiological function is expected to improve by now and we begin to treat the mechanical dysfunction.

Progression One – In supine lying, the affected arm is flexed with the hand resting on the stomach for relaxation. The contralateral arm is stretched out into horizontal abduction.

Progression Two – The affected arm is placed in resting position as stated above while, the therapist moves the contralateral arm into a sequence of elbow flexion-wrist extension followed by elbow extension-wrist flexion (for median nerve) and elbow-wrist extension followed by elbow-wrist flexion (for ulnar nerve).

Progression Three – The contralateral arm is stretched out in horizontal abduction while the affected arm is moved into the sequence of movements explained in progression two.

Progression Four – The contralateral arm is kept in line with the body and the therapist continues to move the affected arm into the same sequence of movements. In addition, the participant is asked to move his/her neck into contralateral side flexion during elbow flexion followed by an ipsilateral side flexion during elbow extension.

Post-measures: Re-evaluation of grip strength was done immediately after mobilisation by using the hand dynamometer.

Statistical Analysis

Proposed sample size: Sample size was estimated using N Master software. From the results of the study undertaken by Ajit and Tejashree[9], the following values depicting the grip strength between the median and ulnar nerve were considered: standard deviation in the first and second group are (11.48) and (11.42) respectively. With a precision of 5% and a confidence interval of 95%, a minimum of 40 subjects were required for this study. Statistical significance was accepted at $p < 0.05$.

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 20.

The pre-test and post-test data of handgrip strength were analysed using paired t-test. The Cronbach alpha α was used to evaluate the internal consistency reliability of the three pre-test and post-test measurements obtained for all subjects. The Cohen's d formula was used to evaluate the effect size from the derived mean and standard deviation.

Results

Table 1: Pre and post intervention values of the mean (SD) grip strength in a cervical radiculopathy cohort (n=40)

		Mean	α
Pair 1	PRE	37.89 (9.4)	0.96
	POST	45.55 (9.8)	0.97

Table 1 shows that the mean hand-grip strength pre-test was 37.89 and post-test was 45.55. An excellent internal consistency is also observed amongst the three pre-test and post-test values of all subjects as depicted by **.**

There was a statistically significant improvement ($p<0.05$) mean grip strength ($t= -9.20$, $p<0.05$), pre versus post (Table 2).

Table 2: Differences in mean with 95% CI of the standard error of the differences.

	Pair Differences		95% CI of the Difference	
	Mean	SD		
			Lower	Upper
Pair 1 PRE- POST	**-7.66**	**5.22**	**-9.33**	**-5.99**

The results revealed that there was a significant change observed in the hand-grip strength after the intervention. Correspondingly, the internal consistency of the three pre-test and post-test measurements were found to be excellent, which implies that there was consistency across the three repeated trials and were not influenced by factors such as learning or fatigue effects. The effect size was calculated, to identify if the results achieved were clinically significant as well.

Discussion

It is necessary that physical therapists perform adequate and effective treatments based on scientific evidence. Despite good results on the effects of neural mobilisation in clinical practice, few studies have demonstrated its effects on grip strength. One such study by Tejashree and Ajit,[9] gave an insight on the effects of neural mobility on functioning of neural mobility. The authors had verified positive benefits of neural mobilisation on pinch and grip strength in healthy individuals, which could thus be applicable for treatment of various pathologies.

In view of this, the present study was performed on patients with CR, with an aim to find out the immediate effects of neural mobilisation on grip strength. This study revealed that, neural mobilization brings about a change in hand-grip strength owing to its ability to improve grip strength immediately post treatment. One possible explanation is that this therapeutic manoeuvre causes a cascading change in its physiological function. The stretch applied to the nerve triggers an increase in acting polymerisation, force generation, release of neurotransmitters and intraneural circulation. In other words, the hypothesis that nervous tissue mobilisation of the median/ulnar nerves, could result in better recruitment of motor units and consequent increase in handgrip strength was observed.[9]

A valid and reliable tool is required for assessment of hand grip strength to evaluate the effectiveness of various procedures. The hand-held dynamometer has been advocated as the outcome measure in patients with CR, with an excellent test-retest reliability for grip strength measurement,[3] and hence used in this study. Further, only subjects between the age group of 30-50 years were considered, as the prevalence of CR is high in the fourth to sixth decades of life[16]. Individuals above 50 years were not included in this study to leave out of account, severe spondylosis which may contraindicate the management of neural mobilization.

In respect to the nerve involvement, Oskay et al.[17] and Villafane at al. had explained in their study that the ulnar and median nerve contribute widely to hand-grip strength. No evidence exists to prove a major contribution of radial nerve in grip strength and hence, for this study only individuals with CR with an ulnar or median nerve involvement were chosen.

Subsequently, to ensure that the procedure of grip strength data collection was not influenced by learning effects, all patients had to perform three submaximal efforts of hand-grip measurement prior to the pre-test measures. Following this, a 15 minute break was given to negate fatigue effects on the hand. The assessor was blinded during the grip strength measurement to rule out the possibility of bias in recording the data. This accounts for the external validity of the study. On the whole, all the above factors were controlled thereby validating these research findings.

This is one of the first few trials conducted in subjects with CR to study the effects of neural mobilization on improving hand-grip strength. Although this study was adequately conducted, there are certain limitations. Firstly, the patients recruited in this study were not classified according to the nerves involved such as, median nerve/ulnar nerve or both nerve involvements. In this event both median and ulnar nerve involvements increases the severity of hand-grip weakness, which could have altered the post-test measurements of grip strength. Also, the dominance of hand was not taken into consideration. In other words, heterogeneity within the sample was present, in terms of nerve involvement. Further, this study only emphasizes on immediate effects of neural mobilization, while the long-term effects have not been taken into account.

Future studies could aim at classifying patients with CR, according to the nerves involved and determining effects of neural mobilization on individual nerves on grip strength. In regard to the long-term effects of neural mobilization, studies can also be conducted to measure hand-grip strength, 24 hours after a single session of neural mobilization.

Conclusion

In this study, the change in hand grip strength immediately after neural mobilization demonstrates the need for further investigation to explore the long-term benefits of neural mobilization in individuals with CR, and classify them on the basis of the spinal level or individual nerve involved. As neural mobilization has an influence on hand grip strength, there is a possibility that daily repetitive sessions could lead to a cumulative result of improved hand grip strength for a longer duration. The present study shows that neural mobilization could be a worthwhile treatment manoeuvre to achieve improved hand grip strength.

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