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# H-reflex latency changes after combined application of traction and neural mobilization in cervical radiculopathy

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## Abstract

**Background:** Cervical radiculopathy is a pathology of the cervical nerve root and mostly caused by a cervical disk herniation leading to chronic pain and disability.

**Objectives:** This study was conducted to show the effect of the combined application of intermittent cervical traction with median nerve mobilization on flexor carpi radialis (FCR) muscle H-reflex latency of median nerve in patients with unilateral cervical radiculopathy due to disk lesion in a pre-post design.

**Methods:** Fifteen patients (10 females and 5 males) with a mean age of 38.07 ± 5.85 years received simultaneous application of intermittent cervical traction and median nerve mobilization. Six sessions were given every other day for 2 weeks. Also, patients perormed chin in exercises and upper back extension with scapular retraction. FCR H-reflex latency was measured pre- and post-treatment.

**Results:** Statistical analysis showed that there was a significant reduction of H-reflex latency at post-treatment in comparison to pretreatment ($t = 5.447$, $p$ value = 0.0001*).

**Conclusion:** Simultaneous application of intermittent cervical traction and median nerve mobilization are effective in improving FCR H-reflex latency in patients with unilateral cervical radiculopathy.

**Keywords:** Cervical radiculopathy, Intermittent traction, Median nerve mobilization, H-reflex

## Introduction

Cervical radiculopathy (CR) is an affection of the cervical nerve root (CNR) that is commonly caused by a cervical disk pathology, spondylosis, and spinal stenosis leading to nerve root inflammation and impingement and hence chronic pain and disability [1]. The annual incidence rate of CR in the USA is roughly 83 per 100,000, and patients in the fifth decade of life (203 per 100,000) are commonly affected [2].

Symptoms of CR are different from one patient to another and this variation of symptoms is due to the level of nerve root affected. Symptoms are sensory like pain, numbness, and tingling sensation and motor such as muscle weakness and hyporeflexia leading to significant disability [3].

Spinal traction and neural mobilization are forms of physical therapy that have been individually used for treatment of CR due to their various benefits [4].

Neural tissue mobilization techniques (NMTs) are methods that induce neural tension by mobilizing nerves through passive or active movements by using tensioning, gliding, and individualized joint movement [5]. NMTs help to reduce nerve adhesion, improve nerve gliding, and decrease neural mechanosensitivity and thus the CNR's structure and function are enhanced in patients with CR [6].

Current evidence for the effect of NMTs for patients with CR is limited [7–12]. There was a lack of randomized controlled trials (RCTs) that study the efficacy of the sole application of median nerve neural mobilization (MNNM) on patients with CR. All trials used a combination of MNNM with other physical therapy modalities MNNM in treatment of CR [13].

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Cervical traction is a force applied to increase the space between the cervical segments and decompress nerve roots [14]. Although there were no evidence-based parameters for intermittent traction, many studies showed a significant effect of it in reducing pain intensity and enhancing functional ability for patients with CR [15, 16]. It is theorized that intermittent traction unloads the spine by stretching muscles and ligaments causing separation between articular surfaces leading to improvements in patient symptoms [17].

There were few RCTs [16, 18] that studied the combined effect of cervical traction either manually or mechanically and neural mobilization on improving neck pain, neck disability, radicular symptoms, cervical spine movements, and grip strength; but to our knowledge, there were no trials that studied the effect of simultaneous application of intermittent cervical traction with MNNN on H-reflex latency of median nerve recorded from flexor carpi radialis (FCR) muscle.

## Subjects

Fifteen male and female patients with unilateral CR, with their age from 30 to 50 years included in this trial in the outpatient clinic of faculty of physical therapy, Cairo University from May 2018 till March 2019. Informed written consent was obtained from participants and the study was approved by the physical therapy faculty ethical committee (No. P.T.RE-012-001589).

## Inclusion criteria and subject selection

Patients from both genders with age group from 30 to 50 years [2, 13, 19–21] with unilateral C5-6 or C6-7 disk protrusion as shown in Fig. 1, numbness along C6-C7 nerve root persisted for more than 3 months and positive provocative test for cervical radiculopathy (Spurling's test, shoulder abduction test, Valsalva maneuver, neck distraction test, and upper limb tension test 1 (Median nerve)) were included in this study [22, 23].


**Fig. 1** MRI showed cervical disk protrusion at the level of C5–C6 and C6–C7

**Fig. 2** Intermittent cervical traction combined with median nerve mobilization

### Exclusion criteria

Patients with C3–C5 lesions, sensory loss or motor weakness, bilateral radiculopathy, shoulder disorders or had cervical surgeries were excluded.

Patients received combined intermittent cervical traction and MNNM. Also, patients received strengthening exercises for deep neck flexors and upper back extensor muscles. Six sessions were given day by day. Patients were evaluated pretreatment and post-treatment for H-reflex latency of the median nerve recorded from FCR muscle.

## Methods

### Assessment procedures

FCR H-reflex latency for median nerve was measured by an electromyogram device (Nicolet Viking Quest, USA 2018; Model No: 0086) in semi-supine lying position with supinated forearm. The hair on the skin of the anterior aspect of forearm was removed when necessary to decrease signal resistance. The motor point of the FCR must be identified through application of low-threshold stimulus to the muscle to allow easy stimulation of the median nerve. Normally, the point that produced the maximum response at the lowest threshold of stimulation was the motor point. After that, the recording electrode (active) was located at the motor point of FCR muscle while the reference electrode (positive) was placed at the lateral aspect of the forearm. Proximally to the recoding electrode, there was a ground electrode applied to the skin of the forearm. To elicit FCR H-reflex, a surface-stimulating electrode was placed along the median nerve in the antecubital fossa [24].

### Treatment procedures

Each patient had 6 sessions for 2 weeks with one session each other day.

#### *Intermittent cervical traction*

Patients were instructed about the procedures and assumed a supine position on the treatment Triton Traction Machine (Chattanooga Corporation, TN 3745, USA, Model T-700; Serial No. 4991) with the body in neutral position. The traction force started at 10% of the patient's body weight and increased gradually about 1–2 kg every session, according to symptoms centralization [25].The hold/rest cycle was set at 50/10 and the angle of pull was 24°. The traction was applied for a period of 20 min [26]. The patient could stop the traction through a bursar switch in the unaffected arm and inform the therapist about any discomfort occurred [16].

#### *Median nerve mobilization*

MNNM was performed during the holding phase of traction. The therapist was on the affected side beside the patient and started the MNNM procedure by depressing the patient's scapula with one hand while maintaining 90° flexion of the elbow, forearm supination, and extension of wrist and fingers with the other hand.

**Table 2** Comparison between pre- and post-treatment values of flexor carpi radialis H-reflex latency

| | FCR H-reflex latency | |
|---|---|---|
| | Pretreatment | Post-treatment |
| *X* (mean) | 12.45 | 11.57 |
| ± SD (standard deviation) | ± 2.88 | ± 2.74 |
| MD (mean difference) | 0.88 | |
| % of improvement | 7.06% | |
| 95% confidence interval (lower-upper limits) | (0.52–1.22) | |
| *t*-value | 5.447 | |
| *p* value | 0.0001* | |
| Level of significance | | S |

*Statistically significant < 0.05

**Table 1** Demographic data of participants

| | Minimum | Maximum | Mean | Standard deviation |
|---|---|---|---|---|
| Age (years) | 30.00 | 48.00 | 38.0769 | 5.85180 |
| BMI (kg/m$^2$) | 26.17 | 29.67 | 27.9177 | 1.11812 |

Then, the therapist abducted the arm passively into 90–100° as shown in Fig. 2. This was followed by tensioning procedure which was performed by applying simultaneous extension of the wrist and elbow followed by a return to the starting position [27]. The holding time for this technique was 15 s followed by 10 s relaxation and was performed for three times [28].

### Strengthening exercises for deep neck flexors

Each patient had strengthening exercises of deep neck flexors through tucking the chin in from supine lying position with the head in contact with the plinth without any pillow [29]. This exercise was frequently performed for 3 sets of 10 repetitions and the holding time of exercise was 5 or 6 s.

### Strengthening exercises for upper back extensors muscles

Each patient had upper back extensors muscles strengthening exercises from prone lying position by retracting both scapulae while raising the head and upper back toward the ceiling. This exercise was frequently performed for 3 sets of 10 repetitions and the holding time of exercise was 5 or 6 s.

### Statistical analyses

Normality assumption, variance homogeneity, and presence of extreme scores for data were examined prior to the final analysis. Histograms with the normal distribution curve used for descriptive analysis showed normal distribution of FCR H-reflex latency. The data seemed to be normally distributed after applying Shapiro-Wilk test for its assessment. The alpha level was applied at 0.05. SPSS software (version 22, Inc., Chicago, IL, USA) which was used for the statistical analysis of the data, and Microsoft Word and Excel was used to draw graphs, formulate tables, etc.

## Results

Patients from both genders (10 females and 5 males) were included in this study. The mean ± standard deviation for their age and BMI were shown in Table 1.

Paired $t$ test analysis revealed that the mean value of FCR H-reflex latency measured after treatment was significantly reduced compared to the mean value of FCR H-reflex latency measured before treatment ($t = 5.447$, $p = 0.0001$) as shown in Table 2 and Figure 3 and the percentage of improvement in FCR H-reflex latency after treatment application was 7.06%.

## Discussion

The results of Savva and Giakas [9] revealed a significant decrease in pain and disability after combined cervical traction with MNNM in one patient only with CR, although it was a case study design which can only report standard guidelines to a limited extent.

Numerous studies have investigated the effect of combined techniques on pain intensity, neck disability index, and radicular symptoms [16, 18, 30]. To the author's knowledge, this is the first study that tried to determine the effect of the simultaneous application of intermittent cervical traction with MNNM on FCR H-reflex latency.

Cervical traction opens the intervertebral foramina and frees the compressed nerve roots making it free

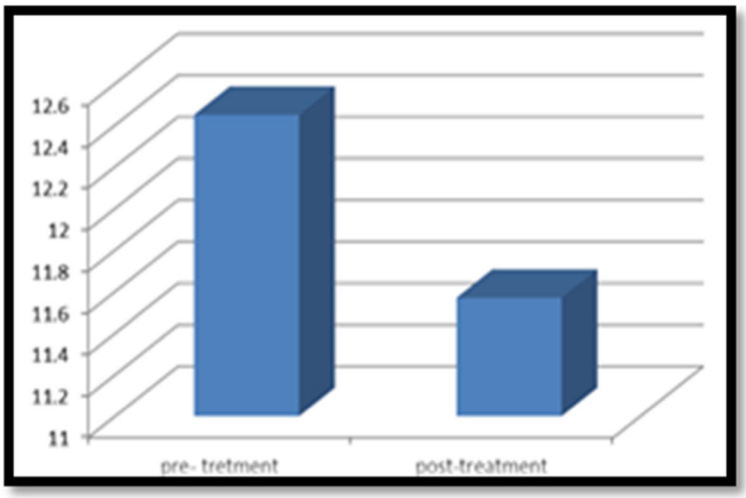


**Fig. 3** Mean values of FCR H-reflex pre- and post-treatment

within the sheath during NMTs leading to normalization of the nerve movement. So, adequate movement of the nerve normalizes the pressure gradient around the nervous tissues and improves the blood supply to the affected nerve. Improved blood supply restores the homeostatic function of the dorsal root ganglion by bringing nutrition and washing out inflammatory waste products. NMTs also stimulate the release of neurotrophic proteins, which is necessary for active regeneration and nerve elongation [31].

The improvement in latency of FCR H-reflex latency after MNNM could be due to that MNNM enhanced the neurophysiological and mechanical functions of the nerve [32, 33]. Elongation of the connective tissues around the nerve roots by traction force stimulates the sensory fibers within the dorsal root leading for summation of Ia afferent inputs at the spinal cord and hence increased response from alpha motor neuron resulting in improved nerve conduction and consequently, reduction in FCR H-reflex latency [34, 35].

Before the beginning of the study, the patients were requested to stop any form of medical or physical treatment and they had only 6 sessions of combined intermittent traction and MNNM in addition to strengthening exercises for deep neck flexors and upper back extensors. The patients were evaluated only for FCR H-reflex latency but patient satisfaction, recurrence of symptoms, and encountered complications were not assessed, and this is one of the limitations of the study and so, we recommend a follow-up study for these patients after the first month, third month, sixth month, and first year to see if any complications or recurrence of symptoms will occur or not.

According to the results of the current study, it can be concluded that there was a statistically significant reduction of FCR H-reflex latency in post-treatment measurement compared to pretreatment measurement after simultaneous application of intermittent cervical traction with MNNM and these techniques are effective in improving patients with unilateral CR.

## Limitations of the study

The age group of patients in this study was between 30 and 50 years and so, the results cannot be generalized to individual age. Parameters of the combined techniques in the study were not standardized according to individual patients. Follow-up of patients' symptoms, recurrence, or any complications encountered was not performed. The long-term effect was not found.

## Recommendations

Further studies are required to investigate the efficacy of combined intermittent cervical traction and MNNM techniques on side to side difference of FCR H-reflex latency, EMG studies measuring the activity of upper trapezius and muscle strength of C6 and C7 nerve roots and quality of life in patients with unilateral cervical radiculopathy.

In addition to these recommendations, the long-term effect of combined techniques needs to be studied by follow-up. Finally, further trials are recommended to show the effectiveness of these techniques in patients with bilateral cervical radiculopathy.

### Abbreviations

CNR: Cervical nerve root; CR: Cervical radiculopathy; FCR: Flexor carpi radialis; MNNM: Median nerve neural mobilization; NMTs: Neural tissue mobilization techniques; RCTs: Randomized controlled trials

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### Authors' contributions

All authors contributed equally in all parts of this study. All authors read and approved the final manuscript.

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### Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to current Cairo University regulations and Egyptian legislation but are available from the corresponding author on reasonable request and after institutional approval.

### Ethics approval and consent to participate

The aim and procedures of the study were explained to every participant and informed consent was obtained before being enrolled in the study. The study was approved by the physical therapy faculty ethical committee (No. P.T.RE-012-001589).

### Consent for publication

Signed consent for publication was obtained from patients.

### Competing interests

The authors declare that they have no competing interests.

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## Publisher's Note