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NEURAL GLIDING VERSUS MECHANICAL TRACTION IN PATIENT WITH CERVICAL RADICULOPATHY

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ABSTRACT

Background: Cervical Traction and Neural Mobilization both have been individually advocated for treatment of Cervical Radiculopathy due to their various effects. But the combined effect of these techniques has not been explored in studies. Hence the purpose is to find the effect of application of cervical traction and neural mobilization for median and ulnar nerves on improvement in neck pain, radicular symptoms, neck disability and cervical range of motion in subjects with unilateral Cervical Radiculopathy.

Methods: An experimental study design, 30 subjects with Unilateral Cervical Radiculopathy and ULTT1 positive for median and ulnar nerves bias, randomized 15 subjects each into two groups- Group A and B respectively. Group A received mechanical Cervical Traction . The Group B received Mechanical Cervical Traction followed by neural gliding for median and ulnar nerves. The duration of intervention was given 3 treatment sessions per week for 6 weeks. Outcome measures such as Numerical Pain Rating Scale (VAS), Neck Disability Index (NDI) and cervical range of motion (CROM) were measured before, at the end of 6th week post treatment.

Results: Comparison of post intervention means at 6 week of treatment there is a statistically significant ($p<0.05$) difference in improvement in outcome measures between two groups. Group B subjects shown greater percentage of improvement than Group A.

Conclusion: The present study concludes that application of mechanical cervical traction followed by neural mobilization is more effective in improving pain, functional disability and severity of radicular symptoms than mechanical cervical traction alone for subjects with Unilateral Cervical Radiculopathy.

Key words: Cervical Radiculopathy, Neck Pain, Median Nerve, Cervical Traction, Neural Mobilization, Pain, Neck Disability, Cervical Range of Motion, Ulnar Nerve.

INTRODUCTION

Cervical radiculopathy (CR) is a widespread diagnosis [1, 2]. Cervical radiculopathy has been defined as an abnormality of a nerve root that originates in the cervical spine [3, 4] resulting from compression and inflammation of nerve root or roots in proximity to the neuroforamen [4, 5].

Typically, CR is associated with symptoms of neck, shoulder, and upper limb pain as well as upper limb paresthesia and weakness, which are attributed to cervical nerve root irritation. The clinical diagnosis of CR relies mainly on the outcome of history taking and a physical examination in which diminished muscle tendon reflexes, sensory disturbances, or motor weakness with dermatomal/ myotomal distribution can be found [1,2].

Mechanical cervical traction is technique used to decompress the nerve root by separating the cervical segments through long-axis traction. Many studies reveals that Intermittent Cervical Traction for Cervical Radiculopathy found to be effective in reduction of pain and disability [6]; however, no standard parameters have been reported. It is speculated that improvements in symptoms are due to distraction of articular surfaces by traction which unloads the components of the spine by stretching muscles, ligaments and functional units[7].

Neural tissue mobilization techniques (NMTs) theorize to examine the neural tension in nerves and mobilize the nerves that exhibit neural tension by passive or active movements by using Tensioning, Sliding and Single Joint Movement techniques and focused on restoring the ability of the nervous system to tolerate the normal compressive, friction, and tensile forces associated with daily and sport activities[8].

With this method, tension was gently applied to the involved nerve root that caused mild pulling but no pain and a low-amplitude repetitive movement was introduced in the direction of perceived neural tension. NMTs are widely used to normalize the CNR's structure and function by reducing nerve adherence, facilitating nerve gliding and decreasing neural mechanosensitivity in patients with cervical radiculopathy[9].

Cervical traction and neural mobilization techniques (NMTs) have been advocated in the management of CR due to their immediate analgesic effect. The analgesic effect of these two techniques has been explored and recognized in many RCT studies and in systematic reviews [10].

Methodology

Thirty patients of both sex and suffered from Cervical Radiculopathy were selected at subacute and chronic stage (for 4 weeks ago) and recruited randomly from outpatient clinic in MUST university and Cairo university. Patient's age was been from 30 to 45 years with BMI was been from 18 to 22 kg/m^2.

In Group A, fifteen patients were received mechanical cervical traction three sessions per week for six weeks. Measurements were conducted before starting the treatment as a first record, at the end of 6 weeks of treatment as second record.

In Group B, fifteen patients were received mechanical cervical traction followed by neural gliding (for both unlar and median nerves) three sessions per week for six weeks. Measurements were conducted before starting the treatment as a first record, at the end of 6 weeks of treatment as second record.

The patients were chosen under the following criteria:

-All patients were suffered from cervical radiculopathy at subacute and chronic stage post 4 weeks from onset of lesion.
-Their age were ranged from 30-45 years with BMI range between 18 to 20 kg/m^2.
-All patients were examined carefully by physician before the study procedures.
-All patients were conscious, well-nourished and co-operative.
-Patients were free from other neurological problems (spondylosis & VBI)except radiculopathy result from cervical disc lesion.
-Patients were free from hepatic disease.
-Patients were free from diabetes mellitus and thyroid diseases.
-Patients were free from any previous surgeries.
-Patients were free from any mentality, personality, and psychological disorders.
-All patients received the same procedures of the study and the same medical care.
-All patients in the various groups received treatment for 6 successive weeks.

The current study excluded the following patients:

-Patients who were examined by physician before starting of the study.
-Uncooperative patients.
-Instability of patient's medical condition.
-Association of other medical or neurological problems.
-Presence of any disease that could affect the research results.
-Radiculopathy not result from cervical disc lesion.

A verbal explanation about the important justification and main points of achievement of the study was explained to every patient.

The procedures of the current study were divided into two main categories:

Measurement procedures:

(a) Initial evaluation procedures (initial phase):

- Each patient was examined medically in order to exclude any abnormal medical problems which previously mentioned.
- Each patient's history was taken in previously prepared questionnaire to collect information about, name, age, BMI and determination about any functional, social, psychological problems.
- The purpose of evaluation procedures were explained in steps for each patient in each group.

(b) Technical measurements phases:

Patients included in the study were assessed before and after the study using:

- Visual Analogue Scale (VAS) for their perceived pain level.
- Neck Disability Index (NDI) for assessing impact of the condition on patient current level of function.
- Cervical mobility using Cervical Range of Motion (CROM).
- Upper Limb Tension Test (ULTTs) for median and ulnar nerves.

Therapeutic Procedures:

The procedures of treatment applications were achieved as the following:

Group A:

Cervical traction:

In this group subjects were treated with only mechanical cervical traction, but no neural gliding was given along with it *(fig. 1).*

Figure 1 Group A*.Mechanical Cervical Traction from supine lying position*

Group B:
Cervical traction followed by Neural Gliding for median and ulnar nerves:
In this group subjects were treated with mechanical cervical traction and neural gliding. Calibrated Biomed Traction unit was used in the study. For Intermittent Cervical Traction subjects were instructed about the procedure and were taken in supine on the treatment couch with the body in neutral position. The cervical spine were placed at an angle of approximately 15 degrees of flexion with traction force to be 5-7% of subject's body weight and were increased approximately 1 kg every visit, depending on centralization or reduction of symptoms and treatment was given for 10 minutes per session[7].
After the mechanical cervical traction, neural gliding procedure was performed for median or ulnar nerves *(fig. 2).*

***Figure 2. Group B** Mechanical Cervical Traction from supine lying position*

For median nerve gliding:
The therapist set on the affected side besides the subject and depressed the Subject's shoulder with one hand while the elbow was in 90 degrees of flexion and forearm in supination and wrist and fingers in extension position using other hand,
then subject's arm was passively taken into 90 to 100 degrees of abduction (as tolerable by the subject)[8].
This was followed by either the sliding or the gliding procedure. If sliding of the nerve was been done then alteration of elbow extension (loading median nerve) with wrist flexion (unloading median nerve) and elbow flexion (unloading median nerve) with wrist extension (loading median nerve) was performed for 6 sets of repetitions *(fig. 3, 4)*. Each set was performed in a slow oscillatory manner, every set for 10 seconds then was followed by 30 seconds rest. As the symptoms were improved the patient was progressed to gliding/ tensioning technique[8].

***Figure 3 .**Neural Gliding for Median Nerve (starting position)*

***Figure 4 .**Neural Gliding for Median Nerve (taking to ending position)*

For Ulnar nerve gliding:
The series of 6 positions below are the ulnar nerve glide sequence. Progress slowly from position 1 through to position 6. The ending position should be held for a count of 15 seconds and the sequence was repeated 3 times. If there is any numbness or tingling in the ending position or within 30 min. of performing the exercises, perform to only position #5 or #6 and then held that position to the count of 15 seconds. In time, the nerve was lengthen and glide more efficiently and

the upper limb should be able to reach the final position. Stretch only until feeling of a gentle tension and avoid pain[9].

- ***Position 1:***
  Shoulder 90° abduction, internal rotation, Elbow full extension and Radio-Ulnar pronation ***(fig. 5).***

Figure 5. *Ulnar Nerve Gliding (position 1)*

- ***Position 2:***
  Radio-Ulnar supination with Wrist and Fingers extension ***(fig. 6).***

Figure 6. *Ulnar Nerve Gliding (position 2)*

- ***Position 3:***
  Index finger and thumb flexion ***(fig. 7).***

Figure 7. *Ulnar Nerve Gliding (position 3)*

- ***Position 4***:
  Elbow flexion with forearm in mid position ***(fig. 8).***

Figure 8. *Ulnar Nerve Gliding (position 4)*

- ***Position 5***:
  Elbow full flexion, forearm in supination, and wrist extension ***(fig. 9).***

Figure 9. *Ulnar Nerve Gliding (position 5)*

- ***Position 6:***
  Then extend the elbow then repeat the technique.

Statistical procedures:

The obtained data was recorded on the evaluative sheet. These data was transferred in to CD using personal computer with statistical program. The statistical procedures and Tools included the following phases:

Data collection phase:

The data regarding to the patients age and BMI. The non affected area and treatment area used were collected before the study. The data regarding circumferential measurements and measurements of pain, functional disabilities and neck range of motion were collected before initiation of the treatment (before treatment) and after treatment application, the prognosis was screened through the tools measurements. The data collection was performed at the same sequence and procedures for all patients in the two different groups of the study.

Data analysis phase:

In this phase, the data was analyzed statistically to obtain the following tools:

(a) **Descriptive statistics:** Descriptive statistics in form of mean, standard deviation, range and standard error were calculated for all patients in both groups of the study to determine the homogeneity and central deviation. The mean in the sum of observation on the number of the observation. The standard deviation is the square root of the variance and is expressed in the unit of the original measures. The variance is a measure of variability around the mean within a data set.

(b) **Analytic statistics:** The statistical package for social science (5pss, vision 17) utilized for data analysis. Each hypothesis was tested separately by using the appropriate statistical tools.

-**Paired T-test** was used to compare the dependant variables (physical functioning , pain, ROM and quality of life), within each group (pre treatment and post treatment to patients in both study and control groups) to detect level of significance.

Data analysis:

1-analytic statistics: The analysis and comparison of the data was made by student's T-test to compare the variables between all groups of the study. Paired T-test was used to compare the dependent variables before and after treatment in the same group. A value of $P \geq 0.05$ will be considered statistically significant.

The Statistical software namely SPSS 17.0 and Microsoft word and Excel have been used to generate graphs, tables.

RESULTS

The results are presented under the following heading ;{A} General characteristics of the subjects;{B} Visual analogue scale (VAS), {C} Neck disability index (NDI) Arabic version; and {D} Cervical range of motion (CROM).

(A) General characteristics of the subjects:

-Age and Body Mass Index (BMI) for both groups:

The basic characteristics of the study patient were described in ***(Table 1).***

in Group (A) with mean age 37.60 years and BMI with mean 19.40 kg/m^2, in Group (B) with mean age 38.67 years, and BMI with mean 20.13 kg/m^2 .

***Table 1**: General characteristics of patients of both groups*

Group	group A				Group B			
Item	Minimum	Maximum	Mean	Std. Deviation	Minimum	Maximum	Mean	Std. Deviation
Age	30	45	37.60	5.207	31	45	38.67	4.467
BMI	18	22	19.40	1.298	18	22	20.13	1.552

(B) Visual Analogue Scale VAS (cm):

Paired T-test was used to compare the dependent variables before and after treatment in the same group.

-Visual analogue scale VAS (cm) for group A:

The main score of VAS *(cm)* for pre and post treatment for group A was (mean pre 6.27±1.100 in group A(control group) and Visual Analogue Scale (mean Post 6.00±1.069 in group A(control group)**.**

Statistical results of group A were not significant (p-values more than 0.05).

Table 2 indicate VAS *(cm)* score of the group (A).whose effect sizes was at or near zero (low performing).

***Table 2**:Mean and standard deviation of pre-treatment, post-treatment of VAS(cm) score of the group (A).*

VAS(cm) group A	Pre	post
Mean	6.27	6.00
Std. Deviation	1.100	1.069
p-value	.506	
Effect Size	.016	

-Visual analogue scale VAS (cm) for group B:

The main score of VAS *(cm)* for pre and post treatment for group B was (mean pre 7.07±1.486 in group B (study group) and Visual Analogue Scale (mean Post 5.20±.775 in group B (study group)**.**

Statistical results of group B were significant (p-values less than 0.05).

Table 3 indicate VAS *(cm)* score of the group B. whose had effect sizes of at least a 0.40 (i.e., high performing).

***Table 3:** Mean and standard deviation of pre-treatment, post-treatment of VAS (cm) score of the group B.*

VAS(cm) group B	Pre	Post
Mean	7.07	5.20
Std. Deviation	1.486	.775
p-value	.000	
Effect Size	.399	

(C) Neck disability index (NDI%):

Paired T-test was used to compare the dependent variables before and after treatment in the same group.

-Neck disability index (NDI%) for group A:

The main score of NDI % for pre and post treatment for group A was (mean pre 43.27 ±8.561 in group A(control group) and NDI % (mean Post 42.00±7.676 in group A(control group)**.**

Statistical results of group A were not significant (p-values more than 0.05).

Table 4 indicate NDI % score of the group A. whose effect sizes was at or near zero (low performing).

***Table 4**: Mean and standard deviation of pre-treatment, post-treatment of NDI % score of the group A.*

NDI %(group A)	Pre	Post
Mean	43.27	42.00
Std. Deviation	8.561	7.676
p-value	.673	
Effect Size	.011	

-Neck disability index (NDI%) for group B:

The main score of NDI % for pre and post treatment for group B was (mean pre 50.93±9.359 in group B (study group) and NDI % Scale (mean Post 43.80 ± 8.233 in group B (study group)**.**

Statistical results of group B were significant (p-values less than 0.05).

Table 5 indicate NDI %score of the group B. whose had effect sizes of at least a 0.20 (i.e., small performing).

Table 5*: Mean and standard deviation of pre-treatment, post-treatment of NDI % score of the group B.*

NDI %(group B)	Pre	Post
Mean	50.93	43.80
Std. Deviation	9.359	8.233
p-value	.035	
Effect Size	.199	

(D) Cervical range of motion CROM (°):

Paired T-test was used to compare the dependent variables before and after treatment in the same group.

-Cervical range of motion CROM (°) for group A:

The main score of CROM **(°)** for pre and post treatment for group A was (mean pre flexion 31.67 ± 4.50 , extension 2.93 ± 0.59 , right side bend 32.00 ± 2.54 , left side bend 31.87 ± 2.42 , right rotation 46.00 ± 4.31 , left rotation 43.00 ±6.49 in group A(control group) and CROM **(°)** (mean Post flexion 33.87 ± 4.44 , extension 3.67 ± 0.62 , right side bend 33.20 ± 1.86 , left side bend 34.20 ± 2.62 , right rotation 47.47 ± 4.60 , left rotation 44.27 ± 6.23 in group A(control group)**.**

Statistical results of group A were not significant (p-values more than 0.05).

Table 6 indicate CROM (°) for group A.

Table 6*: Mean and standard deviation of pre-treatment, post-treatment of CROM score of the group A.*

CROM(°) A		flexion	extension	right side bend	Left side bend	right rotation	left rotation
CROM(°) A pre	Mean	31.67	2.93	32.00	31.87	46.00	43.00
	Std. Deviation	4.50	0.59	2.54	2.42	4.31	6.49
CROM(°) A post	Mean	33.87	3.67	33.20	34.20	47.47	44.27
	Std. Deviation	4.44	0.62	1.86	2.62	4.60	6.23
	p	0.188	0.003	0.151	0.017	0.375	0.59

- Cervical range of motion CROM (°) for group B:

The main score of CROM (°) for pre and post treatment for group B was (mean pre flexion 33.00 ± 5.28 , extension 2.93 ± 0.59 , right side bend 28.33 ± 5.56 , left side bend 30.47 ± 2.77 , right rotation 43.87 ± 3.27 , left rotation 42.20 ± 4.09 in group B (study group) and CROM (°) Scale (mean Post flexion 40.13 ± 6.22 , extension 3.53 ± 0.64 , right side bend 36.67 ± 3.98 , left side bend 40.87 ± 4.36 , right rotation 50.60 ± 4.93 , left rotation 49.33 ± 5.58 in group B (study group)**.**

Statistical results of group B were significant (p-values less than 0.05).

Table 7 indicate CROM (°) for group B.

Table 7: *Mean and standard deviation of pre-treatment, post-treatment of CROM (°) score of the group B.*

CROM(°) B		flexion	extension	right side bend	Left side bend	right rotation	left rotation
CROM(°)B pre	Mean	33.00	2.93	28.33	30.47	43.87	42.20
	Std. Deviation	5.28	0.59	5.56	2.77	3.27	4.09
CROM(°)B post	Mean	40.13	3.53	36.67	40.87	50.60	49.33
	Std. Deviation	6.22	0.64	3.98	4.36	4.93	5.58
	p	0.002	0.013	0.000	0.000	0.000	0.000

Discussion

This study was designed to find out the effect of neural mobilization techniques for

median and ulnar nerves versus mechanical cervical traction in treatment of patients with unilateral cervical radiculopathy.

Thirty patients from both sexes were divided equally and blindly into two equal groups. First group (control) received cervical traction only, the second (study) group received mechanical cervical traction followed by neural mobilization (ulnar and median nerves).

The results of the current study showed a significant improvement in the study group in all measured variables. In the group A, All patients improved in term of pain and neck function and CROM but the improvement wasn't statistically significant. In group B, when neural gliding were performed, the improvement turned to become significant in all measured variables.

In Group A (Traction Group), there were improvement in post intervention measurements but the improvement were no significant and this could be because of Mechanical cervical traction received for 18 sessions that might have shown decrease in pain level and perceived disability in patients with cervical radiculopathy.

Traction increases the separation of the vertebral bodies decreases the central pressure in the disk space and encourages the disk nucleus to return to a central position. The mechanical tension of the annulus fibrosus and ligaments surrounding the disk also tends to force the nuclear material and cartilage fragments toward the center [(11)].

Movement of these materials relieves pain and symptoms if they are compressing nervous or vascular structures. Decreasing the compressive forces also allows for better fluid interchange within the disk and spinal canal. The reduction in disk herniation is unstable and the herniation tends to return when compressive forces return [(11)].

In Group B subjects the improvements could be because of combined application of Mechanical Cervical Traction along with Neural Mobilization. In this present study maintaining the application of cervical traction, slider neural mobilizations was applied after traction to mobilize and restore the normal structure and function of the nerve root that causing radiculopathy. It is speculated that traction causes distraction of articular surfaces, unloads the components of the spine by stretching muscles, ligaments, reduce adhesions within the dural sleeve, relieve nerve root compression within the central foramina, decreases pressure within intervertebral discs, relieves tonic muscle contraction and improves vascular status within the epidural space and perineural structures[(12)].

The significant improvement due to nerve mobilization can be due to following explanation. It is hypothesized that these therapeutic movements can have a positive impact on symptoms by improving intraneural circulation, axoplasmic flow, neural connective tissue viscoelasticity, and by reducing sensitivity of AIGS, but these biologically plausible contentions have not been validated. These techniques may also be able to reduce unwanted fear of movement when provided in conjunction with appropriate neurobiology education, and therefore, they may reduce the reactivity of the pain neuromatrix[(13)].

In the critical review on effectiveness of neural mobilization in patients with spinal radiculopathy, he concluded that results from available studies point toward a trend favoring neural mobilization techniques for radiculopathies but remain far from conclusive and the reasons why he cannot reach any definite conclusions on the effectiveness of NM on patients with SRs are) Existing research literature lacks well

designed RCTs that could clarify the effect of NM in SRs. Available clinical trials and case studies have small sample sizes and Heterogeneity among studies seems to be a reason why it is so difficult to identify which treatment is most likely to be beneficial in which patient group[14].

The concept of combined therapy has proven its efficacy by ***Joghataei, M. et. al., 2004***[15]**,** they studied the effect of cervical traction combined with conventional therapy on grip strength on patients with cervical radiculopathy. They concluded that the application of cervical traction combined with electrotherapy and exercise produced an immediate improvement in the hand grip function in patients with cervical radiculopathy.

The results of this study agreed with the results from ***Savva, C. et. al., 2016*** [13]**,** they conducted a study to find out the efficacy of simultaneous application of cervical traction with neural gliding of the median nerve in a subjects with unilateral cervical radiculopathy, he concluded that the simultaneous application in this manner is more effective in relieving pain and improving function.

In a study performed to compare a three types of cervical traction aiming to evaluate the efficacy of each type by ***Zylbergold, R. S., & Piper, M. C. 1985***[15]**,** They tested 100 patients suffered from cervical radiculopathy and divided them into 3 groups (static, intermittent and manual traction). Their results showed improvement in all measured variables in terms of pain (VAS) and cervical ROM (CROM) after 6 weeks follow up. The pattern of improvement coincides with the result of our study regarding intermittent cervical traction**.**

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CONCLUSIONS

Within the limitations and results of the study, the following conclusions were drawn:

- Cervical traction still proves to be effective treatment modality of choice in treatment of patients with cervical radiculopathy.
- The favorable results of cervical traction can be augmented when applying neural mobilization to the treatment program.
- Neural mobilization is recommended to be performed in a manner that they do not applied simultaneously with traction.
- Better results were noted when selecting of the nerve to be glided is based on the results obtained from symptom distribution and limb tension test.
- The favorable results are found when multi nerves (median and ulnar) are be glided immediately after mechanical cervical traction in treatment of unilateral cervical radiculopathy.

RECOMMENDATONS

The following recommendations are suggested for further research:

- A similar study should be conducted on different types of neurological impairments.

- A similar study should be conducted on bilateral cervical radiculopathy and cervical myolopathy.
- A similar study should be conducted on a more sample size so it can be generalized.

A similar study should be conducted using more objective tools for measuring the study variables (EMG, NCV and isokinetic machine).

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