

Multimodal Intervention of High-Intensity Laser with Neurodynamic Mobilization in Cervical Radiculopathy

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ABSTRACT

Background: Cervical radiculopathy(CR) patients demonstrate sensori motor problems radiating along the distribution of a nerve root in the upper limb, multimodal therapeutic program had significant improvement in CR.

Aim: To investigate the effect of multimodal intervention including new combined effect of high-intensity laser (HILT) and neurodynamic mobilization on pain, cervical range of motion (CROM), hand grip strength, and neck disability index (NDI) in CR patients.

Methods: sixty patients with CR were randomly divided into three equal groups; group A: received median nerve neurodynamic mobilization, group B: received HILT and group C: received the multimodal intervention of median nerve neurodynamic mobilization and HILT, all the groups received also conventional treatment, for 3 sessions/week for four weeks. The Patients were assessed by CROM device, Hand grip dynamometer, Pain Visual Analogue Scale (VAS), and NDI.

Results: Showed a significant decrease in VAS and NDI, and a significant increase in hand grip strength and CROM in group B and group C more than group A, while group C showed the most significant improvement ($p < 0.0001$). There was a negative significant correlation between (NDI and hand grip),(VAS and CROM) and (VAS and hand grip), and a strong positive significant correlation between (VAS and NDI).

Conclusion: The multimodal intervention program had more effects in decreasing pain, neck disability, increasing hand grip strength, and CROM. Therefore this multimodal program considered a potential rehabilitation for CR.

Keywords: high-intensity laser therapy , neurodynamic mobilization, median nerve, hand grip, cervical radiculopathy.

INTRODUCTION

Cervical radiculopathy is the most well-known indication of cervical degenerative disease¹. Cervical radiculopathy (CR) represented with radiating pain in the arm with sensory problems as numbness & paresthesia or motor disorders aggravated by cervical movement or posture². The radiculopathy natural course due to degenerative diseases is common³. The predisposing factors of CR included a various combination of cervical spondylosis, disc herniation, decreased intervertebral height, facet joints osteoarthritis, or cervical vertebrae spondylolisthesis that cause irritation or compression of nerve root²⁻⁴.

Laser treatment considered a non-painful & noninvasive strategy that could be effectively controlled in treatment units for a wide scope of cases, a recently introduced new treatment choice is the Pulsed neodymium-doped yttrium aluminum garnet (Nd:YAG) laser therapy, which is a form of high-intensity laser therapy (HILT). The HILT is better than low-level laser therapy (LLLT) as the HILT can activate and reach deeper and larger regions & joints to diminish the accumulation of heat deeper in tissues and to have photochemical, and photo-thermal efficacy that are hard to reach by LLLT⁵.

These characteristics of HILT improve cell vascular permeability, metabolism, and circulation of the blood to treat the more profound structures & tissues^{6,7}. The HILT

pain control is because of several mechanisms, as the discharge of endogenous opioids, for example, the β -endorphins in the central nervous system is expanded by HILT therapy and these could diminish the pain sensations centrally, while the substance P which sensitizes pain-transmitting neurons in the peripheral nervous system, that leads to hyperalgesia, however, the laser therapy lead to diminish the substance P discharge through the peripheral receptors^{8,9}. The HILT using the Nd:YAG laser has a 1,064 nm wavelength & (3 kW) high peak power⁵. New examinations were revealed the useful impacts of Nd:YAG laser therapy in painful conditions^{10,11}.

Neural mobilization, or neurodynamics, expected to improve different tracts mobility of the nervous system, reestablish the homeostasis around & in the nervous system^[12], and reestablish the peripheral nerves mobilization^[13,14]. The manual therapy technique called the neural gliding or mobilization improves the neurodynamics by reestablishing the balance between the surrounding structures & the relative nerve movements, these strategies can likewise diminish nociceptive conduct in the spinal cord that impact the central mechanisms¹⁵. Neurodynamic rehabilitation concentrated in the peripheral nerve compression disorders, neuromuscular disorders & in different areas of the body, such as radiculopathy of cervical & lumbar, and have been demonstrated to be successful in decreasing pain and movement disability¹².

Neurodynamic mobilization (NDM) leads to produce a neural gliding and sliding, lengthening, pressure, or tension alternation, besides, NDM improves physiologically the intraneural bloodstream and axonal transport^{16,17}. Neurodynamic strategies consisted of both techniques which are the slider technique that is performed gradually with a controlled way to deliver sliding movement of the neural structures comparative with their adjoining tissues, thus permits the pressure and tension to be conveyed along with the nervous system more equally instead of working up to one specific area, and a tensioner technique that works as the neurodynamic test that makes tension on the neural structures without exceeding the tissue limit of elasticity and considered a more vigorous method¹⁸.

However, as the cervical radiculopathy, considered one of the serious problems that prompting a delayed or permanent disability, accordingly this study plans to explore the role of multimodal intervention using the combined effect of HILT with the neurodynamic mobilization and conventional treatment on pain, range of motion, hand grip power and neck disability in patients with cervical radiculopathy, so this study extends the physiotherapy rehabilitation role in patients with cervical problems.

METHODS

Study Design: The study was planned as pre, and post-experimental design, a prospective, randomized, controlled trial that was led in the Faculty of Physical Therapy, Cairo University outpatient clinic of the neurology department, and the outpatient clinic of physical therapy in El Hilal health insurance hospital, El Menofeya governorate, in the period from March 2019 to February 2020. All the Patients were assigned randomly into three equal matched groups every group included 20 patients as follow :group A received neurodynamic technique of median nerve neural mobilization (MNNM), group B received HILT, and group C received the multimodal intervention of HILT combined with median nerve NDM, besides the all groups received likewise a conventional physical therapy program of infrared radiation and interferential stimulation, and all the rehabilitation program was a total of 12 sessions (3 sessions/week for 4 weeks).

Ethical approval for the study: The study was approved by the Institutional Ethics Committee of the Faculty of Physical Therapy, Cairo University, Egypt (No:P.T.REC/012/002106).

Patients: Sixty patients with cervical radiculopathy, were assessed by Cervical Spine Examination Form ^[19], before the treatment program, and all the patients completed all the intervention programs in the three groups. All patients read and signed a consent form before the beginning of the study, the anonymity and confidentiality were assured and all the procedures were performed in compliance with relevant laws and institutional guidelines.

Inclusion criteria: The patients were included in the study if they: (i) had age ranging from 25 to 35 years old from both sexes with a body mass index (BMI) ranged from (20 to 30)Kg/m²,(ii)All the selected patients were diagnosed by the neurologist as cervical spondylosis or disc prolapse with radiculopathy suffering from "6:12" months (iii)all the patients suffered from neck pain with radiating arm pain

aggravated by neck movement as well as at least one other finding of dermatomal numbness, and/or myotome weakness(iv) had unilateral radiculopathy with a positive upper limb tension test (ULTT)²⁰, (v)had pain score above 5 according to Visual analogue scale (VAS)²¹,(vi) had a decreased cervical range of motion scores within 30° to 35° of flexion, 35° to 45° of extension, 25° to 33° of lateral flexion to the affected side, and 40° to 50° of rotation to affected side^[22], and a severe NDI with the score of "25:34"^[23].

Exclusion criteria: The patients were excluded from the study if they: (i) had cervical spondylolisthesis, subluxation or fracture (ii) Pregnant women, (iii) patients of systemic disease as rheumatoid arthritis or neoplastic lesion & (iv) patients with vertebrobasilar insufficiency (v) had previous surgery in the cervical region, and any other neurological diseases, musculoskeletal disorders or deformity of the spine or upper extremity r.

Sample size: a Sample size calculation was performed using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany)²⁴ and revealed that the appropriate sample size for this study is n=60.

Outcome measures:

Cervical range of motion (CROM) goniometer

measurements: The CROM is an inclinometers system with a gravitational reference that is suitable for evaluating the active cervical spine flexion, extension, side bending, and rotation movements, in frontal, sagittal, and transverse planes²⁵. The CROM is a simple device & its interest reproducibility was investigated with great outcomes, which "manufactured by Performance Attainments Associates"^{26,27}. The CROM device was put on the patient's head with the head in a neutral position and looking straightforwardly while the patient was in a relaxed sitting position & his/her leg rested on the floor. The device front lower edge was set on the eyebrow upper edge curve, with the CROM lower back edge at a similar level. The therapist hands placed on the patient's shoulders to help with keeping the patient's body except for the neck, fixed in the neutral position during active movement of the neck to test cervical flexion, extension, side bending & rotation to affected side. The movement angle of the cervical spine was recorded as the difference between the pointer value and the value post neck motion.

Visual analogue scale (VAS): The VAS for pain was reported as a valid & reliable evaluation method for the intensity of pain on a horizontal straight line of fixed length (10 cm), as the left end of the line showed the greatest pain score & the right end showed the least pain scores, then the patient was asked to put a mark, on the line according to his/her pain sensation, with a higher score representing the higher level of pain²¹.

Neck Disability Index (NDI): The NDI is a validated self-report questionnaire to detect the level at which the neck pain influences the daily life of the patient, and the patient's baseline pain, function, and disability status and likewise for monitoring the changes in a patient's status during the rehabilitation. NDI includes 10 items as follows: Pain Intensity, Personal Care, Lifting, Reading, Headaches, Concentration, Work, Driving, Sleeping, and Recreation, with a score (0:5) for every point. The maximum score is 50, with the interpretation scoring (no disability = 0; 4, mild

disability 5:14, moderate disability 15:24, severe disability 25: 34 & complete disability above 34²³.

Hand grip dynamometer for the assessment of hand grip strength: Hand-Held Dynamometer was reported as a reliable and valid instrument to measure the power of the patient's hand grip, "manufactured by Smedley, Stoelting Company, Wood Dale, Illinois"²⁸. The patient was seated in a relaxed position, in a chair & his/ her feet on the floor with adducted shoulder, 90-degree flexion of the elbow, forearm neutral, wrist extension between (0:15) degree, and ulnar deviation (0:15) degree. The patient was asked to grasp gently the dynamometer around readout dial, then to hold the handle and to squeeze as hard as possible for 5 seconds and relax, then second and third trials were performed, with a rest period of 15 seconds was given to avoid the fatigue, the highest score of the three trials was recorded²⁹. The normal average scoring values for age (30:39) years old were in the male the mean of the right & left hand was nearly 47Kg while in the female the mean of the right & left hand was (31, 29)Kg respectively²⁸.

The Treatment protocol: Group A received NDM of the median nerve on affected side in form of sliding and tensioning techniques, without the reproduction of symptoms as the patient was in a supine lying position on the lateral edge of the bed, and firstly for applying the sliding technique which was performed passively by the therapist, there were two steps, the first step: the patient's head and neck were placed by the therapist in maximal ipsilateral side bending with shoulder depression, 90° arm abduction, shoulder lateral rotation and with full extension of the elbow, wrist, and thumb, then for the second step of the sliding technique: the patient's head and neck were placed in maximal ipsilateral side bending with depression of the shoulder girdle, 90° arm abduction, shoulder lateral rotation and the elbow flexed at 100° with neutral position of both, the wrist and thumb. Secondly, as a NDM progression of the median nerve, the tensioning technique was performed as the therapist made the patient's head and neck in maximal contralateral side bending toward the non-affected side, while in the affected side the therapist made depression of the shoulder girdle, 90° arm abduction with shoulder lateral rotation and full extension of the elbow, wrist, and thumb¹⁷, with two-minute hold for every previous NDM positions for three sets with a 1-minute interval between them.

The patient received also a conventional treatment as the NDM combined at the same time of the application with infrared radiation, as the patient skin area of the neck, around paraspinal and trapezius muscles was adequately exposed, and the infrared lamp was positioned at a distance of (50:75 cm), for 15 minutes/ session. Also, the patients at the end of the session received interferential treatment as the patient was in a sitting position and the interferential application performed using an electrotherapy device on the cervical spine and the affected upper limb. The interferential therapy parameters were selected at an amplitude-modulated constant frequency of 100 Hz and a pulse duration of 125 µs due to its analgesic effect, with a duration of 20 minutes/ session³⁰.

Group B: received HILT with a neodymium-yttrium aluminum garnet laser with a pulsating waveform produced by a (HIRO@3 device, ASA, Arcugnano, Vicenza, Italy)¹⁰,

set at the following parameters: Nd:YAG laser with pulsed emission (1064 nm), very high peak powers (3 kW), high levels of fluency (510–1780 mJ/cm energy density), short pulse duration (120–150 µs), low frequency (10–40 Hz), a duty cycle of about 0.1 %, 0.5-cm probe diameter, and 0.2-cm² spot size^[31], for 15 minutes. While the patient was in a relaxed sitting position, the hand piece of the device was positioned in contact with and perpendicular to the treated area, as the scanning was performed longitudinally & transversely to the para-spinal area on the neck posterior aspect, upper back, inter-scapular area, trapezius, sternocleidomastoid muscles, and posterior & lateral shoulder areas. The Patients also received conventional treatment in form of infrared radiation and interferential treatment as group A.

Group C: The Patients received combined multimodal intervention treatment protocol in the form of median nerve NDM combined with infrared radiation as group A, then HILT as group B, and finally interferential treatment application as previous.

Statistical analysis: Descriptive statistics and ANOVA tests were conducted for comparison of age, duration of illness & BMI between groups. A chi-squared test was used for comparison of sex, affected side and cervical radiculopathy cause distributions between the three groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was performed to compare within and between groups effects on VAS, NDI, cervical ROM, and hand grip strength. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparisons. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through SPSS version 25 for windows.

RESULTS

Patients characteristics: The patient's characteristics of the three groups A, B, and C showed in (Table 1). There was no significant difference between groups in age, duration of illness, BMI, sex, the affected side and cervical radiculopathy cause between groups ($p > 0.05$).

Effect of treatment interventions on VAS, NDI, hand grip strength, and cervical ROM: Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F(20,96) = 20.85, p = 0.001$). There was a significant main effect of time ($F(10,48) = 1869.95, p = 0.001$). There was a significant main effect of treatment ($F(20,96) = 8.98, p = 0.001$). Tables 2 & 3 showed descriptive statistics of VAS, NDI, hand grip strength and cervical ROM, and the significant level of comparison between groups as well as a significant level of comparison between before and after treatment in each group.

Within-group comparison: revealed a significant decrease in VAS and NDI, and a significant increase in hand grip and cervical ROM in the three groups post-treatment compared with that pretreatment ($p < 0.001$) (Tables 2,3).

Between-group comparison: The pretreatment revealed a nonsignificant difference in all parameters ($p > 0.05$), while

the post-treatment revealed a significant decrease in VAS and NDI, and a significant increase in hand grip strength & cervical ROM of group C compared with that of group A ($p < 0.001$), while there was no significant difference between group B and C ($p > 0.05$). There was a significant decrease in VAS and NDI and a significant increase in hand grip strength & cervical ROM of group B compared with that of group A post-treatment ($p < 0.05$) (Tables 2,3).

Relationship between NDI and hand grip strength: The correlation between NDI and hand grip was a moderate negative significant correlation ($r = -0.6, p = 0.0001$) (Fig. 1)
d- Relationship between VAS, NDI, hand grip strength, and cervical ROM: The correlations between (VAS and NDI), was a strong positive significant correlation, while between (VAS and hand grip) was moderate negative significant correlation and between (VAS and CROM) was a strong negative significant correlation (Table 4)

Table 1: Basic characteristics of patients.

	Group A	Group B	Group C	p-value
	mean \pm (SD),			
Age, "years"	31.05 \pm 2.9	30.65 \pm 3.11	31.1 \pm 2.91	0.87
Duration of illness "months"	10.3 \pm 1.68	9.85 \pm 1.66	10.85 \pm 1.53	0.16
BMI, "Kg/m ² "	23.9 \pm 2.8	24.2 \pm 2.5	24.5 \pm 2.6	0.83
Gender				
Female	12 (60%)	10 (50%)	10 (50%)	0.76
Male	8 (40%)	10 (50%)	10 (50%)	
Affected side				
Right	13 (65%)	10 (50%)	14 (70%)	0.4
Left	7 (35%)	10 (50%)	6 (30%)	
Cervical radiculopathy cause:				
Disc prolapse	13 (65%)	11 (55%)	12 (60%)	0.8
Spondylosis	7 (35%)	9 (45%)	8 (40%)	

SD, standard deviation; n, number of patients; p-value, level of significance; BMI, body mass index

Table 2. Mean values of VAS, NDI and hand grip pre and post treatment of group A, B and C:

	Group A	Group B	Group C	p-value		
	mean \pm SD	mean \pm SD	mean \pm SD	A vs B	A vs C	B vs C
VAS "cm"						
Before treatment	7.35 \pm 0.74	7.3 \pm 0.8	7.25 \pm 0.78	1	1	1
After treatment	3.75 \pm 0.71	1.9 \pm 0.55	1.5 \pm 0.76	0.001	0.001	0.2
	$p = 0.001$	$p = 0.001$	$p = 0.001$			
NDI "points"						
Before treatment	33.75 \pm 3.07	33.45 \pm 3.05	32.7 \pm 1.75	1	0.67	1
After treatment	22.35 \pm 2	11.3 \pm 1.41	10.4 \pm 1.27	0.002	0.62	0.03
	$p = 0.001$	$p = 0.001$	$p = 0.001$			
Hand grip "Kg"						
Before treatment	28.85 \pm 6.12	30.05 \pm 5.25	29.65 \pm 5.07	0.88	0.93	0.98
After treatment	30.95 \pm 6.1	38.05 \pm 5.78	40.65 \pm 6.06	0.001	0.001	0.24
	$p = 0.001$	$p = 0.001$	$p = 0.001$			

SD, Standard deviation; p-value, Level of significance; VAS, Visual analogue scale; NDI, Neck Disability Index

Table 3. Mean values of cervical ROM pre and post treatment of group A, B and C:

	Group A	Group B	Group C	p-value		
	mean \pm SD	mean \pm SD	mean \pm SD	A vs B	A vs C	B vs C
Flexion CROM						
Before treatment	32.7 \pm 4.64	31.55 \pm 4.91	31.7 \pm 5.62	1	1	1
After treatment	47.1 \pm 4.9	56.15 \pm 4	58.45 \pm 3.7	0.001	0.001	0.27
	$p = 0.001$	$p = 0.001$	$p = 0.001$			
Extension CROM						
Before treatment	38.15 \pm 3.28	39.2 \pm 5.3	40.15 \pm 5.93	1	0.62	1
After treatment	52 \pm 3.11	58.3 \pm 5.02	60.05 \pm 3.92	0.001	0.001	0.54
	$p = 0.001$	$p = 0.001$	$p = 0.001$			
Side bending CROM						
Before treatment	29.8 \pm 3.38	29.45 \pm 4.43	28.7 \pm 3.98	1	1	1
After treatment	37.35 \pm 4.4	40.65 \pm 3.93	42.5 \pm 2.5	0.02	0.001	0.35
	$p = 0.001$	$p = 0.001$	$p = 0.001$			
Rotation CROM						
Before treatment	45.85 \pm 2.47	46.7 \pm 3.3	47 \pm 3.3	1	0.72	1
After treatment	57.65 \pm 2.3	65.7 \pm 2.05	67.15 \pm 2.53	0.001	0.001	0.15
	$p = 0.001$	$p = 0.001$	$p = 0.001$			

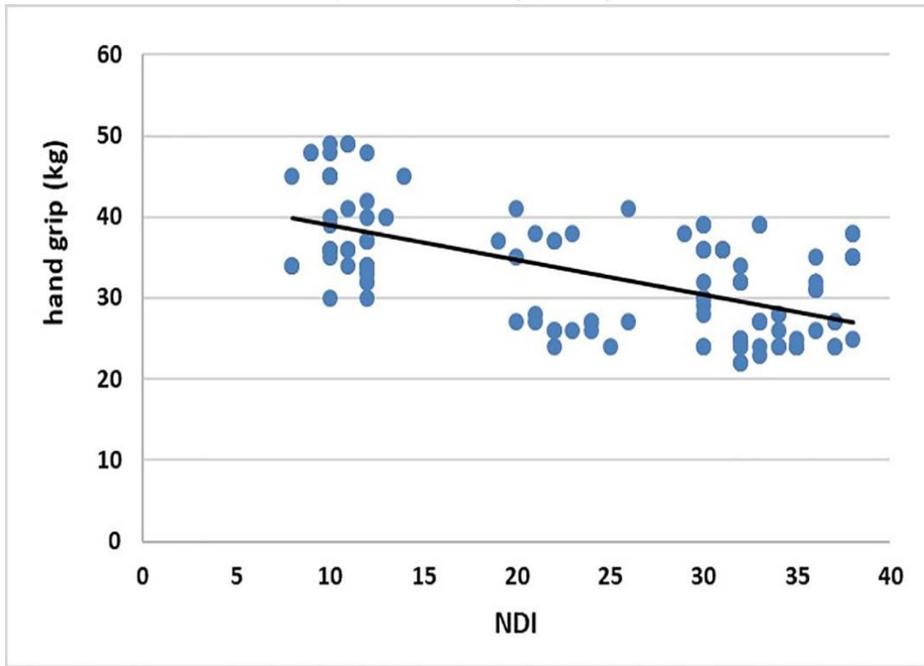
SD, Standard deviation; p-value, Level of significance; CROM, cervical range of motion

Table 4. Correlation between VAS, NDI, hand grip strength and cervical ROM.

VAs	r value	p value	Sig
NDI	0.94	0.0001	S
Hand grip	-0.51	0.0001	S
Cervical Flexion	-0.9	0.0001	S
Cervical Extension	-0.86	0.0001	S
Cervical Side bending	-0.8	0.0001	S
Cervical Rotation	-0.91	0.0001	S

r value, Pearson correlation coefficient; p-value, Level of significance; S, Significant; VAS, Visual analogue scale; NDI, Neck Disability Index

Figure 1 .Correlation between NDI and dynamometer hand grip strength.



DISCUSSION

The current study found that in the treatment of patients with unilateral cervical radiculopathy a three treatment groups received conventional infrared & interferential therapy program with a selected program for each group and the results showed that patients in both group B that received HILT and group C that received the multimodal intervention of HILT with median nerve NDM had a higher statistical significant reduction in pain, NDI scores with improvement in CROM and hand grip strength measurements, than group A which received median nerve NDM, although group A also revealed improvement, so the current study concluded that group C represented the best findings and approved that the multimodal intervention of HILT with median nerve NDM and conventional therapy program is the best treatment program for pain reduction & improvement of motor performance in cervical radiculopathy patients. These results were in agreement with Alayat, et al⁶, who studied the effect of HILT in treatment of patients with chronic neck pain (CNP) on cervical range of motion (ROM), pain, and functional activity, and the results of VAS and NDI showed significant decrease post-treatment, also Haladaj et al³², reported that HILT leads to improve the global mobility & analgesic effect, in the

patient with cervical spondylosis as the NDI & VAS results had a significant reduction after four weeks of treatment.

A study by Kolu et al³³, revealed that using HILT in chronic lumbar radiculopathy patients, was effective treatment method as it decreased the VAS and Oswestry Disability Index scores four weeks after the treatment sessions, likewise the findings of the study by Song et al⁹, that showed that, the HILT treatment for back and neck pain significantly diminished pain and disability scores.

On the other hand, Boyles et al³⁴, concluded that manual therapeutic techniques included neurodynamic techniques combined with specific exercises were more effective in improving function, active range of motion, reducing both pain and disability and limitations in cervical radiculopathy patients. Nee et al³⁵, reported that neural tissue management with the neurodynamic treatment provided immediate clinically relevant benefits without harmful effects for patients with cervical radiculopathy, as there were reductions in neck pain, arm pain & NDI. In a previous study by Roopa et al³⁶, that studied the effects of median and ulnar neural mobilization on hand grip strength in cervical radiculopathy, and the findings showed there was an improvement in hand grip strength measured by hand

held dynamometer as the mean score of hand-grip power pretreatment was 37.89 Kg and post-treatment was 45.55 Kg

The median nerve NDM effect on cervical radiculopathy patients in a previous study by Shivani and Neha³⁷ showed that there was a significant improvement in the cervical ROM and reduction in mean values of VAS as it was 6.47cm before treatment, and decreased to 1.53 cm post-treatment, also there was a significant improvement in cervical ROM as the mean values of cervical flexion & extension were pre-treatment 55.37, 56.63 degrees and post-treatment, 62.53, 61.87 degrees respectively.

While the combined effect of median, ulnar & radial nerves NDM with the transcutaneous nerve stimulation (TENS) on cervical radiculopathy patients in a previous study by Deka et al³⁸ showed that the neural mobilization in combination with TENS had the greatest effect in reduction of pain and disability than neural mobilization alone.

Several guidelines & reviews likewise concluded that a multimodal management strategy, comprising of spinal and neurodynamic mobilization with a specific exercise program or therapeutic modalities as a conservative treatment had a more effect on pain, disability, and motor functions for patients with CR^{2,12,39}. In the same manner, a study by Laxmi et al³⁰, showed that cervical radiculopathy patients who received interferential therapy with neural mobilization and conventional therapy had more improvement than patients that received interferential therapy with conventional therapy, as the scores of VAS and NDI decreased while the cervical ROM increased post-treatment, so this study had been emerging evidence to approve that cervical radiculopathy patients could benefit more from the multimodal treatment that included interferential therapy with neural mobilization and conventional therapy.

The effectiveness of manual therapy for cervical radiculopathy in a study by Thoorns⁴⁰, concluded that there was low-level evidence that unimodal intervention of cervical manipulation affected pain post-treatment immediately but not at a longer time, while the combination of spinal mobilization and motor control exercises were more effective on pain and activity limitations than separate interventions, and also reported that the multimodal intervention that included cervical neurodynamic mobilizations with a selected program of exercises had a more reduction effect on pain in patients with CR. Also a previous study approved that the fatigue & overload of the cervical muscle were inhibited after cervical mobilization because of the improvement of neck ROM, and pain reduction^[41], as the cervical muscle fatigue might affect neck proprioception and lead to postural instability⁴².

These previous results are in agreement with the current study findings that approved that group C who received a multimodal intervention of HILT with median nerve neurodynamic mobilization & conventional therapy had a more significant improvement in hand grip strength, cervical motor performance, and pain reduction, in cervical radiculopathy.

CONCLUSION

Based on the scope and findings of this study, which concluded that the multimodal intervention program of HILT in combination with median nerve NDM had a significantly more effect on decreasing pain, reducing neck disability, increasing hand grip strength and increasing CROM scores, so this multimodal combination program should be considered as a potential rehabilitation program for patients with cervical radiculopathy. Further future studies are recommended to study the effect of multimodal intervention program including HILT and neurodynamic mobilization technique in lumbar spine disorders patients.

Conflict of interest: The authors had no conflict of interest to report

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