RESEARCH PAPER

Adding Instrument Assisted Soft Tissue Mobilization to Core Stability Training in Chronic Mechanical Neck Pain: A Randomized Controlled Trail

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Received: 04th June, 2026; Revised: 25th June, 2026; Accepted: 16th July, 2026; Available Online: 25th July, 2026

ABSTRACT

Objectives: The purpose of this research is to examine the efficacy of treating chronic mechanical neck pain (CMNP) using a combination of core stability training and Instrument Assisted Soft Tissue Mobilization (IASTM).

Methods: Thirty patients suffered from CMNP were recruited from outpatient clinic from Ismailia Medical Complex. Aged from 18-55 years old, their body mass index (BMI) measures varied between 18 and 30 kg/m2. They were randomized into two equivalent groups (n=15) each. Group A: was given traditional physiotherapy (Superficial thermotherapy, Electrotherapy, stretching exercises and active range-of-motion exercises) plus core stability exercise. Group B (study group): was given the identical traditional physiotherapy along with core stability exercise and IASTM. All treatments were performed three sessions each week for four weeks. Pain severity was assessed by visual analogue scale, disability level was evaluated by Arabic Neck Disability Index, cervical ROM and proprioception using cervical ROM goniometer (CROM), muscle activity, and latency were assessed using computerized Electromyography (EMG). All were evaluated before and after intervention.

Results: The results by MANOVA showed a significant reduction in pain intensity ($p < 0.001$), level of disability ($p < 0.001$), joint proprioception ($p < 0.001$) and muscle latency ($p=0.03$), with a significant enhancement in all CROM ($p < 0.001$), muscle amplitude and motor unite potential for Levator scapulae ($p < 0.001$) and upper Trapezius ($p < 0.001$) in both groups post treatments in the favour of group B.

Conclusion: IASTM represent a very effective rehabilitation tools when combined with (core stability and traditional physiotherapy program) in treating patients with CMNP.

Keywords: Core Stability Training, Disability Index Electromyography, Instrument Assisted Soft Tissue Mobilization, Mechanical Neck Pain, Visual Analogue Scale.

How to cite this article: Mahmoud R.M.H, Elhafez H.M, Sedhom M.G, Mohamed R.R, Adding Instrument Assisted Soft Tissue Mobilization to Core Stability Training in Chronic Mechanical Neck Pain: A Randomized Controlled Trail. 2026;16(72s): 331-342. DOI: 10.25258/ijddt.16.72s.37

Source of support: None

Conflict of interest: None

INTRODUCTION:

According to **Hurwitz et al. (2018),** between 30 and 50% of the world's population suffers from neck pain, making it the fourth leading cause of adjusted life years for disability.

There are a number of cervical spine tissues joints, muscles, ligaments, neurological processes, and intervertebral discs that may generate mechanical discomfort. Neck pain is a common problem in today's society due to individuals' sedentary lifestyles, the prevalence of office jobs, and our dependence on technology. Not only that, but research has shown that persistent pain in the cervical region is common and has a great recurrence rate **(Hoving et al., 2001).**

Mechanical neck pain (MNP) is characterized by a lack of coordination between the neck and the head, that may restrict the head's full ROM and increase the pain felt there. As a result, various treatments are used to help patients with CMNP get their soft tissues functioning properly again and restore the mobility in their joints **(Jull et al., 2009).**

There are different modalities as (manual therapy, electrotherapy like TENS, thermotherapy like heating, mechanical methods like traction or dry needling, exercises, and complementary therapy like acupuncture on chiropractic) can be applied to treat patients with MNP. On an overall basis, there is moderate evidence that the following approaches have a favorable impact, as compared to a placebo or other treatments: mobilization, manipulation, along with exercise therapy. **Miller et al. (2010)** suggests combining these therapies as an intervention.

Seffrin et al. (2019) found that IASTM is an additional technique that helps those suffering from neck pain by increasing their strength, ROM, and decreasing their pain levels. According to **Nazari et al. (2019),** it has the potential to alleviate myofascial tension, reduce nociception, and enhance underlying tissue flexibility.

Core stabilization exercises may be categorized as those that aim to retrain the function of the deep trunk muscles or in the form of coordination exercises for static, dynamic, or functional tasks. Patients may build functional strength, neuromuscular control, in addition to endurance in

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their core muscles with stability training programs **(Coulombe et al., 2017).**

So far, up till now, there are no studies that have explored the impact of using IASTM with core stability training exercises on CMNP patients. So, this study was conducted to examine the impact of adding IASTM to core stability training exercises on pain intensity level, CROM, neck proprioception, muscle activity, H-reflex and neck functional level in CMNP patients.

METHODOLOGY

The present study was a Randomized control trial using a pre-posttest design. This research was approved by the Research Ethical Committee of the Faculty of Physical Therapy at Cairo University (P.T.REC/012/003837) before it was implemented. Guidelines for the Care of Human Subjects as outlined in the Helsinki Declaration were followed in this research. Clinical Trial.gov was used to register the research protocol (NCT05860049).

This study was done on 30 patients. The patients were chosen from the outpatient clinic of Physical Therapy Department in Ismailia Medical Complex, Ismailia, Egypt, and received diagnosis as CMNP by a physician with their age was ranging from 18-55 years old **(Mohamed et al., 2020).** Their BMI measures varied between 18 and 30 kg/m2 and were randomized into two equivalent groups (A&B). Group A (control group): was given traditional physiotherapy (Superficial thermotherapy, Electrotherapy, stretching exercises and active range-of-motion exercises) plus core stability exercise. Group B (study group): was given the identical traditional physiotherapy as group A in addition to core stability exercise and IASTM. All treatments were conducted three sessions per week for four weeks. Prior to taking part in the study, all patients were given an informed consent form to fill out.

Inclusion criteria

The participants were selected according to the following criteria, thirty patients diagnosed with CMNP, aged from 18 to 55 years old **(Mohamed et al., 2020),** Their BMI measures varied between 18 and 30 kg/m2, the severity of pain on the VAS should be higher than two out of ten **(Hussain et al., 2016),** pain and stiffness last for at least 3 months **(Reid et al., 2013).**

Exclusion criteria

Patients were excluded if they had the following conditions: disorders with their upper or middle back's sensory systems, cardiac or vascular problems, malignancies, diabetes mellitus, TB, history of surgery on the shoulder, neck, or upper or middle back, or any visible wounds, lesions, or infections in those areas, cervical degenerative joint disease, Autoimmune conditions (rheumatoid arthritis, fibromyalgia) **(Gulick, 2018).**

Evaluation procedure

The study procedure was thoroughly explained to the participants. and each test was described to all of them before starting the program. A pre-treatment evaluation served as a baseline assessment, along with an assessment after the end of treatment session served as a post-treatment evaluation.

A-Pain intensity level assessment:

The most popular method for determining the amount of pain reduction as well as the severity of pain was the VAS. The patient is asked by the healthcare provider to indicate the level of pain by placing a point upon a line that connects two endpoints **(Kelly, 2001).** The 10 cm line has two extremes: the one at the very end represents the patient's worst possible pain, while the other at the very beginning represents the minimum or no pain exist at all. This scale may be arranged vertically but the most commonly used is the horizontal orientation **(Hawker et al., 2011).** To measure the severity of pain, each participant was requested to lie down in a relaxed posture and then identify a point along the line that directly matched to their pain **(Chiarotto et al., 2019).**

B-Neck Functional Level assessment

The NDI, an Arabic version of the widely used disability scale for measuring impairment due to neck discomfort, was utilized for the assessment. Based on the Oswetry Disability Questionnaire, this scale was adjusted. There are 10 elements that make up the NDI, and each one has a score from 0 to 5. A total of 7 questions concern functional activities, two address symptoms, and one pertains to concentration. The total score ranges from 0 to 50. According to **Aslan et al. (2008),** higher scores correspond with higher levels of disability. The NDI is regarded as a valid, dependable, and responsive tool in Arabic. According to **Shaheen et al. (2013),** the Arabic version of the NDI has an intraclass correlation value of 0.96 with a 95% confidence range ranging from 0.93 to 0.97, indicating strong test-retest reliability.

The ten-item NDI was administered to each patient in a relaxed position both prior to and following treatment. On a scale from 0 (indicates no disability) to 5 (indicates complete disability), each item was scored. The individual was asked to choose the response that most accurately reflected the amount of functional limitation in their neck for each item. I recorded the overall score after tallying the scores for each item. Test time ranged from 3 to 7.8 minutes on average. The following was the consensus: No impairment if ranged from 0–4 points (0–8%), 10–28% if ranged from 5 to 14 points which indicates mild disability, moderate disability (if ranged from 15 to 24 points, 30–48%), severe disability (if ranged from 25 to 34 points, 50–64%), as well as total disability (if ranged from 35 to 50 points, 70–100%) **(Macdermid et al., 2009)**.

C-Cervical Range of Motion (ROM) Assessment:

The CROM Goniometer was used for the evaluation. The CROM measures the cervical ROM in many planes, including sagittal, coronal, as well as transverse, as well as rotation. It does this by attaching three inclinometers to a frame which resembles an eyeglasses design: one for side bending, one for extension, as well as additional third for rotation. There was a good level of validity and reliability in the degree-based measurements **(Audette et al., 2010).** Every participant had their cervical AROM assessed in flexion and extension, as well as in bending to the right and left and rotating to the right and left. After taking off their eyeglasses, hats, along with jewellery, the subjects sat on a chair, wearing a T-shirt or tank top, removed any hair covering their ears, neck, or eyes, and engaged in a short presentation of the 6 cervical movements that would be required of them. In order to ensure that the measurements were as accurate as possible, the researchers consistently followed protocols that involved establishing a neutral head as well as neck position (also called anatomical position) and a standard body position for each subject before measuring their motion **(Masaracchio et al., 2019).**

The participants were instructed to sit up straight while they were measured for cervical ROM. They were then placed on a chair with their backs supported until they reached the mid-thoracic level. The individual's head was properly fitted with the CROM device and the magnetic neckpiece. In order to reduce the potential for ROM changes caused by head and neck postures, a neutral position of the head as well as neck position was used. The next step was to have the participants actively move their necks until they felt discomfort or reached their maximal ROM **(Audette et al., 2010).**

The flexion movement was initiated by having the participants tuck their chins in, whereas the extension was initiated by having them elevate their chins. To prevent movement of the thoracic spine, it was instructed to maintain fixed shoulders. While measuring side bending in addition to rotation, the result assessor manually stabilized the opposite shoulder. As soon as the subject finished the ROM, the appropriate inclinometer measured the ROM in degrees. The participant was asked to manually set the inclinometer dial to "zero" prior to performing the rotational movement (**Audette et al., 2010).**

D-Cervical Proprioception Assessment

The CROM Goniometer equipment was used for the assessment. Some common methods to measure cervical proprioception include the neutral head position (NHP) in addition to target head position (THP) tests, which measure how accurately the head can be repositioned. Changing positions to the NHP along with the THP. The methods of testing were identical to those detailed by **Lee et al. (2006)**. Capability to actively return head to neutral position (as chosen by the participant) is measured by the NHP test. Actively repositioning the head to a predetermined target position is measured by the THP test. The subject's head was fitted with the CROM device following the testing protocol was explained. Each participant was asked to assume a self-selected "NHP" posture, which included sitting up straight using feet flat on the floor, back against the chair backrest, as well as focusing straight ahead. After positioning the CROM device above the head, it was attached to the back utilizing a Velcro strap. After that, while monitoring the precision of the relocation in the transverse plane, the magnetic component of the device was positioned so that it rested squarely on the shoulders. This was done by rotating the head medially and laterally. We conducted a calibration of the CROM device with an NHP (**Lee et al., 2006**).

E-cervical muscle activity and H reflex Assessment

Using electromyography, the following was done to record and analyse the activation pattern of the muscle under examination:

After the patient's history and physical were taken, they were given 10 minutes to relax and acclimatize. During this time, each participant did the following to be prepared to participate in the experiment:

When necessary, the area where the electrodes will be placed will be shaved.

To lower skin impedance at the location of the recorded muscle as well as the reference electrode, the skin should be cleansed with alcohol using a piece of cotton.

Electrodes positions (Mclean, 2005):

- The following will be the locations of the electrodes on the dominant side of each individual:
- **Levator scapulae (LS)**: located midway between the posterior portion of the sternocleidomastoid (SCM) along with the anterior portion of the upper trapezius (UT), and laterally to the C3–4 spinous process.
- **Upper trapezius (UT)**: Located 2 centimeters laterally, midway among the posterolateral acromion along with the C7 spinous process.
- **Reference electrode**: placed on top of the C7 spinous process.

Electrode placement locations will be marked and measured utilizing a tape measure; palpation along with manual resistance will be used for confirmation.

Assessment of the maximum voluntary isometric contraction (MVIC):

Manual muscle testing was used for evaluation. After a 7-second hold, the following postures and motions were performed three times versus manual resistance, using a thirty-second rest period in between **(Mclean, 2005).** The LS were tested by having the participant sit down and then conduct a static shoulder elevation contraction while rotating their neck to the same side. A manual resistance was then put over their shoulder for the exercise. Regarding the UT. The participant sat and then statically contracted their shoulder abduction muscles while keeping their arm at a 90-degree angle and rotating neutrally. Manual resistance was applied just above the elbow to give some resistance.

Treatment procedure:

Each group participated in the conventional program for four weeks, with three sessions each week. The physiotherapist who worked with each patient followed the same protocol. The patient had superficial thermotherapy using an infrared lamp, electrotherapy the form of TENS, along with stretching exercises for the muscles of the UT, LS, SCM, along with scalene. Each exercise lasted 30 seconds and was performed five times on each side.

Intervention for group A:

Core stability training: The "abdominal hollowing" exercise, which involves drawing in the abdominal muscles and transversus abdominis, was first introduced to the participants. Motor control of the core stabilization was followed by progressive basic training using the ball in supine, prone, crawling, as well as sitting positions. This included activities such as straight leg raising, bridges, crawling, and extremity motions while sitting as well as on the ball. For each of the 10 sets, we contracted for 10 seconds and relaxed for 5 seconds. Depending on each patient's ability, pain, and level of fatigue, the exercises were gradually increased. There were exercises ranging from 1 to 3 sets, 8 to 15 repetitions, and 5 to 10 seconds of contractions. Rest periods were set at 30 seconds among sets and 2 to 3 minutes between exercises **(Gulsah et al., 2019).**

Intervention for group B:

IASTM: The participant will be sitting comfortably. The individual was positioned with their forearm on a table, with their forehead resting on top of it. The patient will be prepared for the procedure by applying Vaseline to the skin around their neck and by cleaning the M2T blade using an alcohol pad. To begin, we can identify the precise regions of limitation in the RT UT using the M2T blade. The next step is to utilize the M2T blade at a 45-degree angle with treatment planes 1, 2, and 3. Slowly, but painlessly, stroke the muscle from its origin to its insertion for about three minutes. For a duration of four weeks, this process will be carried out twice weekly **(Gulick, 2018).**

Data analysis

Data normality along with group homogeneity were confirmed using Shapiro-Wilk as well as Levene's tests for homogeneity of variances. Both the data distribution plus the variance were normal. The independent t-test was used for group comparisons that took into account all demographic data. The distribution of the sexes was compared using chi-square tests. Utilizing mixed MANOVA, we examined the treatment's impact on VAS, ANDI, CROM, JPE, H-reflex, mean amplitude, as well as motor unit potential. The findings of the MANOVA were followed by further univariate ANOVAs when they were determined to be significant. Post hoc tests using the Bonferroni correction were performed for comparisons that included multiple variables. The significance threshold for all statistical tests was set at a p-value of 0.05. A version of SPSS 23 was utilized.

RESULTS:

Demographic Characteristics:

The subject characteristics of the control along with experimental groups are shown in Table (1). Concerning the general characteristics of the individuals, there were no statistically significant differences among the two groups (p-value > 0.05).

The impact of treatment on the outcome measures was investigated using mixed design multivariate analysis. The groups differed statistically, with Wilk's A = 0.08, F (19, 10) = 6.16, P-value < 0.001, and Partial Eta Squared (2) = 0.92. Furthermore, the time (pre-post treatment) had a statistically significant impact with Wilk's A = 0.01, F (19, 10) = 77.75, p-value < 0.001, η^2 = 0.99, and for the interaction among groups and time, with Wilk's A = 0.05, F (19, 10) = 10.45, p-value < 0.001, η^2 = 0.95.

Between-groups comparison: Baseline and after four weeks of intervention

All assessed variables in the control and study groups did not vary significantly at baseline (P-value > 0.05), as indicated in table (2-3). According to tables (2-3), after four weeks of treatment, the study group showed statistically significant changes compared to the control group across all evaluated variables, with the study group benefiting more than the control group (P-value < 0.05).

Within-groups comparison

The findings from the study group's pre- as well as post-intervention assessments showed statistically significant changes (p-value<0.0001) across all outcome measures, as indicated in table (2-3). According to table (2-3), all outcome measures excluding H-reflex were significantly different in the control group.

Table (1): General characteristics of patients (N=30)*

	Control group	Study group	t- value	p-value
	$\bar{X}$ ±SD	$\bar{X}$ ±SD		
Age (years)	34.73±5.95	36.73 ±7.94	-0.67	0.51
Weight (kg)	63.87±6.29	65.87±5.04	-0.8	0.43
Height (cm)	167.8±6.94	168.27±6.27	-0.19	0.85
BMI (kg/m²)	22.67±1.66	23.19±1.91	0.52	0.43
Gender, n (%)				
Female	**14 (93.33%)**	**13 (86.67%)**	**χ2**	0.54
Male	**1 (6.67%)**	**2 (13.33%)**	**0.37**	

*X^2, Chi Square; * Data are mean± SD for all demographics except gender (%), N: number; P: probability; BMI: body mass index; [a]: non-significance difference.*

Table (2): Within and between group analysis for VAS, ANDI and cervical ROM (N=30)*

Variables	Control Group	Study Group	MD(95% CI)	p-value (between groups)	η^2
VAS (cm)					
Pre-treatment	**6.93±1.28**	**6.67±1.23**	0.27 (-0.67 to 1.21)	0.57[a]	
Post-treatment	**3.8±0.94**	**1.67±0.49**	2.13 (1.57 to 2.69)	0.001 [b]	**0.68**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	3.13	5			
ANDI (score)					
Pre-treatment	**16.93±2.19**	**17.47±2.07**	-0.53(-2.12 to 1.06)	0.5 [a]	
Post-treatment	**9.07±1.33**	**5.13±2.9**	3.93 (2.25 to 5.62)	0.001 [b]	**0.45**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	7.87	12.33			
Cervical flexion (degree)					
Pre-treatment	**39.33±5.78**	**40.33±4.73**	-1 (-4.95 to 2.95)	0.61 [a]	
Post-treatment	**45.47±3.64**	**56.6±5.29**	-11.13 (-14.53 to -7.74)	0.001 [b]	**0.62**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-6.13	-16.27			
Cervical extension (degree)					
Pre-treatment	**39.07±5.75**	**40.67±2.58**	-1.6(-4.93 to 1.73)	0.33 [a]	
Post-treatment	**46.73±3.65**	**57.4±5.14**	-10.67(-14 to -7.33)	0.001 [b]	**0.65**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-7.67	-16.73			
Cervical right side bending (degree)					
Pre-treatment	**34.4±3.91**	**33.27±2.84**	1.13 (-1.42 to 3.69)	0.37 [a]	
Post-treatment	**38.67±3.62**	**42.93±1.79**	-4.27 (-6.4 to -2.13)	0.001 [b]	**0.37**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-4.27	-9.67			
Cervical left side bending (degree)					
Pre-treatment	**35.13±4.34**	**36.2±4.96**	-1.07 (-4.55 to 2.42)	0.54 [a]	
Post-treatment	**39.47±3.54**	**44±1.51**	-4.53 (-6.57 to -2.5)	0.001 [b]	**0.43**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-4.33	-7.8			
Cervical right rotation (degree)					
Pre-treatment	**47.6±2.53**	**46.8±3.59**	0.8 (-1.52 to 3.12)	0.49 [a]	
Post-treatment	**53±3.16**	**62.73±4.62**	-9.73 (-12.7 to -6.77)	0.001 [b]	**0.62**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-5.4	-15.93			
Cervical left rotation (degree)					
Pre-treatment	**45.67±4.17**	**46±4.31**	-0.33 (-3.12 to 1.52)	0.83 [a]	
Post-treatment	**54±5.07**	**63±4.55**	-9 (-12.6 to -5.4)	0.001 [b]	**0.48**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-8.33	-17			

p-value: probability; [a]: non-significance difference; [b]: significance difference; CI: confidence interval.MD: mean difference, VAS: visual analogue scale. cm: centimeter, ANDI: Arabic neck disability index

Table (3): Within and between group analysis for JPE, H-reflex, muscle amplitude and motor unit potential (N=30)*

Variables	Control Group	Study Group	MD(95% CI)	p-value (between groups)	η^2
Cervical flexion JPE (degree)					
Pre-treatment	**4±0.98**	**4.4±1.12**	-0.4 (-1.56 to 0.78)	0.49 [a]	
Post-treatment	**3±0.64**	**1.13±0.35**	1.87 (0.77 to 2.96)	0.001 [b]	**0.3**
p-value (within-group)	0.02 [b]	0.001 [b]			
MD	1	3.27			
Cervical extension JPE (degree)					
Pre-treatment	**4.07±0.85**	**4.33±0.72**	-0.27(-1.12 to 0.59)	0.53 [a]	
Post-treatment	**2.87±0.36**	**0.73±0.13**	2.13(1.46 to 2.81)	0.001 [b]	**0.6**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	1.2	3.6			
Cervical right side bending JPE (degree)					
Pre-treatment	**4.47±0.64**	**4.33±0.62**	0.13 (-0.63 to 0.9)	0.72 [a]	
Post-treatment	**3.33±0.98**	**1.4±0.19**	1.93 (1.29 to 2.58)	0.001 [b]	**0.57**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	1.13	2.93			
Cervical left side bending JPE (degree)					
Pre-treatment	**3.67±0.82**	**3.93±0.8**	-0.27 (-0.87 to 0.34)	0.37 [a]	
Post-treatment	**2.93±0.46**	**1.33±0.49**	1.6 (1.25 to 1.95)	0.001 [b]	**0.75**
p-value (within-group)	0.002 [b]	0.001 [b]			
MD	0.73	2.6			
Cervical right rotation JPE (degree)					
Pre-treatment	**3.87±0.45**	**3.6±0.85**	0.27 (-1.04 to 1.57)	0.68 [a]	
Post-treatment	**2.73±0.46**	**0.67±0.17**	2.07 (1.61 to 2.52)	0.001 [b]	**0.76**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	1.13	2.39			
Cervical left rotation JPE (degree)					
Pre-treatment	**4.13±0.74**	**4.2±0.77**	-0.07 (-0.63 to 0.5)	0.81 [a]	
Post-treatment	**2.67±0.62**	**1.2±0.39**	1.47 (0.98 to 1.95)	0.001 [b]	**0.58**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	1.47	3			
H-reflex latency (ms)					
Pre-treatment	**19.29±2.56**	**18.49±1.48**	0.81 (-0.76 to 2.37)	0.3 [a]	
Post-treatment	**18.87±2.54**	**17.26±0.76**	1.61 (0.21 to 3.01)	0.02 [b]	**0.16**
p-value (within-group)	0.12 [a]	0.001 [b]			
MD	0.43	1.23			
Levator scapulae amplitude (µv)					
Pre-treatment	**142.07±19.88**	**138.27±14.34**	3.8 (-9.16 to 16.76)	0.55 [a]	
Post-treatment	**158.4±20.46**	**180.67±10.71**	-22.27 (-34.48 to -10.05)	0.001 [b]	**0.33**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-16.33	-42.4			
Levator scapulae motor unit potential (µv)					
Pre-treatment	**129.27±14.25**	**125.33±14.88**	3.93 (-6.96 to 14.83)	0.47 [a]	
Post-treatment	**155.4±11.84**	**171.27±12.3**	-15.87 (-24.9 to -6.84)	0.001 [b]	**0.32**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-26.13	-45.93			
Upper trapezius amplitude (µv)					
Pre-treatment	**320.8±56.21**	**308.67±67.71**	12.13 (-34.41 to 58.68)	0.6 [a]	
Post-treatment	**435.2±71.18**	**490.33±89.65**	-55.13 (-60.3 to -15.19)	0.001 [b]	**0.43**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-114.4	-181.67			
Upper trapezius motor unit potential (µv)					
Pre-treatment	**156.8±16.25**	**161.93±14.33**	-5.13 (-16.59 to 6.33)	0.37 [a]	
Post-treatment	**259.4±22.5**	**299.67±17.52**	-40.27 (-66.6 to -13.93)	0.001 [b]	**0.26**
p-value (within-group)	0.001 [b]	0.001 [b]			
MD	-102.6	-137.73			

p-value: probability; [a]: non-significance difference; [b]: significance difference; CI: confidence interval.MD: mean difference, JPE: Joint position error, ms: millisecond, µv: microvolt

DISCUSSION:

This Study was conducted to explore the impact of the addition of IASTM to core stability training on pain severity level, cervical ROM, proprioception, muscle activity, H-reflex in addition to, neck functional level in patients suffering from CMNP. Participants' ages varied between 18 to 55 and their BMIs were between 18 and 30 kg/m2. The study divided the participants into two equivalent groups. Group A, was given traditional physical therapy along with core stability training, Group B (Study): Fifteen patients were received core stability training plus IASTM.

A substantial reduction in VAS was seen in both group A and group B after treatment when compared with pre-treatment ($p<0.001$), and in group B, when compared with group A, after treatment ($p<0.001$), indicating that the treatment had a positive impact on VAS .

The use of traditional physical therapy techniques, such as TENS and IR, which are anti-inflammatory and relievers, may have contributed to the improvement in pain levels seen in both groups. One possible explanation for these reactions is the pain gate hypothesis, which states that heat sensations are transmitted more quickly than nociceptive impulses. When applied locally, IASTM reduces muscular spasm, boosts circulation, and has a warming impact on the neck area, all of which contribute to lessening the severity of pain.

Consistent with the findings of **Soroush et al. (2022),** who demonstrated that core stability exercise can alleviate pain in individuals suffering from CNSNP was the case in three intervention groups: group A, which was given only neck stabilization specific practice, group B, which was given only core stabilization practice, while group C, which was given combined practice. The goal of the stabilization exercises is to improve muscle support along with control of the joints in the spinal column so that pain doesn't get worse or last longer. The 12-week intervention was completed. Neck disability index (NDI), VAS, in addition to neck pain and disability scale (NPDS) were used to assess the degree of pain and impairment in the neck. The range of motion was measured using a goniometer .

Core stabilization exercises alleviate chronic back pain, according to many research **(Hemmati et al., 2011; Yalfani et al., 2017).** Because of the beneficial effects on balance, pain, as well as functional capacity that a six-week program of core stability exercises had on women suffering from chronic low back pain. Results demonstrated that these treatments may alleviate chronic low back pain, alleviate functional impairment, and enhance static and dynamic balance. While one group gets ergonomic guidance in addition to low back segmental stabilization exercises, the other group gets the exercises on their own. Each group received a thorough introduction to ergonomics. The research lasted for a total of eight weeks. Prior to and during the treatments, researchers measured levels of pain, functional impairment, and transverse abdominal muscle activity.

Core stabilization exercises, according to **Rastegar et al. (2016),** substantially reduced CLBP in older women after only 5 weeks. Following the necessary calculation indices (statistical power test), 29 women with CLBP (69±3.4 years old) were divided into two groups: one group was given core stabilization exercise (9 women) and the other group was given control (20 women). Over the course of ten weeks, exercisers did eight core stabilization exercises three times each week. The ultrasonic properties of the lumbar multifidus muscle, which is a component of the spinal column, were assessed both prior to and following a decade. Additionally, the lateral border, anterio-posterior border, and cross-sectional area of multifidus were assessed. Additionally, the pain level was assessed three times: before, during, and after the intervention, using a VAS. The muscles that stabilize the spine—the ones in the back, pelvic floor, and abdominals—are the primary targets of core stability training. Core stability training helps alleviate lower back pain by strengthening and coordinating these muscles, which in turn improves posture.

Another study that found that core stabilization methods reduced pain in the elderly was **Sartipzadeh et al. (2016).** In this semi-experimental research, twenty-four women (range: 50–65 years, average: 55.62 years) were chosen and randomized into one of two groups: the experimental group along with the control group. The females all had knee varus and osteoarthritis. Use of a VAS allowed for the quantification of patients' levels of pain. The BIODEX tool was also used for the purpose of measuring the degree of balance. Core stability exercises were conducted three times weekly for eight weeks by the experimental group. The experimental group had significantly different changes ($p<0.05$) in pain scale scores compared to the other groups.

In a study conducted by **Mylonas et al. (2021),** the researchers found that patients suffering from cervical neck pain who underwent a combination of IASTM techniques as well as neuromuscular retraining exercises according to a holistic model of treatment had a significant reduction in pain and improvement in associated function. The study examined the differences between twenty patients suffering neck pain who got 8 treatment sessions of identical exercises along with a simple massage to those who underwent the same procedures plus a massage. A program that included targeted IASTM applications along with neuromuscular corrective exercises enhanced the functional ROM, functional independence, and functional capacity in women suffering from painful cervical syndrome. Consequently, it was able to alleviate neck pain more effectively than a comparable program that used classical massage techniques alone.

Our findings are consistent with those of El Hafez et al. (2020), who found that IASTM, when administered with an M2T blade for four weeks, is an effective method for alleviating pain in individuals suffering from UT spasms. Two equivalent groups (A and B) were formed from forty patients (34 females and 6 males) ranging in age from 18 to 23 years old, all of whom had activated trigger points in the right UT muscle. Twenty participants from Group A were given M2T blade-assisted IASTM twice weekly for four weeks with stretching exercises. Twenty

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participants from Group B were given stretching exercises and SM twice weekly for four weeks. Pre- and post-treatment patient conditions were assessed using a pressure algometer, the Arabic version of the NDI, as well as VAS. One possible explanation for the improvement in the IASTM group is its capacity to cause micro-trauma to tissues. This leads to a rise in fibroblast release along with an inflammatory response in the affected area. Healing is accelerated by the migration of fibroblasts, which boosts collagen production and tissue regeneration. Subjects experiencing UT spasm can experience an immediate reduction in pain when using the IASTM technique with an M2T blade. This is because the friction among the tool and tissue increases tissue temperature and circulation, which may help enhance tissue oxygenation and eliminate the accumulation of local waste metabolites.

Both the control group and the study group had improvements in patients' disabilities during the duration of the trial; the control group saw a 46.49% improvement and the study group a 70.58% improvement. Statistical analysis revealed that this enhancement was more pronounced in Group B (Study group) compared to Group A (Control). A probable explanation for these improvements is that all modalities even physical therapy (IR and TENS) or core stability exercises stretching exercise can decrease pain and muscle spasm so the disability level would decrease, in addition to IASTM as mentioned previously it could improve circulation toward the site of doing it thus by its role in remove waste products and increase the heating effect and then it decrease muscle spasm.

This study's findings are in line with those of **Celenay et al. (2016),** who demonstrated that 51 individuals suffering from MNP responded well to a four-week program of stabilization techniques and manual therapy. For four weeks, the program met three times a week. Both at baseline and 4 weeks later, participants were evaluated using the following instruments: the Neck Disability Index, the VAS, the Medical Outcomes Study 36-Item Short-Form Health Survey, goniometric measures, along with computerized algorithm of pressure pain threshold. Patients suffering from neck discomfort reported a significant improvement in their quality of life as a result of less pain, better muscle health, and an overall improvement in their posture, making it a more effective treatment option than stabilization treatments .

In addition, a study conducted by **Shah et al. (2020)** showed that while core stability exercises in group A were more effective than conventional physiotherapy alone in alleviating pain and disability associated with CNSNP, the combination of the two treatments yielded better results. As core stability exercises can be beneficial for managing neck pain by improving neck posture, reducing pain and disability, and enhancing upper extremity function. So, these exercises, when combined with conventional physiotherapy, can be more effective than conventional treatment alone. The patients were observed for a duration of 30 days. The clinical examination included a VAS for pain assessment, a NDI for functional assessment, along with a craniocervical flexion test for deep neck flexor strength.

Twenty patients presenting with MNP and FHP were randomized into one of two groups in a randomized control study conducted by **Mylonas et al. (2021).** One group was given 8 treatment sessions of targeted IASTM in conjunction with neuromuscular exercises, while the other group was given classical massage in addition to the same set of exercises. During the course of treatment and again at two and four weeks post-treatment, we assessed the cervical vertebral angle (CVA), cervical ROM along with strength, discomfort (VAS), and the NDI. Throughout the investigation, they discovered that both intervention groups showed improvements in patient impairment. Group A, which got IASTM therapy in addition to neuromuscular exercises, showed a statistically greater enhancement than Group B, which was given traditional massage in addition to the same exercises as Group A for a total of eight sessions. In conclusion, individuals suffering from neck discomfort may see an improvement in their functional status and beneficial postural changes when they combine IASTM with exercises targeting the cervical and thoracic areas.

After receiving an IASTM treatment with an M2T blade, 15 individuals suffering from acute heel pain reported less pain and more activity levels **(Bulbuli, 2017).** The M2T blade was used to evaluate and treat the patients. We collected pre- and post-readings of the Foot Function Index, which is an outcome measure used to quantify pain. Researchers found that by using rhythmic strokes to release the fascia, they were able to remove adhesions and cross-connections, which in turn softened the tense fascia and reduced the amount of impairment.

As compared to before treatment, the present research found that both groups significantly improved in (flexion, extension, lateral flexion on both sides, along with rotation on both sides). The IASTM group, however, showed a statistically significant enhancement above the control group (group Al). Both groups improved their cervical ROM after treatments, however Group B did effectively more so than Group A. these improvements might be core stability exercises might improve muscle core strength that by its role it decrease muscle spasm and then increase CROM, also IASM decrease muscle spasm and then decrease the pain then CROM will also increase, so the study group got the best results in CROM.

Combining manual therapy with neck stabilization techniques was more effective than stabilization techniques alone in reducing disability and pain intensity and increasing the neck's ROM for rotation, according to Elfering (2006). The researchers discovered a negative correlation between pain and the cervical angle of motion, also known as the CVA; hence, they were able to improve ROM by reducing pain.

Furthermore, to the previously mentioned pain reduction and disability reduction from non-specific neck pain, **Soroush et al. (2022)** discovered that the combination of core stability and neck stabilisation specific practice effectively improved the range of motion in various angles and directions of the neck.

According to **Mylonas et al. (2021),** there were no significant differences among the two treatment modalities (IASTM and neuromuscular exercises) in improving the ROM and strength of the majority of cervical motions. Consistent with several studies that have assessed the short-term impact of IASTM procedures on flexibility, this study indicated that, for the majority of cervical motions, ROM improved in the short-term. The strength adaptations were relatively different; for example, the group that had a combination of IASTM soft tissue methods and neuromuscular exercises saw a significant increase in cervical flexion strength shortly following the end of treatment, but a decline in same strength two weeks later. The patient's cervical flexion strength improved again, nevertheless, four weeks after the initial therapy ended **(Damas et al., 2016; Damas et al., 2017).**

Because of the obvious improvement in connective tissue mobility brought about by soft-tissue procedures using specialised equipment, it is reasonable to conclude that myo-dynamic adaptations were amplified. Patients kept on with the neuromuscular retraining exercises inside home after finishing the 4-week basic therapy, which explains why the strength improvement lasted for four weeks after the primary intervention ended **(Harman et al., 2005)**

According to **Ghodrati et al. (2017),** who treated patients with NSNP using a mix of soft tissue release, muscular energy method, and exercises, this came to the same conclusion. Two groups of Iranian patients participated in the 2016–2017 research. Group B served as a control and had no therapy during the 21 days when Group A got intervention treatment. The inclusion as well as exclusion criteria were used to identify the 12 people that made up each group. Six sessions, once every two days for 21 days, were administered to each patient in group A. These sessions included exercise therapy in addition to manual treatment procedures such as muscular energy methods in addition to soft tissue release. Both the first and final sessions, which occurred before and after the therapy, were evaluated clinically. The research was approved after an evaluation of the measuring techniques' reliabilities was conducted prior to its commencement. Results from the VAS for pain, neck ROM, along with NDI were all part of the clinical evaluation. The procedures improved mobility in every direction while decreasing disability and discomfort, according to the data.

The findings of the present research showed that both groups significantly reduced their range of motion (flexion, extension, lateral flexion on both sides, along with rotation on both sides) after treatment compared with before treatment, based on cervical JPE. But compared to the other group (Control), this enhancement was statistically more substantial in the IASTM group.

These results might due to there was a strong direct relation between pain and joint proprioception, so by decreasing pain JPE would also decreased. Cervical tissues, including muscles, ligaments, discs, along with facet joints, have very high rates of innervation, leading to well developed proprioception in this area. But proprioception is impaired when there is discomfort in the cervical area **(Peng et al., 2021) .**

Finally, contrary to what **Hlaing et al. (2021)** found, our data show that the CSE group improved proprioception more than the strength exercises group following four weeks of training. Decreased low back proprioception, caused by dysfunction in the local trunk muscles spindle, may lead to motor function deficits and errors in movement. Retraining the transversus abdominis in addition to lumber multitudes muscles was a primary focus of CSE, which may have enhanced their muscular activity. Another goal was to stimulate the receptors in the muscles and joints, which improved the precision of the sensory-motor integration process and set in motion the fine-tuning of the joints.

Unuvar et al. (2024) found that forty patients with CNP who received myofascial release treatments (IASTM and KS) in a single session showed an enhancement in proprioception. The patients were randomized into two equivalent groups. Although the research found no significant difference between the two therapies, it did find that both had an immediate impact on pain and proprioception in CNP individuals. Cervical tissues, including muscles, ligaments, discs, and facet joints, have very high rates of innervation, leading to well-developed proprioception in this area. On the other hand, proprioception is impaired due to discomfort in the cervical area. Patients experiencing neck discomfort exhibited a rise in the activation of superficial muscles, such as the SCM, and a reduction in the recruitment of deep flexor muscles. In addition to alterations in muscular activation, people experiencing neck discomfort often find it difficult to relax the trapezius along with SCM muscles following activation; this suggests a sensory system deficit.

Based on cervical muscle activity through assessing (latency, muscle amplitude and motor unite potential for Levator scapulae and upper Trapezius) There was a significant decline in latency in both groups after treatment as compared to before. Nevertheless, the IASTM group demonstrated a more substantial reduction in latency compared to the control group.

In contrast, the present findings showed that both groups' muscle amplitude as well as motor unite potential for the LS and UT muscles were significantly higher after treatment than before. Nonetheless, compared to the control group, they increased significantly in the IASTM group.

20 men as well as 20 female patients with CMNP were randomly assigned to two equivalent groups in a research conducted by **Ali et al. (2022).** Group A received the conventional physical treatment program, which included a heated pack, isometric strengthening exercises for the neck muscles, along with passive stretching of the UT, subclavius, and scalene muscles. People in Group B have also received a trunk core training program plus the traditional physiotherapy treatment. Results showed that individuals with CMNP who received standard therapy in addition to a trunk core training program had an

improvement in VAS and NDI. Thus, they were able to increase their neck mobility and strengthen their UT and SCM muscles, which is in line with the findings of the present research.

In contrast, research on the myoelectric impact of IASTM on neck pain patients is very limited; however, **Sevier and Stegink-Jansen (2015)** found that compared to exercise therapy alone, subjects whose treatment plans included both IASTM and exercise therapy had a greater improvement in their muscle strength. The trial had 107 participants with 113 affected elbows who were randomized into either EE therapy (56 elbows) or ASTYM treatment (57 elbows) for a period of four weeks utilizing computer-generated random number tables. Preliminary data gathered at4,8,12,6, and 12 weeks after baseline. Pain during exercise, maximal grip strength, and function are secondary outcomes that complement the primary end measure, the DASH. Because of the sensitive nature of the therapies, it was only possible to blind the rater and the treating doctors.

Bostan and Kaya (2024) also looked at 48 people who had persistent neck discomfort. Both the exercise treatment (ET) and the combination therapy (CT) groups were randomized into the participants. Each group participated in exercise therapy for four weeks, with a total of twelve sessions distributed across three days. Just exercise treatment was given to the ET group. For eight sessions, members of the CT group had IASTM in conjunction with exercise treatment. They said that the deep neck flexor muscles may have been better activated as a result of the pressure from IASTM, which inhibits the superficial muscles while reducing discomfort.

Future studies should be done on investigating the myoelectric function on cervical muscle after combining core stability exercises with IASTM with conventional physical therapy session.

Limitations

The study needs more larger size to make generalization of the results. Also, current study investigated only the short-term effect of our interventions program with neglecting the long-term effect. In our opinion, it is also needed to investigate the acute and long-term effects of these interventions along with different treatment methods.

CONCLUSION:

The findings of this study supported that the IASTM, in addition to core training program for the trunk and traditional treatment, was beneficial for patients with CMNP to decrease pain intensity level, disability level, JPE for all neck movements, and decrease muscle latency with increase cervical ROM, and the activity of LS and UT muscles.

Ethics approval:

The study was approved by a local ethics committee and was carried out in accordance with the Declaration of Helsinki. Consent for publication Written informed consent was obtained from the participant before the study.

Funding:

This research did not receive any specific grants from funding agencies in the public, commercial or not-for-profit sectors.

Declaration of competing interest:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements:

The authors thank all patients who participate in this work.

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