The Egyptian Journal of Hospital Medicine (July 2025) Vol. 100, Page 4155-4166

Effect of Instrument–Assisted Soft Tissue Mobilization versus Muscle Energy Technique Over Sternocleidomastoid in Patients with Chronic Non-Specific Neck Pain

Alaa Mohamed Hassan Saleh [1*], Ragia Mohamed Kamel [2], Mohamad Abdel Fattah Sakr [3], Aya Mahmoud Mohamed [2]

[1]Department of Basic Science, Faculty of Physical Therapy, Misr University for Science and Technology, Cairo, Egypt
[2] Department of Basic Science, Faculty of Physical Therapy, Cairo University, Cairo, Egypt,
[3] Department of Neurology, Faculty of Medicine, Misr University for Science and Technology Egypt
***Corresponding Author:** Alaa Mohamed Hassan Saleh, **Email:** alaanaqib168@gmail.com, **Mobile:** (+20)1121746761

ABSTRACT

Background: Chronic non-specific neck pain (CNSNP) is a prevalent musculoskeletal condition that adversely impacts individuals' functional abilities and general well-being. Increased activation of the sternocleidomastoid (SCM) muscle has been implicated in the pathophysiology of CNSNP, yet few studies have directly compared targeted interventions on this muscle. Instrument-Assisted Soft Tissue Mobilization (IASTM) and Muscle Energy Technique (MET) are emerging manual therapy approaches aimed at improving musculoskeletal dysfunctions.

Objectives: This study aimed to compare the effects of IASTM and MET applied to the SCM, on neck pain, range of motion (ROM), and functional impairment in patients with CNSNP.

Patients and Methods: A single-blind, randomized controlled trial (RCT) was conducted involving 56 participants with CNSNP, who were randomly allocated into three groups: Group A (control) received hot packs and standard neck and scapular exercises; Group B received IASTM applied to the SCM muscle in addition to the control protocol; and Group C received MET applied to the SCM muscle alongside the control protocol.

Results: Both experimental groups showed statistically significant improvements in VAS scores, NDI scores, and cervical ROM compared with the control group. The IASTM group demonstrated greater improvement in neck extension, right and left rotation, lateral flexion, and reduction in pain and disability compared to both MET and control groups.

Conclusion: IASTM and MET applied to the SCM muscle are both effective in alleviating pain, improving cervical ROM, and decreasing functional disability in individuals with CNSNP. IASTM may offer slightly greater benefits, particularly in enhancing cervical mobility. These findings suggest the use of targeted manual therapy approaches for managing CNSNP.

Keywords: Chronic non-specific neck pain, Instrument-assisted soft tissue mobilization, Muscle energy technique, Sternocleidomastoid, Cervical range of motion.

INTRODUCTION

Neck pain (NP), sometimes referred to as cervical spinal pain, acts as a prevalent musculoskeletal condition that is typically thought to be idiopathic [(1)]. The International Association for the Study of pain reviewed the literature and found that between 30% and 50% of the general population, with predominance in women, suffering from neck and cervical vertebral pain. It is highly prevalent among office workers, computer users, and women, particularly those between the ages of 35 and 49. In addition, among young individuals aged 20 to 24, the 12-month prevalence ranges from 42 to 67% [(2)].

Non-specific (simple) NP, commonly identified as mechanical NP, is the most common type of NP. It can be caused by improper postures, anxiety and depression, workplace or athletic traumas, improper computer workstation designs, and desk-bound job positions. Rigidity and limited range of motion (ROM) are frequent signs of NP that are exacerbated by neck motions or prolonged neck positions [(3)].

Higher activity of the superficial cervical flexors, particularly the SCM and anterior scalene muscles, and a reduced activity of the deep cervical flexors (DCF), involving the longus colli and longus capitis muscles, are associated with functional limitations brought on by chronic non-specific neck pain (CNSNP) [(4)].

According to reports, patients with CNSNP had higher activation of the anterior scalene and SCM muscles, particularly while performing dynamic upper limb motions and isometric cervical flexion [(4)].

Büyükturan et al. [(5)] the ipsilateral SCM and anterior scalene muscles were fatigued in those with unilateral CNP. People with CNSNP experience postural instability owing to increased activity and tension of the suboccipital, SCM, upper trapezius, pectoralis, and rotator cuff muscles [(5)].

Barton and Hayes asserted that people with NP could not achieve SCM muscle relaxation induced by biofeedback therapy, and that persistent muscular pain may instead be due to constant muscle activation.

People who utilized screen-based technology (such as cellphones) excessively were found to have CNSNP. According to research, people with CNSNP frequently experienced weakness in their DCF muscles, which led to an overuse of other muscles including the anterior scalene and SCM muscles [(6)].

A common therapy for myofascial restriction is instrument assisted soft tissue mobilization (IASTM),

Received: 30/04/2025
Accepted: 30/06/2025

which was justified by James Cyriax. IASTM is administered using specifically made tools to facilitate soft tissue mobilization to alleviate pain and enhance ROM and function, contrary to the Cyriax method, which uses digital cross friction. It is believed that the use of the instrument gives the therapist a mechanical advantage by enabling more targeted therapy and deeper penetration [(7)].

IASTM is more successful than conventional treatments at reducing mechanical NP and improving cervical ROM and daily living activities [(8)].

Muscle Energy Technique (MET) is an active manual treatment where the corrective force is not controlled by the physiotherapist. In fact, the patient needs to be able to generate focused voluntary contractions of varied intensities. Muscle contractions that should be performed in MET include isometric, concentric, and eccentric contractions, according to Greenman PE's 1989 description. As a result, it is a manual therapy to increase the reduced ROM in any articulation. By encouraging regular muscular movements, this method can alleviate muscle weakness or contracture and lessen localized oedema [(9)]. According to a Systematic Review by **Sbardella *et al.*** [(9)] all the examined trials reported a notable improvement in joint function, pain, and disability. Based on this, the MET is a safe and effective method for treating cervical pain.

After reviewing the literature, and to the best of the authors' knowledge, no research has specifically investigated and compared the efficacy of IASTM and MET on neck pain (NP), cervical ROM, and functional disability when applied to the sternocleidomastoid (SCM), a crucial muscle for neck mobility that is often hyperactive in individuals with persistent neck pain.

PATIENTS AND METHODS

This single-blind, randomized controlled trial (RCT) included 56 patients of both genders with CNSNP, who were recruited from Outpatient Clinic, Faculty of Physical Therapy, Misr University for Science and Technology, Cairo, Egypt. The study was conducted between October 2024 and March 2025.

Design and Setting: A three-group Single-blind RCT pre-post-test, Single blindness for patients only was conducted to investigate and compare the efficacy of IASTM and MET on Neck Pain, ROM and functional disability when applied over Sternocleidomastoid in patients with CNSNP.

Sample Size Calculation: Using pain by VAS, as described in Khan (2022), the sample size was calculated with 90% power at the $\alpha = 0.05$ level, 2 measures for 3 groups, and an effect size of 0.5 using the F-test within and between interaction effects. The minimal appropriate sample size is 54 subjects, adding 6 (11%) subjects as drop out, so total sample size is 60 subjects (20 subjects per group). The sample size was estimated by the G*Power software (version 3.0.10).

Inclusion Criteria: Patients were eligible if they were aged 18–35 years, had neck pain persisting for more than three months, and had a normal BMI (18.5–24.9 kg/m²).

Exclusion Criteria: Patients were excluded if they had specific neck pathologies such as systemic disorders, rheumatoid arthritis, or cervical radiculopathy; bleeding disorders or were receiving anticoagulant medication; mid- or upper-back sensory disorders; current use of nonsteroidal anti-inflammatory drugs (NSAIDs); serious conditions such as cancer, cervical spine fractures, or vascular disorders including vertebrobasilar insufficiency; a history of cervical spine surgery; or whiplash injuries, whether recent or past, that could account for their symptoms.

The subjects were randomly divided into three groups. A computer-generated random number table was used to create a block randomization schedule that assigned participants equally to one of the three treatment groups, with 20 patients in each group. There were four dropouts: two in Group A, one in Group B, and one in Group C, all due to voluntary withdrawal. Fifty-six of the sixty participants completed the study. **Group A (control)** received hot packs and standard neck and scapular exercises; **Group B** received IASTM applied to the SCM muscle in addition to the control protocol; and **Group C** received MET applied to the SCM muscle alongside the control protocol.

Instruments

Instruments for assessment:

1-The visual analogue scale (VAS):

For evaluating the pain degree of severity, the VAS was employed. It is made up of a straight 10-centimeter line (Figure 1) [(10)].

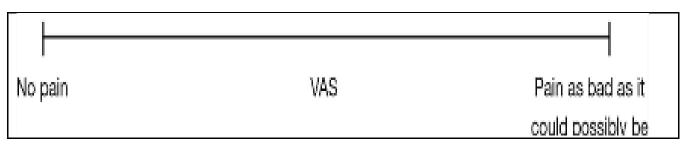

Fig. (1): Visual analogue scale (VAS)

Visual analogue scales are a valid and reliable way to determine both the intensity of sensation and the subjective magnitude of pain. The reliability of the VAS for measuring pain was examined using the interclass correlation coefficient (ICC) for test-retest reliability. All of the matched VAS scores had an ICC of 0.97 [95% confidence interval [CI] = 0.96 to 0.98]. These results suggest that the VAS is reliable enough to be utilized for pain assessment [(11)].

2-Neck disability index (NDI):

People with NP often utilize the NDI, a self-reported evaluative measure, to evaluate their reported disability.

NDI is an outcome measure that is both valid and reliable. The least clinically meaningful difference (MICD) is 7 points, and the ICC for test-retest reliability is 0.68. According to a systematic review, it was the most widely utilized self-reported metric for NP and had adequate support and value [12].

3-Cervical range of motion (CROM):

The CROM device is one of the clinically accessible instruments for measuring CROM (Figure 2) [13].

When compared to Fastrak, the results of **Audette *et al.*** [13] demonstrated the CROM device's strong concurrent validity. Correlation coefficients for extension and bilateral rotations were 0.98, flexion was 0.93, and bilateral flexions were 0.96 to 0.97, indicating the reliability of the measures obtained with the CROM devices [13].

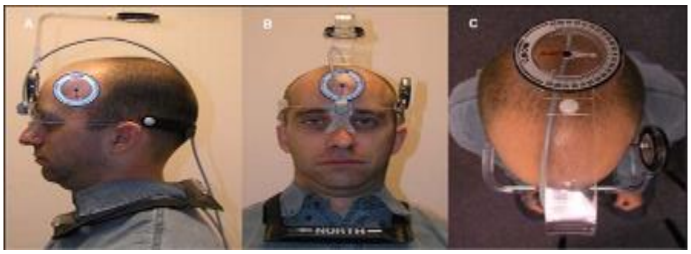

Fig. (2): The CROM device.

Instruments for treatment:

1- Instrument-assisted soft tissue mobilization (IASTM):

M2T-Blade: It is constructed from stainless steel and beveled edges to accommodate different anatomical placements (Figure 3) [14].

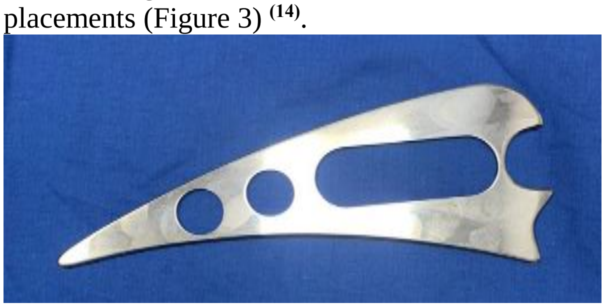

Fig. (3): M2T blade

A systematic review supports IASTM's ability to improve pain and functional capacity in the affected individuals, as well as ROM in unaffected ones [15].

Procedures:

Assessment methods

1- Data collection:

Participant personal history, current health status, and past medical history were collected and documented to determine eligibility for the study.

2-VAS screening:

Following clearance, the participants were told to identify the level of discomfort by marking a point on a VAS line. The distance from zero was measured using a ruler, and the resultant value was adjusted to the nearest value; for example, 5.7 cm was recorded as 6 cm.

3- Neck disability index (NDI):

The NDI is a popular self-reported evaluative metric for analyzing functional impairment in individuals with NP. It consists of ten items with Likert scale scores varying from 0 to 5. The overall score is 50, greater scores denote more impairment. For each NDI question, we directed the participants to select the response that properly identified their situation. The final score was then determined by adding all the points together [16].

4-CROM:

The participants were told to sit upright in a chair, with their feet flat on the ground and their hands rested on their thighs. Only mobility at the neck was permitted due to the usage of two straps that restricted shoulder and torso motions. After being instructed to look directly ahead, the subjects were instructed to turn their heads as far as they could in the therapist's specified direction without shifting their shoulders or torso. In a random order, the six cervical movements (flexion, extension, rotation of both sides, and side bending of both sides) were recorded for CROM. One practice trial was carried out in each direction before any measurements were taken in order to let the individuals become accustomed to the procedure and the movements for which the ranges were being assessed [13].

Treatment:

1- Group (A):

Subjects in group A underwent a conventional physiotherapy program that included applying a hot pack to cervical area for period of 15 minutes prior to Exercise [17], and Exercise program comprising neck ROM exercises (Figure 4), stretching exercises for upper trapezius (Figure 5), levator scapulae (Figure 6), scalenus (Figure 7), and pectorals muscles (Figure 8). Patients were told to stretch every muscle till a slight pain started, sustain that position for 20 seconds, and then attempt the exercise three times a day at home for five repetitions. For four weeks, strengthening exercises were then incorporated into earlier exercises for deep neck muscles (Figures 9 and 10), rhomboids, middle trapezius (Figure 11), and serratus anterior muscles (Figure 12). These later workouts should be done at home 3 times a day for 10 seconds and 10 repetitions. In clinics, patients studied the exercises and performed one set of them while therapist corrected their training mistakes once a week. Any exercise that caused radicular pain, paresthesia, or unbearable upper limb pain had to be stopped, and the patient had to inform the research physician about it at the following treatment session [16]. This group received treatment twice a week for four weeks and all these exercises were completed in three sets.

Fig.(4): Neck ROM and stretching (A: Starting position, B: Flexion, C: Extension, D: Right side bending, E: Left side bending, F:Right side rotation, G: Left side rotation)

Fig.(5):stretch upper fiber of trapezius

Fig.(6):stretch levator scapulae

Fig.(7):stretch scalenus

Fig.(8):stretch pectorals major and minor

Fig.(9): strengthening exercises for deep neck flexors (A: Starting position, B: tuck chin in, C: lefting head of the plenth)

Fig.(10): strengthening exercises for deep neck extensor

Fig.(11): strengthening exercise for (A: rhomboids, B: middle trapezius).

Fig.(12): strengthening exercise for serratus anterior.

2- Group (B):

In addition to the same conventional physiotherapy program, group B received IASTM twice a week for four weeks over sternocleidomastoid muscle bilaterally using an M2T blade. On a treatment table, the patient was comfortable in a supine posture (Figure 13). Vaseline was used as a lubrication after alcohol swabs were utilized to clean the participant's skin and the blade, and the sternocleidomastoid was thoroughly yet comfortably mobilized from origin to insertion for about three minutes using a sweeping method [18].

Fig.(13): application of IASTM over sternocleidomastoid muscle

3- Group (C):

Subjects in group C had post-isometric muscle relaxation (PIR) for the sternocleidomastoid muscle, which is a component of MET introduced by Chaitow, in addition to the same conventional physiotherapy program.

The patient was lying supine with their head off the plinth and in the therapist's hand, while the therapist sat on a stool at the head of the therapeutic table to do the PIR procedure. To conduct PIR for the SCM muscle, the therapist put one hand below the occipital ridge, opposing the side of the affected muscle. The other hand was positioned on the muscle's affected side, with the thumb resting on the participant's forehead and the rest of the hand placed on the head side. The head was rotated toward the involved side, extended, and turned into a lateral flexion far from the involved side. Just above the patient's eye, the therapist put his thumb on the affected side of the participant's forehead. During the contraction phase, the patient held his breath for seven seconds while pushing up against the therapist's thumb and looking up. After then, the patient was told to cease pressing and look down for three seconds while breathing out. After relaxation, the therapist extended the cervical spine for 30 seconds, stretching the muscle toward the floor. Bilaterally, the procedure was conducted three times. Patients underwent treatment for four weeks, attending three sessions per week on alternative days. (Figure 14) [19].

Fig.(14): post-isometric relaxation technique for sternocleidomastoid muscle

***Ethical Consideration*:**

This study was approved by the Institutional Review Board (IRB) of the Faculty of Physical Therapy, Cairo University [No: P.T.REC/012/005583]. It was also registered at ClinicalTrials.gov (NCT06799130). Written informed consent was obtained from all participants. The study protocol conformed to the Declaration of Helsinki, the ethical standard of the World Medical Association for research involving human subjects.

Statistical analysis

A two-way MANOVA was utilized to test the differences among the three groups. Also, the paired t-test was used for comparison between before and after measurements in every group. ANOVA (Analysis of variance) was applied to study difference in initial characteristics of the three groups. Independent samples T- test was employed to study changes across both genders. The level of significance for all tests was set at $p<0.05$, and statistical analysis was carried out by IBM SPSS version 29.0.

RESULTS

Table (1) shows that IASTM and MET had a statistically significant impact on neck ROM, VAS, and neck disability index when applied over sternocleidomastoid. Additionally, a statistically significant difference was seen across all groups. While no statistically significant change was noted across the IASTM and MET groups except for neck extension ROM, it demonstrated a statistically significant variation between the post-measurements of the two studied groups and the control group.

Participants

Pearson formula for calculating sample size was utilized to compute the needed sample size. The formula is as follows:

$$n=\frac{z^2 * p * (1-p)/e^2}{1+\frac{z^2 * p * (1-p)}{e^2 * N}}$$

where p the estimated proportion in population=0.5, N population size=150, e margin of error =10%=0.1, and z is the standard normal value with confidence level 90%=1.64. Using this formula, the sample size needed was found to be 60. The total sample size was then classified into three groups. Table 1 displays the participant's characteristics.

Table (1): Demographic characteristics of the studied subjects

Group	Age(year)	BMI(Kg/m^2)	Gender
IASTM group (n=19)	24.0±3.5	23.4±0.6	Male 7 (36.8%) Female 12 (63.2%)
MET group (n=19)	24.1±3.7	23.1±0.8	Male 8 (42.1%) Female 11 (57.9%)
Control group (n=18)	23.2±3.3	23.7±0.7	Male 7 (38.8%) Female 11 (61.2%)
	P=0.74	P=0.06	P=0.94

Table (1) indicates no significant changes across groups regarding all initial characteristics (p>0.05).

Statistical analysis

The Shapiro-Wilk test was utilized to assess the data normality, and the Levene test was applied to identify the homogeneity of variables in the study groups. Inferential tests were then conducted. To examine the variations among the three groups, a two-way MANOVA was employed. For every test, the significance level was determined at $p<0.05$. IBM SPSS software, version 29.0, was utilized to analyze the data.

Table (2) shows a significant overall difference across the three groups. Also, there is a significant variation in times (within groups) and there is a significant interaction between the time and the groups.

Table (2): Results of the two-way MANOVA across the three groups

Factor	F	p
Groups(between)	8.2	0.00*
Times(within)	80.8	0.00*
Interaction	4.8	0.00*

*Indicates significance at p-level<0.05

Table (3) shows that the measurements of the IASTM and control groups, as well as the MET group and the control group, differ significantly, but the IASTM and MET groups weren't significantly different, with the exception of neck extension.

Also, the post means of the three groups show the superiority of the IASTM group having the highest post neck ROM and lowest post VAS and disability index, while the control group had the lowest ROM and highest post VAS and disability index.

Table (3): Post measurements of the three groups and differences between them

	IASTM group		MET group		Control group		Post hoc tests		
Factor	mean	SD	mean	SD	mean	SD	IASTM-MET	IASTM-Control	MET-Control
Neck flexion	59.54	8.62	58.14	10.24	56.11	6.37	0.65	0.12	0.26
Neck extension	68.26	6.10	63.47	7.70	54.07	7.32	0.008*	0.00*	0.03*
Neck RT rotation	77.30	7.51	75.09	8.81	59.87	9.82	0.32	0.00*	0.06*
Neck LF rotation	78.37	8.14	77.68	11.18	58.87	8.63	0.88	0.00*	0.00*
Neck RT side bending	48.14	2.25	48.04	2.12	37.44	3.87	0.48	0.00*	0.00*
Neck LT side bending	48.05	2.30	48.91	1.76	39.37	3.97	0.08	0.00*	0.00*
VAS	1.37	1.01	1.74	0.87	3.33	1.28	0.17	0.00*	0.01*
Neck disability index	10.74	2.60	11.37	2.67	20.78	5.41	0.25	0.00*	0.001*

DISCUSSION

The study's goals was to investigate effect of IASTM and MET on Neck ROM, VAS and neck disability index when applied over sternocleidomastoid, and to compare the difference between the IASTM group, the MET group and the control group regarding Neck ROM, VAS and neck disability index, and the differences between before and after measurements in every group in patients with CNSNP.

The findings indicated statistically significant improvements in pain reduction, increased ROM, and decreased disability in the two groups studied in comparison to the control group. While both IASTM and MET were effective, IASTM showed superior results for neck extension ROM.

IASTM as applied in this study, was associated with statistically significant post-treatment improvements in pain (p=0.000*), function (p=0.000*) and all ROM measures (p=0.000*) except for neck flexion, no statistically significant change was noted between before and after measurements (p=0.065). These outcomes are supported by prior research such as **Paranjape & Lad** [18], who reported that both manual and IASTM techniques were beneficial in enhancing ROM, pain, and function in individuals with chronic NP. Similarly, **Lambert *et al.*** [14] and **Lee & Song** [20] emphasized IASTM's impact on enhancing blood flow, reducing tissue viscosity, and relieving myofascial tension. These mechanisms are believed to underline the observed pain relief and functional improvements in the present study.

Studies by **Hammer & Pfefer** [21] and **Baker *et al.*** [22] also confirmed IASTM's role in improving flexibility and function, particularly in populations with musculoskeletal dysfunction. In athletic contexts, **Heinecke *et al.*** [23] demonstrated IASTM's efficacy in maintaining shoulder ROM in collegiate athletes. These findings collectively align with the present study's conclusion that IASTM is a clinically effective intervention for enhancing neck function and reducing discomfort. **Mahmood *et al.*** [24] similarly, found that IASTM outperformed conventional physiotherapy for neck pain.

Muscle energy technique when applied over the sternocleidomastoid muscle, also led to statistically significant improvements in pain (p=0.000*), function (p=0.000*) and all ROM measures (p=0.000*) except for neck flexion ROM, no statistically significant change was noted between before and after measurements (p=0.212). These findings were supported by prior research by **El Laithy & Fouda** [19] and **Phadke *et al.*** [25] that assessed the impact of PIR on 30 individuals with mechanical neck discomfort and found that PIR significantly relieved pain and increased ROM [14][35]. Also, our findings aligned with **Phadke *et al.*** [25] that previously showed MET's superiority over static stretching in terms of pain relief and ROM gains in individuals with mechanical NP. The mechanism is thought to involve neuromuscular reflexes, such as Golgi tendon organ inhibition and resetting of muscle resting length [26]. Research by **Gupta *et al.*** [27] supported these findings as he found that MET significantly improved both pain and functional status when comparing the benefits of PIR with isometric exercises for nonspecific NP.

Targeted treatment of the sternocleidomastoid muscle indicated significant improvements in comparison to the control group, reinforcing the idea that specific muscle focus in rehabilitation provides superior clinical outcomes. Research by **Büyükturan *et al.*** [5] and **Muralisankar *et al.*** [28] demonstrated that focusing on SCM stretching and massage yielded improvements in pain, endurance, and ROM, particularly in extension and rotation in patients with chronic NP. **Centrone & Joshua** [29] further supported these findings by showing immediate gains in cervical ROM and muscle symmetry following SCM-specific resistance exercises.

Comparative analysis between IASTM and MET revealed no significant post-treatment differences in most variables except for neck extension ROM, where IASTM showed superior effectiveness (p=0.008*). These findings align with those of **Elagamawy *et al.*** [30] who discovered that both IASTM and MET were beneficial in improving pain severity, pain pressure threshold (PPT), neck ROM and function in individuals with upper trapezius myofascial trigger points yet reported no differences in pain or disability indices. **Sorathiya *et al.*** [31] noted that both MET and IASTM effectively enhanced hamstring flexibility in healthy young adults. but, found that IASTM demonstrated a more significant improvement in hamstring muscle extensibility and knee extension ROM as compared to MET, and **Nazary-Moghadam *et al.*** [32] likewise found greater hamstring flexibility with IASTM than MET or Modified Hold-Relax techniques.

Despite some contradictions, such as findings by **Bhosale & Kolke** [33] suggesting comparable ROM outcomes between the two methods post-operatively, the bulk of literature aligns with the conclusion that IASTM offers slightly more significant improvements in ROM. As reported by **Page** [34], Clinical improvement, even in the absence of statistical significance, further supports the utility of IASTM. Therefore, both interventions remain viable options depending on clinical presentation.

CONCLUSION

Both IASTM and MET are effective therapeutic modalities for reducing pain, enhancing functional mobility, and increasing cervical ROM when applied to the sternocleidomastoid (SCM) muscle in patients with CNSNP. While both methods produce similar benefits in most outcome measures, IASTM demonstrates superior outcomes for neck extension ROM. This suggests that integrating IASTM into clinical practice may provide additional functional gains.

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