ORIGINAL ARTICLE

Instrument Assisted Soft Tissue Mobilization versus Integrated Neuromuscular Inhibition Technique in Nonspecific Chronic Neck Pain: Single-blinding Randomized Trial

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ABSTRACT

Objective: This study aimed to compare the effects of instrument-assisted soft tissue mobilization (IASTM) vs integrated neuromuscular inhibition technique (INIT) on pain intensity, pressure pain threshold, neck disability, and electrophysiological properties in nonspecific chronic neck pain.

Methods: We performed a pre-post prospective randomized controlled trial on 90 participants with nonspecific chronic neck pain. The participants were chosen randomly from physical therapy out-patient clinics in the Giza governorate and allocated randomly by permuted block to the following 3 groups: Group A received INIT on the upper trapezius in addition to supervised traditional therapy (STT) as hot pack, stretching and strengthening exercises, Group B received IASTM on the upper trapezius in addition to STT, and Group C received STT only. Treatment was 3 times per week for 4 weeks. Pain intensity by visual analog scale (VAS), pressure pain threshold (PPT) by commander algometer, neck disability by Arabic Neck Disability Index (ANDI), and electrophysiological properties in the form of muscle amplitude by root mean square (RMS), and fatigue by median frequency (MDF) were measured at baseline and after 4 weeks.

Results: In the within-group analysis, there was a statistically significant decrease in VAS, ANDI, and RMS% values within each group with favor to INIT. In PPT and MDF, there was a significant increase within each group with regard to INIT as P value <.05. In the between-group analysis at posttreatment, the results reported a statistically significant difference between INIT and STT, and also between IASTM and STT in all variables. Between INIT and IASTM, there was no statistically significant difference in VAS and NDI, but there was a statistically significant difference in PPT, RMS%, and MDF. The post hoc test reported improvement in all variables in all groups, with more favor to the INIT group in PPT and electrophysiological properties only.

Conclusion: In this study, we found no statistically significant differences between INIT and IASTM in VAS and ANDI posttreatment, but there were differences between INIT and STT group and IASTM and STT group. (J Chiropr Med 2023;22;247-256)

Key Indexing Terms: *Neck Pain; Trigger Points; Electromyography*

INTRODUCTION

Nonspecific chronic neck pain (NCNP) is a common disorder with symptoms lasting more than 12 weeks.[1] Pain is felt in the lateral and dorsal aspects of the neck and may radiate to the extremities, but no pathogenic signs or symptoms are present.[2] The prevalence of neck pain is about 70% of the general population.[3] Neck pain affects women more than men due to a lack of exercise and psychological factors.[4,5] Inactivity and abnormal loading cause the formation of small nodular taut bands with oversensitive painful focus in the musculature around the neck, known as myofascial trigger points (MTrPs), resulting in a musculoskeletal imbalance in the upper quarter of the body.[6]

When an MTrP is compressed, it causes tenderness, referred sensations, motor dysfunction, and autonomic symptoms.[7] An MTrP is classified as active or latent based on its ability to reproduce clinical symptoms. When compressed, an active trigger point (TrP) partially or

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Paper submitted April 21, 2022; in revised form April 13, 2023; accepted July 21, 2023.

1556-3707

https://doi.org/10.1016/j.jcm.2023.07.004

completely reproduces a familiarized symptom experienced by the patient. However, latent MTrPs do not reproduce any familiarized clinical presentation experienced by the patient.[8] A study using electromyography (EMG) has detected differences in cervical muscle activity between patients with NCNP and healthy individuals.[9] Impaired function of the upper trapezius (UT) may cause or prolong neck pain. It transfers loads from the shoulder girdle to cervical structures with low pain tolerance as a result of its superior attachments.[10] Moreover, neck pain is often associated with guarding muscle spasms, resulting in a reduction of blood flow to this muscle and increased pain. Also, weakness of the superficial and deep cervical spine extensors is common in patients with neck pain.[11]

The primary goals of treating neck pain and MTrPs are to resolve the spasm, ease the pain, and deactivate the TrPs. Many studies have been conducted to assess the efficacy of various modalities and techniques in treating patients with NCNP and TrPs,[1] such as spray and stretch techniques,[12] ultrasound,[13] laser,[14] and heat packs.[15] Manual interventions include muscle energy techniques (METs),[16] ischemic compressions (ICs),[17] and pressure release therapy.[18]

One of these methods is the integrated neuromuscular inhibition technique (INIT), which is a combination of METs, IC, and strain counter strain (SCS) techniques that can be an effective way to deactivate and treat TrPs.[19] Instrument-assisted soft tissue mobilization (IASTM) with the M2T blade (M2T-Blade: IASTM Technology, Hamilton, ON, Canada) is a multifunctional instrument. Instrument-assisted soft tissue mobilization is inexpensive and has a variety of planes that can be used in treatment. Many studies have demonstrated its effectiveness in alleviating patients' symptoms.[20]

Various techniques are used to treat neck pain, but few are both efficient and inexpensive. For researchers, determining the most appropriate intervention for individuals with NCNP remains a priority. According to the literature, IASTM and INIT were effective as well as non-exhaustive treatment methods for patients experiencing mechanical neck pain,[19,20] but there was a lack of literature that compared IASTM and INIT, so this study was conducted to compare INIT and IASTM in patients with NCNP.

Therefore, the purpose of this study was to compare the effects of IASTM vs INIT on pain intensity, pressure pain threshold (PPT), neck disability, and electrophysiological properties in patients with NCNP. It was hypothesized that the IASTM and INIT could improve pain, function, and electrophysiological properties more than supervised traditional therapy (STT) in patients with NCNP.

Methods

Study Design

A prospective, single-blinded, randomized clinical trial was reported in accordance with the Consolidated Standards of Reporting Trials checklist and the Helsinki Declaration (1964).[21] The participants were recruited from Kasr-El Einy, Omm El-Masryyen, and El-Matareyya hospitals, and the study was carried out at the faculty of physical therapy's outpatient clinic from January to December 2021.

Participants

The participants with NCNP who were referred by an orthopedist were assessed for eligibility to join this study. The participants were asked to join if they had active TrPs in their UT muscle, pain at rest, a jump sign when pressure is applied, limited range of motion (ROM), and referred pain.[22] Furthermore, the participants reported pain in the posterior or posterior lateral aspect of the neck in the previous 3 months, and their ages ranged from 18 to 30 years,[23] body mass index (BMI) from 18 to 25 kg/m^2; participants with BMI of ≥25 kg/cm^2 were avoided, as there is a correlation between the thickness of skin and fascia and location of MTrPs.[24] Participants were excluded if they showed signs of serious pathology, such as malignancy or infection, history of cervical spine surgery in the previous 6 to 12 months, vascular syndromes such as basilar insufficiency, signs of cervical radiculopathy or myelopathy, or history of trauma or fractures in the cervical spine.[25] All patients were also checked for contraindications to treatment (eg, red flags, including pathologic fractures, neoplasm, systemic inflammatory diseases, infections, cervical myelopathy, and previous neck surgery), and participants with red flags were excluded. The remaining patients who had the diagnosis of NCNP were included in this study.[26]

Ethics

The faculty of physical therapy's research ethics committee prospectively approved (P.T.REC/012/003038) and registered (clinicaltrials.gov ID: NCT04702100) the study protocol. All participants signed the written consent form before participating in this trial.

Randomization

Ninety participants with NCNP were allocated randomly by a computer-generated block randomization program to the following 3 equal groups: the IASTM group, the INIT group, and the control group that received STT. The size of each block was 9, and the allocation ratio was 1:1:1 to avoid bias between the 3 groups. The first author was responsible for the step of randomization and was not involved in assessment or treatment. The codes of randomization were kept in an opaque sealed envelope to ensure the concealment of the allocation. The third author assessed the participant's outcome measures and was blinded to the allocation and the treatment steps.

Assessment Instruments

All dependent variables were measured before and after 12 sessions of treatment; the primary outcome was pain intensity. The secondary outcomes were PPT, neck disability, and electrophysiological properties of the UT.

Pain Intensity. The pain was measured using a visual analog scale (VAS). The VAS is a self-reported measure with a horizontal or vertical line that is typically 10 centimeters in length. It is a valid and reliable tool for measuring the severity of the pain; the line's extremes refer to the pain status as "no pain" or "worst pain." Each patient was asked to draw a line on the spot where they felt the most pain.[27] The minimal clinically important difference is 3.1 points.[28]

Pressure Pain Threshold. Pressure pain threshold was assessed by Commander Algometer (JTECH medical, Midvale, UT). The algometer is a handheld device that uses manual pressure stimulation to assess pain sensitivity in deep structures. It has been widely used and validated.[28] To determine the PPT, the algometer's tip was placed on the target TrP while the patient was in a sitting position. The pressure was increased by 1 kg per second. When the patient expressed distress and confirmed it verbally, the pressure value was documented as kg/cm^2. This procedure was repeated 3 times at 60-second intervals, and the mean kg/cm^2 value was obtained as the measured PPT.[29]

Neck Disability. The Arabic Neck Disability Index (ANDI) was used to assess neck disability. It is a valid and consistent tool with 10 categories. Each category is scored from 0 to 5, with an extreme possible score of 50.[30] Each participant was asked to select 1 reaction that best described the neck function. Numbers were calculated and recorded after participants completed the index. A score of 0 to 4 indicates no disability, a score of 5 to 14 indicates mild disability, a score of 15 to 24 indicates moderate disability, a score of 25 to 34 indicates severe disability, and a score greater than 34 indicates total disability. The lower the overall score, the less affected daily activity performance is. The higher the score, the more restricted daily activities are.[31]

Electrophysiological Properties. Neurosoft's electromyogram device (Neuro-EMG-Micro, Neurosoft, Ivanovo, Russia) was used to assess the electrophysiological properties in the form of muscle amplitude (normalized root mean square [RMS]) and muscle fatigue in the form of median frequency (MDF) for the UT. To reduce skin impedance, the electrode placement sites were hairless and cleaned with a piece of cotton and alcohol.[32] The following electrodes were positioned on each participant's affected side: the active one was placed 2 cm lateral to the center of a line drawn from the C7 spinous process to the posterolateral acromion, whereas the reference electrode was placed over the wrist joint.[32] Prior to filtering, EMG signals with systemic bias were removed, and the full wave was rectified. After that, the linear envelope signals were normalized to maximal voluntary isometric contractions (MVIC).

Assessment of the MVIC of UT. It was performed as described by McLean[32]; the participants performed isometric shoulder abduction with the arm at 90° of abduction and neutral rotation. Each contraction lasted 7 seconds and was repeated 3 times against manual resistance, with a 30-second rest in between.

Following the MVIC assessment, participants were asked to write for 15 minutes; this task was chosen because it is the most common daily task for participants and involves a semi-static load, which aggravates their symptoms. Throughout the examination, the patient sat in a chair with the back completely supported, feet flat and supported on the floor, and hips and knees flexed 90°. The positioning of the head, neck, shoulder, and spine has been standardized in order to minimize their impact on UT activities.[33] The normalized RMS was computed as follows: RMS percent normalized = EMG amplitude during writing task / (average of 3 MVIC trials) × 100.[34] The MDF was calculated from the raw EMG signals.

Interventions

After baseline measurement, the envelopes were opened by the fourth author, who started the treatment protocol. The fourth author had 12 years of experience in treating participants with NCNP.

The INIT group received INIT + STT 3 times a week for 4 weeks. For INIT, the participant was in a supine lying position to minimize tension in the UT. During the PPT evaluation process, the site of the TrP was determined and marked. First, intermittent IC (Fig 1) was initiated by using the thumb and index finger to apply a pincer grip to the TrP in the middle of the UT. The pressure would be applied intermittently for 5 seconds on and 5 seconds off, and this pressure was repeated for 90 seconds until the pain

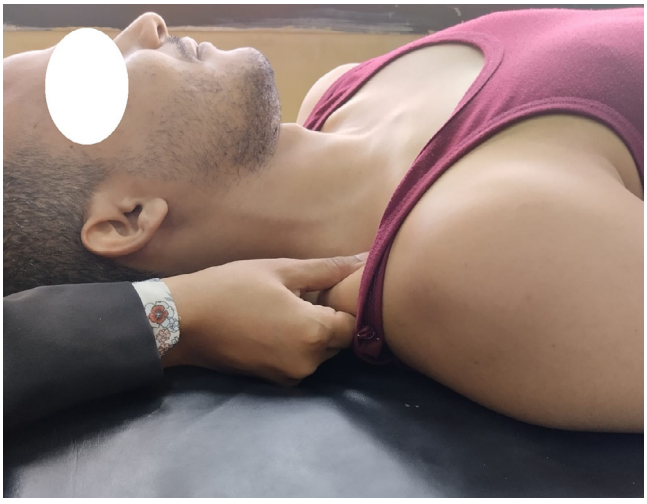

Fig 1. *Intermittent ischemic compression.*

Fig 2. *Strain counter strain.*

subsided. Second, the SCS (Fig 2) began by applying pressure to the trigger point and asking the participants how much pain they were experiencing. The participants' heads were passively flexed laterally to the affected side. The therapist then held the participant's forearm and passively moved the shoulder to about 90° of abduction while monitoring the discomfort induced by the TrP,and then asked the patient about the intensity of pain. If the pain decreased by 70% from the start, the position was held for 30 seconds and repeated 2 to 3 times.[35] Third, the MET (Fig 3) begins with one of the investigator's hands stabilizing the affected shoulder and the other on the head side. The participant was asked to move the stabilized shoulder and head in the direction of the other. This contraction lasted 7 seconds and had a maximum voluntary contraction of 20%. After that, the muscle was lengthened for 30 seconds. This technique was done 3 times per session.[35]

The IASTM group received IASTM + STT 3 times a week for 4 weeks. For IASTM, the M2T blade was used to identify specific parts of the limitation on the right UT. After that, treatment planes 1−2−3 were used. Prior to treatment, Vaseline was applied as a lubricant to the skin around the neck area, and an alcohol pad was used to clean the instrument. Then, using an M2T blade at a 45° angle, long, slow strokes over the muscle were performed, beginning at its insertion and ending at its origin, for 2 to 3 minutes (Fig 4). If the participant felt a burning sensation, they were instructed to apply an ice pack.[36]

The control group (STT only) received STT 3 times a week for 4 weeks and included 10 minutes of moist heat (hot pack),[37] isometric strengthening exercises for all cervical muscles by applying manual resistance on the side of the head for side bending, the occiput for extension, and the forehead for flexion.[38] The resistance was sustained for 10 seconds and repeated 10 to 15 times,[38] then they received stretching exercises for extensor muscles for 30 seconds and repeated 3 times in every session.[37] Finally, active ROM exercises for the neck and chin were performed.[39]

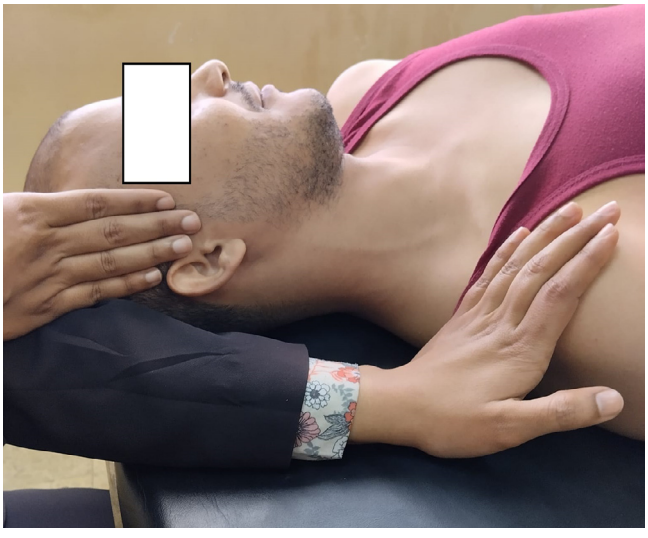

Fig 3. *Muscle energy technique.*

Fig 4. *IASTM technique. IASTM, instrument-assisted soft tissue mobilization.*

Sample Size Calculation

The number of participants were identified by calculating the effect size of the primary outcome (pain level) from a pilot study on 15 participants, 5 participants within each group. F tests-multivariate analysis of variance (ANOVA); repeated measures and within and between interactions were used. The effect size was 0.32, type I error was 0.05, and type II error was 1-β = 0.8. The total sample size was equal to 72 participants, and due to the estimation of dropout, 25% increased, so the total sample was 90 participants. The G*Power (version 3.1.9.2, Kiel University) software program[40] was used for detection.

Statistical Analysis

All of the measurement variables (age, weight and height, BMI, VAS, PPT, ANDI, MDF, and RMS) were investigated by the Shapiro-Wilk test, and all of them were normally distributed. One-way ANOVA was used to clarify the difference between groups' demographic data and baseline measurements of all dependent variables. For clarification of the difference between time (pre and post) and treatments (groups), two-way multivariate ANOVA was used. The F value depends on Wilks' lambda test. A post hoc test was used to investigate the difference between pre and post within every group and detect the difference between groups at pretreatment and posttreatment variables. A partial eta square (η^2) was used to identify the magnitude of the difference (effect size) between groups. The χ^2 test was used to clarify the difference between groups on 6 variables. The SPSS program (version 23; IBM Corp, Armonk, New York) was used, and the significance level (α) was 0.05. To account for the missing data from the 1-month measurement, an intention to treat analysis using multiple imputations was performed.

Results

One hundred participants with NCNP were recruited from outpatient physical therapy clinics, and 10 participants were excluded because they had received treatment in the past 3 months. So, 90 participants entered this study and were allocated randomly to 3 equal groups. Four participants dropped out from the last assessment in this trial; 1 from INIT and the other in the STT-only group because of a busy schedule, and 2 from IASTM due to the COVID-19 virus (Fig 5). Eighty-six participants completed the study with no differences in intervention adherence between the INIT, IASTM, and STT-only groups. The number of attendees was used to determine adherence; the adherence percentage in INIT was 97.2, IASTM was 98.6, and the adherence percentage in the STT-only group was 97.8.

Participants' Characteristics

The data reported no statistically significant difference between groups on all dependent variables and demographic data. The χ^2 test found no difference between groups on 6 variables (Table 1).

Instruments Score

The general multivariate analysis reported a statistically significant effect at time as Wilks' Lambda (Λ) value = .02, F value = 477.4, and P = .0001 and also for the groups as Λ =.08, F value = 23.83, and P = .0001. Finally, the interaction between time and groups was Λ = .07, F value = 28.75, and P value = .0001. In the univariate analysis, there were statistically significant effects in the groups for VAS (F = 15.8 and P = .001), PPT (F = 10.6 and P = .001), ANDI (F = 9.69 and P = .001), MDF (F = 181.51 and P = .0001), and RMS% (P = 69.68 and P = .0001). The univariate analysis also reported a statistical significant effect at interaction between time and the groups for VAS (F = 31.52 and P = .0001), PPT (F = 17.71 and P = .0001), ANDI (F = 23.67 and P = .0001), MDF (F = 200.62 and P = .0001), and RMS% (F = 46.52 and P = .0001).

Within-Group Analysis

The post hoc test reported a statistically significant decrease in VAS, ANDI, and RMS% values within each group compared with patients that received INIT. In PPT and MDF, there was a significant increase within each group with regard to INIT (P value <.05) (Table 2).

Between-Group Analysis

A post hoc analysis of posttreatment differences in VAS and ANDI revealed no statistically significant difference between INIT and IASTM, but there were significant differences between the INIT and STT group and also the IASTM and STT group. In PPT, MDF, and RMS, there were statistically significant differences between all groups ($P < .05$) (Table 3). The partial eta square investigated the magnitude of the difference between groups and reported a large difference between them as $\eta^2 > .14$. In VAS posttreatment, there were high differences between groups (η^2 = .51; PPT η^2 =.39; ANDI η^2 =.43; MDF η^2 = .94; and RMS% η^2 = .78).

Discussion

This study compared the effects of INIT and IASTM on pain, function, and electrical activity of the UT in patients with chronic neck pain. The results revealed no statistically significant differences between INIT and IASTM in VAS and ANDI posttreatment, but there were differences

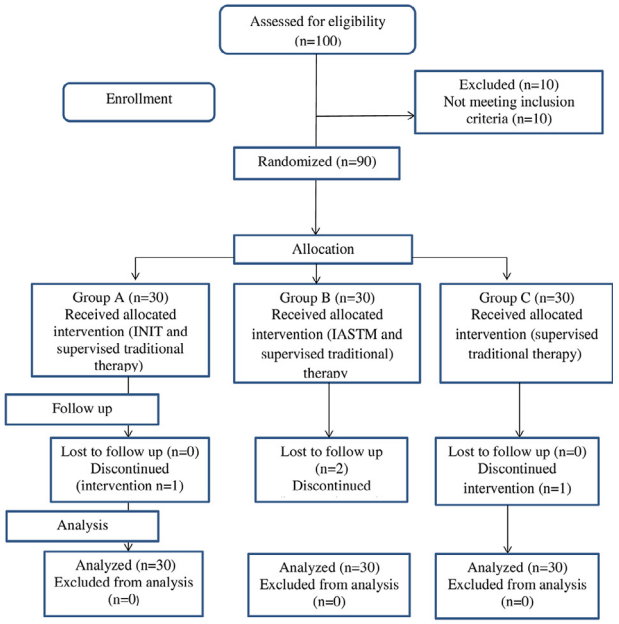

Fig 5. *Flow diagram.*

between the INIT and STT groups and also the IASTM and STT groups. In PPT, MDF, and RMS, there was a difference between all groups ($P < .05$). Secondly, the minimal clinically important difference for VAS was 3.1,[27] for NDI was 7.5 points[41] and finally for PPT was 1.1 kg/cm^2,[43] so there was no clinically important difference between INIT and IASTM in VAS, NDI, and PPT. Finally, there were no statistically and clinically significant differences between INIT and IASTM in VAS and NDI, but there was only a statistically significant difference between INIT and IASTM in PPT. Minimal clinically important differences depended on previously published studies; however, there were no published studies that calculated for muscle amplitude and fatigue.

The improvement in the INIT group could be attributed to INIT's multiphase (IC, SCS, MET). Intermittent IC increases PPT and inhibits muscle tone by stimulating A-β fibers, which affects and closes the pain gate. Simultaneously, there is an increase in blood flow to the muscles, which undermines the theory of energy crisis and inhibits muscle tone.[20,42] In the SCS technique, a nociceptive response is elicited in response to pressure, which can reduce tension and stress in the affected muscle. Reduced

Table 1. *Baseline Characteristics of Participants With NCNP*

Characteristics—Mean (SD)	INIT Group	IASTM Group	Control Group	*P* Value
Age (y)	20.7 ± 1.3	20.8 ± 1.4	21.75 ± 1.7	.07[a]
Weight (kg)	61.9 ± 11.8	62.8 ± 9.2	60.5 ± 9.3	.79[a]
Height (cm)	164.5 ± 6.5	163.2 ± 5.6	160.7 ± 6.2	.14[a]
BMI (kg/m^2)	22.7 ± 3.5	23.5 ± 3.1	23.4 ± 2.9	.73[a]
Sex (male/female)	2/28	4/26	3/27	$\chi^2 = .74$ $P = .69$[a]
Affected side				
Right	27	28	29	$\chi^2 = 1.07$ $P = .58$[a]
Left	3	2	1	
VAS	6.9 ± .64	6.8 ± 1.2	7.1 ± .7	.57[a]
PPT	.72 ± .25	.73 ± .18	.74 ± .2	.97[a]
ANDI	25.5 ± 2.18	24.7 ± 2.88	24.5 ± 2.66	.44[a]
MDF	53.48 ± 3.89	55.11 ± 3.71	52.35 ± 4.97	.12[a]
RMS%	11.14 ± .82	11.41 ± 1.1	11.29 ± .92	.67[a]

Data are presented as mean ± SD.
ANDI, Arabic neck disability index; *BMI*, body mass index; *IASTM*, instrumented assisted soft tissue mobilization; *INIT*, integrated neuromuscular inhibition technique; *MDF*, median frequency; NCNP, nonspecific chronic neck pain; *PPT*, pressure pain threshold; *RMS*, root mean square; *VAS*, visual analog scale.
[a] No significant difference.

Table 2. *Within-Group Analysis of Results of Assessments Tools in INIT, IASTM, and Control Groups*

Assessment Tools	Pretreatment—Mean (SD)	Posttreatment—Mean (SD)	Percent of Change %	95% CI (MD)	*P* Value
VAS					
INIT group	6.9 ± .64	2.3 ± .57	67	4.09−5.11	<.01[a]
IASTM group	6.8 ± 1.2	3.2 ± 1.1	53%	3.01−4.11	<.01[a]
STT group	7.1 ± .7	5.3 ± 1.7	25%	1.29−2.31	<.01[a]
PPT					
INIT group	.72 ± .25	1.39 ± .34	93%	−.711 to −1.03	<.01[a]
IASTM group	.73 ± .18	1.17 ± .35	60%	−.61 to −.28	<.01[a]
STT group	.74 ± .2	.93 ± .32	26%	−.36 to −.04	<.01[a]
ANDI					
INIT group	25.5 ± 2.18	10.2 ± 2.37	60%	13.49−17.11	<.01[a]
IASTM group	24.7 ± 2.88	11.9 ± 3	52%	10.944−14.55	<.01[a]
STT group	24.5 ± 2.66	17.75 ± 5.27	28%	4.94−8.55	<.01[a]
MDF					
INIT group	53.48 ± 3.89	94.73 ± 3.71	77%	−38.98 to −43.52	<.01[a]
IASTM group	55.11 ± 3.71	76.2 ± 4.38	38%	−23.35 to −18.81	<.01[a]
STT group	52.35 ± 4.97	61.87 ± 1.7	18%	−11.79 to −7.24	<.01[a]
RMS%					
INIT group	11.14 ± .82	5.01 ± .58	55%	5.48−6.77	<.01[a]
IASTM group	11.41 ± 1.03	7.28 ± .98	36%	3.47−4.77	<.01[a]
STT group	11.29 ± .92	9.57 ± 1.27	15%	1.06−2.36	<.01[a]

ANDI, Arabic neck disability index; *BMI*, body mass index; *IASTM*, instrumented assisted soft tissue mobilization; *INIT*, integrated neuromuscular inhibition technique; *MD*, mean difference; *MDF*, median frequency; *PPT*, pressure pain threshold; *RMS*, root mean square; *STT*, supervised traditional therapy; *VAS*, visual analog scale.
[a] Indicates statistical significance.

Table 3. *Between-Group Analysis in Posttreatment of Assessments Tools in INIT, IASTM, and Control Groups*

Assessment Tools	INIT vs IASTM (95% CI) (MD)		INIT vs STT (95% CI) (MD)		IASTM vs STT (95% CI) (MD)	
VAS	−.9 (−1.87 to .08)	*P* = .08[a]	−3 (−3.97 to −2.02)	*P* < .01[b]	−2.1 (−3.07 to −1.12)	*P* < .01[b]
PPT	.42 (0.15-0.68)	*P* < .01[b]	.65 (.38-.92)	*P* < .01[b]	.23 (.03-.5)	*P* < .01[b]
ANDI	−1.7 (−4.7 to 1.2)	*P* = .44[a]	−7.5 (−10.5 to −4.59)	*P* < .01[b]	−5.8 (8.75 to −2.84)	*P* < .01[b]
MDF	18.53 (15.96-21.1)	*P* < .01[b]	32.86 (30.28-35.43)	*P* < .01[b]	14.32 (11.75-16.89)	*P* < .01[b]
RMS%	−2.2 (−3.04 to −1.5)	*P* < .01[b]	−4.65 (−5.32 to −3.79)	*P* < .01[b]	−2.29 (−3.05 to −1.52)	*P* < .01

ANDI, Arabic neck disability index; *BMI*, body mass index; *IASTM*, instrumented assisted soft tissue mobilization; *INIT*, integrated neuromuscular inhibition technique; *MD*, mean difference; *MDF*, median frequency; *PPT*, pressure pain threshold; *RMS*, root mean square; *STT*, supervised traditional therapy; *VAS*, visual analog scale.
[a] No significant difference.
[b] Indicates statistical significance.

muscle tone can result in increased blood circulation subsequently. Furthermore, this technique normalizes the length of sarcomeres in the tissues that house the TrPs by resetting the muscle spindles, potentially reducing pain.[43]

The MET, which works on autogenic inhibition of muscle, is crucial in achieving tonus release (inhibition). This technique involves applying isometric muscle contraction, which causes the Golgi tendon organ to activate, resulting in muscle relaxation and a decrease in the activity of the muscle.[43] According to Fryer and Fossum[44], the sequence of muscle and joint mechanoreceptor activation elicits the firing of local somatic efferent. This, in turn, causes sympathoexcitation and activation of the periaqueductal grey matter, which is involved in descending pain modulation.[44] These findings were consistent with those of Hidayat et al,[45] who investigated the effect of INIT on neck function in UT myofascial pain syndrome. They found that INIT was effective in decreasing the neck disability index score.[45]

Furthermore, Nagrale et al[42], presented the role of INIT on upper fiber trapezius TrPs using VAS, NDI, and ROM as measures. Finally, Saadat et al[19] studied the effects of INIT on PPT and the numeric pain scale in participants with UT TrPs. The study included 32 female participants who were randomly assigned into 2 groups. The intervention group received INIT in a single session, while the control group received no treatment. According to the findings, the intervention group's pain intensity was significantly reduced.[19]

The improvement in IASTM group could be attributed to the ability of IASTM in detecting and removing adhesions within scar tissues. Instrument-assisted soft tissue mobilization can also boost fibroblast proliferation, increase vascular response, and improve collagen fiber matrix remodeling in disordered collagen fibers. Furthermore, the IASTM technique has been shown to result in clinical benefits, such as increased ROM after treatment and strength.[20]

The findings of our study agreed with those of El-Hafez et al,[36] who conducted a study to investigate the effect of IASTM on UT active TrPs. They concluded that IASTM is an effective tool for deactivating TrPs and reducing pain levels.[36] Also, Fryer and Hodgson[22] investigated the use of IASTM in conjunction with exercises for patients experiencing neck pain. They claimed that combining IASTM with exercises resulted in greater pain and function improvement.[22] Gulick[25] conducted a study to investigate the effect of IASTM on the UT MTrPs. Pressure pain threshold was measured before and after 3 weeks of application. The results demonstrated that IASTM can effectively increase PPT.[25] Furthermore, Emshi et al[46] conducted a study on 81 participants with active TrPs in the UT to compare the effects of IASTM and dry needling on pain and function. Their findings indicated that both techniques were useful, with no significant difference in the measured variables.[46]

There is a lack of literature that supports the use of INIT and IASTM in participants with active TrPs to decrease muscle activity. There were no studies performed to compare our results with theirs. The only study that investigated the effect of MET on resting bioelectrical activity on muscles was reported by Ptaszkowski et al,[47] who found no change in resting bioelectrical activity after the application of MET 3 times a day. No improvement in resting bioelectrical activity may be attributed to the short duration of treatment.[47] We proposed that improvements in UT electrical activity occur as a result of TrP deactivation, collagen realignment, increased blood supply, and reset of the muscle spindle, which return the muscle to its normal length.

Improvements in pain function and muscle activity were also documented in the STT-only group. The cumulative effect of postural adjustment training (chin-in), cervical extensor stretching, isometric exercise, and moist heat exercise can be due to this refinement. Postural exercises may help to reduce the adverse loads on the cervical joints caused by poor cervical alignment. Also, it has the potential to strengthen the deep postural stabilizing muscles of the spine. If these exercises are performed repeatedly throughout the day, postural patterns will change.[48]

The improvement in the STT only-group could be attributed to the rapid hypoalgesic effects of isometric exercises in conjunction with stretching exercises, which is generally consistent with the proposed mechanism of action of isometric exercise. These exercises are used to treat cervical pain caused by somatic dysfunction.[49] Stretching exercises can also help to relax a spasm. It relaxes muscles by acting on their viscoelastic properties. Applying a constant external load slowly to a shortened muscle causes deformation and increases the target muscle's flexibility.[50]

Limitations and Future Studies

Firstly, INIT and IASTM have a clinical role in improving ROM. We did not measure ROM, so this is lacking in this study. Cervical ROM needs to be measured in future research. We did not investigate the long-term effect, so it is unknown how long the treatment benefits lasted. Finally, proprioception and endurance of cervical muscles were not measured in this study. Future research should measure these variables.

Conclusion

In this study, we found no statistically significant differences between INIT and IASTM groups in VAS and ANDI posttreatment, but there were differences between the INIT and STT groups and also between the IASTM and STT groups.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): H.M.E.
Design (planned the methods to generate the results): A.S.A.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): H.A.H.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): M.O.G.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): H.A.H., A.S.A.
Literature search (performed the literature search): M.O.G.
Writing (responsible for writing a substantive part of the manuscript): H.A.H., A.S.A.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): H.M.E.

Practical Applications

- The results of this trial examined the effect of both techniques on electrophysiological properties of upper trapezius muscle and compared the results of both techniques.
- Both instrument-assisted soft tissue mobilization and integrated neuromuscular inhibition technique reduced pain and muscle amplitude and improved function.

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