How to Cite:
Mohamed, R. R., Edris, H. M., Elsayed, W. H., & Mohamed, N. H. (2022). Effect of Integrated neuromuscular inhibition technique versus instrument assisted soft tissue mobilization on chronic mechanical neck pain. *International Journal of Health Sciences*, *6*(S8), 2219–2234. https://doi.org/10.53730/ijhs.v6nS8.11871

Effect of integrated neuromuscular inhibition technique versus instrument assisted soft tissue mobilization on chronic mechanical neck pain

Rania R Mohamed
Lecturer of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University, Cairo, Egypt
Corresponding author email: raniareda22@cu.edu.eg

Hajar M Edris
Assistant Lecturer of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Sinai University, Ismailia, Egypt

Wadida H Elsayed
Professor of Physical Therapy, Basic Science Department, Faculty of Physical Therapy, Cairo University, Cairo, Egypt

Nabil H Mohamed
Professor of Neurology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

***Abstract*---**Background: Mechanical Neck Pain is considered one of the commonly known musculoskeletal conditions with active trigger points. It incorporates a great effect on economic productivity and becomes a major health problem. Purpose: to compare the effect of integrated neuromuscular inhibition technique versus instrument assisted soft tissue mobilization in patients with chronic mechanical neck pain. Methods: 60 participants were randomly enrolled into three equal groups. Group A received a conventional physical therapy program, Group B received a conventional physical therapy program plus integrated neuromuscular inhibition technique, and Group C received a conventional physical therapy program plus instrument assisted soft tissue mobilization. The measurements were conducted using the Visual Analogue Scale, Cervical Range of Motion, Neck Disability Index and Pressure Algometer. Results: MANOVA test demonstrated a significant pain reduction in the three groups. Cervical ROM revealed that there was more improvement in group C. Neck disability index, there were no significant differences in improvement of three groups. Pain pressure threshold, there was

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
Manuscript submitted: 9 April 2022, Manuscript revised: 18 June 2022, Accepted for publication: 27 July 2022

more improvement in group C. Conclusion: Integrated Neuromuscular Inhibition Technique showed superiority than Instrument Assisted Soft Tissue Mobilization in improvements of pain intensity level, cervical ROM, neck disability level and pressure pain threshold in patients with chronic mechanical neck pain.

***Keywords*---**integrated neuromuscular inhibition technique, instrument assisted soft tissue mobilization, chronic mechanical neck pain.

Introduction

Mechanical Neck Pain (MNP) is mostly well-known muscular disorder [1]. It has no known identified cause and is considered as MNP [2]. The pain resulting from prolonged postures and neck movements [3] Chronic Mechanical Neck Pain (CMNP) is defined by the International Association for the Study of Pain as neck pain that lasts longer than three months [4]. It is very common, with 70% of people experiencing pain in their life. In today's environment, neck pain has a significant impact on economic output. As a result, it becomes a severe health issue. It caused by mechanical dysfunction, which produces joint movement abnormality, such as irregular mobility inside the capsule, which restrict motions [5].

Myofascial Trigger Points (MTrPs) of neck muscles might play a vital role within the genesis of MNP. It is a hyperirritable spot inside the felt band of muscle which is unpleasant when the involved tissues are compressed, stretched, or overloaded, resulting in a typical pain pattern that may be important in the development of MNP [6]. It is generally treated conservatively and the most commonly used interventions are electrical agents, thermal therapeutic agents, exercises, soft tissue and manual therapy techniques [7]. The Integrated Neuromuscular Inhibition Technique (INIT) is a technique that is widely used by physiotherapists in clinical practice. It has significant evidence in reducing pain, improving range of motion (ROM), and decreasing disability in individuals with MNP [8]. In patients with MNP, upper trapezius trigger points deactivated by INIT showed much more effectiveness than muscle energy technique alone in terms of pain relief, stiffness reduction, and improved functional capacity [9].

The Cyriax cross friction massage inspired Instrument Assisted Soft Tissue Mobilization (IASTM). [10]. It might be a technique that involves using specifically developed devices to break down scar tissue and fascial limitations in soft tissues (muscles, ligaments, tendons, fascia, and nerves) in order to reduce pain intensity level, enhance ROM and function [11]. There is a debate in the literature about which treatment is more effective INIT or IASTM in lowering pain intensity level, enhancing neck ROM, and improving function with CMNP. So this study was conducted to compare the effect of Integrated Neuromuscular Inhibition Technique with Instrument Assisted Soft tissue Mobilization in patients with Chronic Mechanical Neck Pain.

Material and Methods

This study was conducted in Physical Therapy Department in Omrania Family Medicine Center, Giza, Egypt, Ministry of Health from July 2021 to April 2022 to compare the effect of INIT versus IASTM on pain intensity level, cervical ROM, neck functional level, and PPT in patients with CMNP.

Design of the study

This study was a randomized controlled trial; pre and post-test design. Prior to initiating the study, ethical approval was obtained from the Research Ethical Committee, Faculty of Physical Therapy, Cairo University, Egypt (P.T.REC/012/002711). The study adopted regulations established by the Helsinki Declaration for human participants. The study protocol was signed up online on clinical trial.gov under the identification number (PACTR202102626402431).

Sample size calculation

G*Power was used to compute the sample size (version 3.1.9.2). The type I error rate was set at 5% (alpha-level 0.05), the effect size was 0.6 of the major outcome variable visual analogue scale (VAS), and the type II error rate was set at 90% power in the calculation. This study required minimum sample size of thirty patients. The recommended minimum sample size for this investigation was 60 people, based on a dropout rate.

Randomization

A blinded independent researcher randomly assigned individuals to three equal groups (A, B, and C) by opening sealed envelopes containing computer-produced randomization serially numbered index cards using the SPSS software. Each patient participated in the study after signing an informed consent form and had the availability to withdraw at any time during the study protocol.

Participants

Sixty-five participants diagnosed by orthopedic physician as CMNP, they were recruited from the Physical Therapy Department in Omrania Family Medicine Center, Ministry of Health (Giza, Egypt). Their age ranged from 18 to 38 years [8]. Their BMI were ranged from 18-30 kg/m2 referred to the physical therapy department. The subjects participated in the study if they had MNP more than 3 months [4] and the level of pain on VAS should be higher than two out of ten [12]. Five participants were dropout from the study as they did not meet the inclusive criteria. The participants were excluded if they have sensory abnormalities in the upper or middle back, circulation or heart disorders, any surgery on the shoulder, neck, or upper/mid back, exhibiting inadequate cooperation, musculoskeletal disorders, autoimmune conditions (rheumatoid arthritis, fibromyalgia), and If they had upper trapezius muscle trigger point injections in the previous six months [12]. They were randomly assigned into three groups:

Group A: (n=20) were received a conventional physical program of isometric exercises, passive stretching, chin in exercise, and hot packs. Group B: (n=20) were received conventional physical therapy program plus INIT. Group C: (n=20) were received conventional physical therapy program plus IASTM. Treatment was done three times/week for four weeks.

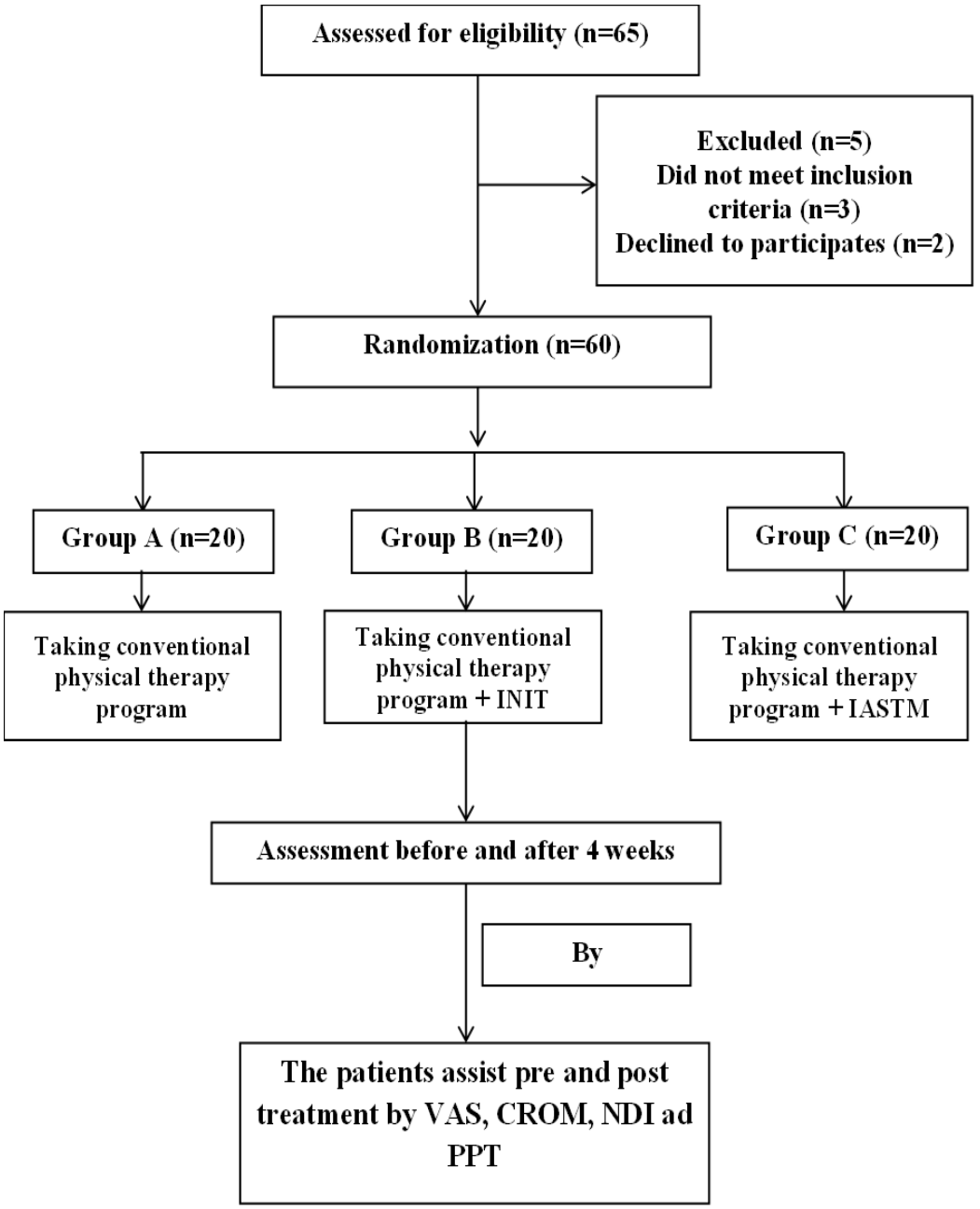

Fig (1): Flow chart of the procedure of the study

Instrumentation
Instrumentation for assessment

- Visual analogue scale was used to assess pain intensity level. It is a self-reported pain measuring scale that consisted of a horizontal line with 10 cm long. No pain and worst pain are the extremes of line [14].
- CROM goniometer was used to assess cervical ROM. The results were represented in degrees. This device is valid and reliable with intrarater intraclass correlation coefficients (ICCs) ranging from 0.84 and 0.96 and interrater ICCs from 0.73 to 0.94 in all cervical range of motion. It can be easily utilized with both asymptomatic and symptomatic individuals, as it needs slight palpation to detect the landmarks and can test all directions of cervical range without the need to change the inclinometer's position [15].
- The neck disability index is an instrument for assessing self-reported impairment related to neck pain. Therapists and academics both utilize it. The Arabic version of the NDI was employed in this investigation. It is a valid and reliable instrument that may be used to measure neck pain in Arab patients. It has a two-factor, ten-item format. As a result, it is suitable for clinical and research use [16].
- Pressure Algometer is a tool used to determine the highest amount of pressure that can be endured before turning that pressure sensation into pain, normally in cases complaining from myofascial pain to detect myofascial trigger points. Pressure pain thresholds recognized by testing can provide a quantitative measure of the patient's tenderness, as tender spots will require an abnormally low force level to elicit pain. The pressure algometer has high validity and excellent reliability, with Pearson (r) correlations of its maximal force reading reaching 0.99 between it and the force plate and ICCs of 0.70–0.94 [17,18].

Instrumentation for treatment

Instrument Assisted Soft Tissue Mobilization can be used by clinicians to efficiently locate and treat people who have been diagnosed with soft tissue dysfunction. It uses ergonomically constructed devices to detect and repair fascial limitations, promote fast localization, and efficiently treat soft tissue fibrosis, chronic inflammation, or degeneration [19].

Procedures

Assessment procedure

The pain intensity level was assessed by VAS. Each participant was instructed to mark the point on the line that precisely matched his/her pain. The cervical ROM was assessed by CROM. The cervical range of motion for flexion, extension, lateral flexion, and rotations using separate inclinometers. These inclinometers are attached to a frame similar to that for eyeglasses: one in the sagittal plane for flexion-extension, a second in the frontal plane for lateral flexion, and a third in the horizontal plane for rotation [15]. The neck functional level was assessed by NDI. Each item is scored 5 for a maximum total score of 50. If the first statement is marked the section score = 0, and the last statement is marked = 5. If all 10

sections are completed, the obtained patient's score can be multiplied by 2 to produce a percentage score. If a section is omitted, divide the patient's total score by the number of sections completed times 5 [20].

Pressure Algometer was used to assess pressure pain threshold and tenderness in the upper trapezius muscle. Each patient was asked to determine the pain area because they had active myofascial trigger points. The area was confirmed by pincer palpation and then it was marked. The transducer probe tip was applied to the myofascial trigger point, perpendicularly over it. A required pressure was exerted on the site of myofascial trigger points by pressing the transducer firmly downwards. The digital display was given the actual pressure applied at the site in pound force. The participant was participated to sustained pressure that was steadily raised until the participant showed the first symptom of pain and said "STOP." At this moment, the measurement was recorded for the pressure pain threshold value [21].

Treatment procedure

Conventional physical therapy program

Isometric training for neck flexors, extensors, lateral flexors and rotators. The exercises were done from sitting with back supported in sets of fifteen repetitions for each exercise, passive stretching exercises for extensor muscles, lateral flexor muscles, and scalene muscle, Chin in exercise, and applying hot packs to the cervical area for 15 minutes while sitting on a table with a pillow [22].

Integrated Neuromuscular Inhibition Technique application

It is a therapeutic method that consisted of the ischemia compression method, the strain counter strain technique (SCS), and muscle energy technique are included in this sequence. Palpation is used to locate the painful location, which is then treated by ischemia compression. The muscle is then positioned in an extremely shortened posture while the compression is kept in place to lessen the pain caused by the pressure SCS. The last component of the technique involves isometric contraction using the muscle energy technique, which is aimed at releasing the muscle [23].

Ischemic compression technique

To relieve tension in the upper trapezius muscle, the patient was positioned supine. The affected side's arm was in a slight shoulder abduction posture, with the elbow bent and the hand lying on the stomach. The investigator discovers the trigger points by interviewing the individuals about the location of pain and then using pincer palpation to locate the trigger points. The therapist used a pincer grip again, this time putting the thumb and index finger over the spot. Gradually increasing pressure was applied until the tissue resistance barrier was found. Firm pressure is administered to the tender spot for five seconds of pressure, two to three seconds of relaxation, followed by another five seconds of pressure, and so on, until a palpable shift is seen [8,9].

Positional Release Technique

The ease posture was frequently achieved by putting the muscle in a shortened/relaxed position. The point at which pain was decreased by at least 70% was considered as ease. To relieve pain, the patient was positioned in a supine posture with the neck laterally flex towards the affected side and the ipsilateral arm in flexion, abduction, and external rotation by the practitioner. While monitoring the trigger point pain and asking the patient about the degree of pain, apply pressure to the trigger point and question the participant about the amount of pain. The position of ease was identified when pain fell by seventy percent from the start, and it was held for ninety seconds and repeated for three times [8,9].

Muscle Energy Technique

Finally, the patients were given MET to the upper trapezius muscles that were affected. Shoulder elevation was achieved by isometric contraction. One hand of the investigator was on the mastoid region on the side of the head, while the other was on the shoulder. The individual was asked to bring his stabilized shoulder and ear closer together. The contraction lasted seven seconds, with a maximal voluntary contraction of twenty seconds and then relax. After that, stretching was done. Maintain the soft tissue stretch via lateral bending, flexion, and ipsilateral rotation of the patient's head on the contralateral side. Stretching was done three times every treatment session, each time for thirty seconds [8, 9]

Instrument Assisted Soft Tissue Mobilization

Before applying IASTM, the conventional program was conducted. A stainless stain tool was employed in this experiment. An alcohol pad was used to clean the instrument. A lubricant was applied to the skin around the neck area. The instrument was used to locate restricted regions in the upper trapezius muscle. Each participant sat on a stool with forearms propped up on a treatment table. Patients instructed to rest their brow on his or her forearms. The tool was used at a 45^0 to sweep for 3 minutes (longitudinal strokes, comparable to an effleurage stroke, executed parallel to the muscular fibers along the muscle without generating any pain from the origin to the insertion). The tool was cleaned with alcohol after each treatment. If the individuals felt a burning feeling after the exercise, they were told to use an ice pack [24].

Statistical Analysis

The outcome measures were statistically analyzed and compared using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Data were tested, for normality assumption, homogeneity of variance, and presence of extreme scores. Normality test of data using Shapiro Wilk test was used. It showed the measured variables were normally distributed ($p<0.5$). Data was expressed as mean and standard deviation for all outcomes except for gender (counts). Two way mixed designed MANOVA were used to compare between the groups on the combined effect of all outcomes. When MANOVA is statistically significant, follow up with univariate ANOVAs for every outcome with Bonferroni

correction to protect against type I error. All statistical analysis was significant at 0.05 level of probability ($P \leq 0.05$)

Results

The baseline demographic characteristics of participants showed no statistically significant differences among groups regarding age, weight, height, body mass index and gender ($P>0.05$) as shown in table (1).

Table (1): Baseline Demographic Characteristics of Participants

Characteristics	Group A (n=20)	Group B (n=20)	Group C (n=20)	F-value	P-value
Age (years) ±SD	26.8±3.83	29.25±4.67	28.55±4.29	1.774	0.18
Sex (M/F) Males, n (%) Females, n (%)	 7(35%) 13(65%)	 4(20%) 16(80%)	 6(30%) 14(70%)	X^2 =1.15	0.56
Weight (kg) ±SD	69.6±10.77	67.75±7.44	68.8±6.61	0.24	0.79
Height (cm) ±SD	167.6±6.07	164.2±5.89	164.1±6.75	2.0	0.14
BMI (kg/m^2) ±SD	24.74±3.18	24.86±2.19	25.56±2.34	0.57	0.57

F-value, fisher test; P-value, probability value; M, males; F, females; X 2, Chi Square; BMI, body mass index * Data are mean± SD for age and height and counts for gender, P-Value < 0.05 indicate statistical significance.

The results showed no statistically significant differences between groups regarding pain intensity level, pain pressure threshold, neck disability index, neck flexion, extension, right and left lateral flexion, and right and left rotation ROM outcome measures ($P>0.05$)as shown in table (2).

Table (2): Baseline Clinical Characteristics of participants

Characteristics	Group A (n=20)	Group B (n=20)	Group C (n=20)	F-Value	P-Value
VAS (mm)	71.5±20.07	65.5±16.05	69.0±10.21	0.71	0.5
PPT (kg/cm^2)	1.44±0.35	1.49±0.27	1.49±0.27	2.26	0.11
NDI	15.6±5.82	16.9±5.26	15.8±3.35	0.4	0.67
Flex (deg.)	36.35±4.23	37.75±6.23	38.0±4.78	0.6	0.55
Ex (deg.)	38.9±5.05	43.4±8.56	41.6±7.89	1.91	0.16
RLF (deg.)	37.3±7.74	35.85±5.06	36.6±3.12	0.33	0.72
LLF (deg.)	39.05±5.68	38.1±6.23	39.1±4.22	0.21	0.81
RR (deg.)	49.35±8.52	51.7±7.84	51.2±4.38	0.6	0.55
LR (deg.)	53.1±8.48	50.35±7.56	51.0±5.44	0.78	0.46

VAS, Visual Analogue Scale; PPT, Pain Pressure Threshold; NDI, Neck Disability Index; Flex, Flexion, deg., degrees; Ext, Extension; RLF, Right Lateral Flexion; LLF, Left Lateral Flexion; RR, Right Rotation; LR, Left Rotation; CI, Confidence interval; p, probability value. * Data are mean± SD, P-Value < 0.05 indicate statistical significance.

Clinical Characteristics of Participants after 4 weeks of intervention

The clinical characteristics of participants after 4 weeks of intervention are shown in table (3). The results showed statistically significant differences between groups regarding pain pressure threshold, neck flexion, extension, right lateral flexion and right rotation ROM outcome measures (P<0.05). However, no statistically significant differences were found between the groups regarding pain intensity level, neck disability index, left lateral flexion, and left rotation ROM outcome measures (P>0.05).

Table (3): Clinical Characteristics of Participants after 4 weeks of Intervention

Characteristics	Group A (n=20)	Group B (n=20)	Group C (n=20)	F-Value	P-Value
VAS (mm)	26.5±14.61	23.0±14.18	22.5±12.09	0.51	0.6
PPT (kg/cm2)	1.74±0.47	2.18±0.66	2.64±0.45	14.18	0.0001*
NDI	5.2±2.48	4.45±2.31	3.75±2.55	1.75	0.18
Flex (deg.)	41.8±3.0	44.55±3.97	52.2±8.85	16.91	0.0001*
Ex (deg.)	43.5±3.75	50.35±7.33	50.25±9.54	5.82	0.005*
RLF (deg.)	41.9±5.56	42.45±2.31	46.8±4.79	7.41	0.001*
LLF (deg.)	45.45±6.86	47.20±5.22	44.25±1.94	1.69	0.19
RR (deg.)	56.25±4.0	59.7±6.47	60.45±4.8	3.72	0.03*
LR (deg.)	57.85±4.34	60.5±4.43	60.15±3.48	2.46	0.09

VAS, Visual Analogue Scale; PPT, Pain Pressure Threshold; NDI, Neck Disability Index; Flex, Flexion, deg., degrees; Ext, Extension; RLF, Right Lateral Flexion; LLF, Left Lateral Flexion; RR, Right Rotation; LR, Left Rotation; CI, Confidence interval; p, probability value. * Data are mean± SD, P-Value < 0.05 indicate statistical significance.

Table (4): Between groups changes effects after 4 weeks of intervention

Outcome	Group A versus Group B		Group A versus Group C		Group B versus Group C		Partial Eta Square
	MD (95% CI)	P-Value	MD (95% CI)	P-Value	MD (96% CI)	P-Value	
VAS (mm)	0.35 (-0.72, 1.42)	0.99	0.4 (-0.67, 1.47)	0.99	0.05 (-1.02, 1.12)	0.99	0.02
PPT(kg/cm^2)	-0.44 (-0.86, -0.02)	0.04*	-0.9 (-1.32, -0.48)	<0.0001*	-0.46 (-0.88, -0.04)	0.03*	0.33
NDI	0.75 (-1.16, 2.66)	0.99	1.45 (-0.46, 3.36)	0.2	0.7 (-1.21, 2.61)	0.99	0.06
Flex(deg.)	-2.75 (-7.32, 1.82)	0.43	-10.4 (-14.97, -5.83)	<0.0001*	-7.65 (-12.22, -3.08)	0.0004*	0.37
Ex(deg.)	-6.85 (-12.53, -1.18)	0.01*	-6.75 (-12.43, -1.08)	0.01*	0.1 (-5.58, 5.78)	0.99	0.17
RLF(deg.)	-0.55 (-4.01, 2.91)	0.99	-4.9 (-8.36, -1.44)	0.003*	-4.35 (-7.81, -0.89)	0.009*	0.2
LLF(deg.)	-1.75 (-5.73, 2.23)	0.85	-1.2 (-2.78, 5.18)	0.99	2.95 (-1.03, 6.93)	0.21	0.06
RR(deg.)	-3.45 (-7.5,	0.12	-4.2 (-8.25, -	0.01*	-0.75 (-4.8,	0.99	0.12

	0.6)		0.15)		3.3)		
LR(deg.)	-2.65 (-5.86, 0.56)	0.14	-2.3 (-5.51, 0.91)	0.25	0.35 (-2.86, 3.56)	0.99	0.08

VAS, Visual Analogue Scale; PPT, Pain Pressure Threshold; NDI, Neck Disability Index; Flex, Flexion, deg., degrees; Ext, Extension; RLF, Right Lateral Flexion; LLF, Left Lateral Flexion; RR, Right Rotation; LR, Left Rotation; CI, Confidence interval; p, probability value. * Data are mean± SD, P-Value < 0.05 indicate statistical significance.

Table (5): Within group changes from baseline to after 4 weeks of intervention

Outcomes	Group A (n=20)		Group B (n=20)		Group C (n=20)	
	Change from baseline to 4weeks		Change from baseline to 4weeks		Change from baseline to 4weeks	
	MD (99% CI)	P-Value	MD (99% CI)	P-Value	MD (99% CI)	P Value
VAS (mm)	45.0 (38.05, 51.95)	<0.0001*	42.5 (35.55, 49.45)	<0.0001*	46.5 (39.55, 53.45)	<0.0001
PPT(kg/cm^2)	-0.3 (-0.53, -0.07)	0.01*	-0.7 (-0.92, -0.47)	<0.0001*	-0.97 (-1.19, -0.74)	<0.0001
NDI	10.4 (8.43, 12.37)	<0.0001*	12.45 (10.45, 14.42)	<0.0001*	12.05 (10.08, 14.02)	<0.0001
Flex(deg.)	-4.45(-8.17, -2.73)	0.0002*	-6.8 (-9.52, -4.08)	<0.0001*	-14.2(-16.92, -11.48)	<0.0001
Ex(deg.)	-4.6(-7.11, -2.09)	0.0005*	-6.95(-9.46, -4.44)	<0.0001*	-8.65(-11.16, -6.14)	<0.0001
RLF(deg.)	-4.6(-7.01, -2.19)	0.0003*	-6.6(-9.01, -4.19)	<0.0001*	-10.2(-12.61, -7.79)	<0.0001
LLF(deg.)	-6.4(-9.29, -3.51)	<0.0001*	-9.1(-11.99, -6.21)	<0.0001*	-5.15(-8.04, -2.26)	0.0007
RR(deg.)	-6.9(-10.03, -3.77)	<0.0001*	-8.0(-11.13, -4.87)	<0.0001*	-9.25(-12.38, -6.12)	<0.0001
LR(deg.)	-4.75(-7.55, -1.95)	0.001*	-10.15(-12.95, -7.35)	<0.0001*	-9.15(-11.95, -6.35)	<0.0001

VAS, Visual Analogue Scale; PPT, Pain Pressure Threshold; NDI, Neck Disability Index; Flex, Flexion, deg., degrees; Ext, Extension; RLF, Right Lateral Flexion; LLF, Left Lateral Flexion; RR, Right Rotation; LR, Left Rotation; CI, Confidence interval; p, probability value. * Data are mean± SD, P-Value < 0.05 indicate statistical significance.

Discussion

Chronic Mechanical Neck Pain is characterized by a persistence of symptoms for a period longer than 3 months [4]. The exact origin and pathophysiological mechanisms of chronic neck pain remain unclear. Many researchers have linked chronic symptoms to changes in neck muscles [25]. Individuals with CMNP exhibit muscle weakness and reduced endurance in the neck flexor muscles compared to healthy adults, which is highly associated with pain and disability [26]. The results of the study on pain intensity level revealed that there was no significant differences in improvement of three groups A, B, and C (P= 0.6), and

on cervical ROM revealed that there was more improvement in group C than groups A and B in neck flexion (P< 0.0001), neck right lateral flexion (P= 0.001), and neck right rotation (P=0.03) , when in neck extension there was no significant difference in improvement between groups B and C but there was more improvement in group B and C than group A (P=0.005). There was no significant differences in improvement of three groups A, B, and C in neck right lateral flexion and neck right rotation. Neck functional level revealed that there was no significant differences in improvement of three groups A, B, and C (P= 0.18) and on pressure pain threshold, there was more improvement in group C than groups A and B (P=0.0001).

In the line with the current study, Ismail (2008) which investigated the effect of an integrated exercise program of strength, endurance and flexibility in chronic mechanical neck pain patient. The experimental group performing strengthening exercises, endurance exercises and stretching or a control group performing strength and stretching only. The results suggested that there was improvement in ROM, neck pain, and disability. Further explanation was presented by Ylinen et al. (2004) who evaluated the effect of isometric exercises on chronic neck pain in women. The study evaluated neck flexion, extension, and rotation strength in women with chronic neck pain compared with healthy participants. The repeatability of peak isometric neck strength measurements in patients with neck pain was evaluated by the neck strength measurement system and the results found that there was a significant improvement in muscle strength and neck pain.

The results were also confirmed by Lars et al. (2014) that done on women with trapezius myalgia. The intervention group received specific strength training when control group did not received treatment. Women with trapezius myalgia have lower strength capacity than healthy controls. It stated that high-intensity strength training effectively improves strength capacity of the painful trapezius muscle and lead to marked prolonged relief in neck muscle pain. The explanation of the improvements with IASTM was due to the ability of IASTM to induce tissue micro trauma. This induces a regional inflammatory process and increases the release of fibroblasts. Fibroblast migration increases collagen synthesis and tissue regeneration, accelerating the healing process. In addition, increases in tissue temperature and blood flow due to friction between the tool and the tissue may contribute to improved tissue oxygenation and removal of local waste metabolites. It agreed with the results of the study done by (Baker et al., 2013).

The explanation for the increased PPT may be related to a decrease in cell matrix adhesions within the MTrP. Histological sections after IASTM revealed that fibroblasts aligned parallel to the collagen fibers [30]. Likewise, electron microscopy supported improved collagen fiber bundle formation and orientation after IASTM. This realignment of the matrix reduces the randomness of the cells which can be responsible for the adhesion of the tissues [31]. The effect of IASTM is similar to manual massage as sweeping (effleurage) and fanning (petrissage) that increase circulation to the treated area and this will lead to an increase in tissue temperature and blood flow which may contribute to improve tissue nutrition, oxygenation, and removal of local metabolites (Portillo-Soto et al., 2014).

Draper et al. (2010) demonstrated the importance of increased tissue temperature in the reduction of tissue stiffness that enhanced PPT. This study explained that pain reduction was due to the release of the involuntary contraction of the muscle. Reduction of muscle guarding may be an important precursor to the restoration of motion. Furthermore, the IASTM may have stimulated the A-beta sensory fibers to block the A-delta and C-fibers. As per the gate control theory of pain management, as long as the sensory fibers are firing, the gate to the transmission of pain is closed. This blocks the substance P from the pain receptors via presynaptic inhibition at the dorsal horn (Gulick, 2018).

The findings of the present study were supported by (El-hafez et al., 2020) that compared the effect of IASTM versus stripping massage for upper trapezius myofascial trigger points on two groups. It was found that both groups showed significant improvement in pain intensity level, pressure pain threshold, and neck functional level but there are no significant differences between the two groups. Also the findings of the current study were in agreement with (Emshi, et al., 2021) that compared the effects of IASTM and dry needling on active myofascial trigger points of the upper trapezius muscle. It revealed that both IASTM and dry needling were determined to improve pain intensity level, PPT, cervical ROM, and NDI in participants with active trigger points in the upper trapezius, although IASTM was more effective in active cervical lateral flexion.

In line with the current study (Lytras et al., 2020) that investigated the effects of exercise and an integrated neuromuscular inhibition technique program in the management of chronic mechanical neck pain on two groups. This study showed that the addition of the INIT to a therapeutic exercise program had a positive effect on pain, functionality, and the quality of life in individuals with CMNP. The present study was consistent with (Saadat et al., 2018) that studied the effects of integrated neuromuscular inhibition technique on pain threshold and pain intensity in patients with upper trapezius trigger points. The results showed that pain intensity significantly decreased in the intervention group immediately after treatment and 24 hours after treatment in comparison with the control group and there were no significant differences in pressure pain threshold between both groups.

Moreover (Abd El-Azeim et al., 2018) compared integrated neuromuscular inhibition technique versus kinesiotape on upper trapezius myofascial trigger points between three equal groups. The result was INIT and KT are effective methods in the management of participants with active trigger points at upper trapezius myofascial trigger points with superiority for INIT. In addition, (Mohamed et al., 2021) investigated the combined effects of extracorporeal shockwave therapy and integrated neuromuscular inhibition on myofascial trigger points of upper trapezius. It concluded that combined treatment with extracorporeal shockwave therapy and INIT for treating myofascial trigger points in the upper trapezius is more effective than using only one of the two approaches in terms of clinical, functional, and neurophysiological aspects.

The limitation of the study

This study was conducted to compare the effect of integrated neuromuscular inhibition technique versus instrument assisted soft tissue mobilization after 4 weeks and further studies were needed to determine the long term effect of INIT versus IASTM in patients with chronic mechanical neck pain.

Conclusion

Based on the scope and findings of this study, it concluded that adding INIT or IASTM to conventional physical therapy program showed significant improvements in pain intensity level, cervical ROM, neck functional level, and pressure pain threshold than conventional physical therapy program alone in patients with CMNP.

Interest conflicts
There is no declaration of conflict of interest.

Funding source
No funding agencies supported this research by any grant in commercial, public or sectors of profit.

Acknowledgement

We would like to thank everyone who took part in this study for their great cooperation during the whole study.

References

1. Abd El-Azeim, A. S., Ahmed, S. E. B., Draz, A. H., Elhafez, H. M., & Kattabei, O. M. (2018): Integrated neuromuscular inhibition technique versus kinesiotape on upper trapezius myofascial trigger points a randomized clinical trial. International Journal of Physiotherapy, 5(3), 105-112.
2. Audette I, Dumas JP, De Serres SJ, (2010): Validity and between-day reliability of the cervical range of motion (CROM) device, J Orthop Sports PhysTher. 40(5):318-23.
3. Baker R., Nasypany A., Seegmiller J., and Baker J., (2013): Instrument-assisted soft tissue mobilization treatment for tissue extensibility dysfunction. International Journal of Athletic Therapy and Training; 18 (5): 16-21.
4. Boonstra AM, Preuper HR, Reneman MF, Posthumus JB, Stewart RE. (2008): Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. International journal of rehabilitation research. 1; 31(2):165-9.
5. Chaitow L., &DeLany, J. (2008): Clinical application of neuromuscular techniques: the upper body (Vol. 1). Elsevier Health Science. 1-20.
6. Draper, D.O., Mahaffey, C., Kaiser, D., Eggett, D., Jarmin, J., (2010): Thermal ultrasound decreases tissue stiffness of trigger points in upper trapezius muscles. Physiother. Theory Pract. 26 (3), 167–172.

7. Edris H. M., El-Sayed W. H., Mohamed G. I. (2017): Mulligan versus kinesio tape in patients with mechanical neck pain. Int J Physiother Res; 5(6):2443-2450.
8. El-Hafez, H. M., Hamdy, H. A., Takla, M. K., Ahmed, S. E. B., Genedy, A. F., & Al Shaymaa, S. (2020): Instrument-assisted soft tissue mobilisation versus stripping massage for upper trapezius myofascial trigger points. Journal of Taibah University Medical Sciences, 15(2), 87-93.
9. Emshi, Z. A., Okhovatian, F., Kojidi, M. M., Baghban, A. A., & Azimi, H. (2021). Comparison of the effects of instrument assisted soft tissue mobilization and dry needling on active myofascial trigger points of upper trapezius muscle. Medical journal of the Islamic Republic of Iran, 35 (1), 59.
10. Ernst E (2007): Adverse effects of spinal manipulation: a systematic review. J R Soc Med 100: 330-338.
11. Falla D, Jull G, Hodges P, Vicenzino B. (2006): An endurancestrength training regime is effective in reducing myoelectric manifestations of cervical flexor muscle fatigue in females with chronic neck pain. Clin Neurophysiol.; 117 (4):828- 837.
12. Fejer R. and Kyvik K., (2006): The prevalence of neck pain in the world population: a systematic critical review of the literature. Spine; 32(3):353-362.
13. Fischer, A. A. (1987). Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. Pain, 30(1), 115-126.
14. Gulick D. T. (2018): Instrument-assisted soft tissue mobilization increases myofascial trigger point pain threshold. Journal of bodywork and movement therapies, 22(2), 341-345.
15. Hakkinen A, Ylinen J, Rinta-Keturi M, Talvitie U, Kautiainen H, Rissanen A. (2004): Decreased neck muscle strength is highly associated with pain in cervical dystonia patients treated with botulinum toxin injections. Arch Phys Med Rehabil.; 85 (10):1684-1688.
16. Hammer W., (2008): The effect of mechanical load on degenerated soft tissue. J BodywMovTher. ; 12(3):246–256.
17. Hoving J., Koes B., de Vet H., (2002): Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain: A randomized, controlled trial. Annals of Internal Medicine; 136:713-722.
18. Hussain S, Ahmad A, Amjad F. et al. (2016): Effectiveness of Natural Apophyseal Glides versus Grade I and II Maitland Mobilization in Non-Specific Neck Pain; 22(1):23-29.
19. Hyung I., Kim S., Lee S., (2009): The effect of immediate pain and cervical ROM of cervical pain patients on stretching and manipulation. J Korean SocPhysTher, 21: 1–7.
20. Imai, K., Ikoma, K., Chen, Q., Zhao, C., An, K.N., Gay, R.E., (2015): Biomechanical and histological effects of augmented soft tissue mobilization therapy on Achilles tendinopathy in a rabbit model. J. Manip. Physiological Ther. 38 (2), 112–118.
21. Ismail M. (2008): The Effect of Neck Endurance Training as a Component of an Exercise Program for Chronic Non-specific Neck Pain. Bull. Fac. Ph. Th. Cairo Univ. 13(1): 309-315.
22. Jyothirmai B, Senthil Kumar K, Raghavkrishna S, Madhavi K. (2015): Effectiveness of Integrated Neuromuscular Inhibitory Technique (INIT) With

Specific Strength Training Exercises in Participants with Upper Trapezius Trigger Points. Int J Physiother.; 2(5): 759-764.
23. Kinser AM, Sands WA, Stone MH. (2009): Reliability and validity of a pressure algometer. J Strength Cond Res. ;23 (1):312314.
24. Lars L., Andersen, Christoffer H., Andersen L., Andersen H., Skotte H., Suetta C., Sogarrd K., Saltin B., Siogoard G. (2014): High-Intensity Strength Training Improves Function of Chronically Painful Muscles: Case-Control and RCT Studies; Bio. Med. 48 (16): 1227-1234.
25. Loghmani M.T., and Warden S.J., (2009): Instrument-assisted cross-fiber massage accelerates knee ligament healing. JOSPT 39 (7), 506–514.
26. Lytras, D. E., Sykaras, E. I., Christoulas, K. I., Myrogiannis, I. S., & Kellis, E. (2020): Effects of exercise and an integrated neuromuscular inhibition technique program in the management of chronic mechanical neck pain: a randomized controlled trial. Journal of Manipulative and Physiological Therapeutics, 43(2), 100-113.
27. Mohamed, D. A. A., Kamal, R. M., Gaber, M. M., & Aneis, Y. M. (2021): Combined Effects of Extracorporeal Shockwave Therapy and Integrated Neuromuscular Inhibition on Myofascial Trigger Points of Upper Trapezius: A Randomized Controlled Trial. Annals of Rehabilitation Medicine, 45(4), 284.
28. Nagrale AV, Glyn P, Joshi A, Ramteke G. (2010): The efficacy of an integrated neuromuscular inhibition technique on upper trapezius trigger points in participants with non-specific neck pain: a randomized controlled trial. J Man ManipTher.; 18(1): 37–43.
29. Nangbe, F. (2018). A sociological appraisal of biomedical waste management and its sanitation implications for private clinics in Cotonou town. *International Research Journal of Management, IT and Social Sciences*, *5*(5), 42-53. https://doi.org/10.21744/irjmis.v5n5.284
30. O'Riordan, C., Clifford, A., Van De Ven, P., & Nelson, J. (2014): Chronic neck pain and exercise interventions: frequency, intensity, time, and type principle. Archives of physical medicine and rehabilitation, 95(4), 770-783.
31. Portillo-Soto A, Eberman LE, Demchak TJ, Peebles C. (2014): Comparison of blood flow changes with soft tissue mobilization and massage therapy. J Altern Complement Med.; 20 (12):932-936.
32. Saadat, Z., Hemmati, L., Pirouzi, S., Ataollahi, M., & Ali-Mohammadi, F. (2018): Effects of Integrated Neuromuscular Inhibition Technique on pain threshold and pain intensity in patients with upper trapezius trigger points. Journal of bodywork and movement therapies, 22(4), 937-940.
33. Sands WA, McNeal JR, Murray SR, Stone MH. (2015): Dynamic compression enhances pressure to pain threshold in elite athlete recovery: exploratory study. J Strength Cond Res.;29 (5):12631272.
34. Sanjay K., Badu V., Kumar S., (2013): short term efficacy of kinesiotaping and exercises on choronic mechanical neck pain. Int J Physiother Res; 1(5): 283-292.
35. Sawali, L. (2018). Drills forehand training strategy on the stroke of forehand drive ability in tennis. *International Journal of Physical Sciences and Engineering*, *2*(2), 11–20. https://doi.org/10.29332/ijpse.v2n2.133
36. Shah JP, Thaker N, Heimur J, Aredo JV, Sikdar S, Gerber LH. (2016): Myofascial Trigger Points Then and Now: A Historical and Scientific Perspective. Am AcadPhys Med Rehabil.; 7(7): 746-761.

37. Shaheen A., Omar M., Vernon H. (2013): Cross-cultural adaptation, reliability, and validity of the Arabic version of neck disability index in patients with neck pain. Altern Med. 38(10):609-615.
38. Stow R., (2011): Instrument-assisted soft tissue mobilization. International journal of athletic therapy and training, 16(3):5-8.
39. Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. *International Journal of Health Sciences*, *6*(1), i-v. https://doi.org/10.53730/ijhs.v6n1.5949
40. Vernon H. (2008): The neck disability index: state-of-the-art, 1991- 2008. J Manipulative Physio Ther; 31:491-502.
41. Ylinen J., Salo P., Nykanen M., Kautiainen H., Hakkinen A. (2004): Decreased isometric neck strength in women with chronic neck pain and the repeatability of neck strength measurements; Arch. Phys. Med. Rehabil. 85(8): 1303-1308.