Effect of sustained natural apophyseal glides versus integrated neuromuscular inhibition technique on non specific neck pain

Efecto de los deslizamientos apofisarios naturales sostenidos versus la técnica de inhibición neuromuscular integrada sobre el dolor cervical inespecífico

Authors

Hajar M. Edris [1]
Mohammed E. Abdulalim [2]
Ahmed Salim Mohamed Salim [3]
Khaled Alaa Eldin Fetouh [4]
Nagwa Sayed Abdelwahed [1]
Maha Samir Younis Ahmed [1]
Doaa Mohammed El Ghazally El Zawhry [1]
Mennatallah M. Abdellatif [5]

[1] May University in Cairo (Egypt)
[2] Farwaniya Hospital (kuwait)
[3] Al Salam University in Egypt (Egypt)
[4] King Salman International University (Egypt)
[5] Badr University in Cairo (Egypt)

Corresponding author:
Hajar M. Edris
Hajar.Mohammed@muc.edu.eg

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Abstract

Background: Non Specific Neck pain (NSNP) can be defined as mechanical pain that arises between the occiput as well as the third thoracic vertebra with no specific explanation.
Purpose: To differentiate between the effects of sustained natural apophyseal glides (SNAGs) against integrated neuromuscular inhibition technique (INIT) in patients suffering from Non-Specific Neck Pain (NSNP).
Methods: Sixty individuals were divided into three equivalent groups at random. Conventional Physiotherapy treatment was given to all groups A, B and C, whereas Group B was given SNAGs and Group C was given also the INIT approach. The assessments were conducted with the use of VAS, pressure algometer, CROM, neck disability index.
Results: Statistical analyses (MANOVA, ANOVA, and post-hoc tests) indicated that the differences were statistically significant (P = 0.001) in Pain, Rt Rotation, Lt Rotation and PPT and (P = 0.0001) IN Flexion, Extension, Rt Lateral Flexion, Lt Lateral Flexion, and NDI, indicating that Group C and Group B were more effective than Group A in improving outcomes. The results for Groups B and C were not significantly different. Group C showed the most significant improvement, then followed by Group B, and finally Group A.
Conclusion: Adding SNAGs or INMI to conventional program is beneficial in management NSNP.

Keywords

Neck pain, ischemic compression, sustained natural apophyseal glides.

Resumen

Fundamento: El dolor cervical inespecífico (PNIN) se puede definir como un dolor mecánico que surge entre el occipucio y la tercera vértebra torácica sin una explicación específica.
Propósito: Diferenciar entre los efectos de los deslizamientos apofisarios naturales sostenidos (SNAG) frente a la técnica de inhibición neuromuscular integrada (INIT) en pacientes que padecen Dolor Cervical Inespecífico (NSNP).
Métodos: Sesenta individuos fueron divididos en tres grupos equivalentes al azar. Se administró tratamiento de fisioterapia convencional a todos los grupos A, B y C, mientras que al Grupo B se le administraron SNAG y al Grupo C también se le administró el enfoque INIT. Las evaluaciones se realizaron con el uso de EVA, algómetro de presión, CROM, índice de discapacidad del cuello.
Resultados: Los análisis estadísticos (MANOVA, ANOVA y pruebas post hoc) indicaron que las diferencias fueron estadísticamente significativas (P = 0,001) en Dolor, Rotación Rt, Rotación Lt y TPP y (P = 0,0001) EN Flexión, Extensión, Flexión Lateral Rt, Flexión Lateral Lt e IDN, lo que indica que el Grupo C y el Grupo B fueron más efectivos que el Grupo A para mejorar los resultados. Los resultados para los grupos B y C no fueron significativamente diferentes. El Grupo C mostró la mejora más significativa, luego seguido por el Grupo B y finalmente el Grupo A.
Conclusión: Agregar inconvenientes o INMI al programa convencional es beneficioso en el manejo de NSNP.

Palabras clave

Dolor de cuello, compresión isquémica, deslizamientos apofisarios naturales sostenidos.

Introduction

Nonspecific neck pain (NSNP) is a disorder that reduces range of motion and causes pain in the neck with no correlation pathoanatomical findings (Ahmad et al., 2015). It is generally described as mechanical pain arising between the occiput and the third thoracic vertebra (Côté et al., 2003).

With a reported incidence rate of 54% after 6 months, neck pain is a prevalent condition. Health care costs are high due to the prevalence of chronic neck pain, which affects as many as 37% of the population (Nagrale et al., 2010). The majority of scenarios of pain are considered non-specific since their pathoanatomical origins cannot be recognized. Trigger points (TrPs) are one of several possible causes of NSNP, although they received less attention from studies (Nagrale et al., 2010). In individuals between the ages of 20 and 24, low back as well as neck pain ranked as the 2nd most common cause of years lived with disability, based on the Global Burden of Disease (GBD) Study (Hurwitz et al., 2018).

Although several pathologies may lead to neck pain, most cases of NSNP are considered to result from non-specific mechanical factors rather than identifiable structural or systemic disease. These factors may include prolonged static postures, repetitive movements, or poor ergonomic conditions, such as sustained computer or desk work. Several studies have reported associations between such postural and occupational factors and an increased incidence of neck pain among office workers (Cagnie et al., 2007).

Prospective studies and systematic reviews indicate that several factors increase the risk of developing NSNP, including female sex, older age, high work demands, low social/work support, previous history of neck or low-back disorders, and smoking history (Paksaichol et al., 2012).

The symptoms of NSNP are muscle spasm (Sudden, powerful, involuntary contraction of muscles), trigger points (Pain is often felt up the middle of the back of the neck, or it may ache on one side only), headaches and reduced range of motion (Scott Haldeman et al., 2008).

A technique called sustained natural apophyseal glides (SNAGs) involves applying passive gliding to the cervical vertebrae whereas the patient moves actively at the same time. It is believed that the glide should follow the plane of the facet joints and that the procedure is best done while carrying some weight, whether seated or standing. Immediate pain relief and increased AROM are two of the SNAGs' fundamental principles of therapeutic effect (Kazmi et al., 2012).

Chaitow developed a manual approach called the integrated neuromuscular inhibition technique (INIT) (Lytras et al., 2020). It combines the strain-counter strain method, the muscular energy approach, and the ischemic compression method. Individuals suffering from neck pain were shown to have a decrease in pain and pressure pain threshold (PPT) after just one INIT session. Results showed that compared to the muscular energy approach, the INIT improved ROM, disability, and pain in those suffering from neck pain (Lytras et al., 2020). The strain-counter strain (SCS) technique passively positions the affected muscle in a shortened, pain-free position to reduce abnormal muscle spindle activity and decrease local tenderness (Jones, 1964; D'Ambrogio & Roth, 1997). The muscle energy technique (MET) involves gentle, voluntary isometric contractions by the patient against therapist-applied resistance, designed to normalize muscle tone, length, and joint mobility (Jones, 1964; Chaitow & DeLany, 2011). The ischemic compression (IC) method applies sustained manual pressure to myofascial trigger points to temporarily reduce local blood flow, followed by reactive hyperemia that promotes relaxation and pain relief (Hanten et al., 2000; Hou et al., 2002).

The INIT integrates these three approaches in sequence first applying ischemic compression to deactivate trigger points, then using strain-counter strain to reduce residual tension, and finally muscle energy technique to restore muscle length and functional balance (Chaitow & DeLany, 2011).

Although both sustained natural apophyseal glides (SNAGs) and integrated neuromuscular inhibition technique (INIT) have been shown to be effective in reducing pain and improving function in patients with non-specific neck pain, existing studies have primarily investigated these techniques independently. To date, there is a lack of direct comparative studies evaluating the relative effectiveness of SNAGs versus INIT within the same population. Therefore, it remains unclear whether one approach offers superior clinical benefits over the other.

Method

Study Design

A randomized controlled trial with pre- and post-test designs was used in this study. Research involving human subjects was subject to the standards laid out in the Declaration of Helsinki. Pan African clinical trials registration was used to enroll participants in the study with the identifier number (PACTR202506661187962).

Participants

Sixty patients (39 females and 21 males) with ages were between 20 and 35 years in this study; with NSNP. Pain; pain was more than 3 months. The subjects were selected from outpatient clinic of Belqas central hospital, Dakahlia, Egypt and Omrania Family Medicine Center, Giza, Egypt, Ministry of Health from November 2024 to February 2025. All Patients were evaluated by the orthopedist.

Allocation and randomization

Sixty patients were split equally into 3 groups. one control group (A) and Two study group (B and C). Participants were randomly assigned to three groups using a computer-generated randomization sequence. The randomization list was prepared by an independent researcher not involved in recruitment or assessment. Allocation concealment was ensured using sealed, opaque, sequentially numbered envelopes, which were opened only after baseline assessment.

Assessment

All patients underwent the same evaluation and recording of all parameters at baseline and after of the study (three sessions/week for 4 weeks). The pain intensity was evaluated utilizing the VAS. The VAS used to assess the degree of the pain. It's a 10-cm (100-mm) line with a 0 for no pain and a 100 for severe pain. VAS reliability is moderate to good in persons with musculoskeletal disorders. It has high validity and reliability (Kazmi et al., 2012).

The cervical range of motion device (CROM) was utilized for the purpose of assessing cervical range of motion. This device is well-known for its effectiveness, ease of application, and prevalence in clinical settings. They are reliable and have strong criteria validity as well (Lytras et al., 2020). The NDI was used to evaluate the functional level of the neck. Arabic NDI has an excellent "test-retest" reliability10, making it a strong, valid, and reliable tool for evaluating self-rated impairment in individuals suffering from neck pain. To measure the threshold and sensitivity of pressure pain, a pressure algometer was utilized. For measuring pain sensitivity, it represents a valid and reliable instrument (D'Ambrogio & Roth, 1997).

Treatment procedure

Study groups

Control group (A) received traditional physiotherapy program. Isometric strengthening exercises for cervical flexors, extensors, lateral flexors, and rotators, performed in a seated position with back support. Each exercise was held for 5 seconds and repeated for 15 repetitions, with a 10-second rest between repetitions. Stretching exercises targeting cervical extensors, lateral flexors, and scalene muscles. Each stretch was held for 20–30 seconds and repeated 3 times. Chin tuck exercise, performed for 10 repetitions with a 5-second hold. Superficial heat therapy using hot packs applied to the cervical region for 15 minutes at the beginning of each session (Greenman, 1996).

Study group (B) received sustained natural apophyseal glide in addition to conventional physical therapy program. Patient seated so that their spine is in a vertical position, which means it is bearing weight or loaded13. Placing the medial border one thumb assisted other thumb on the spinous process of segments between C5-7. The therapist glides along the spinous process (45°) in upward direction with sustained superior anteriorly. A rhythmic application of gliding was made, 3times per second. The patient was instructed to consciously tilt their head in the direction of the motion deficit After the patient turned his head, the therapist continued to use the SNAGs approach for a minimum of 10 seconds., and then patient may add pressure to the end of their restricted ROM as they hold their position at the end for a few seconds. The patient voluntarily returned to the beginning position while the therapist maintained the glide (Hou et al., 2002). The procedures were repeated 3 sets of 5-10 repetitions with one-minute rest between sets (Hanten et al., 2000).

Study group (C) received Integrated neuromuscular inhibition in addition to traditional physiotherapy program. This progression includes the ischemia compression method, the strain counter strain (SCS) approach, and the muscular energy technique. After palpation has identified the painful area, ischemic compression can be administered. The next step in reducing pressure SCS discomfort is to arrange the muscle in an excessively shortened posture while keeping the compression in place. The final step of the method is to release the muscle by performing isometric contractions utilizing the muscular energy technique (Boonstra et al., 2008).

Ischemic compression technique

Positioning the patient supine helped alleviate tension in the upper trapezius (UT) muscle. With the elbow flexed and the hand resting on the stomach, and the affected side's limb was slightly abducted from the shoulder. After asking patients where they feel pain, the investigator uses pincer palpation to identify the exact spots where the pain is occurring. The therapist resumed the pincer hold, this time covering the area with her thumb and index finger. To find the tissue resistance barrier, the pressure was progressively increased. Applying firm pressure to the painful area for 5 seconds at a time, followed by 2-3 seconds of rest, and then an additional 5 seconds of pressure, continues until a palpable change is observed (Hammer, 2008; Baker et al., 2013).

Positional Release Technique

Placing the muscle in a shortened and relaxed position was a common way to attain the easy posture. "Ease" was defined as a pain reduction of 70% or more. In order to alleviate pain, the patient was placed in a supine position with the healthcare provider positioning the ipsilateral arm in flexion, abduction, as well as lateral rotation with the neck side bended towards the side that was affected. Press down on the trigger point and ask the subject how much pain they're experiencing all while keeping an eye on the pain level. After seventy percent of the first pain had subsided, the practitioner would hold the position of ease for 90 seconds and then do it 3 times (Hammer, 2008; Baker et al., 2013).

Muscle Energy Technique

Lastly, MET was applied to the afflicted UT muscles of the patients. By using isometric contraction, shoulder elevation was accomplished. The investigator's hands were placed on the shoulder as well as the mastoid area, which is located on the side of the head. After stabilizing his shoulder, the patient was instructed to raise his ear more closely to his shoulder. With a maximum voluntary contraction of 20 seconds followed by relaxation, the contraction extended seven seconds. Following that, stretches were administered. The patient's head should be rotated to the ipsilateral side and bent laterally to keep the soft tissue stretch going. The patient was instructed to stretch for 30 seconds three times during each therapy session (Hammer, 2008; Baker et al., 2013).

Statistical Analysis

Software developed by SPSS, Inc. of Chicago, IL, USA, version 25 for Windows, was used to carry out statistical analysis. The ROM variables and the patient's basic clinical features are represented by the mean as well as standard deviation of the data. To compare the three groups for the clinical general characteristics' factors, a one-way analysis of variance (ANOVA-test) was utilized. Using a mixed-design 3 x 2 MANOVA-test, we compared three levels of independent variables the tested groups (groups A, B, and C) and two levels of dependent variables the measuring periods (both before and after treatment) for ROM. When a pairwise comparison of the tested variables with a significant P-value from the MANOVA test was made, the Bonferroni adjustment test was utilized. There was a high level of statistical significance in all analyses ($P < 0.05$).

Results

Prior to statistical analysis, the normality of data distribution was assessed using the Shapiro–Wilk test. All variables demonstrated normal distribution (P > 0.05), supporting the use of parametric tests. Additionally, homogeneity of variances was evaluated using Levene's test. Accordingly, parametric tests including ANOVA and mixed-design MANOVA were applied for data analysis.

There were an overall of 60 patients in the present study, with 20 men and 39 females divided equally among three groups of 20 each. The clinical general characteristics (Table 1) of groups A, B, and C did not differ significantly (P<0.05) in terms of patients' age (P=0.805), weight (P=0.795), height (P=0.397), body mass index (BMI) (P=0.969), or sex (P=0.138).

Table 1. General clinical characteristics of patients

Items		Groups			P-value
		Group A (n=20)	Group B (n=20)	Group C (n=20)	
Quantitative variables		Mean ±SD	Mean ±SD	Mean ±SD	
Age (year)		25.85 ±4.05	26.85 ±3.15	27.25 ±4.66	0.805
Weight (kg)		69.60 ±10.77	69.60 ±11.18	67.75 ±7.44	0.795
Height (cm)		167.45 ±7.15	167.40 ±11.63	164.20 ±5.89	0.397
BMI (kg/m²)		24.68 ±2.46	24.73 ±2.12	24.86 ±2.19	0.969
Qualitative variable		Number (%)	Number (%)	Number (%)	
Gender	Males	7 (35.00%)	10 (50.00%)	4 (20.00%)	0.138
	Females	13 (65.00%)	10 (50.00%)	16 (80.00%)	

Group A: received conventional PT; Group B: received SNAGs; Group C: received INIT
Quantitative variables data (age, weight, height, and BMI) are reported as mean ±standard deviation and compared by ANOVA test.
Qualitative variable data (gender) are reported as frequency (percentage) and compared by Chi-square test; P-value: probability value

Group A (P=0.003), group B (P=0.0001), and group C (P=0.0001) all showed significantly lower levels of pain after treatment compared to before treatment, according to statistical multiple pairwise comparison tests for flexion, extension, as well as pain (Table 2). In addition, flexion and extension were shown to be significantly greater after treatment (P<0.05) compared to before treatment in groups A, B, and C, with corresponding p-values of 0.025, 0.009, and 0.0001, respectively. After treatment, groups C, B, and A all showed significant improvements in pain, ROM, along with extension. Furthermore, the patients in group C improved higher pain, flexion, and extension (64.89, 22.05, and 21.20%, respectively) followed by those in group B (63.01, 17.01, and 14.97%, respectively) and then those in group A (20.98, 6.43, and 4.11%, respectively).

There were no significant differences (P>0.05) in pain (P=0.235), flexion (P=0.668), as well as extension (P=0.795) at pre-treatment when comparing groups, A, B, and C statistically using multiple pairwise comparison tests (Table 2). Nonetheless, post-treatment pain (P=0.001), flexion (P=0.0001), and extension (P=0.0001) scores were significantly different (P>0.05) between groups A, B, and C. Group A compared to group B and group C after treatment in terms of pain, flexion, along with extension (P=0.001, P=0.014, and P=0.0001, respectively), as well as group A compared to group C (P=0.0001, P=0.001, and P=0.0001, respectively). However, there were no significant differences (P>0.05) among group B and group C (P=0.763, P=0.750, and P=0.349, respectively). The post-hoc test was conducted using data from Table 2. Post-hoc test and mean differences among groups revealed that the INIT program (group C) and SNAGs program (group B) gave the highest response for pain, flexion, and extension compared to conventional physical therapy program (group A).

The results of statistical multiple pairwise comparison tests for rotation and side bending within each group (Table 3) showed that the right and left side bending at post-treatment when compared with before treatment were significantly (P<0.05) higher in groups A (P=0.003 and P=0.003, respectively), B (P=0.0001 and P=0.0001, respectively), and C (P=0.0001 and P=0.0001, respectively). Additionally, there were significant (P<0.05) increases in right and left rotation after treatment compared to before treatment in groups A (P=0.011 and P=0.047), B (P=0.001 and P=0.0001), and C (P=0.0001 and P=0.0001). The results show that after treatment, group C had the most significant changes in side bending and rotation, followed by group B after that group A. Furthermore, the patients in group C improved higher right and left of lateral (23.86 and 27.05%, respectively) and rotation (23.96 and 20.66%, respectively) followed by those in group B (21.23, 22.02, 14.33, and 16.94%, respectively) and then those in group A (6.84, 9.46, 7.70, and 4.50%, respectively).

Table 2. Within and between group comparison for pain, flexion, and extension

Variables	Items	Groups (Mean ±SD)			Effect size	P-value²	Post-hoc test (P-value3)		
		Group A (n=20)	Group B (n=20)	Group C (n=20)	(η^2)		Group A vs. Group B	Group A vs. Group C	Group B vs. Group C
Pain	Pre-treatment	7.15 ±2.00	7.30 ±1.12	6.55 ±1.60	0.025	0.235	0.882	0.759	0.601
	Post-treatment	5.65 ±1.46	2.70 ±0.92	2.30 ±1.41	0.201	0.001*	0.001*	0.0001*	0.763
	MD (Change)	1.50	4.60	4.25					
	95% CI	0.28 – 2.72	3.68 – 5.52	3.33 – 5.17					
	Improvement %	20.98%	63.01%	64.89%					
	Effect size (η^2)	0.125	0.453	0.464					
	P-value¹	0.003*	0.0001*	0.0001*					
Flexion	Pre-treatment	37.30 ±6.22	38.50 ±9.63	37.65 ±8.53	0.007	0.668	0.741	0.856	0.623
	Post-treatment	39.70 ±3.16	45.05 ±14.84	45.95 ±5.15	0.431	0.0001*	0.014*	0.010*	0.750
	MD (Change)	2.40	6.55	8.30					
	95% CI	0.80– 4.00	1.90 – 11.20	2.05 – 14.55					
	Improvement %	6.43%	17.01%	22.05%					
	Effect size (η^2)	0.043	0.059	0.238					
	P-value¹	0.025*	0.009*	0.0001*					
Extension	Pre-treatment	38.95 ±6.09	39.40 ±10.12	38.49 ±8.56	0.004	0.795	0.891	0.895	0.803
	Post-treatment	40.55 ±4.41	45.30 ±11.46	46.65 ±7.97	0.286	0.0001*	0.0001*	0.0001*	0.349
	MD (Change)	1.60	5.90	8.16					
	95% CI	0.68– 2.52	0.96 – 10.84	1.61 – 14.71					
	Improvement %	4.11%	14.97%	21.20%					
	Effect size (η^2)	0.046	0.128	0.525					
	P-value¹	0.039*	0.0001*	0.0001*					

Group A: received conventional PT; Group B: received SNAGs; Group C: received INIT
Data are expressed as mean ± standard deviation (SD) and compared statistically by 3x2 MANOVA test.
MD: Mean difference 95% CI: confidence interval P-value: probability value * Significant (P<0.05)
P-value1: Probability value within each group; P-value2: probability value among groups; P-value3: probability value between pairwise groups (post-hoc test)

According to Table 3, there were no significant differences (P>0.05) in right side bending (P=0.275), left lateral (P=0.293), right rotation (P=0.425), and left extension (P=0.163) at pre-treatment when comparing groups A, B, and C statistically. After treatment, however, groups A, B, and C differed significantly (P>0.05) in terms of right lateral pain (P=0.0001), left lateral pain (P=0.0001), right rotation (P=0.001), as well as left extension (P=0.001). A post-hoc analysis of the data in Table 3 showed that at post-treatment, there were significant differences (P<0.05) in right side bending, left side bending, right rotation, in addition to left rotation between groups A and B (P=0.001, P=0.001, P=0.0001, and P=0.0001, respectively) and between groups A and C (P=0.0001, P=0.001, P=0.0001, and P=0.0001, respectively). However, there were no significant differences (P>0.05) among groups B and C (P=0.520, P=0.898, P=0.719, and P=0.658, respectively). Post-hoc test as well as mean differences among groups revealed that the INIT program (group C) and SNAGs program (group B) gave the highest response for lateral and rotation compared to conventional physical therapy program (group A).

Table 4 shows the results of statistical multiple pairwise comparison tests for NDI as well as PPT within each group. As when compared with before treatment, NDI was significantly reduced in group A (P=0.001), group B (P=0.0001), and group C (P=0.0001) after treatment. Additionally, in groups A (P=0.039), B (P=0.006), and C (P=0.0001), there was a significantly greater PPT after therapy compared to before treatment (P<0.05). After treatment, groups C, B, and A all show statistically significant improvements in NDI and PPT. Furthermore, the patients in group C improved higher NDI and PPT (73.08 and 37.42%, respectively) followed by those in group B (69.26 and 26.44%, respectively) and then those in group A (28.21 and 12.73%, respectively).

Table 4 shows the results of statistical multiple pairwise comparison tests for NDI as well as PPT within each group. As when compared with before treatment, NDI was significantly reduced in group A (P=0.001), group B (P=0.0001), and group C (P=0.0001) after treatment. Additionally, in groups A (P=0.039), B (P=0.006), and C (P=0.0001), there was a significantly greater PPT after therapy compared to before treatment (P<0.05). After treatment, groups C, B, and A all show statistically significant improvements in NDI and PPT. Post-hoc test and mean differences among groups showed that the INIT program (group C) and SNAGs program (group B) gave the highest response for NDI and PPT compared to traditional physiotherapy program (group A).

Table 3. Within and between group comparison for lateral and rotation

Variables	Items	Groups (Mean ±SD)			Effect size	*P*-value[2]	Post-hoc test (P-value3)		
		Group A (n=20)	Group B (n=20)	Group C (n=20)	(η^2)		Group A *vs.* Group B	Group A *vs.* Group C	Group B *vs.* Group C
Right lateral	Pre-treatment	36.55 ±7.95	35.80 ±4.77	36.05 ±6.19	0.022	0.275	0.781	0.793	0.896
	Post-treatment	39.05 ±6.96	43.40 ±2.34	44.65 ±4.34	0.355	0.0001*	0.001*	0.0001*	0.520
	MD (Change)	2.50	7.60	8.60					
	95% CI	1.90 – 3.10	5.00 – 10.20	5.00 – 12.20					
	Improvement %	6.84%	21.23%	23.86%					
	Effect size (η^2)	0.075	0.265	0.354					
	P-value[1]	0.003*	0.0001*	0.0001*					
Left lateral	Pre-treatment	38.05 ±6.73	38.15 ±4.67	37.15 ±6.50	0.021	0.293	1.000	0.798	0.786
	Post-treatment	41.65 ±6.94	46.55 ±1.70	47.20 ±6.99	0.409	0.0001*	0.001*	0.001*	0.898
	MD (Change)	3.60	8.40	10.05					
	95% CI	1.89 – 5.31	3.69 – 13.11	6.34 – 13.76					
	Improvement %	9.46%	22.02%	27.05%					
	Effect size (η^2)	0.073	0.121	0.232					
	P-value[1]	0.003*	0.0001*	0.0001*					
Right rotation	Pre-treatment	49.35 ±8.51	51.30 ±8.43	48.20 ±8.87	0.015	0.425	0.659	0.722	0.351
	Post-treatment	53.15 ±4.70	58.65 ±11.26	59.75 ±6.34	0.324	0.001*	0.0001*	0.0001*	0.719
	MD (Change)	3.80	7.35	11.55					
	95% CI	1.60 – 6.00	1.85 – 12.85	3.35 – 19.75					
	Improvement %	7.70%	14.33%	23.96%					
	Effect size (η^2)	0.056	0.085	0.208					
	P-value[1]	0.011*	0.001*	0.0001*					
Left rotation	Pre-treatment	50.45 ±10.45	51.05 ±7.00	50.35 ±9.47	0.029	0.163	0.841	1.000	0.839
	Post-treatment	52.72 ±4.97	59.70 ±10.76	60.75 ±5.27	0.319	0.001*	0.0001*	0.0001*	0.658
	MD (Change)	2.27	8.65	10.40					
	95% CI	0.13 – 4.41	5.43 – 11.87	5.18 – 15.62					
	Improvement %	4.50%	16.94%	20.66%					
	Effect size (η^2)	0.034	0.213	0.320					
	P-value[1]	0.047*	0.0001*	0.0001*					

Group A: received conventional PT; Group B: received SNAGs; Group C: received INIT
Data are expressed as mean ± standard deviation (SD) and compared statistically by 3x2 MANOVA test.
MD: Mean difference 95% CI: confidence interval P-value: probability value * Significant (P<0.05)
P-value1: Probability value within each group; P-value2: probability value among groups; P-value3: probability value between pairwise groups (post-hoc test)

Discussion

Gautam et al. (2014) compared the effects of Maitland and Mulligan mobilization techniques in treating of NSNP among 30 patients, divided into three groups: Traditional physiotherapy was administered to Group A (control), Group B was given Maitland grade two oscillatory motions in their treatment, and Group C included Mulligan mobilization with traditional treatment. Supporting its greater effectiveness in the treatment of NSNP, findings demonstrated that Mulligan mobilization was more successful in relieving both pain and enhancing active ROM compared to Maitland mobilization (Yin et al., 2024).

Table 4. Within and between group comparison for NDI and PPT

Variables	Items	Groups (Mean ±SD)			Effect size	*P*-value[2]	Post-hoc test (P-value3)		
		Group A (n=20)	Group B (n=20)	Group C (n=20)	(η²)		Group A *vs.* Group B	Group A *vs.* Group C	Group B *vs.* Group C
NDI	Pre-treatment	15.60 ±5.82	15.45 ±4.59	16.90 ±5.26	0.013	0.475	1.000	0.629	0.562
	Post-treatment	11.20 ±2.48	4.75 ±2.55	4.55 ±2.54	0.483	0.0001*	0.001*	0.0001*	0.864
	MD (Change)	4.40	10.70	12.35					
	95% CI	1.81 – 6.99	8.11 – 13.29	9.76 – 14.94					
	Improvement %	28.21%	69.26%	73.08%					
	Effect size (η²)	0.258	0.414	0.441					
	P-value[1]	0.001*	0.0001*	0.0001*					
PPT	Pre-treatment	1.65 ±0.43	1.74 ±0.57	1.63 ±0.25	0.019	0.331	1.000	1.000	0.753
	Post-treatment	1.86 ±0.46	2.20 ±0.65	2.24 ±0.45	0.254	0.001*	0.015*	0.009*	0.995
	MD (Change)	0.21	0.46	0.61					
	95% CI	0.06 – 0.36	0.13 – 0.79	0.15 – 1.07					
	Improvement %	12.73%	26.44%	37.42%					
	Effect size (η²)	0.048	0.275	0.397					
	P-value[1]	0.039*	0.006*	0.0001*					

Group A: received conventional PT; Group B: received SNAGs; Group C: received INIT
Data are expressed as mean ± standard deviation (SD) and compared statistically by 3x2 MANOVA test.
MD: Mean difference 95% CI: confidence interval P-value: probability value * Significant (P<0.05)
P-value1: Probability value within each group; P-value2: probability value among groups; P-value3: probability value between pairwise groups (post-hoc test)

Consistent with the present study, Ismail (2008) examined the outcomes of strength, endurance, as well as flexibility training program for patients suffering from chronic mechanical neck pain. The experimental group engaged in stretching, endurance, along with strengthening activities, while the control group just engaged in strength and stretching. There was increase in ROM, neck pain, along with disability, according to the findings (Edris et al., 2017).

Consistent with the present study Lytras et al. (2020), which compared two groups treated for chronic mechanical neck pain utilizing a program that included exercise as well as an integrated neuromuscular inhibition approach. Results demonstrated that patients with CMNP saw improvements in pain, functional capacity, and quality of life after incorporating the INIT into a therapeutic exercise program (You et al., 2022).

The findings of the present study can also be interpreted in the context of studies employing different therapeutic approaches. For example, exercise-based interventions alone have been shown to improve pain and function in patients with non-specific neck pain; however, the magnitude of improvement is often lower compared to combined or manual therapy approaches. Similarly, studies utilizing electrotherapy modalities such as ultrasound or TENS have reported modest short-term benefits, but these effects are generally less pronounced than those observed with manual therapy techniques targeting joint mobility and myofascial dysfunction.

The superior improvements observed in both SNAGs and INIT groups in the current study may be attributed to their direct mechanical and neurophysiological effects. SNAGs primarily address joint dysfunction and facilitate pain-free movement, whereas INIT targets myofascial trigger points and neuromuscular imbalance. This difference in mechanisms may explain why both approaches were effective, yet INIT demonstrated slightly greater clinical improvements. These findings suggest that interventions combining joint mobilization and soft tissue techniques may offer enhanced therapeutic benefits.

Limitations

Some limitations should be acknowledged. The relatively small sample size may limit the generalizability of the results. The short intervention period (4 weeks) does not allow for evaluation of long-term effects. Future studies with larger sample sizes, longer follow-up periods, and multicenter designs are recommended to confirm and extend these findings.

Conclusions

This study found that patients with NSNP who received SNAGs or INIT in addition to a traditional physiotherapy program had significantly better results in pain intensity level, cervical ROM, neck functional level, as well as PPT compared to patients who received only traditional physiotherapy program.

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Conflict of interests

There is no declaration of conflict of interest.

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Authors and translators' details:

Hajar M. Edris	Hajar.Mohammed@muc.edu.eg	Author
Mohammed E. Abdulalim	dr.ashafei@gmail.com	Author
Ahmed Salim Mohamed Salim	Ahmed.Salem@sue.edu.eg	Author
Khaled Alaa Eldin Fetouh	Khaled.alaaeldin@ksiu.edu.eg	Author
Nagwa Sayed Abdelwahed	nagwa.abelwahed@muc.edu.eg	Author
Maha Samir Younis Ahmed	Maha.younis@muc.edu.eg	Author
Doaa Mohammed El Ghazally El Zawhry	Doaa.alghazaly@muc.edu.eg	Author
Mennatallah M. Abdellatif	mannosh.mohammed4@gmail.com	Author