Upper cervical translatoric mobilization versus suboccipital muscle energy technique in patients with mechanical neck pain and forward head posture

Movilización traslatoria cervical superior versus técnica de energía muscular suboccipital en pacientes con dolor mecánico de cuello y postura de la cabeza hacia adelante

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Abstract

Background: Mechanical neck pain (MNP) is frequently associated with forward head posture (FHP), yet optimal management remains debated.
Objectives: to compare the effects of upper cervical translatoric mobilization (UC-TSM) versus suboccipital muscle energy technique (MET), when combined with traditional physical therapy, in patients with MNP and FHP.
Subjects and Methods: Forty-four patients aged 25–40 years were randomly allocated into three groups: Group A (n=15) received UC-TSM plus conventional therapy, Group B (n=15) received suboccipital MET plus conventional therapy, and Group C (n=14) received conventional therapy alone. Three times weekly for four weeks. Outcome measures: were assessed pre- and post-treatment included pain intensity (Visual Analogue Scale), cervical range of motion (CROM device), neck disability (Neck Disability Index), and craniovertebral angle (photographic analysis via Surgimap software).
Results: Baseline characteristics were comparable across groups ($p>0.05$). All groups demonstrated significant within-group improvements post-treatment in pain, disability, range of motion, and craniovertebral angle ($p<0.05$). However, Group A exhibited significantly greater reductions in pain and disability, and more pronounced craniovertebral angle improvement compared to Groups B and C ($p<0.05$). No significant between-group differences were observed in cervical range of motion ($p>0.05$).
Conclusion: Adding UC-TSM to traditional physical therapy yields superior outcomes in alleviating pain, reducing disability, and correcting forward head posture compared to suboccipital MET or conventional therapy alone in patients with mechanical neck pain and FHP.

Keywords

Forward head posture, upper cervical translatoric mobilization, suboccipital muscle energy technique, mechanical neck pain.

Resumen

Antecedentes: El dolor mecánico de cuello (MNP) se asocia frecuentemente con la postura de la cabeza hacia adelante (FHP), pero el manejo óptimo sigue siendo debatido. Objetivos: comparar los efectos de la movilización translatoria cervical superior (CU-TSM) versus la técnica de energía muscular suboccipital (MET), cuando se combina con fisioterapia tradicional, en pacientes con MNP y FHP.
Sujetos y Métodos: Cuarenta y cuatro pacientes de edad 25-40 años fueron asignados al azar en tres grupos: Grupo a (n=15) recibió de la UC-TSM además de la terapia convencional, el Grupo B (n=15) recibió suboccipitales se REUNIÓ además de la terapia convencional, y el Grupo C (n=14) recibieron terapia convencional solo. Tres veces por semana durante cuatro semanas. Medidas de resultados: fueron evaluados antes y después del tratamiento incluyen la intensidad del dolor (Escala Visual Analógica), el rango de movimiento (CROM dispositivo), el cuello de la discapacidad (Índice de Discapacidad cervical), y craniovertebral ángulo fotográfico a través de análisis de Surgimap software).
Resultados: Las características basales fueron comparables entre los grupos ($p>0,05$). Todos los grupos demostraron mejoras significativas dentro del grupo después del tratamiento en dolor, discapacidad, rango de movimiento y ángulo craneovertebral ($p < 0,05$). Sin embargo, el Grupo A mostró reducciones significativamente mayores en el dolor y la discapacidad, y una mejora del ángulo craneovertebral más pronunciada en comparación con los Grupos B y C ($p < 0,05$). No se observaron diferencias significativas entre grupos en el rango de movimiento cervical ($p>0,05$).
Conclusión: Agregar UC-TSM a la fisioterapia tradicional produce resultados superiores para aliviar el dolor, reducir la discapacidad y corregir la postura de la cabeza hacia adelante en comparación con MET suboccipital o terapia convencional sola en pacientes con dolor de cuello mecánico y FHP.

Palabras clave

Postura de la cabeza hacia adelante, movilización traslatoria cervical superior, técnica de energía muscular suboccipital, dolor mecánico de cuello.

Introduction

Mechanical neck pain (MNP) is a common musculoskeletal disorder and a frequent complaint in primary care settings (Ferrari & Russell, 2003). Prolonged sitting and altered head–neck posture can increase cervical extensor muscle activity and mechanical load on the cervico-thoracic region, which may contribute to symptoms (Edmondston et al., 2011).

The suboccipital muscles are common sites of myofascial trigger points, which are linked to forward head posture (FHP) and can contribute to chronic neck pain and cervicogenic symptoms (Fernández-de-las-Peñas et al., 2006). Notably, these muscles contain a very high density of muscle spindles, functioning as key proprioceptive monitors that play an important role in head posture control (Kulkarni et al., 2001).

Upper cervical mobilization techniques, including Upper Cervical translatoric Segmental Mobilization (UC-TSM), are proposed to improve joint mobility and modulate pain by targeting upper cervical segmental dysfunction. Previous clinical studies have reported immediate improvements in cervical mobility and pressure pain sensitivity following upper cervical translatoric mobilization (Iqbal et al., 2015).

Muscle Energy Technique (MET) is a gentle manual therapy approach primarily targeting soft tissues, though it may also influence joint mobility. Suboccipital Muscle Energy Technique (MET) has been shown to improve craniovertebral and cranio-horizontal angles in individuals with forward head posture (Waje & Satralkar, 2020). In patients with mechanical neck pain, MET has been associated with reductions in pain and disability and can be as effective as static stretching (Phadke et al., 2016).

UC-TSM and Suboccipital MET are based on different biomechanical and neurophysiological concepts, while they are frequently used to treat MNP and FHP. In order to restore arthrokinematic glide and normalize cervical proprioceptive afferent signals, which are frequently compromised in

Chronic neck pain, UC-TSM is a joint oriented mobilization that mainly targets segmental hypomobility and dysfunctional mechanoreceptor input at the C0–C1–C2 levels (Dunning et al., 2012; Iqbal et al., 2015; Ghulam et al., 2023). MET, on the other hand, is a muscle-oriented approach that lengthens shortened suboccipital musculature, modulates muscle spindle sensitivity, and reduces myofascial tone by using submaximal isometric contractions followed by post-isometric relaxation (Joshi & Poojary, 2022; Sachin et al., 2026). It is still unclear which therapeutic target joint mechanics or myofascial tension is more crucial for the best clinical results because FHP involves a complex interplay of upper cervical joint positional faults, persistent hyperactivity of cervical extensors, and altered sensorimotor control (Jaganjyoti et al., 2024; Malviya, 2025). In order to support clinical decision making, a direct comparison of these two methods is not only appropriate but also essential. The rapidly increasing prevalence of FHP in the digital age further highlights this need due to prolonged smartphone use and sedentary postural habits (Apoorva & Digvijay, 2025). Finding the best manual therapy approach for this expanding patient population is therefore highly relevant today.

To the best of our knowledge, no previous study has directly compared the effects of UC-TSM and suboccipital MET. Therefore, this study was conducted to investigate and compare their effects on CVA, pain intensity, cervical ROM, and functional ability in patients with MNP and FHP.

Method

Study Design

This study was a randomized, single-blind clinical trial (blinding applied to the outcome assessor). Participants were recruited from Benha University Hospitals, and the study was conducted at the Physical Therapy Outpatient Clinic, Faculty of Physical Therapy, Benha University.

Ethical considerations

All participants provided written informed consent after receiving a detailed explanation of the study's aims and procedures. This study complied with national regulations, institutional policies, and the prin-

ciples of the Declaration of Helsinki. It was approved by the Faculty of Physical Therapy Ethics Committee, Benha University, Benha, Egypt (Approval No.: PT.BU.EC0.22) and was registered in the ClinicalTrials.gov with identification number (NCT07164963).

Participants

Forty-four participants (23 females and 21 males), aged 25–40 years, were recruited from the outpatient clinic of the Faculty of Physical Therapy, Benha University diagnosed with MNP and FHP for at least three months, MNP was diagnosed based on the clinical practice guidelines established by Blanpied et al. (2017).

Inclusion criteria

Patients were included if they had:

- Unilateral or bilateral neck pain of ≥3 months duration, localized to the cervical region or radiating to the shoulder/scapular area without distal radiation beyond the elbow.
- Pain reproduced or aggravated by active cervical movement or sustained postures.
- Neck disability index (NDI) score between 22 and 40 points (44%–80%) using the validated Arabic version of the NDI (Shaheen et al., 2016).
- Forward head posture, evidenced by a reduced CVA.
- Normal neurological screening.

Exclusion criteria

Patients excluded if they had:

- History of trauma to cervical region, spinal surgery, malignancy, or systemic pathology.

Randomization

Sixty individuals were assessed for eligibility. Ten were excluded, five didn't meet inclusion criteria, four declined to participate, and other reasons was one. Forty-four participants were randomized into three groups (Group A, n = 15, Group B, n = 15, Group C, n = 14) (Figure 1).

Group A (n = 15): UC-TSM + traditional physical therapy,

Group B (n = 15): Suboccipital Muscle Energy Technique (MET) + traditional physical therapy,

Group C (n = 14): Traditional physical therapy only (hot packs and Kendall exercises) (Kendall et al., 2005; Cramer et al., 2012).

Allocation concealment was achieved using sequentially numbered, opaque, sealed envelopes. Randomization was performed by a researcher not involved in treatment or data collection. Two therapists delivered the interventions and were not blinded to group assignment. A third blinded assessor conducted all pre- and post-intervention measurements.

Instrumentation and Procedures

All participants were assessed before the first session and after completing the four-week program.

a. Assessment of CVA

The craniovertebral angle was measured using photographic posture analysis via Surgimap software, a method validated for CVA measurement (Aafreen et al., 2023). A 64-megapixel camera (Oppo Reno 12) was mounted on a tripod 50 cm from the participant, with the lens aligned to shoulder height. Participants stood in a relaxed, neutral posture, looking straight ahead at an eye-level target. The right ear tragus and C7 spinous process were marked, and a lateral photograph was captured.

b. Assessment of Cervical ROM

Cervical active range of motion in flexion and extension was measured using a Cervical Range of Motion (CROM) device, a reliable inclinometer-based system that measures motion in all planes (Hole et al., 1995).

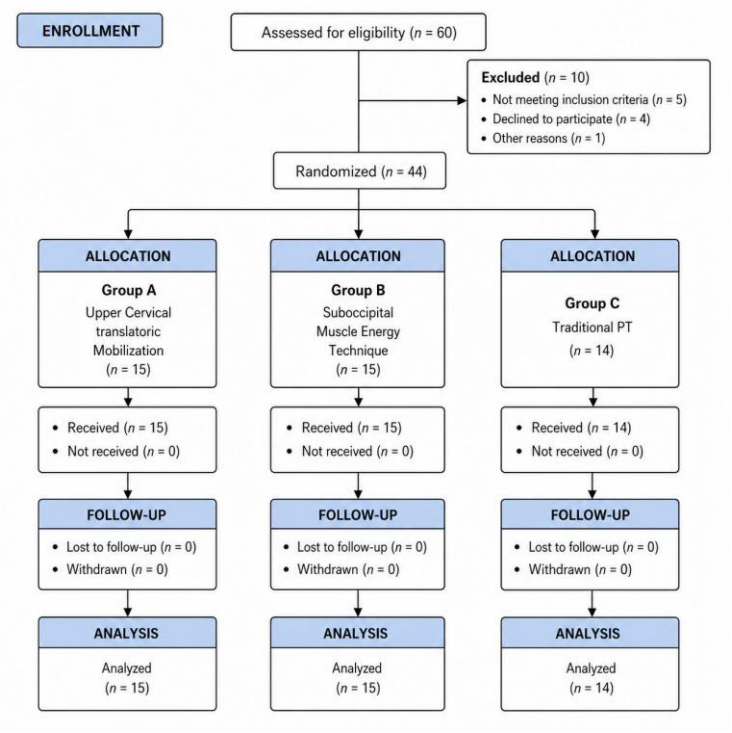
c. Assessment of Pain Intensity

Pain was assessed using the Visual Analogue Scale (VAS), a 10-cm line anchored by "no pain" (0) and "worst imaginable pain" (10) (Abd Elrazik et al., 2021).

d. Assessment of Neck Functional Ability

The Arabic version of the Neck Disability Index (NDI; total score 0–50) was used, which has been validated as a reliable and responsive tool for Arabic-speaking patients with neck pain (Shaheen et al., 2013). For reporting, the raw NDI total score was converted to a percentage (NDI%) by multiplying by 2.

Figure 1. CONSORT flow diagram of participant enrollment, allocation, follow-up, and analysis



Intervention

All groups received the same traditional physical therapy program three times per week for four weeks:

Hot packs applied for 20 minutes (Cramer et al., 2012), followed by Kendall exercises, including:

(a) Deep cervical flexor strengthening: Supine chin tuck held for 2–8 seconds,

(b) Cervical extensor stretching: Seated, hands-on occiput and chin, gentle neck flexion held for 30 seconds,

(c) Shoulder retraction strengthening: Using a TheraBand, pulling backward to bring scapulae together,

(d) Pectoralis major stretching: Therapist-assisted bilateral stretch.

Each strengthening exercise was performed for 3 sets of 12 repetitions; each stretch was held for 30 seconds and repeated 3 times (Kendall et al., 2005).

Group A (UC-TSM + traditional therapy)

Fifteen patients received UC-TSM in addition to the traditional program. Each session included 30-second series of upper cervical translatoric mobilizations with 10-second rests, totaling 30 minutes.

Technique: Patient supine, cervical spine neutral. Therapist placed one hand dorsally at the C1 vertebral arch (using the radial border of the index finger) and the other hand was placed posteriorly under the

occiput, with the shoulder positioned anteriorly on the patient's forehead. The mobilization force was directed dorsally from the shoulder until the therapist felt a marked resistance and then applied slightly more pressure in order to perform a stretching mobilization. No pain was reported by the subjects during the intervention (Iqbal et al., 2005).

Group B (Suboccipital Muscle Energy Technique (MET) + traditional therapy)

Fifteen patients received suboccipital MET plus the traditional program.

Technique: Patient supine. Therapist stood at the head, supporting the occiput with one hand and the forehead with the other. The patient performed a submaximal isometric contraction into cervical extension against resistance for 10 seconds, then relaxed. The therapist then passively stretched the suboccipital muscles for 20 seconds. This sequence was repeated 3 times to induce post-isometric relaxation (Chaitow, 2014; Balaji et al., 2025).

Group C (Control)

Fourteen patients received only the traditional physical therapy program (hot packs + Kendall exercises).

Sample Size Determination

Sample size was calculated a priori using G*Power software (v3.1.9.2). Based on a pilot study (n = 15; 5 per group) with CVA as the primary outcome, the following parameters were used:

Test: ANOVA (Repeated measures, within-between interaction),

$\alpha = 0.05$, $\beta = 0.10$ (power = 90%),

Effect size (f) = 0.322,

Partial $\eta^2 = 0.098$.

The analysis indicated a required sample size of 36 participants. Accounting for potential dropouts, we aimed for 45, but ultimately included 44 (15, 15, and 14) with complete follow-up.

Statistical Analysis

Descriptive statistics are presented as mean ± standard deviation. The Shapiro-Wilk test was used to assess normality of the data. A two-way mixed ANOVA (group [A, B, C] × time [pre, post]) was performed for each continuous outcome (VAS, NDI%, CVA, and cervical ROM). Where significant interactions or main effects were detected, post hoc pairwise comparisons were conducted with Tukey's honestly significant difference (HSD) test. Baseline between-group differences in demographic variables were examined using one-way ANOVA for continuous variables and the chi-square test for categorical variables. Statistical significance was set at $p < 0.05$. P values were reported to three decimal places; values < 0.001 were reported as <0.001.

Results

Baseline characteristics

Descriptive statistics for demographic data of the three groups were shown in Table 1. There were no significant differences between groups in baseline characteristics ($p > 0.05$).

Table 1. Descriptive statistics for demographic data of the three groups.

Variable	Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD	P value
Age (year)	32.93±5.85	33.6±5.68	34.36±5.33	0.79
Weight (kg)	78.4±5.91	79.13±5.78	77.86±6.31	0.85
Height (cm)	172.13±7.93	172.4±6.4	174.21±8.36	0.73
BMI (kg/m²)	26.65±3.43	26.71±2.55	25.78±2.95	0.66
Gender (M/F)	7/8	7/8	7/7	0.98

Group A: Upper Cervical translatoric Segmental Mobilization (UC-TSM), Group B: Suboccipital Muscle Energy Technique (MET), Group C: Traditional physical therapy, SD: Standard deviation, P: p value, BMI: Body mass index, M: Male, F: Female

Within and between group comparisons in pain, disability, CVA, and ROM

Descriptive statistics for pain (VAS), disability (NDI%), CVA, and ROM (cervical flexion and extension) are presented in Table 2. The mixed ANOVA showed significant time effects within the three groups for all outcomes post-treatment ($p < 0.05$). There were no significant differences between groups at pre-treatment; however, significant between-group differences were observed at post-treatment in pain, disability, and CVA (Table 2). Tukey HSD post hoc comparisons showed that Group C had higher pain post-treatment compared with Group A (MD = 2.1, $p < 0.001$) and Group B (MD = 1.7, $p = 0.004$); Group A had lower disability post-treatment compared with Group B (MD = -10.1, $p = 0.002$) and Group C (MD = -15.3, $p = 0.001$); and Group A had higher CVA post-treatment compared with Group B (MD = 2.4, $p = 0.047$) and Group C (MD = 3.9, $p = 0.001$) (Table 3).

Table 2. Descriptive and analytical statistics for pain, disability (NDI%), CVA, and ROM within and between the three groups

Variable	Time	Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD	Between groups P value
Pain	Pre	6.73±1.163	6.33±1.397	6.43±1.453	0.700
	Post	3.00±1.254	3.40±0.986	5.07±1.639	<0.001
Within group MD (SD), Cohen's d, P value		3.7 (1.5), 2.43, <0.001	2.9 (0.8), 3.67, <0.001	1.4 (1.1), 1.23, <0.001	—
Disability (NDI%)	Pre	58.26±8.648	58.26±8.514	59.58±8.950	0.900
	Post	36.00±9.072	46.14±5.316	51.28±8.250	<0.001
Within group MD (SD), Cohen's d, P value		22.2 (7.6), 2.93, <0.001	12.2 (5.2), 2.32, <0.001	8.2 (3.50), 2.37, <0.001	—
CVA	Pre	42.033±3.2412	42.947±3.8262	43.629±3.3960	0.470
	Post	49.740 ±1.4836	47.327±3.0628	45.871±3.2111	0.001
Within group MD (SD), Cohen's d, P value		-7.7 (3.5), -2.23, <0.001	-4.4 (2.3), -1.93, <0.001	-2.2 (1.9), -1.2, 0.001	—
Cervical flexion ROM	Pre	40.433±0.9715	40.633±1.6034	40.143±1.6626	0.660
	Post	50.253±2.1820	50.533±4.1381	48.671±2.0296	0.210
Within group MD (SD), Cohen's d, P value		-9.8 (2.1), -4.58, <0.001	-9.9 (3.6), -2.75, <0.001	-8.5 (2.5), -3.39, <0.001	—
Cervical extension ROM	Pre	58.80±8.002	60.13±7.318	59.71±7.151	0.880
	Post	60.13±7.308	61.93±6.892	61.21±6.727	0.780
Within group MD (SD), Cohen's d, P value		-1.2 (2.3), -0.85, 0.040	-1.8 (1.9), -0.97, 0.002	-1.5 (1.1), -1.37, <0.001	—

Group A: Upper Cervical translatoric Segmental Mobilization (UC-TSM), Group B: Suboccipital Muscle Energy Technique (MET), Group C: Traditional physical therapy, ROM: Range of motion, MD: Mean difference, SD: Standard deviation, P: p value

Table 3. Tukey HSD post hoc multiple comparisons between groups for pain, disability (NDI%), and CVA post-treatment.

Variable	Groups	MD	SE	Effect size (Cohen's d)	P value	95% Confidence Interval		Power (%)
						Lower Bound	Upper Bound	
Pain Post	A vs B	-0.400	0.479	-0.36	0.684	-1.56	0.76	16
	A vs C	-2.071*	0.487	-1.43	<0.001	-3.26	-0.89	95
	B vs C	-1.671*	0.487	-1.25	0.004	-2.86	-0.49	90
Disability Post (NDI%)	A vs B	-10.134*	2.812	-1.36	0.002	-16.98	-3.30	95
	A vs C	-15.286*	2.862	-1.76	<0.001	-22.24	-8.32	99
	B vs C	-5.152	2.862	-0.75	0.182	-12.12	1.80	51
CVA Post	A vs B	2.4133*	0.9814	1	0.047	0.027	4.800	74
	A vs C	3.8686*	0.9988	1.57	0.001	1.440	6.297	98
	B vs C	1.4552	0.9988	0.46	0.322	-0.974	3.884	22

Group A: Upper Cervical translatoric Segmental Mobilization (UC-TSM), Group B: Suboccipital Muscle Energy Technique (MET), Group C: Traditional physical therapy, MD: Mean difference, SE: Standard error, P: p value, CVA: Craniovertebral angle.

Discussion

The present study compared the efficacy of Upper Cervical translatoric Mobilization (UC-TSM) and Suboccipital Muscle Energy Technique (MET) as adjuncts to traditional physical therapy in patients with Mechanical Neck Pain (MNP) and Forward Head Posture (FHP). The results indicate that while both manual therapy approaches enhance outcomes, UC-TSM combined with conventional therapy yields superior improvements in pain, functional disability, and postural alignment compared to MET and traditional therapy alone.

Improvement in Craniovertebral Angle (CVA)

These improvements may be attributed to components of the traditional therapy protocol, including deep cervical flexor activation (e.g., craniocervical flexion exercises) and postural re-education (Kay et al., 2012; Blanpied et al., 2017).

In the current study, improvements in CVA were significantly greater in the UC-TSM group compared with conventional therapy alone. One plausible explanation is that upper cervical mobilization may help normalize cervical afferent input and facilitate more efficient postural control strategies. Altering cervical proprioceptive input has been shown to modify postural reactions (Li et al., 2022), and proprioceptive impairment is a recognized feature of chronic neck pain (Stanton et al., 2015; Peng et al., 2021).

Restoring a more neutral head posture may reduce sustained muscle loading on cervical extensors and decrease stress on passive structures, which can contribute to symptom improvement (Edmondston et al., 2011; Sun et al., 2014).

Additionally, forward head posture has been associated with altered cervical sagittal alignment and increased strain on posterior cervical tissues, potentially contributing to mechanical neck pain (Sun et al., 2014).

All groups reported decreased pain intensity post-intervention, but Group A showed the greatest reduction in VAS scores (from 6.73 to 3.00), significantly better than Group B (to 3.40) and Group C (to 5.07). This indicates that UC-TSM contributes more substantially to pain relief than MET or traditional therapy alone. The analgesic effect of mobilization may stem from several mechanisms, including modulation of spinal nociceptive input via the gate control theory, inhibition of muscle spasm, and reduction of joint capsule tension (Bialosky et al., 2009).

In contrast, MET works primarily through post-isometric relaxation, autogenic inhibition via Golgi tendon organs, and normalization of muscle tone (Chaitow, 2014). While effective, these mechanisms may be less impactful in patients with joint hypomobility or segmental dysfunction. A systematic review by Coulter et al. (2019) found that spinal mobilization techniques significantly reduce pain in patients with mechanical neck pain, with effects superior to exercise alone. Our findings align with this evidence, reinforcing the value of joint mobilization in pain management.

Moreover, the persistent pain in Group C (reduction of only 1.4 points) highlights the limitations of relying solely on thermotherapy and general exercises without addressing joint or neuromuscular dysfunctions. This supports the integration of manual therapy into comprehensive rehabilitation programs (Gross et al., 2015).

Functional Disability (NDI)

Neck disability, measured via the Neck Disability Index (NDI), improved in all groups, but Group A showed the most significant functional gains (22.2 percentage-point reduction (NDI%)), significantly greater than Group B (12.2 points) and Group C (8.2 points). This underscores the clinical relevance of UC-TSM in improving daily functioning in the same line with Mohamed & Abd Elrazik (2020). The combination of pain relief, improved posture, and enhanced joint mobility likely contributes to improved sensorimotor control and movement confidence, leading to better functional outcomes (Zaidi et al., 2025).

The smaller improvement in Group C reflects the inadequacy of passive modalities like hot packs when used in isolation (Clijsen et al. 2022). While Kendall exercises are beneficial for strengthening and flexibility, they may not sufficiently address joint restrictions or neuromuscular inhibition commonly present in chronic neck pain. The addition of manual therapy appears essential for optimizing power and functional recovery (Abd Elrazik et al., 2021). It is also reported by Gross et al. (2015), who found that manual therapy combined with exercise leads to faster and more sustained improvements in neck disability.

Cervical Range of Motion (ROM)

Cervical flexion and extension range of motion improved in all groups, although there were no appreciable post-treatment group differences. This implies that rather than the particular manual approaches, the common elements of the intervention such as heat treatment, stretching, and active exercises may

be the main driver of ROM increases (Afonso et al., 2021). Both UC-TSM and MET may have a beneficial effect on ROM, however differing effects may show up over time or at larger dosages. However, the significance of the other results is not diminished by the lack of notable variations in ROM. In clinical practice, patients tend to value improvements in pain, posture, and function more than isolated increases in range of motion, particularly when there are deficiencies in cervical motor control (Picher et al., 2025).

Although improvements in cervical range of motion were statistically significant within all groups, these results must be interpreted in light of measurement accuracy. The CROM device has a Minimal Detectable Change (MDC95) of 4°–7° (Coulter et al., 2019; Malviya, 2025), while photographic analysis (Surgimap) has an MDC95 of 3°–5° for the craniovertebral angle (Audette et al., 2010). Consequently, the observed improvements in cervical flexion (~8.5°–9.9°) exceed the MDC95, indicating true clinical change. In contrast, the smaller gains in extension (~1.2°–1.8°) fall within the range of measurement error and should be attributed to variability rather than therapeutic effect. Crucially, primary outcomes (VAS, NDI, and CVA) all exceeded their respective Minimal Clinically Important Difference (MCID) thresholds, confirming the clinical relevance of UC-TSM despite the negligible changes in extension ROM.

Comparison Between UC-TSM and Suboccipital Muscle Energy Technique (MET)

In patients with MNP and FHP, this study is one of the first to directly compare UC-TSM and suboccipital MET. The findings indicate that UC-TSM is more successful in reducing pain, function, and posture, even though both are moderate, non-thrust manual procedures thought to be safe for the cervical spine. This could be because MET concentrates more on myofascial release and muscle length normalization, whereas it directly affects joint mechanics and proprioception.

Chronic neck pain is associated with muscle imbalance and reduced cervical range of motion, supporting the rationale for interventions targeting muscle function and mobility (Durall et al., 2012). In contrast, mobilization techniques have been shown to improve pain and postural control, particularly in the upper cervical region (Iqbal et al., 2015; Rana et al., 2025). These results support the hypothesis that joint-targeted interventions may be more effective for patients with FHP and associated sensorimotor deficits.

Clinical Implications

The results are in agreement with adding UC-TSM to physical therapy programs for young to middle-aged people with MNP and FHP. To improve pain alleviation, postural correction, and functional outcomes, clinicians should think about combining upper cervical mobilization with exercise therapy. UC-TSM might be a useful tool in outpatient orthopaedic and musculoskeletal rehabilitation settings because of its safety and simplicity of use.

Strengths and Limitations

This study's randomized controlled design, utilization of objective measurements (such as CROM and photographic posture analysis), and incorporation of validated outcome instruments (NDI and VAS) are among its strengths. Statistical reliability was improved by employing power analysis to establish the sample size beforehand.

Conclusions on the durability of benefits are limited by the short intervention period (4 weeks) and the absence of long-term follow-up. Furthermore, it was not possible to blind therapists, which could have introduced performance bias. Longer follow-up times, electromyographic (EMG) evaluations, and bigger sample sizes should be features of future research.

Future Research

Future studies should analyse the long-term effects of UC-TSM and MET, look into the best dosage (frequency and duration), and use surface EMG to assess how they affect cervical proprioception and muscle activation patterns. The relative advantages of various methods would be further clarified by comparative research with other manual techniques (such as Maitland mobilizations and Mulligan SNAGs).

Conclusion

MNP and FHP can be effectively managed with both UC-TSM and suboccipital MET in conjunction with conventional physical therapy. On the other hand, UC-TSM shows better results in terms of pain reduction, neck-related dysfunction improvement, and craniovertebral angle correction. These results confirm that the best manual therapy method for treating mechanical neck pain with forward head posture is upper cervical joint mobilization.

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