Original article

Efficacy of muscle energy technique with stretching versus muscle energy technique with myofascial release in upper cross syndrome

Eficácia da técnica de energia muscular com alongamento versus técnica de energia muscular com liberação miofascial na síndrome da cruz superior

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ABSTRACT | INTRODUCTION: Cervical pain represents one of the most prevalent musculoskeletal disorders, with the potential for secondary complications if left untreated. The primary causes of neck pain are cervical spine and soft tissue disorders, while neck pain due to postural abnormalities is known as upper cross syndrome (UCS). Epidemiological studies indicate that neck pain is prevalent in the general population but is significantly more common among office workers. Optimal management strategies require further investigation to improve treatment outcomes. This study aims to evaluate and compare two therapeutic approaches for managing Upper Cross Syndrome (UCS): Muscle Energy Technique (MET) combined with Myofascial Release Therapy (MFR), and MET combined with Muscle Stretching Exercises. **MATERIAL AND METHODS:** This non-randomized, active-controlled trial enrolled 40 patients with neck pain, assigned to two intervention groups of 20 participants each: Muscle Energy Technique (MET) with Myofascial Release Therapy (MFR), and MET with Muscle Stretching Exercises. The study assessed pain intensity using the Visual Analogue Scale (VAS) and forward head posture using the Craniovertebral Angle (CVA) at baseline and three weeks post-treatment. **RESULTS:** VAS score for pain showed a mean change of 1.7 and 1.8 in the MET with MFR group and MET with the Muscle Stretching Exercises group after 11 sessions. The CVA increased by 2.08° in the MET with MFR group and by 1.78° in the MET with the Muscle Stretching Exercises group. Both groups showed significant improvements in pain and forward head posture ($p<0.001$), with no significant difference between the interventions. **CONCLUSION:** Both MET combined with MFR and MET with Muscle Stretching Exercises demonstrate improvement in pain and CVA.

KEYWORDS: Posture. Rehabilitation. Muscle Stretching Exercises. Pain. Physical Therapy. Disability.

RESUMO | INTRODUÇÃO: A dor cervical representa um dos distúrbios musculoesqueléticos mais prevalentes, com potencial para complicações secundárias se não tratada. As principais causas de dor no pescoço são distúrbios da coluna cervical e dos tecidos moles, enquanto a dor no pescoço devido a anormalidades posturais é conhecida como síndrome cruzada superior (UCS). Estudos epidemiológicos indicam que a dor cervical é prevalente na população em geral, mas é significativamente mais comum entre trabalhadores de escritório. Estratégias de manejo ideais requerem investigação adicional para melhorar os resultados do tratamento. Este estudo tem como objetivo avaliar e comparar duas abordagens terapêuticas para o manejo da Síndrome da Cruz Superior (SCU): Técnica de Energia Muscular (ATINGIDA) combinada com Liberação Miofascial (LMF) e MET combinada com Alongamento. **MATERIAL E MÉTODOS:** Este estudo não-randômico e com controle ativo envolveu 40 pacientes com dor cervical, distribuídos aleatoriamente em dois grupos de intervenção de 20 participantes cada: Técnica de Energia Muscular (ATINGIDA) com Liberação Miofascial (LMF) e ATINGIDA com Alongamento. O estudo avaliou a intensidade da dor usando a Escala Visual Analógica (EVA) e a postura anterior da cabeça usando o Ângulo Craniovertebral (AVC) no início do estudo e três semanas após o tratamento. **RESULTADOS:** A pontuação VAS para dor mostrou uma alteração média de 1,7 e 1,8 no grupo MET com LMF e ATINGIDA com o grupo Exercícios de Alongamento Muscular após 11 sessões. O AVE aumentou 2,08° no grupo ATINGIDA com LMF e 1,78° no grupo ATINGIDA com Exercícios de Alongamento Muscular. Ambos os grupos apresentaram melhoras significativas na dor e na postura anterior da cabeça ($p<0,001$), sem diferença significativa entre as intervenções. **CONCLUSÃO:** Tanto o MET combinado com o LMF quanto o ATINGIDA com exercícios de alongamento muscular demonstram melhora da dor e do AVE.

PALAVRAS-CHAVE: Postura. Reabilitação. Exercícios de Alongamento Muscular. Dor. Fisioterapia. Inabilidade.

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1. Introduction

Cervical pain represents a highly prevalent musculoskeletal disorder with age-independent onset potential, capable of significantly impairing functional capacity and activities of daily living.[1-5] Epidemiological studies have reported an annual prevalence of neck pain in the general population ranging from 15% to 44%.[3] However, among office workers, the prevalence is notably higher, with estimates reaching 50% to 60%.[3] The etiology of cervical pain is multifactorial, with primary contributors including disorders of the cervical spine and associated soft tissues, such as muscles, ligaments, intervertebral discs, and facet joints.[1,2,6,7]

A type of cervical neck pain, upper cross syndrome (UCS), is marked by postural abnormalities and muscle imbalances.[1,2,6] This condition highlights the intricate relationship between biomechanical factors and the experience of pain in the cervical region.[1,2,6] This syndrome manifests as hypertonic anterior cervical and pectoral musculature, coupled with hypotonic deep cervical flexors and scapular stabilizers.[1,6,7]

Occupational and lifestyle factors significantly contribute to the onset of UCS, with sedentary behaviours being a predominant risk factor.[6,8] Common predisposing activities include prolonged seated positions, extended computer use, and improper ergonomics in academic or occupational settings.[6,8] Non-mechanical factors, such as psychological states including depression or low self-esteem, may indirectly contribute to UCS development through their influence on postural habits.[9,10]

The contemporary rehabilitation paradigm for UCS focuses on restoring musculoskeletal equilibrium and optimizing functional movement patterns.[11] Treatment modalities include physical therapy, manual therapy techniques, ergonomic interventions, and, when indicated, pharmacological management.[7] Alternative therapies such as acupuncture, chiropractic care, yoga, and Pilates have also been employed in UCS management.[8] The primary objective of these interventions is to address muscle imbalances and compensatory mechanisms associated with the condition.[9]

Muscle Energy Technique (MET) has gained traction as a manual therapy approach in UCS management.[4] This method involves active patient participation in performing isometric contractions against therapist-applied resistance.[7,12] MET aims to lengthen hypertonic muscles (e.g., upper trapezius, levator scapulae, pectoralis major) and strengthen hypotonic muscles (e.g., lower trapezius, rhomboids, deep cervical flexors).[11] The proposed mechanisms of action include post-isometric relaxation, reciprocal inhibition, improved muscle flexibility, and enhanced joint mobility.[13]

The efficacy of Muscle Energy Technique (MET) in the management of Upper Cross Syndrome (UCS) has demonstrated promise in preliminary studies.[6,7] However, the synergistic effects of MET when combined with complementary modalities such as Muscle Stretching Exercises or Myofascial Release Therapy (MFR) remain insufficiently elucidated in the current literature.[14,15] The paucity of empirical evidence regarding the potential augmentation of therapeutic outcomes through the integration of these techniques necessitates further investigation. Previous research has not comprehensively evaluated the combined application of MET with either Muscle Stretching Exercises or MFR in the context of UCS treatment. This gap in the literature presents an opportunity for the exploration of potentially enhanced therapeutic strategies. Consequently, a hypothesis has been formulated proposing that the integration of MET with either MFR or Muscle Stretching Exercises protocols may yield superior outcomes in the management of UCS compared to isolated interventions.

2. Material and methods

2.1 Study design

The present study was a single-blinded, non-randomized, active-controlled trial. The research protocol was approved by the Institutional Ethical Committee (IEC) of Guru Jambheshwar University of Science and Technology (letter no. PTY/2024/143 dated 22/02/2024) and registered with the Clinical Trial Registry of India (CTRI/2024/03/064347).

2.2 Participants

Sample size determination utilized a Minimal Clinically Important Difference (MCID) of 16.55 and a standard deviation of 17.53 for the Visual Analogue Scale, yielding 20 participants per group (N=40) with 80% power (α=0.05), accounting for a 10% attrition rate.[16] Each willing participant was required to provide written consent per the Declaration of Helsinki (2013) after being provided with comprehensive information about the study in their comprehensible and local language.

Forty male and female participants aged between 17 and 30 years (mean age: 22.62 ± 2.5 years) diagnosed with upper crossed syndrome were recruited for the study, as shown in Table 1. The diagnosis of upper crossed syndrome was confirmed based on the presence of abnormalities in scapular position and rhythm, assessed using the Scapular Dyskinesis Test.[17] Additionally, participants exhibited postural deviations, including excessive thoracic kyphosis (≥42°), forward head posture (≥44°), or rounded shoulders (≥49°), as quantified using a flexicurve ruler.[17] A licensed general physician conducted these assessments. The study was carried out at the Department of Physiotherapy, GJUS&T. Exclusion Criteria were: 1) Any neurological disorder; 2) Any cardiovascular disorder; 3) Any surgical history of neck; 4) Uncooperative individuals; 5) People older than 30 years of age; 6) People younger than 17 years of age. Prior to participation, all subjects provided written informed consent in accordance with ethical guidelines. Participants were anonymized through a blinding procedure to maintain confidentiality and minimize bias. Participants were informed that they were receiving treatment for their condition but were not told which technique was used. Subjects were informed of their right to withdraw from the study at any time without consequence. The enrolled participants were divided into two intervention groups: the MET with MFR group and the MET with Muscle Stretching Exercises group.

2.3 Procedure

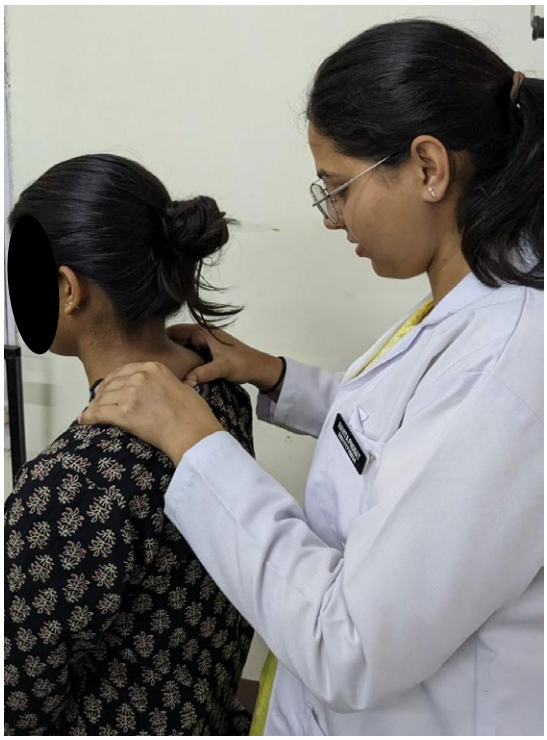
Subjects meeting the diagnostic criteria for upper cross syndrome and satisfying the predetermined inclusion and exclusion criteria were recruited for participation in the study. Demographic and clinical data were collected using a standardized intake form, encompassing variables such as gender, age, employment status, marital status, and educational level. The intervention protocol consisted of two treatment modalities: Muscle Energy Technique (MET) combined with Myofascial Release Therapy (MFR), and MET combined with Muscle Stretching Exercises. Treatments were administered by the physiotherapist on alternate days over three weeks (11 sessions, each averaging 30 minutes). Outcome measures were assessed at two time points: baseline, and at the conclusion of week three of the intervention period. Throughout the study duration, no adverse events, including mild bruising, increased stiffness, or muscle strain, were reported in either intervention group. This observation suggests a favorable safety profile for both treatment protocols within the context of this investigation.

2.4 MET with MFR group

2.4.1 MFR technique

The Myofascial Release Therapy was administered with the subject in a seated position.[18,19] The therapist employed a low-load, sustained stretch targeting the restricted fascial tissues of the upper thoracic region.[18,19] This manual intervention was executed for 1 minute using the therapist's elbows, fingers, or knuckles as contact points to identify and address fascial restrictions[18,19], and the procedure was repeated for a total of four repetitions. The technique aimed to facilitate gradual tissue elongation and enhance mobility through the application of sustained pressure and controlled movement along the identified restrictive barriers (Figure 1).[18,19]

Figure 1. Myofascial release technique



Source: the authors (2024).

2.4.2 MET for upper trapezius

The patient was positioned supine with the arms resting alongside the trunk on the side to be treated, and the head was side-bent away from the affected side.[20] The therapist, standing behind the patient, stabilized the shoulder with one hand while placing the other hand on the ear area of the same side of the head.[20] The therapist then applied a controlled stretch by gently moving the shoulder and head in opposite directions.[20] The patient was instructed to perform a light-resisted contraction (approximately 20% of maximal effort) by drawing the stabilized shoulder toward the ear.[20] This contraction was held for 8-10 seconds, and the procedure was repeated for a total of four repetitions (Figure 2).[20]

Figure 2. Muscle energy technique for upper trapezius

Source: the authors (2024).

2.4.3 MET for sternocleidomastoid muscle

The patient was positioned supine with the head in a neutral position, supported by the therapist's hands.[20,21] A pillow or cushion was placed under the patient's shoulders to maintain a slight extension of the head.[20,21] The therapist then rotated the patient's head to the point of maximal range of motion limitation.[20,21] The patient was instructed to apply a light isometric contraction (approximately 20% of maximal effort) by lifting the fully rotated head towards the ceiling. This contraction was held for 8-10 seconds, with a total of four repetitions performed (Figure 3).[20,21]

Figure 3. Muscle energy technique for sternocleidomastoid muscle

Source: the authors (2024).

2.4.4 MET for levator scapulae muscle

The patient was positioned in a supine position while the therapist stood behind the patient. The therapist's contralateral arm was placed under the patient's neck, supporting the shoulder to be treated, while the other hand directed the head through subsequent movements.[21] The therapist lifted the neck into full flexion with the forearm and then guided the head into full side flexion and rotation away from the side being treated.[21] The patient was instructed to apply a light isometric contraction (approximately 20% of maximal effort) by gently pushing the head backward towards the table while performing a slight shoulder shrug.[21] This contraction was held for 8-10 seconds, with a total of four repetitions performed (Figure 4).[21]

Figure 4. Muscle energy technique for levator scapulae muscle

Source: the authors (2024).

2.5 MET with Muscle Stretching Exercises Group

MET protocol implemented in this group was identical to that administered in the MET with MFR group. This standardization of the MET component across both intervention groups ensures consistency in the application of this specific manual therapy technique, thereby minimizing potential confounding variables related to differences in MET administration. This methodological approach facilitates a more precise comparison of the differential effects between MET combined with MFR and MET combined with Muscle Stretching Exercises, as the MET component remains constant between the two intervention protocols.

2.5.1 Stretching of upper trapezius muscle

The patient was asked to sit on a chair. The therapist stands behind the patient and locates the upper trapezius muscle.[22-24] Then gently tilt the patient's head sideways, towards the opposite shoulder while supporting the neck. The therapist may use their hands to apply controlled pressure to the shoulder or head to increase the stretch.[22-24] The stretch was held for 20 seconds, and 4 repetitions were performed. The whole process was repeated on the other side (Figure 5).[22-24]

Figure 5. Stretching for upper trapezius muscle

Source: the authors (2024).

2.5.2 Stretching of levator scapulae

The patient was positioned in a seated posture. The therapist rotated the patient's head 45 degrees to one side and directed it downward, with the chin tucked toward the chest. The therapist then used their arm to apply gentle downward traction, further increasing the stretch.[24] The stretch was maintained for 20 seconds, and a total of four repetitions were performed (Figure 6).[24]

Figure 6. Stretching for levator scapulae muscle

Source: the authors (2024).

2.5.3 Stretching of pectoralis major muscle

The patient was positioned in a seated posture while the therapist stood behind. With the patient's arm flexed at the elbow, the therapist placed their hands just above the elbow and gently abducted the arm to the side, forming a 90-degree angle with the body.[19,24] The therapist then applied controlled and gentle pressure to guide the arm toward the opposite side of the body, effectively stretching the pectoralis major muscle.[19,24] The stretch was maintained for 20 seconds and repeated four times (Figure 7).

Figure 7. Stretching for pectoralis major muscle

Source: the authors (2024).

2.6 Outcome measures

The primary outcome measures employed in this study were the Visual Analogue Scale (VAS) for pain assessment[25,26] and the Craniovertebral Angle (CVA) for postural evaluation.[27] The VAS is a validated, unidimensional measure of pain intensity widely used in diverse adult populations, including those with chronic pain. The CVA, measured through photogrammetric analysis, serves as a quantitative indicator of forward head posture, with smaller angles indicating a greater degree of forward head positioning. These outcome measures were assessed at two-time points: baseline (pre-intervention) and at the conclusion of the three-week intervention period.

2.7 Statistical analysis

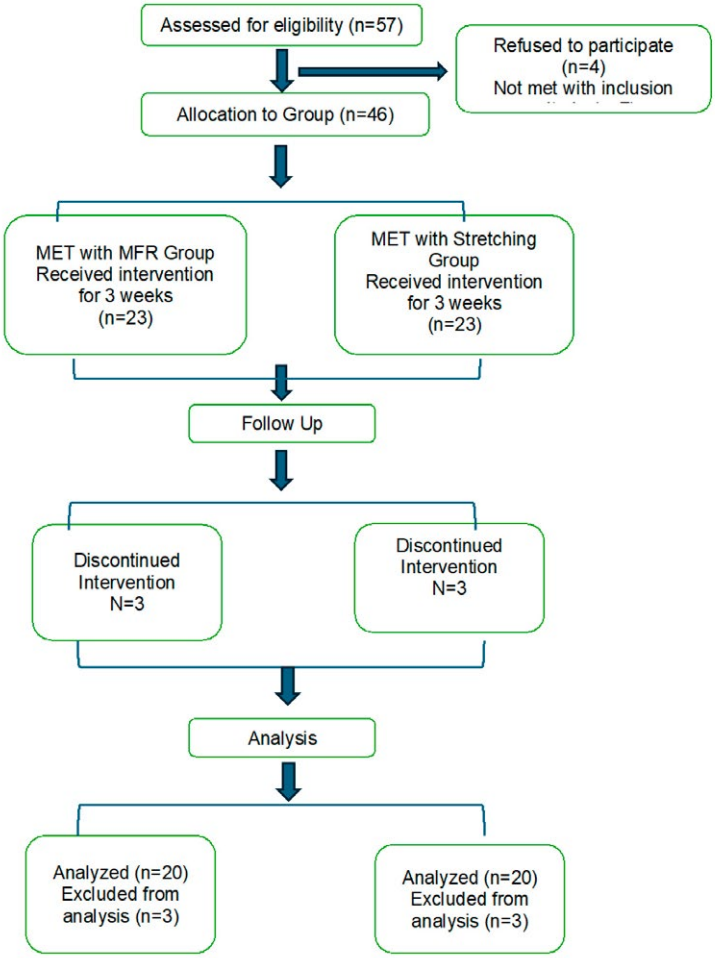
Data were analyzed using R software, with outliers identified as values exceeding 3 standard deviations from the mean. The alpha level for statistical significance was set at 0.05. Descriptive statistics were calculated for demographic variables, and continuous variables were reported as means ± standard deviations. The normality of continuous data was assessed using histograms, Kolmogorov-Smirnov, and Shapiro-Wilk tests. For within-group analysis, the Wilcoxon Signed Rank test was applied to determine changes in VAS scores, while a paired t-test was used to evaluate changes in CVA scores in both groups. The Kruskal-Wallis test was employed for between-group analysis and paired t-test for within-group analysis to compare changes in VAS and CVA scores, as shown in Tables 2, 3, and 4.

3. Results

3.1 Baseline comparison

The study enrolled 46 participants, equally distributed between two intervention groups: Muscle Energy Technique (MET) with Myofascial Release Therapy (MFR) (n=23) and MET with Muscle Stretching Exercises (n=23). All 46 participants completed the prescribed 11 treatment sessions. However, six subjects were subsequently excluded from the final analysis due to incomplete adherence to the treatment protocol: three from the MET with MFR group (two citing time constraints, one reporting excessive distance from the treatment facility) and three from the MET with Muscle Stretching Exercises group (due to unspecified personal issues). Consequently, the final analytical sample consisted of 40 participants (MET with MFR group, n=20; MET with Muscle Stretching Exercises group, n=20). The participant flow, including recruitment, allocation, follow-up, and analysis, was documented in accordance with the Consolidated Standards of Reporting Trials (CONSORT) guidelines, as illustrated in the accompanying flowchart (Figure 8).

Figure 8. Screening and selection are shown in the flowchart according to CONSORT guidelines



Source: the authors (2024).

Analysis of baseline data revealed no statistically significant differences between the pre-intervention scores of both groups [VAS (MD = -0.3; p=0.27), CVA ((MD = -0.2; p=0.58)], indicating homogeneity in initial measurements. This equivalence at baseline suggests that any subsequent differences observed between the groups can be attributed to the interventions rather than pre-existing disparities, thus enhancing the internal validity of the study.

Table 1. Descriptive sample characteristics for all participants

Participant Characteristics (n=40)	Mean (SD)
Age (years)	22.62 (2.5)
Weight (kg)	71.51 (22.92)
Height (cm)	162 (33)
Marital Status, n (%)	
Single	18 (45)
Married	22 (55)
Sex, n (%)	
Male	16 (40)
Female	24 (60)
Smoking Status, n (%)	
Non - Smoker	40 (100)
Smoker	0 (0.0)
Drinking Status, n (%)	
Non-Drinker	30 (75)
Drinker	10 (25)
Education Level, n (%)	
Certificate or diploma	0 (0.0)
Bachelor's degree	28 (70)
Postgraduate degree	12 (30)

Source: the authors (2024).

Table 2. Within group (intergroup) analysis of VAS in MET with MFR group and MET with muscle stretching exercises group by using Wilcoxson signed rank test

Group		Mean	Median	P Value
MET with MFR	**Pre VAS**	**4.9**	**4.5**	**<0.001**
	Post VAS	**3.1**	**3**	**<0.001**
MET with Muscle Stretching Exercises	**Pre VAS**	**5**	**5**	**<0.001**
	Post VAS	**3.3**	**3**	**<0.001**

Source: the authors (2024).

Table 3. Within group (intergroup) analysis of CVA in MET with MFR group and MET with muscle stretching exercises by using paired t-test

Group		Mean±SD	t- value	p-value	Lower Bound	Upper Bound
MET with MFR	**Pre CVA**	**47.50±0.969**	**-8.241**	**<0.001**	**-2.615**	**-1.554**
	Post CVA	**49.59±0.946**	**-1.843**	**<0.001**	**-2.562**	**-1.106**
MET with Muscle Stretching Exercises	**Pre CVA**	**47.68±1.016**	**-14.519**	**<0.001**	**-2.046**	**-1.530**
	Post CVA	**49.46±0.72**	**-3.247**	**<0.001**	**-4.353**	**-2.126**

Source: the authors (2024).

Table 4. Between group (intragroup) analysis of CVA and VAS in MET with MFR group and MET with muscle stretching exercises by using Kruskal-Wallis Test

	Chi-squared value	df	p-value
CVA	**0.30**	**1**	**0.58**
VAS	**0.12**	**1**	**0.72**

Source: the authors (2024).

Analysis of the primary outcome measures revealed statistically significant improvements in both intervention groups after the 3-week treatment period. The Visual Analogue Scale (VAS) for pain demonstrated the greatest mean reduction in the Muscle Energy Technique (MET) with Myofascial Release Therapy (MFR) group (Mean Difference [MD] = 1.8, $p \leq 0.01$), followed closely by the MET with Muscle Stretching Exercises group (MD = 1.7, $p \leq 0.01$). Regarding the Craniovertebral Angle (CVA), indicative of forward head posture, the MET with MFR group exhibited the most substantial mean increase (MD = -2.08 ± 0.25, $t(19) = -8.24$, $p \leq 0.01$), with the MET with Muscle Stretching Exercises group also showing significant improvement (MD = -1.78 ± 0.12, $t(19) = -14.5$, $p \leq 0.01$). These results suggest that both interventions were effective in reducing pain and improving cervical posture, with the MET with MFR protocol demonstrating marginally superior outcomes in both measures. Detailed results are presented in Tables 2 and 3. A Kruskal-Wallis H test was conducted to evaluate differences between two intervention groups (MET with MFR and MET with Muscle Stretching Exercise), focusing on the outcome measures of CVA and VAS scores. As shown in Table 4 the analysis revealed no significant differences between the groups for either outcome measure, with VAS scores showing $\chi^2(1, N = 40) = 0.12$, $p = 0.72$, and CVA measurements indicating $\chi^2(1, N = 40) = 0.30$, $p = 0.58$. These results suggest that the choice between MET with MFR and MET with Muscle Stretching Exercise did not significantly impact participants' VAS or CVA scores.

4. Discussion

The present investigation aimed to evaluate the efficacy of the MET combined with MFR and MET combined with Muscle Stretching Exercises interventions on pain intensity and craniovertebral angle in patients diagnosed with upper cross syndrome. The findings of this study provide evidence that both MET combined with MFR and MET combined with Muscle Stretching Exercises is effective in reducing pain and improving craniovertebral angle in this patient population. Significant improvements in both outcome measures were observed following a three-week intervention period.

Comparative analysis of the results revealed no statistically significant difference between the MET with MFR and MET with Muscle Stretching exercise protocols in the management of Upper Cross Syndrome (UCS). This finding suggests that both interventions may offer comparable therapeutic benefits in addressing the musculoskeletal imbalances characteristic of UCS. The absence of significant differences between the two treatment modalities implies that clinicians may have flexibility in selecting either approach based on individual patient needs, practitioner expertise, or resource availability.

The present study's findings are consistent with and extend previous research on the efficacy of Muscle Energy Technique (MET) and Muscle Stretching Exercises for upper cross syndrome and neck pain. Ali et al. demonstrated the superiority of MET over muscle stretching exercises in reducing pain and improving range of motion (ROM) in patients with upper cross syndrome.[1] Similarly, Thacker et al. concluded that MET was more effective than prescribed exercises in treating upper cross syndrome.[28] Kawaldeepkaur et al. reported that combining conventional physical therapy with MET produced optimal outcomes in enhancing ROM and reducing pain intensity in non-specific neck pain. This corroborates our finding that MET is efficacious in alleviating cervical spine pain.[17,29,30] Mahajan et al. further supported these results, demonstrating MET's superiority over static stretching in reducing pain intensity and increasing cervical ROM in sub-acute mechanical neck pain.[31] However, Ylinen et al. found both manual therapy and stretching exercises beneficial in reducing neck pain and disability in patients with nonspecific neck pain.[32] This aligns with Hakkinen et al. findings, which suggested that pain reduction through these techniques may decrease motor system inhibition, thereby improving neck function.[33] The consistent findings across multiple studies strengthen the reliability of our conclusions and underscore the clinical relevance of incorporating these techniques into treatment protocols for musculoskeletal disorders of the cervical spine and upper quarter.

The present study exhibits several notable strengths that enhance its scientific rigor and clinical relevance. Primarily, this investigation represents the first active-controlled trial to directly compare the efficacy of Muscle Energy Technique (MET)

combined with Myofascial Release Therapy (MFR) versus MET combined with Muscle Stretching Exercises. This novel comparative approach addresses a significant gap in the existing literature. The findings suggest a shift in therapeutic decision-making by supporting a more integrated approach. Clinicians may lean toward combining MET with MFR or MET with Muscle Stretching Exercises, especially in cases where postural imbalances and pain are more severe, as it addresses both soft tissue and joint function comprehensively. The methodological design of the study is particularly robust, employing an active control group rather than a passive or no-treatment control. This design strategy allows for a more nuanced evaluation of treatment efficacy, enabling the discernment of cumulative effects of the combined interventions (MET with MFR and MET with Muscle Stretching Exercises) rather than isolating individual technique effects. Such an approach more closely mirrors clinical practice, where multiple techniques are often employed concurrently. To minimize bias, sample size calculations were employed, enhancing the reliability of the results. Furthermore, the findings are both statistically significant and clinically relevant, underscoring their practical application in therapeutic settings.

This study has several limitations that warrant consideration. The findings may not be generalizable to older adults, as the sample comprised only young participants. The applicability to broader age groups remains unclear. The study design did not incorporate randomization, presenting an opportunity to explore potential confounding factors in future research. Additionally, the sample size suggests the need for larger studies to enhance statistical power and clinical relevance. Future research should investigate age-related differences in upper cross syndrome, focusing on long-term follow-ups to improve clinical relevance and applicability.

5. Conclusion

The findings of this investigation demonstrate the efficacy of two therapeutic protocols - Muscle Energy Technique (MET) combined with Myofascial Release Therapy (MFR) and MET combined with Muscle Stretching Exercises - in ameliorating pain and improving craniovertebral angle in patients presenting with upper cross syndrome. Statistical analysis revealed no significant differences between the two protocols in terms of treatment effects. These findings suggest that integrating either MFR or Muscle Stretching Exercises with MET may provide comparable therapeutic benefits in addressing musculoskeletal imbalances associated with upper cross syndrome. The innovative combination of these therapeutic modalities offers clinicians a versatile and effective approach to treating upper cross syndrome, allowing for tailored interventions that consider patient-specific factors, clinician proficiency, and available resources.

Authors contributions

The authors declared that they have made substancial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsability for all aspects of the study.

Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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