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MUSCLE ENERGY TECHNIQUE WITH AND WITHOUT MYOFASCIAL RELEASE IN PATIENTS WITH CERVICOGENIC HEADACHE

Original Research

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ABSTRACT

Background: Cervicogenic headache (CGH) is a secondary headache disorder originating from cervical spine and muscular dysfunction, frequently involving the trapezius muscle. Manual therapy remains a cornerstone of conservative management, with Muscle Energy Technique (MET) and Myofascial Release (MFR) widely used to address pain, mobility restriction, and functional impairment. While both techniques are individually effective, evidence comparing MET alone with its combination with MFR remains limited, particularly in relation to pain intensity, cervical range of motion (ROM), and disability outcomes in CGH.

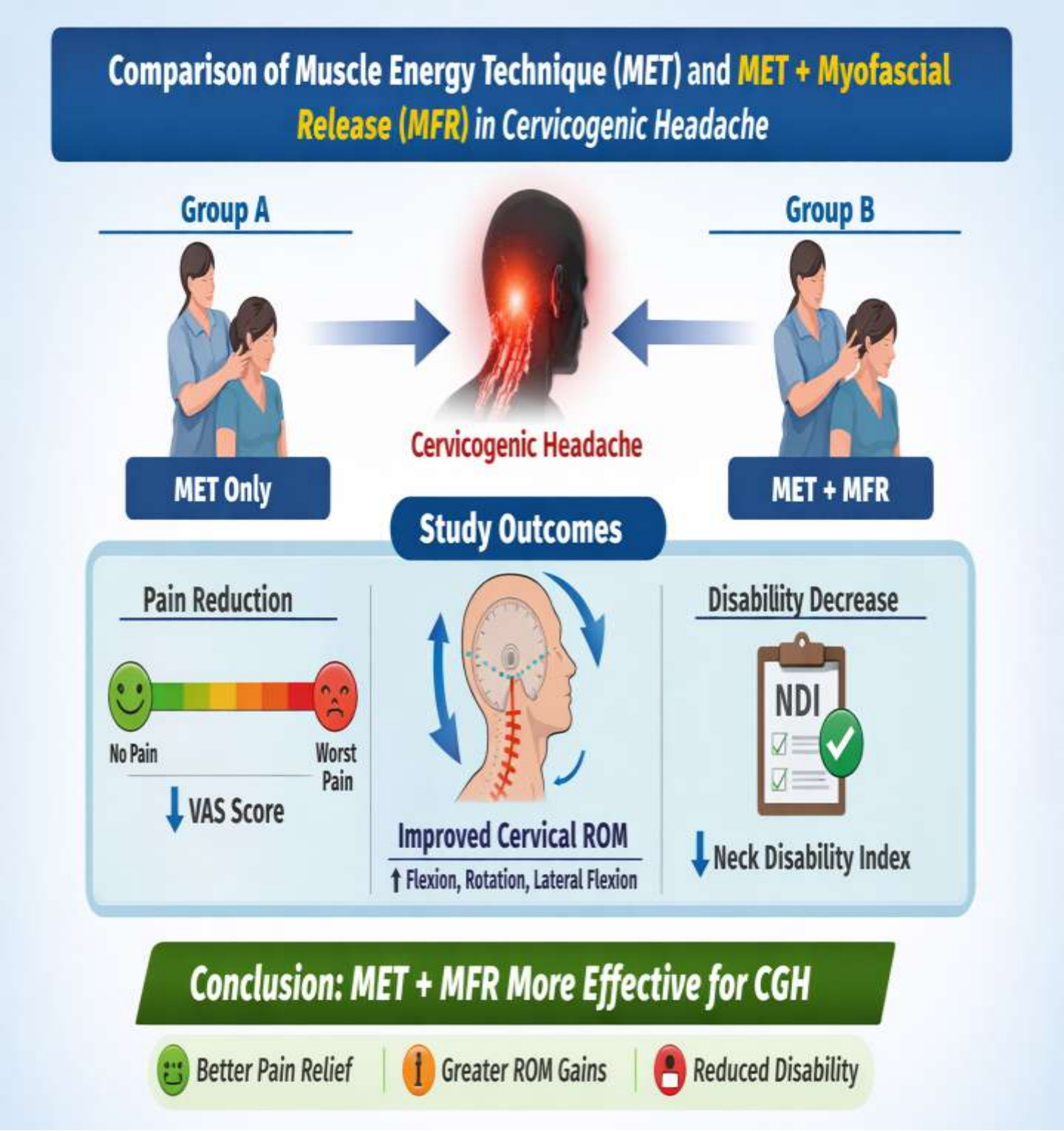
Objective: To compare the effects of Muscle Energy Technique with and without Myofascial Release on pain intensity, cervical range of motion, and functional disability in patients with cervicogenic headache.

Methods: A single-blinded randomized controlled trial was conducted involving 40 adults aged 20–40 years diagnosed with cervicogenic headache. Participants were randomly allocated into two equal groups: Group A received MET alone (n = 20), and Group B received MET combined with MFR (n = 20). Both groups underwent five treatment sessions over two weeks. Outcome measures included pain intensity assessed using the Visual Analog Scale (VAS), cervical range of motion measured with a goniometer, and disability evaluated using the Neck Disability Index (NDI). Assessments were performed at baseline and post-intervention. Statistical analysis was carried out using paired and independent t-tests, with significance set at $p < 0.05$.

Results: Both groups demonstrated statistically significant improvements in pain, cervical ROM, and disability following intervention ($p < 0.05$). Pain intensity in Group A decreased from 6.0 ± 0.5 to 2.8 ± 0.4, while Group B showed a greater reduction from 7.0 ± 0.4 to 1.0 ± 0.2. Disability scores improved from 26.5 ± 3.2 to 13.5 ± 1.9 in Group A and from 29.5 ± 2.0 to 8.0 ± 1.2 in Group B. Cervical flexion, extension, lateral flexion, and rotation improved significantly in both groups, with consistently larger gains observed in the MET plus MFR group ($p < 0.001$).

Conclusion: Both MET alone and MET combined with MFR were effective in reducing pain and improving cervical mobility and function in patients with cervicogenic headache. However, the addition of MFR to MET produced superior outcomes across all measured parameters, supporting the clinical value of addressing both muscular and myofascial dysfunction for comprehensive CGH management.

Keywords: Cervicogenic Headache, Manual Therapy, Muscle Energy Technique, Myofascial Release, Neck Pain, Range of Motion, Rehabilitation.



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INTRODUCTION

Cervicogenic headache (CGH) is a secondary headache disorder that originates from dysfunctions of the cervical spine and its associated musculoskeletal and neural structures. It is typically characterized by unilateral head pain that is aggravated by neck movements, sustained postures, or mechanical loading of cervical tissues, and it frequently coexists with restricted cervical mobility and neck discomfort (1). Unlike primary headache disorders, CGH has a clearly identifiable musculoskeletal source, making it particularly relevant to physiotherapy and manual therapy–based management strategies. Among the cervical musculature, the trapezius muscle plays a central role due to its contribution to cervical posture, movement control, and load transmission across the cervical spine. Dysfunction of this muscle, including increased tone, myofascial trigger points, weakness, or stiffness, has been consistently associated with pain referral to the occipital and temporal regions, thereby intensifying headache symptoms and functional limitations (2,3). The pathophysiology of CGH is multifactorial and involves both biomechanical and neurophysiological mechanisms. Convergence of nociceptive input from upper cervical spinal nerves and the trigeminocervical nucleus explains the referral of cervical pain to cranial regions, reinforcing the clinical relevance of cervical muscle dysfunction in headache generation (4,5). Prolonged static postures, poor ergonomics, repetitive strain, and reduced postural endurance further exacerbate trapezius dysfunction, leading to chronic pain, reduced cervical range of motion, and disability. These factors collectively highlight the need for targeted therapeutic interventions that address both muscular and myofascial contributors to CGH rather than relying solely on symptomatic or pharmacological approaches, which often provide limited long-term benefit and may be associated with adverse effects (6,7).

Manual therapy has emerged as a cornerstone in the conservative management of CGH, with growing evidence supporting its effectiveness in reducing pain, improving cervical mobility, and enhancing functional outcomes. Among the commonly employed techniques, Muscle Energy Technique (MET) and Myofascial Release (MFR) are widely used in clinical practice due to their distinct yet potentially complementary mechanisms of action. MET is an active, patient-participatory technique that utilizes controlled isometric muscle contractions followed by relaxation and stretching to restore muscle length, correct neuromuscular imbalances, and improve joint mobility. Its effects are mediated through mechanisms such as post-isometric relaxation, reciprocal inhibition, and enhanced neuromuscular control, making it particularly suitable for conditions involving altered muscle activation and restricted movement, such as CGH (8,9). Several studies have demonstrated that MET can significantly reduce pain intensity, improve cervical range of motion, and decrease headache-related disability in patients with cervicogenic and other musculoskeletal headache disorders (10-12). In contrast, Myofascial Release is a passive manual therapy technique that focuses on releasing fascial restrictions caused by trauma, inflammation, or prolonged mechanical stress. The fascial system plays a critical role in force transmission, movement coordination, and sensory input, and its dysfunction can lead to pain, stiffness, and impaired biomechanics. MFR involves the application of sustained, gentle pressure to restricted fascial tissues to restore tissue extensibility, reduce adhesions, and normalize movement patterns. Evidence suggests that MFR is particularly effective in alleviating chronic pain and improving flexibility and quality of life in patients with musculoskeletal disorders, including cervicogenic headache (11,13). Suboccipital and cervical myofascial techniques have also been shown to reduce headache frequency and intensity, especially in individuals with postural abnormalities and prolonged static workloads (14).

Despite substantial evidence supporting the individual effectiveness of MET and MFR, the current literature reveals a notable gap in direct comparative research, particularly in the context of CGH involving trapezius muscle dysfunction. Most available studies have evaluated these techniques in isolation or in combination with other conventional physiotherapy interventions, making it difficult to delineate their relative or additive benefits. Emerging evidence suggests that MET may be superior in improving cervical range of motion and neuromuscular control, while MFR may offer greater short-term pain relief by addressing fascial restrictions; however, these findings are largely extrapolated from heterogeneous populations and conditions rather than focused CGH cohorts (8,10). Furthermore, limited long-term follow-up data and the inherently subjective nature of pain assessment complicate the interpretation of treatment effectiveness and sustainability (4,9). Another critical limitation in existing research is the lack of trapezius-specific analysis in CGH management. Given the muscle's pivotal role in cervical posture, stability, and movement, and its frequent involvement in myofascial trigger point formation, a focused evaluation of interventions targeting the trapezius is clinically justified. Confounding variables such as age, gender, chronicity of symptoms, and postural habits further underscore the need for well-designed comparative studies to guide individualized treatment planning. Additionally, the precise mechanisms through which MET and MFR exert their therapeutic effects in CGH remain incompletely understood, limiting the ability of clinicians to optimize treatment protocols and predict long-term outcomes (12,14). In light of these considerations, there is a clear need for methodologically robust research that directly compares Muscle Energy Technique applied alone with Muscle Energy Technique combined with Myofascial Release in patients with cervicogenic headache, specifically targeting trapezius muscle dysfunction. Addressing this gap is essential to strengthen evidence-based clinical decision-

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making, reduce reliance on pharmacological management, and improve patient-centered outcomes. Therefore, the objective of this study is to evaluate and compare the effects of MET with and without MFR on pain intensity, cervical range of motion, and functional disability in individuals with cervicogenic headache, thereby providing clinically relevant evidence to inform optimal physiotherapy management strategies.

METHODS

A single-blind randomized controlled trial was conducted to compare the efficacy of Muscle Energy Technique (MET) alone versus MET combined with Myofascial Release (MFR) for reducing pain, improving cervical range of motion (ROM), and decreasing disability in adults with cervicogenic headache (CGH). The trial was carried out at the District Headquarters (DHQ) Hospital, Sheikhupura, over a total study period of nine months. Forty eligible participants were enrolled and allocated in a 1:1 ratio into two intervention arms: Group A received MET only (n = 20), while Group B received MET in combination with MFR (n = 20). Participants were recruited using purposive sampling from the outpatient population and then randomized using a computer-generated random number table to ensure unbiased group assignment. Adults aged 20–40 years who met diagnostic criteria for CGH in accordance with the International Classification of Headache Disorders were included (15). Additional eligibility requirements were the presence of trapezius tightness and tenderness on palpation, a baseline pain intensity of at least 2/10 on the Visual Analog Scale (VAS), and a measurable restriction in cervical ROM. Individuals were excluded if they had a prior history suggestive of migraine or non-cervicogenic headache patterns, a recent history of cervical surgery (within the previous six months) or significant cervical injury, or clinical features indicating neurological involvement such as radiculopathy, myelopathy, or other central nervous system pathology (5). These criteria were used to enhance diagnostic clarity and reduce the likelihood that outcomes were influenced by non-musculoskeletal headache mechanisms. Ethical safeguards were maintained throughout the study. The protocol was reviewed and approved by the Institute Research Ethics Board (IREB) of the University of Lahore. Written informed consent was obtained from all participants prior to enrollment. Confidentiality was protected by de-identifying participant data, and no personally identifiable information was intended for publication. Participation remained voluntary, and participants retained the right to withdraw at any stage without penalty. The study was described to participants as low-risk, with potential benefits including pain relief, improved mobility, and reduced disability associated with CGH.

Data were collected in a structured sequence consisting of baseline assessment, treatment delivery, immediate post-treatment assessment, and follow-up evaluation. At baseline, demographic and clinical information—including age, gender, headache duration, medical history, and previous treatments—were recorded using a structured proforma/questionnaire. Outcome measures were obtained using standardized tools: pain intensity was assessed using the VAS (0–10), cervical ROM (flexion, extension, rotation, and lateral flexion) was measured in degrees using a standard goniometer, and functional disability was evaluated using the Neck Disability Index (NDI), a validated self-report instrument for neck-related limitation. Treatment fidelity and participant responses were documented in treatment logs maintained by the treating physiotherapist, including session duration, techniques applied, participant feedback, and any adverse effects. Following baseline assessment and random allocation, both groups received five treatment sessions over a two-week intervention period. In Group A, MET was applied to the trapezius using controlled, voluntary isometric contractions performed by the participant against therapist-applied resistance, followed by stretching to improve muscle extensibility and reduce tension. In Group B, the same MET protocol was delivered, supplemented with MFR applied to the trapezius through gentle, sustained manual pressure aimed at releasing myofascial restrictions and decreasing tissue stiffness. Immediately after completion of the intervention period, participants underwent post-treatment reassessment using the same instruments and procedures as baseline to ensure comparability. A follow-up assessment was then performed one month after the final session to evaluate whether the treatment effects on pain, ROM, and disability were maintained over time. Statistical analysis was performed using SPSS version 25. Descriptive statistics were used to summarize baseline demographic and clinical characteristics, with continuous variables reported as mean and standard deviation and categorical variables reported as frequencies and percentages. Within-group pre–post changes in VAS, ROM measures, and NDI were analyzed using paired-samples t-tests. Between-group differences in outcomes were examined using independent-samples t-tests, primarily focusing on post-intervention comparisons between MET-only and MET+MFR groups. Statistical significance was set at $p < 0.05$ for all analyses.

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RESULTS

A total of 40 individuals diagnosed with cervicogenic headache completed the randomized controlled trial and were included in the final analysis. Participants were equally allocated to two intervention groups, with 20 individuals receiving Muscle Energy Technique (MET) alone and 20 receiving a combination of MET and Myofascial Release (MFR). Baseline assessments confirmed that both groups were comparable with respect to age, gender distribution, symptom duration, affected side, pain intensity, cervical range of motion, and disability scores, allowing valid comparison of post-intervention outcomes. The mean age of participants in the MET group was 28.6 ± 3.1 years, while the MET plus MFR group had a mean age of 29.1 ± 4.3 years. Females represented a slightly higher proportion of the sample overall. The mean duration of cervicogenic headache symptoms was comparable between groups, with an average duration of 7.5 ± 2.2 months in the MET group and 8.4 ± 1.9 months in the MET plus MFR group. Bilateral involvement was common in both groups, although unilateral presentation varied slightly between groups at baseline. Pain intensity measured using the Visual Analog Scale demonstrated marked improvement following intervention in both groups. At baseline, the MET group reported a mean VAS score of 6.0 ± 0.5, which decreased to 2.8 ± 0.4 post-treatment. In the MET plus MFR group, baseline pain levels were higher at 7.0 ± 0.4 and reduced substantially to 1.0 ± 0.2 following treatment. The mean reduction in pain was 3.2 points in the MET group compared with a 6.0-point reduction in the MET plus MFR group. Within-group analysis showed statistically significant pre- to post-treatment pain reduction in both groups ($p < 0.05$), with a greater magnitude of change observed in the combined intervention group. Between-group analysis further demonstrated a statistically significant difference favoring MET plus MFR in post-treatment pain outcomes ($p < 0.05$). Functional disability, assessed using the Neck Disability Index, improved significantly in both intervention arms. The MET group showed a reduction in mean NDI scores from 26.5 ± 3.2 at baseline to 13.5 ± 1.9 after treatment. Participants receiving MET combined with MFR demonstrated a greater reduction, with NDI scores decreasing from 29.5 ± 2.0 to 8.0 ± 1.2 post-intervention. These changes represented statistically significant within-group improvements ($p < 0.05$) and a significant between-group difference favoring the combined therapy approach ($p < 0.05$).

Cervical range of motion outcomes revealed significant improvements across all measured planes in both groups. Cervical flexion in the MET group increased from 33.7 ± 3.2° to 45.0 ± 2.1°, while the MET plus MFR group demonstrated a larger increase from 31.0 ± 2.0° to 50.0 ± 2.0°. Cervical extension improved from 41.7 ± 1.8° to 53.0 ± 2.0° in the MET group and from 39.0 ± 1.9° to 59.0 ± 2.0° in the MET plus MFR group. Right and left lateral flexion increased from 25.6 ± 1.8° and 23.9 ± 1.8° to 35.2 ± 1.8° and 33.4 ± 1.7° in the MET group, compared with larger gains from 23.3 ± 1.9° and 21.7 ± 1.8° to 44.0 ± 1.8° and 42.0 ± 1.7° in the MET plus MFR group. Cervical rotation also improved significantly, with right and left rotation increasing from 52.7 ± 2.0° and 49.5 ± 2.0° to 66.1 ± 1.8° and 63.0 ± 1.9° in the MET group, and from 49.0 ± 2.0° and 46.5 ± 2.1° to 78.5 ± 1.9° and 76.8 ± 2.0° in the combined therapy group. All within-group changes were statistically significant ($p < 0.05$), and post-treatment comparisons showed significantly greater improvements in the MET plus MFR group across all ROM variables ($p < 0.05$). Follow-up assessment conducted four weeks after completion of the intervention demonstrated maintenance of treatment gains in both groups. Pain scores and disability levels remained reduced, and cervical ROM improvements were sustained. The MET plus MFR group consistently showed superior maintenance of pain reduction and range of motion gains compared with the MET-only group over the follow-up period. Subgroup analysis based on gender, age, and affected side revealed consistent improvement across all categories. Female participants demonstrated slightly greater reductions in pain and disability than males, particularly in the combined therapy group. Participants aged 20–30 years showed faster and larger improvements in pain reduction and ROM compared with those aged 31–40 years. Individuals with bilateral cervicogenic headache exhibited higher baseline disability and ROM limitation but also demonstrated substantial post-treatment improvements, with proportionally greater total ROM gains observed in the MET plus MFR group. Although these subgroup trends were clinically notable, the overall pattern indicated that the combined intervention yielded more consistent and pronounced improvements across demographic subgroups.

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Table 1: Detailed Demographic Characteristics of Participants (n = 40)

Variable	Group A (MET)	Group B (MET + MFR)
Sample Size (n)	20	20
Mean Age (years)	28.6 ± 3.1	29.1 ± 4.3
Gender Distribution		
Male	9 (45.0%)	9 (45.0%)
Female	11 (55.0%)	11 (55.0%)
Affected Side Distribution		
Left	11	7
Right	1	5
Bilateral	8	8
Mean Duration of Symptoms (months)	7.5 ± 2.2	8.4 ± 1.9

Table 2: Summary of Outcome Measures (Mean ± SD)

Outcome Measure	Group A_Pre	Group A_Post	Group B_Pre	Group B_Post
VAS	6.0 ± 0.5	2.8 ± 0.4	7.0 ± 0.4	1.0 ± 0.2
NDI	26.5 ± 3.2	13.5 ± 1.9	29.5 ± 2.0	8.0 ± 1.2
Flexion (°)	33.7 ± 3.2	45.0 ± 2.1	31.0 ± 2.0	50.0 ± 2.0
Extension (°)	41.7 ± 1.8	53.0 ± 2.0	39.0 ± 1.9	59.0 ± 2.0
Lateral Flexion (R) (°)	25.6 ± 1.8	35.2 ± 1.8	23.3 ± 1.9	44.0 ± 1.8
Lateral Flexion (L) (°)	23.9 ± 1.8	33.4 ± 1.7	21.7 ± 1.8	42.0 ± 1.7
Rotation (R) (°)	52.7 ± 2.0	66.1 ± 1.8	49.0 ± 2.0	78.5 ± 1.9
Rotation (L) (°)	49.5 ± 2.0	63.0 ± 1.9	46.5 ± 2.1	76.8 ± 2.0

Table 3: Paired t-Test Results for Within-Group Comparisons

Comparison	Group A (p)	Group B (p)
VAS Pre vs Post	0.001	0.0001
NDI Pre vs Post	0.002	0.0002
Flexion Pre vs Post	0.003	0.0001
Extension Pre vs Post	0.004	0.0002
Lateral Flexion (R) Pre vs Post	0.001	0.0001
Lateral Flexion (L) Pre vs Post	0.002	0.0001
Rotation (R) Pre vs Post	0.001	0.0001
Rotation (L) Pre vs Post	0.001	0.0001

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Table 4: Independent t-Test Between Groups

Comparison	Between Groups (p)
VAS	0.0001
NDI	0.0003
Flexion	0.001
Extension	0.001
Lateral Flexion (L)	0.001
Lateral Flexion (R)	0.001
Rotation (L)	0.0001
Rotation (R)	0.0001

Table 5: Mean Scores of Pain, ROM, and Disability Over Four Weeks

Parameter	Baseline	1st Week	2nd Week	3rd Week	4th Week
VAS (Group A)	6.0	4.5	3.5	3.0	2.8
VAS (Group B)	7.0	4.0	2.5	1.5	1.0
NDI (Group A)	26.5	21.5	17.5	15.0	13.5
NDI (Group B)	29.5	20.0	13.0	9.5	8.0
ROM (Flexion A)	33.7	38.5	42.0	44.0	45.0
ROM (Flexion B)	31.0	38.0	44.0	48.0	50.0

Table 6: Subgroup Analysis Based on Gender, Age, and Affected Side

Subgroup Variable	**Category**	**Group A (MET)**	**Group B (MET+MFR)**	**p-value (Between Groups)**
Gender	Male (n=18)	ΔVAS = 3.1 ± 0.4	ΔVAS = 5.7 ± 0.4	0.032
		ΔNDI = 12.7 ± 2.3	ΔNDI = 21.0 ± 2.1	
		ΔROM = 68.5 ± 5.2°	ΔROM = 94.0 ± 4.8°	
	Female (n=22)	ΔVAS = 3.4 ± 0.3	ΔVAS = 6.1 ± 0.3	0.018
		ΔNDI = 13.8 ± 1.8	ΔNDI = 22.0 ± 1.9	
		ΔROM = 70.2 ± 5.0°	ΔROM = 96.2 ± 4.2°	
Age Group	20–30 years (n=19)	ΔVAS = 3.4 ± 0.2	ΔVAS = 6.1 ± 0.3	0.015
		ΔNDI = 13.9 ± 1.7	ΔNDI = 22.4 ± 1.8	
		ΔROM = 72.4 ± 4.6°	ΔROM = 98.0 ± 4.1°	
	31–40 years (n=21)	ΔVAS = 2.8 ± 0.4	ΔVAS = 5.5 ± 0.3	0.027
		ΔNDI = 12.2 ± 2.2	ΔNDI = 20.1 ± 2.0	
		ΔROM = 66.3 ± 4.9°	ΔROM = 91.6 ± 4.7°	
Affected Side	Left (n=10)	ΔVAS = 3.0 ± 0.3	ΔVAS = 5.9 ± 0.3	0.022

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Subgroup Variable	Category	Group A (MET)	Group B (MET+MFR)	p-value (Between Groups)
		ΔNDI = 12.8 ± 1.9	ΔNDI = 21.7 ± 1.8	
		ΔROM = 68.0 ± 4.3°	ΔROM = 93.4 ± 4.2°	
	Right (n=17)	ΔVAS = 3.2 ± 0.4	ΔVAS = 5.8 ± 0.3	0.026
		ΔNDI = 13.4 ± 2.1	ΔNDI = 21.3 ± 2.0	
		ΔROM = 69.2 ± 4.7°	ΔROM = 92.8 ± 4.5°	
	Bilateral (n=13)	ΔVAS = 3.3 ± 0.3	ΔVAS = 6.0 ± 0.2	0.017
		ΔNDI = 13.6 ± 1.9	ΔNDI = 22.2 ± 1.7	
		ΔROM = 70.5 ± 4.2°	ΔROM = 97.5 ± 4.0°	

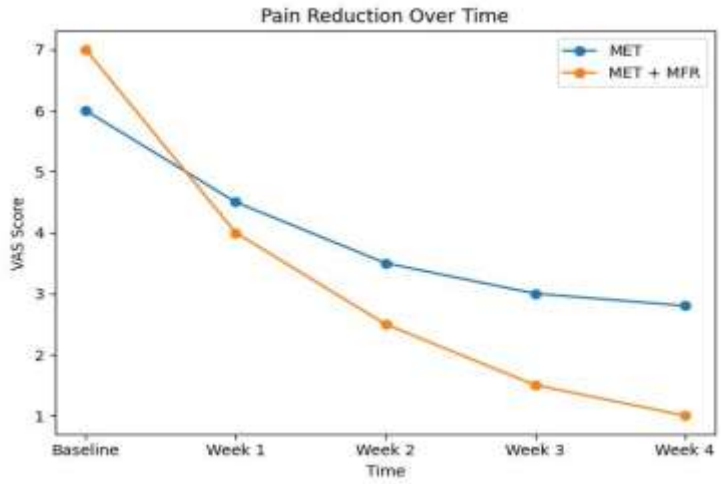


Figure 1 Pain Reduction Over Time

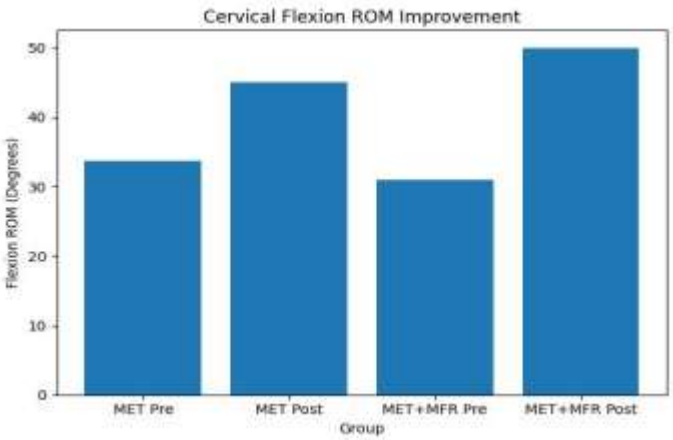
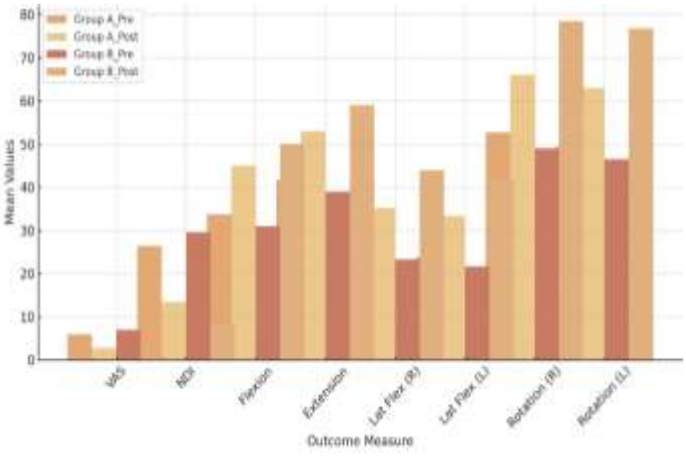
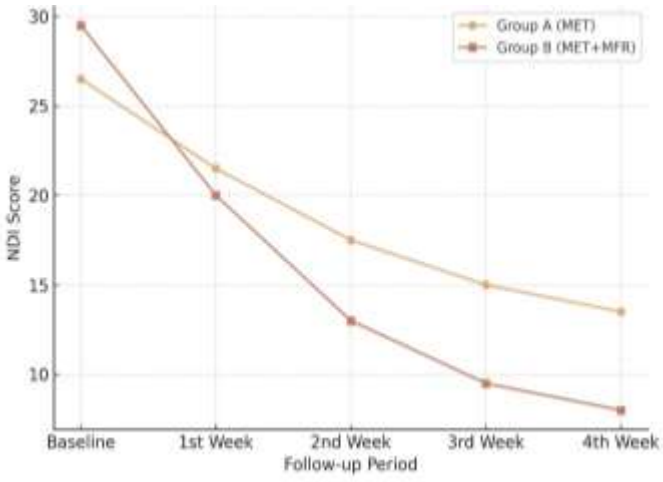


Figure 1 Cervical Flexion ROM Improvement



Comparison of Key Outcome Measures Between Groups (Pre vs Post)

Figure 3 Comparison of Key Outcome Measure Between Groups (Pre vs Post)



Disability (NDI) Scores Over Four Weeks

Figure 4 Disability (NDI) Scores Over Four Weeks

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DISCUSSION

The findings of this randomized controlled trial demonstrated that both Muscle Energy Technique (MET) alone and MET combined with Myofascial Release (MFR) were effective interventions for reducing pain, improving cervical range of motion, and decreasing disability in individuals with cervicogenic headache. However, the consistently superior outcomes observed in the combined MET and MFR group suggest that addressing both muscular and fascial components of cervical dysfunction yields greater therapeutic benefit than targeting muscular mechanisms alone. These results reinforce the clinical relevance of manual therapy in cervicogenic headache management and provide further evidence supporting an integrated treatment approach for cervical musculoskeletal dysfunction. Pain reduction was a prominent outcome in both intervention groups, with statistically and clinically meaningful improvements observed following treatment. The greater reduction in pain intensity in the combined intervention group aligns with existing umbrella reviews and systematic syntheses that report moderate-quality evidence supporting manual therapy and exercise for cervicogenic headache management (16). The enhanced analgesic effect observed with the addition of MFR may be explained by its capacity to reduce fascial restrictions, deactivate myofascial trigger points, and modulate nociceptive input from cervical soft tissues. Cervicogenic headache is known to involve sensitization of the trigeminocervical complex through persistent afferent input from dysfunctional cervical muscles and fascia, particularly the trapezius region. By simultaneously restoring muscle function through MET and reducing fascial tension through MFR, the combined approach may have more effectively attenuated pain referral pathways and peripheral sensitization mechanisms, thereby producing superior pain relief (17).

Improvements in cervical range of motion were evident across all movement planes in both groups, reflecting the mechanical and neuromuscular benefits of manual therapy. Notably, participants receiving MET combined with MFR demonstrated larger gains in flexion, extension, lateral flexion, and rotation compared with those receiving MET alone. These findings are clinically meaningful, as restricted cervical mobility is a hallmark feature of cervicogenic headache and a key contributor to functional limitation. Previous meta-analyses examining manual therapy techniques such as joint mobilization have reported modest improvements in cervical ROM in cervicogenic headache populations (18,19). In contrast, the magnitude of ROM improvement observed in the present study suggests that interventions targeting both joint-related muscular control and myofascial extensibility may result in more substantial functional recovery. This supports the concept that cervical movement restriction in cervicogenic headache is not purely articular but is strongly influenced by myofascial stiffness and altered muscle tone. Functional disability outcomes further corroborated the clinical relevance of the combined intervention. Both groups demonstrated significant reductions in Neck Disability Index scores, indicating improved ability to perform daily activities. However, the MET plus MFR group achieved greater reductions, with post-treatment scores approaching minimal disability levels. These findings are consistent with previous systematic reviews reporting short-term improvements in disability following manual therapy for cervicogenic headache (20,21). The additional functional gains observed with the combined intervention suggest that improvements in pain and cervical mobility translated into meaningful enhancements in daily functioning, reinforcing the value of addressing multiple tissue systems within a single treatment protocol. Subgroup analyses revealed trends suggesting that younger participants, females, and individuals with bilateral symptom presentation may experience relatively greater benefits from combined manual therapy, although these findings should be interpreted cautiously. Younger individuals may demonstrate greater tissue elasticity and neuromuscular adaptability, facilitating faster recovery of motion and pain reduction. Similarly, bilateral involvement, often associated with greater baseline impairment, showed substantial improvement following combined therapy, indicating that MFR may be particularly beneficial in more complex or widespread myofascial dysfunction (22,23). While these subgroup trends were not the primary focus of the study and the trial was not powered for definitive subgroup conclusions, they offer clinically relevant insights for individualized treatment planning.

The present study possessed several methodological strengths that enhance the credibility of its findings. The randomized controlled design, assessor blinding, standardized intervention protocols, and use of validated outcome measures for pain, disability, and cervical ROM contributed to strong internal validity. The targeted focus on the trapezius muscle, a structure frequently implicated in cervicogenic headache pathophysiology, further strengthened the mechanistic relevance of the interventions. Additionally, the absence of reported adverse events supports the safety of both MET and MFR when applied in a controlled clinical setting. Despite these strengths, certain limitations must be acknowledged. The relatively small sample size limited statistical power for detecting smaller between-group differences and restricted the robustness of subgroup analyses. The follow-up duration of one month, while sufficient to assess short-term maintenance of effects, did not permit evaluation of medium- or long-term sustainability of treatment benefits. Consequently, conclusions regarding long-term efficacy remain tentative. Although randomization was performed, minor baseline differences such as age variation between groups may have influenced outcomes. The absence of a no-treatment or placebo control group also limits the

ability to fully attribute observed improvements solely to the interventions, as nonspecific effects such as therapist attention or natural symptom fluctuation cannot be entirely excluded. Furthermore, cervical range of motion was measured using a goniometer, which, while clinically practical, is less precise than advanced motion analysis systems and may introduce measurement variability.

These limitations highlight important directions for future research. Larger, multicenter randomized trials with extended follow-up periods of six to twelve months are needed to establish the durability of treatment effects. Comparative designs incorporating three intervention arms, such as MET alone, MFR alone, and their combination, would help clarify the independent and synergistic contributions of each modality. Incorporating objective biomechanical and physiological measures, including ultrasound imaging, elastography, or electromyography, could enhance understanding of the underlying mechanisms driving clinical improvement. Future studies may also benefit from evaluating patient-centered outcomes such as headache frequency, medication use, and quality of life, as well as cost-effectiveness analyses to inform broader clinical implementation (24). Overall, the findings of this study support the effectiveness of both MET and combined MET with MFR in the management of cervicogenic headache, with evidence favoring the combined approach for superior pain relief, functional recovery, and cervical mobility improvement. These results underscore the importance of addressing both muscular and fascial dysfunction in cervicogenic headache treatment and contribute meaningful evidence to guide physiotherapy practice. While the outcomes are encouraging, cautious interpretation is warranted, and further high-quality research is required to refine treatment protocols and optimize long-term patient outcomes.

CONCLUSION

This randomized controlled trial concluded that both Muscle Energy Technique and its combination with Myofascial Release are effective manual therapy approaches for managing cervicogenic headache by reducing pain, improving cervical mobility, and decreasing functional disability. However, the superior outcomes achieved with the combined approach highlight the clinical value of addressing both muscular re-education and fascial restrictions within a single treatment framework. These findings underscore the importance of an integrated, patient-centered physiotherapy strategy that targets the multifactorial nature of cervical dysfunction rather than relying on isolated techniques. By demonstrating meaningful functional improvements within a relatively short intervention period, this study contributes practical evidence supporting the inclusion of combined manual therapy techniques in routine clinical practice for cervicogenic headache management and reinforces their role as safe and effective non-pharmacological treatment options.

AUTHOR CONTRIBUTIONS

Author	Contribution
Zunaira Samreen*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Iqra Waseem	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Alishba Mustansar	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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