RESEARCH PAPER

Effect of Combined Dry Cupping Therapy and Muscle Energy Technique on Upper Crossed Syndrome Patients: A Randomized Control Study

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ABSTRACT

Background: Upper crossed syndrome (UCS) is an increasingly prevalent postural malalignment characterized by distinct muscle imbalances that contribute significantly to the global burden of neck and shoulder pain. Although unimodal interventions such as manual therapies or dry cupping are frequently employed, their isolated capability to treat complex, multi-planar mechanical imbalances is controversial.

Objective: This study evaluated and compared the therapeutic efficacy of combining Dry Cupping therapy with the Muscle Energy Technique (MET) against each intervention applied independently, focusing on core parameters: Visual Analogue Scale (VAS), Neck Disability Index (NDI), Craniovertebral Angle (CVA), and Sagittal Shoulder-C7 Angle (SSA).

Methods: A pre-test post-test double-blinded randomized controlled trial design was employed. Seventy-six adults (aged 20–40 years) diagnosed with UCS were randomly allocated into four equal experimental groups (n = 19 per group): Group A received combined dry cupping and MET with conventional therapy; Group B received dry cupping with conventional therapy; Group C received MET with conventional therapy; and Group D received conventional therapy alone. Interventions were conducted over an 8-week period. Primary outcomes included Visual Analogue Scale (VAS), functional impairment via the Arabic version of the NDI, and objective sagittal alignment parameters (CVA and SSA) measured using precision photometry via the Kinovea software application.

Results: Post-treatment analysis demonstrated that the multimodal protocol (Group A) yielded statistically superior outcomes compared to all individual treatment strategies ($P < 0.05$). Group A demonstrated a highly significant 91.4% reduction in pain intensity on the VAS and 81.9% reduction in functional disability on the NDI. Biomechanical realignment was similarly pronounced in Group A, showing a 27.3% increase in the CVA (restoring forward head posture) and a 21.7% increase in the SSA (mitigating rounded shoulder protraction). Monotherapies (Groups B and C) yielded mild modifications but failed to show statistically significant variations between one another ($P > 0.05$), while Group D showed the least improvement.

Conclusion: The combination of dry cupping therapy and MET provides a highly potent, synergistic clinical strategy that outperforms standalone protocols. This multi-modal approach effectively mitigates structural pathomechanics and resolves functional impairment, offering an evidence-based recommendation for clinical rehabilitation optimization.

Trial registration: Clinicaltrials.gov (NCT07654543).

Keywords: Upper Crossed Syndrome, Dry Cupping Therapy, Muscle Energy Technique, Visual Analogue Scale, Neck Disability Index, Craniovertebral Angle, Sagittal Shoulder Angle,

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INTRODUCTION

People with rounded shoulders and a forward-leaning head posture are known as having UCS. Some occupations may be risky due to the high risk of musculoskeletal injuries, especially in the neck and upper extremities, caused by repetitive motion, static posture, and heavy lifting. Use of an uncomfortable or unnatural posture for an extended period of time might cause the head to tilt forward. (Mubashir, 2021)

The main symptoms of UCS are a lack of flexibility and stiffness in the muscles of the upper back, shoulders, and neck. Various musculoskeletal symptoms, such as headaches, chest discomfort, tingling in the upper arms, restricted range of motion in the neck or shoulders, and pain in the upper back, neck, or chest, are indications of this illness. Common examples of "postural abnormalities" that may lead to these symptoms include FHP, round shoulders, scapular winging with greater internal rotation and abduction, and thoracic hyperkyphosis. In addition, problems with the atlanto-occipital, cervicothoracic, and glenohumeral joints as well as postural irregularities and upper limb misalignments are outcomes of these imbalances. Joint degeneration, abnormal movement patterns, and injury may result from the syndrome's hallmark uncomfortable postures, which place continuous stress on the joints. (Chang et al., 2023)

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Muscles that are primarily dynamic and phasic in function tend to weaken with time, yet these muscles are engaged more often in varied activities. Disturbance in postural control results from imbalances in the muscles of the opposite group in UCS.(Mujawar & Sagar, 2019)
This muscle activation pattern alters the body's center of gravity and exerts prolonged, destructive mechanical stress on crucial regional articulations, including the atlanto-occipital, cervicothoracic, and glenohumeral joints . Clinically, these structural changes manifest as prominent postural deviations, specifically FHP and protracted, rounded shoulders .Beyond causing localized muscular soreness and headaches, unmanaged UCS triggers accelerated osteoarthritic changes, limits joint mobility, and induces chronic soft-tissue impairments that diminish long-term occupational productivity and systemic quality of life.(Chang et al., 2023)

To manage these mechanical imbalances, physical therapists utilize various manual and holistic interventions. Cupping therapy relies on localized negative vacuum pressure to accelerate local metabolic activity, stimulate microcirculation, and break down fascial adhesions (Jia et al., 2025). Concurrently, the Muscle Energy Technique (MET)—specifically its Post-Isometric Relaxation (PIR) variant—leverages voluntary submaximal contractions against an equal operator counterforce . PIR targets autogenic inhibition via the Golgi tendon organ reflex arc to decrease muscle hyperactivity and safely restore structural resting lengths (Khan et al., 2022)
While individual therapies show promise for short-term pain relief, systematic data increasingly question their standalone capacity to alter the deeply ingrained pathomechanics of UCS. Unimodal strategies often fail to trigger long-lasting neuromuscular adjustments or correct multi-planar structural misalignments (Chen et al., 2025) Therefore, this randomized controlled trial was conducted to evaluate the potential synergistic effect of a multimodal strategy combining dry cupping with MET. This paper examines the efficacy of this combined approach against single-modality protocols, specifically evaluating changes in pain by Visual Analogue Scale (VAS) functional disability (NDI) and objective sagittal deviations craniovertebral angle and sagittal shoulder angle.

MATERIALS AND METHODS

Study design

This study followed a pre-test post-test double-blinded randomized controlled trial design

Randomization

To minimize bias and ensure the internal validity of the study. The blinding process was seamlessly integrated with the randomization phase, where eligible subjects were assigned to one of the four groups (A, B, C, or D) utilizing a sealed-envelope method. All group assignments were pre-coded sequentially. This rigorous containment ensured that the participating volunteers were aware of the specific group allocations prior to or during the intervention period.

Setting

The clinical trial was conducted at the Faculty of Physical Therapy, May University in Cairo, and within private clinical facilities, spanning a data collection timeline from September 2024 through November 2025.

Sample size estimation

The sample size was determined using G*power program version 3.1.9.7. With an alpha error probability of 0.05 and a power (1-beta) of 0.95, the minimum required sample size was identified as 76 participants.

Participants

A total of 84 adult subjects were initially screened, from which 76 participants meeting all diagnostic thresholds for UCS were enrolled. Participant inclusion was restricted to individuals between 20 and 40 years of age. The exact diagnostic criteria required patient with pain score of ≥4 out of 10 on the VAS (Boonstra et al., 2014) and 5 to 14 score on Neck Disability Index (Jovicic et al., 2018) and with a baseline CVA of less than 48 degrees and a SSA of less than 52 degrees. These thresholds signify objective FHP and shoulder protraction, respectively. Figure (1)

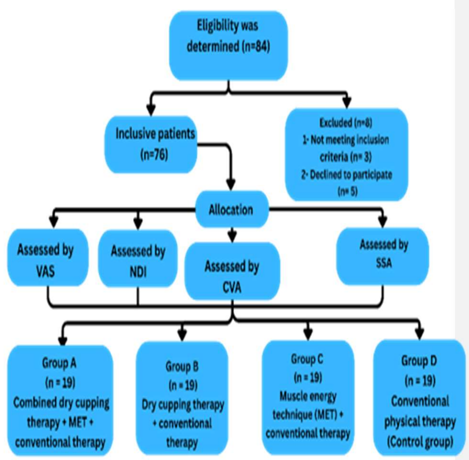

Figure (1). Study flow chart

Exclusion Criteria:

- Patients with a history of traumatic neck injuries (e.g., whiplash, fractures), cervical radiculopathy, disc herniation, or specific spinal diseases.
- Individuals recovering from recent spinal, cervical, or shoulder surgeries.
- Presence of active skin lesions, open wounds, abrasions, or localized infections at the target anatomical placement sites (SI-14 and GB-21 acupoints) that would contraindicate dry cupping application.

Instrumentation

Assessments were conducted uniformly across all groups at baseline (pre and post-intervention) following the 8-week treatment protocol.

- **Visual Analogue Scale (VAS):** A 10 cm vertical line used to measure the intensity of cervical pain, where 0 cm represents "no pain" and 10 cm represents "extreme pain".(Hawker et al., 2011)
- **Neck Disability Index (NDI) - Arabic Version:** The NDI questionnaire was used to measure functional limitations from regional impairment. It assesses 10 clinical sections (such as pain profiles, concentration, and activities of daily living), with each item scored from 0 to 5. The total score ranges up to 50, where higher scores indicate greater functional disability.(Fawzy et al., 2025)
- **Craniovertebral Angle (CVA):** This biomechanical index reflects the architectural severity of head posture. It is defined as the angle formed between a horizontal line drawn through the spinous process of C7 and an intersecting line extending from the tragus of the ear to the C7 landmark (Gadotti & Magee, 2008)
- **Sagittal Shoulder-C7 Angle (SSA):** This geometric marker quantifies shoulder roundedness and anterior protraction. It is formed by the intersection of a horizontal reference line passing through the lateral aspect of the acromion with a line drawn from the C7 spinous process to the lateral acromion (Cibinello et al., 2021)
- Both CVA and SSA were measured using precision digital photogrammetry via the Kinovea software application. To maintain accuracy, a high-resolution digital camera was mounted at a standard distance of 1.5 meters from the subject on a fixed base while the patient in lateral view, with the optical axis adjusted to match each participant's shoulder line . Anatomical markers were positioned on the ear tragus, the C7 spinous process, and the lateral acromion while subjects maintained a relaxed, upright sitting posture looking straight ahead. (11) Figure (2)

Figure 2 Measuring CVA & SSA

Interventional Protocols

Dry Cupping Therapy (Groups A and B) Fig 3

Before starting the intervention, patient preparation involved an inspection of the skin surface and thorough cleansing of the target areas using an alcohol swab (70% alcohol) to ensure optimal hygiene and a secure seal. The patient was then placed in a comfortable, upright sitting position on a standard clinical chair .The dry cupping method was performed at the start of the session using four cups bilaterally , before any active manual therapy or exercise, to maximize local hyperaemia and reduce tissue tension. The levator scapular point (SI-14) and the upper trapezius point (GB-21) were individually treated with the dry cupping method in groups A and B, respectively. The region of application dictated the size of the plastic cup, which ranged from 25 to 50 mm. A vacuum was created by pressing the plastic cup against the spot and then using the compressor pump to remove air. Finally, an eight-minute duration was maintained for the cupping treatment before the cups were safely removed.(Yim et al., 2017) Figure (3)

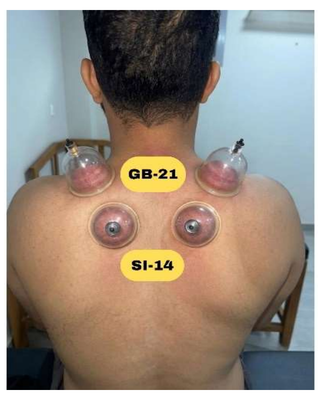

Figure 3 Dry Cupping Therapy

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Muscle Energy Technique (Groups A and C)

The Post-Isometric Relaxation (PIR) manual protocol targeted the spasmed muscles of the neck, including the upper trapezius, levator scapulae, and sternocleidomastoid. Participants were placed in a supine position on the treatment table with their head free from the edge of the plinth, supported by the physical therapist. (Chaitow et al., 2024)

The therapist initially guided the target muscle to its maximum pain-free length barrier. The patient then executed a mild, voluntary submaximal contraction (10%

to 20% force) away from the restriction barrier, maintaining isometric resistance against the therapist's counterforce for 7 seconds. During this effort, the patient performed a controlled inhalation and held their breath. The patient was then instructed to slowly exhale and relax for 3 seconds. The therapist immediately introduced a gentle, passive static stretch in the opposite direction for 30 seconds to engage the newly established structural length barrier. This manual cycle was repeated three consecutive times for each muscle bilaterally. (Chaitow et al., 2024)

Post-Isometric Relaxation (PIR) of the Upper Trapezius the patient's cervical spine was guided into flexion and contralateral lateral flexion just short of the barrier, while the therapist stabilized the ipsilateral shoulder girdle and the ipsilateral mastoid process. The patient then performed a 7-second isometric contraction by holding a deep breath while simultaneously trying to elevate the stabilized shoulder and laterally flex the ear toward that shoulder against unyielding manual resistance. This was followed by a 3-second relaxation phase where the patient exhaled, allowing the therapist to engage the new tissue barrier by passively stretching the shoulder caudally and maintaining this elongated position for 30 seconds. (Chaitow et al., 2024)

Post-Isometric Relaxation (PIR) of the Levator Scapulae the therapist supported the patient's cervical spine and moved it into flexion, contralateral lateral flexion, and contralateral rotation to engage the barrier, while placing the opposing hand on the ipsilateral shoulder girdle. The patient then performed a 7-second isometric contraction by holding a deep breath, gently extending the head backward toward the involved side, and elevating the ipsilateral shoulder against the therapist's resistance. This was followed by a 3-second relaxation phase where the patient exhaled, allowing the therapist to passively advance the cervical spine into deeper flexion, contralateral side bending, and contralateral rotation. Finally, this elongated position was maintained for 30 seconds while the patient actively assisted in depressing the ipsilateral shoulder caudally. (Chaitow et al., 2024)

Post-Isometric Relaxation (PIR) of the Sternocleidomastoid the therapist stabilized the contralateral occipital ridge and placed their opposite thumb on the patient's ipsilateral forehead, guiding the cervical spine into contralateral lateral flexion, ipsilateral rotation, and extension to lengthen the muscle. The patient then performed a 7-second isometric contraction by looking upward, inhaling, holding their breath, and pushing against the therapist's thumb. This was followed by a 3-second relaxation phase where the patient looked downward and exhaled, allowing the therapist to immediately engage the new barrier by passively stretching the sternocleidomastoid into deeper cervical extension toward the floor for 30 seconds. (Chaitow et al., 2024)

Conventional therapy was applied to all groups

Shoulder Stabilization Exercise

The patient sat tall on the edge of the plinth with a neutral spine, feet flat, and elbows bent at 90 degrees by their sides. They smoothly squeezed their shoulder blades backward and downward—as if pinching a pencil between them—while keeping the tops of their shoulders completely relaxed. Patient held this firm contraction for 3 to 5 seconds while breathing normally, then slowly released back to the starting position.(Nemati et al., 2024)

Shoulder Shrugging Exercise

The patient sat upright on the edge of a plinth with their feet supported, their spine in a neutral alignment, and their arms resting relaxed at their sides. Patient performed a bilateral shoulder shrug by smoothly elevating their scapulae straight upward toward their ears to maximize upper trapezius activation without bending their elbows or leaning their torso. Patient held this elevated position firmly for 3 to 5 seconds while maintaining normal breathing, followed by a slow, controlled lowering of the shoulders back to the starting baseline.

Deep Neck flexors ex

The patient lay in a supine position with their head maintained in a neutral position. The patient performed a gentle cervical flexion by nodding their head forward, as if signaling "yes," effectively tucking the chin while keeping the superficial neck muscles, such as the sternocleidomastoid, completely relaxed. The patient held this deep contraction firmly for 3 to 5 seconds while maintaining a normal breathing pattern, followed by a slow, controlled release back to the starting baseline.(Nitayarak & Charntaraviroj, 2021)

All exercises were performed for 2 to 3 sets of 10 to 12 repetitions

Statistical analysis

All statistical analyses were conducted using SPSS software version 22. Using analysis of variance (ANOVA), comparing the groups based on measurements such as age, height, weight, and body mass index (BMI). Also, to compare the four groups based on sex, the Kruskal-Wallis test was used. Additionally, in order to compare the results of the four groups, MANOVA was executed. Nevertheless, in order to find the differences between the groups, multiple comparisons were used, and to find the significant changes within the groups, pairwise comparisons were used. Using the Kolmogorov-Smirnov test, to ensured that the data was normal. In addition, the data homogeneity tested using Levene's test. All statistical tests were set with a significance threshold of $P < 0.05$.

RESULTS

All 76 randomized patients ($n = 19$ per group) completed the 8-week intervention protocol with zero attrition. Baseline demographic and physical attributes demonstrated high uniformity among groups ($P \geq 0.05$), confirming successful randomization (Table 1)

1. Visual Analogue Scale (VAS)

Pre-treatment

There was no significant difference in pain assessed by VAS between the four treatment groups ($p = 0.883$) (Table 2).

Post-treatment
After the therapy, the four groups' pain assessed by VAS differed significantly (P<0.05) according to Table 2. Groups A and B, A and C, B and D, C and D, and A and D all showed a significant difference in post-hoc testing (P<0.05). However, there was no significant variance between Groups B and C (p = 0.989) according to (Table 2).

2. Neck Disability Index (NDI)

Pre-treatment
There was no significant difference in NDI score between the four groups pre-treatment (p = 0.946) (Table 3).

Post-treatment
After therapy, the groups A,B and C NDI scores differed significantly (P<0.05) (Table 3). While no changes in Group D. There was a notable distinction between groups A and B, A and C, and A and D in the post-hoc testing (P<0.05). On the other hand, there was no significant variation between groups B and C, B and D, and C and D (P values of 0.959, 0.118, and 0.981, respectively). (3)

3. Craniovertebral Angle (CVA)

Pre-treatment
There was no significant difference in degree between the four groups (p = 0.925)

Post-treatment
the groups A,B and C showed a notable variations in degree after treatment .While no changes in Group D Table 4. A significant difference was shown by post-hoc testing between groups A and B, A and C, A and D, and B and D (P<0.05). On the other hand, there was no significant variation between groups B and C or C and D (P values of 0.308 and 0.138, respectively. Table (4)

Table 1. Comparison of characteristics between groups A, B, C, and D.

	Group A (Combined Technique) n=19		Group B (Cupping) n=19		Group C (Muscle Energy) n=19		Group D (Control) n=19		F-value	P-value
	X ± SD		X ± SD		X ± SD		X ± SD			
Age (years)	36.6±5.3		38±6.3		38±5.3		38.3±6		0.336	0.779
Weight (Kg)	64.1±8		63.7±8.6		63.5±8.7		63.8±7.6		0.016	0.997
Height (cm)	169.8±8.2		170.6±8.6		169.1±9.4		169.4±8.3		0.125	0.945
BMI (kg/m^2)	22.1±1.3		21.8±1.5		22.2±1.7		22.2±1.5		0.310	0.824
	Male	Female	Male	Female	Male	Female	Male	Female	Chi-Square	P-value
Sex distribution	14(73.7%)	5(26.3%)	14(73.7%)	5(26.3%)	14(73.7%)	5(26.3%)	15(78.9%)	4(21.1%)	0.208	0.976

*X: Mean, SD: Standard deviation, p-value: Probability value, *: significance, n: number of participants*

Table 2. Comparison between groups regarding Visual Analogue Scale (VAS)

Visual Analogue Scale VAS	Group A (Combined Technique) n=19	Group B (Cupping) n=19	Group C (Muscle Energy) n=19	Group D (Control) n=19	Comparison between group	
	X ± SD	X ± SD	X ± SD	X ± SD	F-value	P-value
Before Intervention	6.16±1.3	6.17±1.2	5.95±1.3	6.26±1.1	0.219	0.883
After Intervention	0.53±0.5	4.6±1	5±1.2	5.8±0.4	45.274	P<0.05*
percentage of change	91.4%	25.4%	15.9%	7.3%		
Comparison within group	P<0.05*	P<0.05*	P<0.05*	0.019*		

Post-intervention Multiple Comparisons		
	MD	P-value
Group (A) vs. Group (B)	-4.1	P<0.05*
Group (A) vs. Group (C)	-4.5	P<0.05*
Group (A) vs. Group (D)	-5.3	P<0.05*
Group (B) vs. Group (C)	-0.37	0.989
Group (B) vs. Group (D)	-1.2	P<0.05*
Group (C) vs. Group (D)	-0.8	0.034*
MANOVA overall main effect		

	P-value	Significance
Group effect	P<0.05*	S
Time effect	P<0.05*	S
Interaction effect (group x time)	P<0.05*	S

*X: Mean, SD: Standard deviation, p-value: Probability value, *: significance, MD: mean difference, n: number of participants*

Table 3. Comparison between groups regarding Neck Disability Index (NDI).

Neck Disability Index NDI	Group A (Combined Technique) n=19	Group B (Cupping) n=19	Group C (Muscle Energy) n=19	Group D (Control) n=19	Comparison between group	
	X ± SD	X ± SD	X ± SD	X ± SD	F-value	P-value
Before Intervention	22.6±5.4	22.5±5.9	21.6±5.5	22.1±4.6	0.123	0.946
After Intervention	4.1±1.9	18.5±4.9	19.9±5.1	21.8±4.5	66.338	P<0.05*
percentage of change	81.9%	17.8%	7.9%	-		
Comparison within group	P<0.05*	P<0.05*	0.002*	0.700		
Post-intervention Multiple Comparisons						
			MD		P-value	
Group (A) vs. Group (B)			-14.4		P<0.05*	
Group (A) vs. Group (C)			-15.8		P<0.05*	
Group (A) vs. Group (D)			-17.9		P<0.05*	
Group (B) vs. Group (C)			-1.4		0.989	
Group (B) vs. Group (D)			-3.4		0.118	
Group (C) vs. Group (D)			-1.9		0.981	
MANOVA overall main effect						
			P-value		Significance	
Group effect			P<0.05*		S	
Time effect			P<0.05*		S	
Interaction effect (group x time)			P<0.05*		S	

Table 4. Comparison between groups regarding Craniovertebral angle (CVA).

Craniovertebral angle (CVA)°	Group A (Combined Technique) n=19	Group B (Cupping) n=19	Group C (Muscle Energy) n=19	Group D (Control) n=19	Comparison between group	
	X ± SD	X ± SD	X ± SD	X ± SD	F-value	P-value
Before Intervention	42.1±2.6	42.6±2.9	42.5±2.6	42.2±2.4	0.127	0.925
After Intervention	53.6±2.2	45.6±2.6	44.1±2.3	42.3±2.4	84.068	P<0.05*
percentage of change	27.3%	7%	3.8%	-		
Comparison within group	P<0.05*	P<0.05*	P<0.05*	0.840		
Post-intervention Multiple Comparisons						
			MD		P-value	
Group (A) vs. Group (B)			8		P<0.05*	
Group (A) vs. Group (C)			9.3		P<0.05*	
Group (A) vs. Group (D)			11.3		P<0.05*	
Group (B) vs. Group (C)			1.5		0.308	
Group (B) vs. Group (D)			3.3		P<0.05*	
Group (C) vs. Group (D)			1.8		0.138	
MANOVA overall main effect						
			P-value		Significance	
Group effect			P<0.05*		S	
Time effect			P<0.05*		S	
Interaction effect (group x time)			P<0.05*		S	

4. Sagittal Shoulder-C7 Angle (SSA)

Pre-treatment

there was no significant difference in angles between the four groups .(p = 0.936)

Post- the groups A,B and C showed a notable variations in degree after treatment (P<0.05).While no changes in Group D according to Table 5. According to post-hoc testing, there was a notable difference among groups A and B, A and C, A and D, and B and D (P<0.05). On the other hand, there was no significant variance between groups B and C or C and D (P values of 0.452 and 0.190, respectively). Table (5)

Table 5. Comparison between groups regarding Sagittal segmental alignment (SSA).

Sagittal segmental alignment (SSA)	Group A (Combined Technique) n=19	Group B (Cupping) n=19	Group C (Muscle Energy) n=19	Group D (Control) n=19	Comparison between group	
	X ± SD	X ± SD	X ± SD	X ± SD	F-value	P-value
Before Intervention	46.1±2.7	46.6±3.2	46.5±2.7	46.3±2.4	0.139	0.936
After Intervention	56.1±2.4	49.6±2.9	48.1±2.4	46.3±2.3	54.574	P<0.05*
percentage of change	21.7%	6.4%	3.4%	-		
Comparison within group	P<0.05*	P<0.05*	P<0.05*	0.841		
Post-intervention Multiple Comparisons						
			MD		P-value	
Group (A) vs. Group (B)			6.5		P<0.05*	
Group (A) vs. Group (C)			8		P<0.05*	
Group (A) vs. Group (D)			9.8		P<0.05*	
Group (B) vs. Group (C)			1.5		0.452	
Group (B) vs. Group (D)			3.3		0.001*	
Group (C) vs. Group (D)			1.8		0.190	
MANOVA overall main effect						
			P-value		Significance	
Group effect			P<0.05*		S	
Time effect			P<0.05*		S	
Interaction effect (group x time)			P<0.05*		S	

DISCUSSION

This study set out to assess the clinical superiority of a multi-modal intervention, showing that combining dry cupping therapy and MET with conventional therapy (Group A) yields significantly greater therapeutic benefits than applying either method in isolation. Specifically, Group A achieved a highly significant 91.4% reduction in pain intensity on the VAS and an 81.9% improvement in functional capacity on the NDI.

Furthermore, this combined protocol yielded statistically superior outcomes (P < 0.05) across all objective biomechanical and structural parameters— CVA, and alignment SSA—when compared to the dry cupping (Group B), MET (Group C), and control (Group D) cohorts. Conversely, post-hoc multiple comparisons revealed that when dry cupping or MET were administered as monotherapies, their post-intervention scores frequently demonstrated no statistically significant variations from one another or from the control group in key dimensions such as functional disability (P = 0.989).

The therapeutic efficacy of dry cupping therapy is driven by three synergistic pathways: mechanical decompression, vascular stimulation, and neurophysiological pain modulation. Mechanically, negative vacuum pressure lifts soft tissues to stretch tight fascia and disrupt local adhesions, while vascular stimulation induces hyperemia, releases endothelial nitric oxide, and enhances tissue perfusion to clear metabolic wastes. Finally, neurophysiologically, the treatment activates cutaneous mechanoreceptors to block pain transmission via the Gate Control Theory, stimulates Diffuse Noxious Inhibitory Controls, and releases systemic beta-endorphins to elevate the overall pain threshold.(Al-Bedah et al., 2019)

The application of MET leverages the voluntary activation of target muscle fibers to engage autogenic inhibition pathways (Yang et al., 2023), during the initial submaximal isometric contraction, increased tension within the myotendinous junction stimulates Golgi Tendon Organ Type Iβ afferent fibers, which synapse onto inhibitory interneurons in the spinal cord to suppress homonymous α-motor neuron activity (Lafans & Troncoso, 2020). This transient post-contraction refractory state reduces motor drive and intrinsic resting tone, allowing the muscle-tendon unit to be lengthened up to its new barrier with minimal reflex resistance.

Concurrently, sustained isometric loading induces viscoelastic stress relaxation and transiently decreases passive muscle-tendon stiffness, facilitating greater tissue deformation (Stenersen & Bordoni, 2021). Furthermore, the alternating contraction-relaxation sequence exerts a muscular pump effect that enhances local microcirculation and washes out metabolic nociceptors, thereby elevating local stretch pain (Ahmed et al., 2020). Taken together, these neurophysiological and biomechanical mechanisms provide a robust rationale for the clinical efficacy of PIR in restoring functional range of motion and alleviating myofascial tension.(Javed et al., 2024)

The clinical superiority of the multimodal approach observed in Group A of this investigation is strongly supported by recent high-level global evidence. In a comprehensive network meta-analysis evaluating the effectiveness of musculoskeletal manipulations in patients with neck pain, researchers analyzed 101 randomized controlled trials and concluded that multimodal care represents the most effective strategy for reducing pain intensity and neck disability. (Gong et al., 2024). Multimodal protocols provide persistent neuromuscular stimulation that can enhance dynamic stability, restore balance to opposing muscle groups, and break the cycle of pain-induced movement avoidance .(Chen et al., 2025)

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A systematic review specifically targeting chronic neck pain found that cupping therapy—even when compared against active controls—significantly reduced both pain intensity and functional disability, demonstrating a meaningful reduction on the NDI that met minimal clinically important differences (Kim et al., 2018). While a systematic evidence suggest that the clinical benefits of standalone dry cupping may be limited or influenced by placebo effect due to using dry cupping as a monotherapy modality.(Silva et al., 2019)

In a systematic review evaluating single-modality treatments, cupping therapy demonstrated immediate efficacy for short-term pain relief but failed to significantly reduce functional disability when used in isolation ($P = 0.51$). This limitation occurs because negative vacuum pressure modulates pain pathways primarily through fast-acting mechanosensitive β nerve fibers. While this mechanism helps control pain, it is insufficient to alter the structural pathomechanics or underlying muscle imbalances characteristic of UCS.(Jia et al., 2025)

A systematic review and meta-analysis by Sbardella highlighted that while the application of MET yields notable clinical benefits for non-specific neck pain. Their findings demonstrate that integrating MET significantly mitigates pain intensity and reduces functional disability—as measured by standardized metrics like the NDI by addressing underlying myofascial restrictions and restoring normal neuromuscular tone.(Sbardella et al., 2021)

Investigating the impact of post-isometric relaxation targeted at the upper trapezius and levator scapulae musculature, the study by Phadke demonstrated a highly significant reduction in pain alongside a substantial drop in NDI scores ($p < 0.001$). This contemporary evidence strongly mirrors the positive intra-group outcomes recorded in the MET cohort (Group C) of the present investigation. (Phadke et al., 2016)

The significant post-treatment improvement in the CVA observed in this study aligns closely with recent evidence emphasizing targeted MET applications for sagittal head realignment. Specifically, Kulkarni et al. (2025) demonstrated that while MET targeting either the levator scapulae or anterior scalene yields statistically significant gains in CVA ($P = 0.001$), post-isometric relaxation applied directly to the levator scapulae produces a superior correction of FHP ($P = 0.002$). (Kulkarni et al., 2025)

Joshi & Poojary (2022) demonstrated that combining MET with posture correction exercises in patients presenting with FHP resulted in a statistically significant improvement in the CVA compared to simple range-of-motion controls ($P < 0.025$).(Joshi & Poojary, 2022)

Research by Aneis et al. (2022) demonstrated that a comprehensive program—integrating MET, cervical and scapulothoracic stabilization exercises, and ergonomic postural training—yields superior outcomes compared to the application of MET in isolation. Patients receiving this multimodal intervention showed statistically significant improvements in pain intensity, neck functional disability, and sagittal postural metrics, such as the CVA and SSA.(Aneis et al., 2022)

Arshad et al. (2025) demonstrated that applying MET specifically PIR targeting hyperactive muscles in patients presenting with anterior postural deviations, chronic tightness of the pectoralis major and minor exerts a continuous anterior pull on the scapula and humeral head, leading to improvement in the anterior shoulder translation i.e FHP and an improvement in SSA. ($P = 0.001$). (Arshad1 et al., 2025)

Conclusion

The combination of dry cupping therapy and MET provides a highly potent, synergistic clinical strategy that outperforms standalone protocols. This multi-modal approach effectively mitigates structural pathomechanics and resolves functional impairment, offering an evidence-based recommendation for clinical rehabilitation optimization.

Limitations

Due to the absence of mid- or long-term follow-up (e.g. 3 to 6 months post-treatment), this study cannot definitively determine the long-term retention of structural alignments CVA and SSA or ensure protection against subsequent therapeutic decay.

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