

Effectiveness of Muscle Energy Technique on Pain, Neck Disability, and Craniovertebral Angle in Smartphone Users with Cervicogenic Headache and Forward Head Posture: A Randomized Controlled Trial

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ABSTRACT

Background:

Cervicogenic headache (CGH) is a secondary headache arising from dysfunction of the cervical spine and its associated musculoskeletal structures. Prolonged smartphone use is associated with forward head posture (FHP), which increases mechanical stress on the cervical region and contributes to the development of cervicogenic headache. Muscle Energy Technique (MET) is a manual therapy intervention that aims to reduce pain, improve muscle flexibility, restore joint mobility, and correct postural dysfunction.

Objective:

To evaluate the effectiveness of Muscle Energy Technique in reducing pain, improving functional disability, and correcting forward head posture among smartphone users with cervicogenic headache.

Methods:

A randomized controlled trial was conducted among 40 smartphone users aged 18–35 years diagnosed with cervicogenic headache associated with forward head posture. Participants were randomly allocated into two groups: the experimental group (n = 20) received Muscle Energy Technique, while the control group (n = 20) received conventional physiotherapy management. Treatment was administered three sessions per week for four weeks. Outcome measures included the Visual Analogue Scale (VAS) for pain intensity, Neck Disability Index (NDI) for functional disability, and Craniovertebral Angle (CVA) for postural assessment. Pre- and post-intervention outcomes were analysed using appropriate statistical tests.

Results:

Both groups demonstrated significant improvements following the intervention ($p < 0.001$). However, the MET group showed significantly greater reductions in pain intensity and neck disability, along with greater improvement in craniovertebral angle, compared with the conventional therapy group ($p < 0.001$). These findings indicate that MET was more effective in reducing cervicogenic headache symptoms and improving postural alignment.

Conclusion:

Muscle Energy Technique is an effective intervention for managing cervicogenic headache associated with forward head posture among smartphone users. It significantly reduces pain, improves neck-related functional disability, and enhances postural alignment compared with conventional physiotherapy. MET may be considered an effective treatment option in the physiotherapy management of cervicogenic headache related to prolonged smartphone use.

Keywords:

Muscle Energy Technique, Cervicogenic Headache, Forward Head Posture, Smartphone Users, Neck Disability Index, Craniovertebral Angle, Physiotherapy.

INTRODUCTION

Cervicogenic headache (CGH) is a secondary headache originating from dysfunction of the cervical spine and its associated musculoskeletal structures. It is typically characterized by unilateral pain referred from the neck to the occipital, temporal, frontal, or orbital regions and is often aggravated by neck movement or sustained cervical postures. CGH is a common musculoskeletal condition that negatively affects functional performance, work productivity, and quality of life.^{1,2}

The widespread use of smartphones has led to a substantial increase in forward head posture (FHP), particularly among young adults. Prolonged neck flexion during smartphone use increases mechanical loading on the cervical spine, resulting in muscular imbalance, joint dysfunction, and postural alterations. Individuals with FHP commonly exhibit tightness of the upper trapezius, sternocleidomastoid, levator scapulae, suboccipital, and pectoral muscles, along with weakness of the deep cervical flexors. These biomechanical changes are strongly associated with the development and persistence of cervicogenic headache.³⁻⁵

Assessment of patients with CGH commonly includes evaluation of pain intensity, functional disability, and postural alignment. The Visual Analogue Scale (VAS), Neck Disability Index (NDI), and Craniovertebral Angle (CVA) are reliable and widely used outcome measures for assessing these domains. A reduced CVA reflects greater forward head posture and has been associated with increased neck pain and disability.^{6,8}

Conservative physiotherapy plays a major role in the management of cervicogenic headache. Among various manual therapy techniques, Muscle Energy Technique (MET) has gained considerable attention because of its ability to reduce muscle tightness, improve joint mobility, relieve pain, and restore postural alignment. MET utilizes voluntary isometric muscle contractions followed by controlled stretching, based on the principles of post-isometric relaxation and reciprocal inhibition. Previous studies have reported beneficial effects of MET in improving cervical range of motion, reducing pain, and enhancing functional outcomes in individuals with cervical musculoskeletal disorders.^{7,9,10}

Although several studies have investigated the effects of MET on neck pain and postural dysfunction, limited evidence is available regarding its effectiveness in smartphone users with cervicogenic headache associated with forward head posture. Therefore, the present study aimed to evaluate the effectiveness of Muscle Energy Technique in reducing pain, improving neck-related disability, and correcting forward head posture among smartphone users with cervicogenic headache using the VAS, NDI, and CVA as outcome measures.⁸⁻¹⁰

Materials and Methods

This randomized controlled trial was conducted to evaluate the effectiveness of Muscle Energy Technique (MET) in individuals with cervicogenic headache associated with forward head posture among smartphone users. The study was carried out over a period of four weeks in the Department of Physiotherapy and selected physiotherapy outpatient clinics. A total of 40 participants aged between 18 and 35 years who fulfilled the eligibility criteria were recruited using a convenient sampling technique and randomly allocated into two equal groups ($n = 20$ each). The experimental group received Muscle Energy Technique, whereas the control group received conventional physiotherapy management.

Participants were eligible if they used smartphones for more than two hours daily for at least the previous three months, had a clinical diagnosis of cervicogenic headache, demonstrated forward head posture with a craniovertebral angle (CVA) of less than 50° , experienced headache aggravated by neck movement or sustained cervical posture, and reported mild to moderate neck-related disability. Individuals with a history of cervical spine surgery, fracture, severe cervical trauma, migraine, tension-type headache, cluster headache, cervical radiculopathy, cervical myelopathy, neurological disorders affecting the cervical spine, or vestibular disorders were excluded from the study. Written informed consent was obtained from all participants before enrolment.

Baseline assessment was performed before the intervention using the Visual Analogue Scale (VAS) to evaluate pain intensity, the Neck Disability Index (NDI) to assess neck-related functional disability, and the Craniovertebral Angle (CVA) to quantify forward head posture. The CVA was measured from standardized lateral photographs using ImageJ software. All outcome measures were reassessed after completion of the four-week intervention period using the same assessment procedures.

Participants allocated to the experimental group received Muscle Energy Technique using the post-isometric relaxation method for the upper trapezius, sternocleidomastoid, and levator scapulae muscles. Each muscle was positioned at its restrictive barrier, followed by a gentle isometric contraction of approximately 20% of maximal effort for 7–10 seconds against therapist resistance. After complete

relaxation, the muscle was passively stretched to a new restrictive barrier and maintained for 20–30 seconds. This procedure was repeated three times for each muscle during every treatment session. In addition, participants received education regarding correct smartphone posture and strategies to avoid prolonged neck flexion. The intervention was administered three times per week for four consecutive weeks, resulting in a total of 12 treatment sessions.

The control group received conventional physiotherapy consisting of stretching exercises for the upper trapezius, sternocleidomastoid, levator scapulae, and pectoral muscles, deep cervical flexor strengthening exercises, scapular retraction exercises, and postural correction training. The frequency and duration of treatment were identical to those of the experimental group, with three treatment sessions per week for four weeks.

Statistical Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) software (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic characteristics and outcome measures, with continuous variables expressed as mean $\pm$ standard deviation (SD). Baseline demographic and clinical characteristics between the two groups were compared using the independent t -test. Within-group differences between pre- and post-intervention scores for the Visual Analogue Scale (VAS), Neck Disability Index (NDI), and Craniovertebral Angle (CVA) were analysed using the paired t -test. Between-

group comparisons of post-intervention scores and mean change scores were performed using the independent *t*-test. A *p*-value of less than 0.05 was considered statistically significant.

Results

A total of 40 participants completed the study and were equally allocated to the Muscle Energy Technique (MET) group (*n* = 20) and the control group (*n* = 20). There were no statistically significant differences between the groups with respect to age, gender distribution, or baseline outcome measures (VAS, NDI, and CVA), indicating that the groups were comparable before the intervention.

Following four weeks of intervention, both groups demonstrated significant improvements in pain intensity, neck-related disability, and forward head posture (*p* < 0.001). However, the magnitude of improvement was significantly greater in the MET group than in the control group.

In the MET group, the mean VAS score decreased from 7.50 ± 0.51 to 2.35 ± 0.49 , while the mean NDI score improved from 29.50 ± 1.43 to 8.35 ± 0.93 . The mean Craniovertebral Angle (CVA) increased from $42.10 \pm 1.12^\circ$ to $51.75 \pm 1.12^\circ$, demonstrating significant improvement in forward head posture (all *p* < 0.001).

In the control group, the mean VAS score decreased from 7.50 ± 0.51 to 4.65 ± 0.49 , the mean NDI score improved from 29.60 ± 1.31 to 17.45 ± 0.89 , and the mean CVA increased from $42.10 \pm 1.12^\circ$ to $46.35 \pm 0.81^\circ$. Although these improvements were statistically significant (*p* < 0.001), they were less pronounced than those observed in the MET group.

Between-group analysis of post-intervention outcomes demonstrated that the MET group achieved significantly better results than the control group for all outcome measures. Participants treated with MET exhibited lower pain intensity (VAS: 2.35 ± 0.49 vs. 4.65 ± 0.49), lower neck disability (NDI: 8.35 ± 0.93 vs. 17.45 ± 0.89), and greater improvement in craniovertebral angle (CVA: $51.75 \pm 1.12^\circ$ vs. $46.35 \pm 0.81^\circ$) compared with the control group (all *p* < 0.001).

Overall, the findings indicate that Muscle Energy Technique was significantly more effective than conventional physiotherapy in reducing pain, improving functional disability, and correcting forward head posture among smartphone users with cervicogenic headache.

Discussion

The present study evaluated the effectiveness of Muscle Energy Technique (MET) in reducing pain, improving neck-related disability, and correcting forward head posture among smartphone users with cervicogenic headache. The findings demonstrated significant improvements in both the experimental and control groups following four weeks of intervention. However, participants who received MET showed significantly greater improvements in pain intensity, functional disability, and craniovertebral angle than those who received conventional physiotherapy, indicating the superior effectiveness of MET in the management of cervicogenic headache associated with forward head posture.

The reduction in pain observed in the experimental group may be attributed to the physiological effects of Muscle Energy Technique. MET utilizes voluntary isometric muscle contractions followed by passive stretching, which promote post-isometric relaxation and reciprocal inhibition. These neurophysiological mechanisms help reduce muscle hypertonicity, improve local circulation, decrease mechanical stress on

cervical structures, and restore normal cervical biomechanics. Since cervicogenic headache is closely associated with muscle tightness and joint dysfunction, reducing muscular tension may contribute to decreased nociceptive input from cervical tissues and subsequent pain relief.

The significant improvement in Neck Disability Index (NDI) scores suggests that MET effectively enhanced cervical function and reduced activity limitations. Restoration of muscle flexibility and cervical mobility likely enabled participants to perform daily activities with less discomfort. In addition, correction of muscular imbalance around the cervical spine may have improved postural control and functional performance, thereby contributing to lower disability scores. These findings indicate that improvements in pain were accompanied by meaningful functional recovery.

An important finding of the present study was the significant increase in Craniovertebral Angle (CVA) in the experimental group, indicating improvement in forward head posture. Prolonged smartphone use is associated with sustained cervical flexion and anterior displacement of the head, leading to adaptive shortening of the upper trapezius, sternocleidomastoid, levator scapulae, suboccipital, and pectoral muscles. By specifically addressing these shortened muscles, MET may restore muscle length, reduce postural asymmetry, and improve cervical alignment, resulting in improved craniovertebral angle measurements.

The findings of this study are consistent with previous research reporting the beneficial effects of Muscle Energy Technique in individuals with neck pain, forward head posture, and cervicogenic headache. Earlier studies have demonstrated that MET effectively reduces pain, improves cervical range of motion, enhances postural alignment, and decreases functional disability by restoring normal muscle function and cervical biomechanics. The present study extends these findings by specifically demonstrating the effectiveness of MET in smartphone users with cervicogenic headache associated with forward head posture.

Although both groups showed statistically significant improvements after treatment, the experimental group demonstrated superior outcomes across all measured variables. This suggests that the addition of Muscle Energy Technique to conventional physiotherapy provides greater therapeutic benefits than conventional physiotherapy alone. These findings support the incorporation of MET into routine physiotherapy practice for individuals presenting with cervicogenic headache related to forward head posture.

The present study has certain limitations. The sample size was relatively small, and the intervention period was limited to four weeks. Long-term follow-up was not performed; therefore, the sustained effects of the intervention could not be determined. Future studies with larger sample sizes, multicentre recruitment, longer follow-up periods, and comparison with other manual therapy techniques are recommended to further establish the long-term effectiveness of Muscle Energy Technique in the management of cervicogenic headache.

Conclusion

The findings of the present study demonstrate that Muscle Energy Technique (MET) is an effective intervention for the management of cervicogenic headache associated with forward head posture among smartphone users. Although both the experimental and control groups showed significant improvements following four weeks of treatment, participants who received MET exhibited significantly greater reductions in pain intensity and neck-related disability, along with greater improvement in craniovertebral angle. These findings suggest that incorporating MET into conventional physiotherapy may provide superior clinical outcomes by improving cervical muscle function, reducing mechanical stress on the cervical spine, and correcting postural alignment. Therefore, Muscle Energy Technique can be considered an effective and clinically applicable treatment approach for individuals with cervicogenic headache associated with forward head posture resulting from prolonged smartphone use.

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Tables

Table 1 : Group Statistics of improvement score

Outcome Measure	Group	n	Mean	Standard Deviation	Standard Error
VAS (Pre)	MET	20	7.50	0.51	0.11
	Control	20	7.50	0.51	0.11
VAS (Post)	MET	20	2.35	0.49	0.11
	Control	20	4.65	0.49	0.11
NDI (Pre)	MET	20	29.50	1.43	0.32
	Control	20	29.60	1.31	0.29

NDI (Post)	MET	20	8.35	0.93	0.21
	Control	20	17.45	0.89	0.20
CVA (Pre)	MET	20	42.10	1.12	0.25
	Control	20	42.10	1.12	0.25
CVA (Post)	MET	20	51.75	1.12	0.25
	Control	20	46.35	0.81	0.18

Table 2: Paired Sample t-Test

Group	Outcome Measure	Mean Difference	t-value	df	P-value
MET	VAS	5.15	-34.333	19	<0.001
	NDI	21.15	-63.205	19	<0.001
	CVA	9.65	73.502	19	<0.001
Control	VAS	2.85	-19.000	19	<0.001
	NDI	12.15	-92.544	19	<0.001
	CVA	4.25	42.782	19	<0.001

Table 3: Independent Sample t-Test

Outcome Measure	MET (Mean ± SD)	Control (Mean ± SD)	Mean Difference	t-value	df	P-value
VAS (Post)	2.35 ± 0.49	4.65 ± 0.49	-2.30	-14.863	38	<0.001
NDI (Post)	8.35 ± 0.93	17.45 ± 0.89	-9.10	-31.607	38	<0.001
CVA (Post)	51.75 ± 1.12	46.35 ± 0.81	5.40	17.472	38	<0.001

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