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IMMEDIATE EFFECTS OF HAMSTRING MUSCLE ENERGY TECHNIQUE (MET) VS. HAMSTRING STRETCHING ON CERVICAL SPINE RANGE OF MOTION, PAIN, AND CRANIOVERTEBRAL ANGLE IN COLLEGE STUDENTS WITH NECK PAIN: A COMPARATIVE STUDY

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ABSTRACT

Background: Neck pain is a common musculoskeletal disorder among college students, often linked to prolonged sitting, screen exposure, and poor posture. Evidence suggests hamstring tightness may contribute to cervical dysfunction through myofascial and postural connections.

Objective: To compare the immediate effects of hamstring MET versus static stretching on cervical mobility, posture, and pain in college students with neck pain.

Methods: Forty-two college students with neck pain were randomly assigned to either a MET group or a static stretching group (n = 21 each). Interventions were applied using standardized hamstring flexibility protocols. Pain was measured with the Numerical Pain Rating Scale (NPRS), CROM with universal goniometry, and CVA through photographic analysis. Pre- and post-intervention values were analyzed using paired and unpaired t-tests, with significance set at $p < 0.005$.

Results: Both groups showed significant within-group improvements in NPRS, CROM, and CVA ($p < 0.001$). Between-group comparisons revealed greater benefits in the MET group across all outcomes ($p < 0.05$). NPRS scores decreased more substantially in the MET group (7.04 to 3.28) than in the stretching group (7.14 to 4.09). M*Et al*so produced superior improvements in cervical flexion, extension, rotation, and CVA, reflecting enhanced posture. **Conclusion:** Both hamstring interventions reduced pain and improved cervical function, but MET demonstrated greater efficacy. Addressing hamstring tightness may aid cervical dysfunction management, and further research should explore long-term effects.

Keywords: Hamstring Tightness, Hamstring MET, Neck Pain, Hamstring Stretching, NPRS, Cervical Range of Motion, Craniovertebral Angle

INTRODUCTION:

Neck pain is a widespread musculoskeletal complaint that significantly affects young adults, especially college students, due to prolonged studying, intensive digital screen usage, and poor posture habits **[1]**. Studies indicate that forward head posture and decreased cervical range of motion (CROM) often accompany neck discomfort in this demographic **[2]**. This condition not only restricts movement but also negatively impacts academic concentration, sleep quality, and overall well-being, and may also contribute to anxiety and fatigue **[1]**.

The multifactorial etiology of neck pain in college students includes persistent static postures, inadequate ergonomics, physical inactivity, and elevated academic stress **[3]**. Structural imbalances such as weakened deep neck flexors and tight posterior chain musculature further exacerbate cervical dysfunction. Interestingly, emerging research reveals that indirect factors, like hamstring tightness, can contribute to cervical discomfort by altering global postural alignment **[4]**. Neck pain affects 38–62% of college students annually, with prevalence peaking at 62.7% during online learning, and higher rates observed among medical and female healthcare students **[5, 6]**.

Contrary to the traditional focus on cervical structures, recent studies have highlighted hamstring tightness as a significant indirect factor in neck pain. For instance, a cross-sectional study reported that approximately 70% of individuals with chronic neck pain presented with hamstring tightness measured via active knee extension **[7]**. The myofascial continuum evidenced by tensegrity models supports this distal-to-proximal influence **[8]**.

The hamstrings, (biceps femoris, semitendinosus, and semimembranosus) originate at the ischial tuberosity and insert below the knee joint. They are essential for hip extension, knee flexion, and pelvic stabilization. When chronically shortened, these muscle s induce a posterior pelvic tilt, diminishing lumbar lordosis and triggering compensatory changes in the spine **[9]**. Because the spine functions as a kinetic chain, pelvic misalignment can foster increased thoracic kyphosis and forward head posture. A forward-shifted head reduces the craniovertebral angle (CVA), placing excessive strain on cervical extensors and accelerating pain development **[4, 9]**. The superficial back line, a fascial pathway linking the plantar fascia, hamstrings, back muscles, and suboccipital fascia transmits tension across the body. Restriction in hamstring mobility increases tension along this line, which may contribute to reduced cervical flexibility and heightened neck pain **[8, 9]**. In a cross-sectional study of patients with chronic neck and low back pain, 70.2% exhibited hamstring tightness (active knee extension test), with 67.3% of neck pain sufferers affected **[10]**. These findings suggest that hamstring tightness is highly prevalent in individuals with cervical discomfort, highlighting its possible role in symptomatology **[10]**.

Furthermore, limited hamstring flexibility impairs lumbopelvic proprioception, compelling compensatory activation of cervical musculature. A 2024 study demonstrated decreased deep neck flexor endurance in individuals with hamstring tightness **[4]**, emphasizing the neuromechanical interdependence between distal and proximal segments.

Two primary interventions target hamstring tightness: static stretching and Muscle Energy Technique (MET). MET, which employs patient-generated isometric contractions against resistance, leverages post-isometric relaxation and reciprocal inhibition—allowing for rapid gains in muscle length and joint mobility. Static stretching involves passive, sustained elongation.

Systematic reviews highlight the efficacy of MET in reducing both pain and improving cervical ROM in non-specific neck pain patients **[11, 12]**. Jeong (2022) **[9]** showed that increasing hamstring flexibility through either MET or static stretching immediately improved CVA and CROM, demonstrating the potential of hamstring-targeted distal interventions to influence neck posture and mobility. Engaging the neuromuscular system, MET often yields faster functional gains, while static stretching remains accessible and widely practiced **[11, 12]**.

Despite strong biomechanical rationale and preliminary evidence, there is limited research directly comparing the immediate effects of hamstring MET versus passive stretching on cervical outcomes in college populations. This knowledge gap highlights an opportunity to inform more integrative treatment approaches for neck pain.

Objective of the study:

- To see the effectiveness of hamstring Muscle Energy Technique (MET) on neck pain using NPRS in college students with neck pain.
- To see the effectiveness of hamstring stretching on neck pain using NPRS in college students with neck pain.
- To see the effectiveness of hamstring MET on cervical spine range of motion in college students with neck pain.
- To see the effectiveness of hamstring stretching on cervical spine range of motion in college students with neck pain.
- To see the effectiveness of hamstring MET on Craniovertebral Angle in college students with neck pain.
- To see the effectiveness of hamstring stretching on Craniovertebral Angle in college students with neck pain.
- To see the difference between the effectiveness of hamstring MET and hamstring stretching on neck pain, cervical range of motion, and Craniovertebral Angle in college students with neck pain.

MATERIALS AND METHODS:

Study Design: This was a comparative experimental study conducted to evaluate and compare the immediate effects of Hamstring Muscle Energy Technique (MET) and Static Hamstring Stretching on cervical spine range of motion (CROM), craniovertebral angle (CVA), and neck pain in college students with non-specific neck pain.

Sample Size & Participants: A total of 42 college students, both male and female, were recruited and randomly assigned into two equal groups of 21 participants each. All participants provided written informed consent prior to inclusion in the study.

Materials Used: Numerical Pain Rating Scale (NPRS), Universal Goniometer for CROM, Camera with reflective markers for Craniovertebral Angle (CVA) assessment, Exercise mats, Pillows, Chairs/benches, Recording sheets

Participants were included if they were willing to participate and provide informed consent, comprised both male and female students, had a Neck Disability Index (NDI) score of ≥5 indicating mild disability, and reported a Numerical Rating Scale (NRS) score of ≥3 at rest or during active cervical movement. Participants were excluded if they had a Straight Leg Raise (SLR) greater than 80° initially, experienced acute neck or low back pain, had a history of fractures, growth disorders, neurological or orthopedic conditions, lumbar or cervical disc herniation, spinal stenosis, or vascular diseases affecting the head or neck.

Procedure: Subjects were recruited based on the inclusion and exclusion criteria and provided informed consent. Participants were randomly assigned into two groups using a simple random sampling method: the MET Group and the Stretching Group.

Intervention:

Group A – Muscle Energy Technique (MET):

Participants were positioned supine. One leg was kept straight or slightly bent, while the other was bent at the hip and knee, and then slowly straightened until hamstring tightness was perceived. The therapist moved the leg slightly back from this point and instructed the participant to push gently (approximately 25% effort) against resistance for 7–10 seconds. After relaxing, the leg was stretched further during exhalation and held for 30 seconds. This procedure was repeated three times.

Group B – Static Hamstring Stretching:

Participants lay supine with a pillow under the contralateral knee. One leg was held in 90° hip flexion by the participant using both hands. The therapist placed the participant's foot on their shoulder and applied a sustained hamstring stretch for 30 seconds. This stretch was also repeated three times.

Outcome Measures:

1. Numerical Pain Rating Scale (NPRS)- for subjective assessment of pain

A valid and reliable subjective tool used to assess the intensity of pain on a scale from 0 (no pain) to 10 (worst imaginable pain). It has excellent test-retest reliability (ICC = 0.92) and is sensitive to change in musculoskeletal conditions **[13]**.

2. Cervical Range of Motion (CROM)- for quantifying mobility

An objective measure used to evaluate the mobility of the cervical spine in different directions (flexion, extension, lateral flexion, and rotation) with Universal Goniometry. The CROM device demonstrates high inter-rater reliability (ICC > 0.80) and is widely used in clinical and research settings **[14]**.

3. Craniovertebral Angle (CVA)- to assess forward head posture

CVA is a commonly used photographic measurement for evaluating forward head posture. It is measured by placing reflective markers on the tragus of the ear and the spinous process of the seventh cervical vertebra (C7). A lateral photograph is taken while the participant is standing in a relaxed posture, and the angle formed between a horizontal line through C7 and a line connecting C7 to the tragus is measured. A smaller CVA indicates a greater degree of forward head posture. A smaller CVA is associated with greater postural dysfunction. It has been shown to have good intra- and inter-rater reliability (ICC = 0.86–0.94) **[15]**.

Statistical Analysis: For our study, a total of 42 individuals were enrolled, with 21 participants per group completing the intervention. Statistical analysis was conducted using SPSS version 26.0. Baseline data were normally distributed in both groups. Paired and unpaired t-tests were used for within-group and between-group comparisons, respectively. Statistical significance was set at $p < 0.005$.

RESULTS:

Table 1 shows that both groups were demographically comparable. The MET group had 7 males and 14 females, while the Stretching group had 8 males and 13 females, with no significant difference ($p = 0.747$). The mean age was 23.47 ± 1.32 years in the MET group and 22.90 ± 1.33 years in the Stretching group ($p = 0.771$). These findings indicate homogeneity between the groups in terms of age and gender.

The statistical analysis in **Table 2** demonstrates significant improvements within both the MET and Stretching groups across all outcome measures from pre- to post-intervention ($p < 0.001$). Notably, the MET group showed greater improvements in pain reduction (NPRS), cervical range of motion (flexion, extension, lateral flexion, and rotation), and craniovertebral angle (CVA) compared to the Stretching group. Between-group comparisons revealed statistically significant differences favoring the MET group for all outcomes ($p < 0.05$), indicating that Muscle Energy Technique was more effective than static hamstring stretching in improving cervical spine function, posture, and reducing pain among college students with neck pain.

Table 1: Demographic Data

Variables	Group 1 (MET Group)	Group 2 (Stretching Group)	Chi- Square test	p-value
Male: Female	7: 14	8: 13	0.1037	0.747
Age (years)	23.47 ± 1.32	22.90 ± 1.33	0.1124	0.771

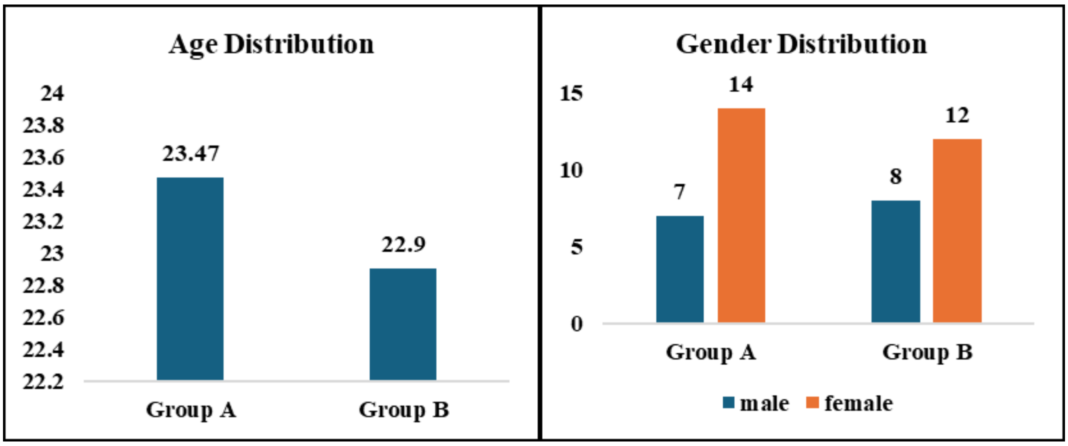

Chart 1: Age and gender distribution

Table 2: Statistical Analysis Within and Between Groups (Pre- and Post-Intervention)

Outcome Measure	Time Point	MET Group (Mean ± SD)	p-value (within group)	Stretching Group (Mean ± SD)	p-value (within group)	p-value (between groups)
NPRS	Pre	7.04 ± 1.07	<0.001	7.14 ± 1.19	<0.001	0.02
	Post	3.28 ± 0.95		4.09 ± 1.22		
Cervical Flexion (°)	Pre	43.00 ± 1.22	<0.001	42.90 ± 1.48	<0.001	0.001
	Post	52.28 ± 1.90		49.80 ± 1.77		
Cervical Extension (°)	Pre	57.47 ± 2.80	<0.001	56.95 ± 2.43	<0.001	0.006
	Post	64.14 ± 2.55		61.19 ± 2.54		
Lateral Flexion Right (°)	Pre	15.95 ± 1.46	<0.001	16.33 ± 1.42	<0.001	0.001
	Post	23.38 ± 1.59		21.19 ± 1.24		
Lateral Flexion Left (°)	Pre	63.33 ± 2.37	<0.001	63.04 ± 2.88	<0.001	0.007
	Post	74.09 ± 1.33		71.95 ± 1.37		
Rotation Right (°)	Pre	15.95 ± 1.53	<0.001	15.85 ± 1.98	<0.001	0.010
	Post	23.57 ± 1.59		22.33 ± 1.46		
Rotation Left (°)	Pre	64.00 ± 2.34	<0.001	63.33 ± 3.13	<0.001	0.008
	Post	74.71 ± 1.70		72.69 ± 1.55		
Craniovertebral Angle (°)	Pre	48.02 ± 3.12	<0.001	47.84 ± 2.45	<0.001	0.040
	Post	52.17 ± 1.95		50.41 ± 1.52		

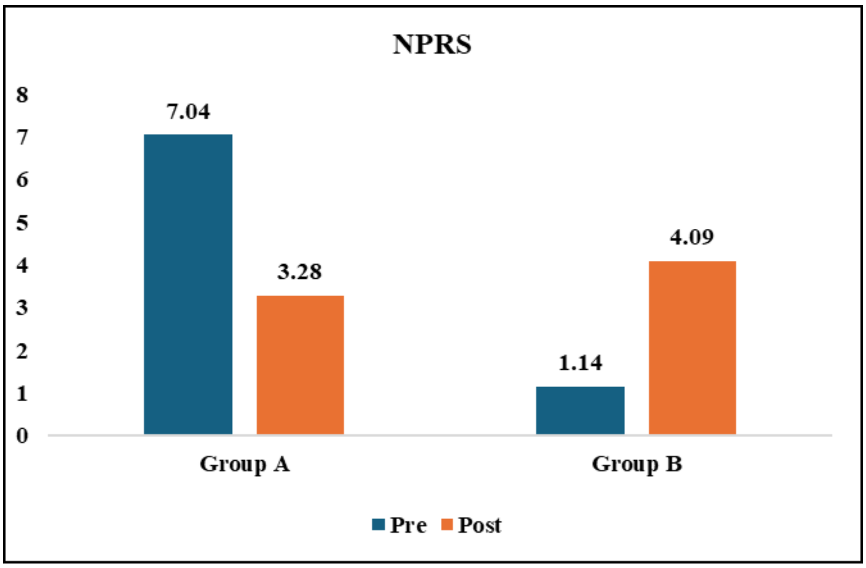

Chart 2: Comparison of Pre- and Post-Intervention NPRS Scores Between MET and Stretching Groups

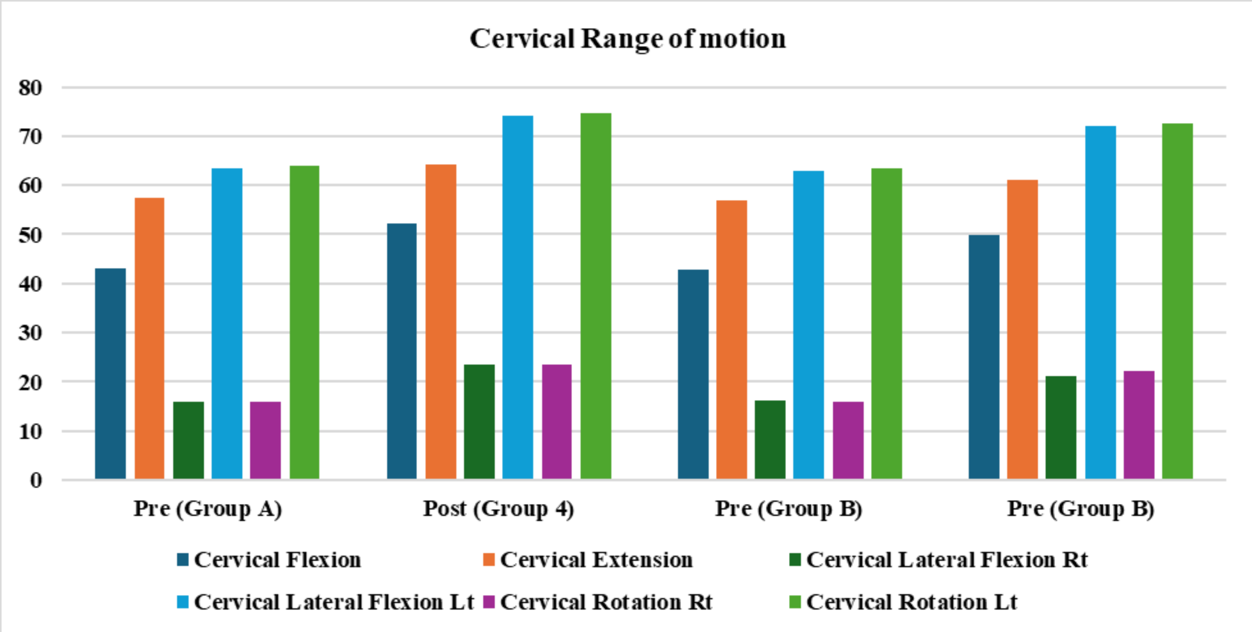

Chart 3: Comparison of Pre- and Post-Intervention CROM Scores Between MET and Stretching Groups

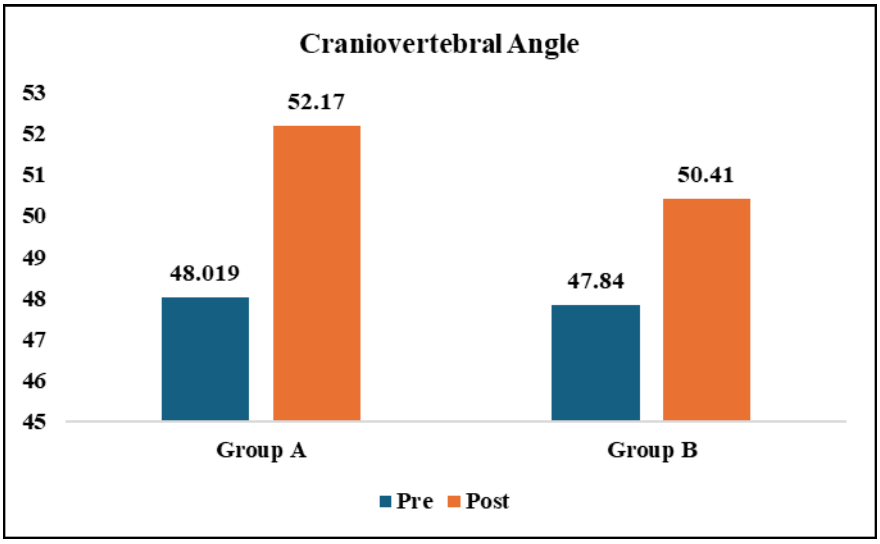

Chart 4: Comparison of Pre- and Post-Intervention CVA Scores Between MET and Stretching Groups

DISCUSSION:

This study aimed to investigate and compare the immediate effects of hamstring Muscle Energy Technique (MET) and static hamstring stretching on cervical spine range of motion (CROM), pain intensity (NPRS), and craniovertebral angle (CVA) in college students with non-specific neck pain. Both interventions produced significant within-group improvements; however, the MET group consistently demonstrated superior results across all outcome measures.

The MET group showed a significant reduction in pain (NPRS from 7.04 to 3.28), while the Stretching group also improved (from 7.14 to 4.09), indicating effective pain relief in both groups but greater improvement with MET. Cervical ROM improved substantially in both groups, with the MET group achieving higher gains in flexion (from 43° to 52.28°), extension (from 57.47° to 64.14°), and other directional movements. Additionally, CVA an indicator of forward head posture increased more in the MET group (from 48.02° to 52.17°) compared to the Stretching group (from 47.84° to 50.41°), indicating better postural correction.

These findings support the concept of myofascial continuity, particularly the Superficial Back Line described by Myers (2013) **[16]** and reinforced by Naroz (2024) **[17]**, which proposes a functional and anatomical connection between the hamstrings and the cervical spine. Tightness in the hamstring can affect pelvic tilt and lumbar curvature, leading to compensatory misalignments in the thoracic and cervical regions. By targeting the hamstrings, both MET and stretching may have indirectly improved upper body mechanics and reduced cervical strain.

Our findings are in line with previous research that highlights the efficacy of both MET and static stretching in improving hamstring flexibility. Studies by Kang *et al*. (2023) **[18]**, Lim Sang Hoon *et al*. (2009) **[19]**, and Bhutta *et al*. (2025) **[20]** demonstrated significant gains in flexibility and pain reduction following MET application. The stretching group's results also support earlier findings by Sullivan *et al*. (2009) **[21]**, Davis *et al*. (2005) **[22]**, and Medeiros *et al*. (2016) **[23]**, who reported substantial improvement in hamstring flexibility through passive stretching.

However, the MET group in our study showed comparatively better outcomes, likely due to the neuromuscular mechanism of post-isometric relaxation, where an isometric contraction is followed by relaxation and passive stretching, resulting in enhanced muscle extensibility. This aligns with Krupp *et al*. (2020) **[24]**, who emphasized the impact of posterior chain flexibility on spinal alignment and cervical discomfort.

Moreover, a study by Jeong (2022) **[9]** concluded that both static stretching (SS) and proprioceptive neuromuscular facilitation (PNF) improved SLR, CVA, and CROM within groups but not significantly between groups. In contrast, our findings revealed statistically significant between-group differences favouring MET, suggesting that MET may offer a more effective approach than passive stretching alone for immediate cervical improvements.

This study had several limitations. First, the sample size was relatively small (n=42), which may affect the generalizability of the results. Second, the study evaluated only short-term (immediate) effects; no long-term follow-up was conducted to assess the sustainability of the improvements or recurrence of symptoms. Third, the availability of eligible participants was limited to a specific college population, which may not reflect broader demographic groups. Additionally, participant activity levels and daily postural habits, which can influence neck pain, were not controlled.

The results of this study have important clinical implications. Incorporating MET into rehabilitation protocols for patients with neck pain especially those with identified hamstring tightness may yield superior results in terms of pain reduction, improved cervical range of motion, and correction of forward head posture. This suggests that clinicians should assess and address lower limb flexibility, particularly the hamstrings, when managing cervical dysfunctions. The study reinforces the importance of a holistic, kinetic-chain-based approach in musculoskeletal rehabilitation.

CONCLUSION:

This study concluded that both Muscle Energy Technique (MET) and hamstring stretching were effective in producing immediate improvements in cervical range of motion (CROM), craniovertebral angle (CVA), and neck pain among college students. However, the MET group demonstrated significantly greater enhancements in all outcome measures compared to the stretching group. These results support the biomechanical and myofascial connection between the hamstring muscles and cervical spine, reinforcing the importance of addressing lower limb flexibility in the management of cervical dysfunction. The findings have practical applications in clinical settings, suggesting that incorporating MET into rehabilitation protocols can yield superior outcomes for patients presenting with neck pain and hamstring tightness. This approach may be particularly beneficial in young adult populations like college students, who are prone to postural imbalances due to prolonged sitting and academic stress. Future research should explore the long-term effects of these interventions, include larger and more diverse populations, and consider additional variables such as functional outcomes, activity levels, and recurrence rates. Investigating the role of other posterior chain muscles and integrating multimodal treatment approaches could further enhance understanding and effectiveness in managing cervical musculoskeletal disorders.

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