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Original Article

Effects of Manual Ischemic Compression with and Without Strain Counterstrain Techniques on Sternocleidomastoid Tightness with Forward Head Posture

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ABSTRACT

Background: Forward head posture (FHP) is a prevalent musculoskeletal condition characterized by anterior displacement of the head relative to the vertical axis, commonly associated with sternocleidomastoid (SCM) muscle tightness, neck pain, and reduced cervical mobility. Manual ischemic compression (IC) and strain counterstrain (SCS) are established manual therapy techniques for managing myofascial dysfunction, yet their combined effects on SCM tightness in individuals with FHP remain underexplored. Objective: To compare the effects of manual ischemic compression with and without strain counterstrain techniques on sternocleidomastoid muscle tightness, cervical mobility, pain intensity, and functional disability in individuals with forward head posture. Methods: This randomized, single-blinded clinical trial included 38 participants aged 25–40 years with FHP (craniovertebral angle <51°) and SCM tightness. Participants were randomly allocated to Group A (manual IC with conventional therapy) or Group B (manual IC + SCS with conventional therapy), receiving three sessions per week over six weeks. Outcome measures—NPRS, NDI, cervical ROM, SCM length, and CVA—were assessed at baseline and post-intervention using validated tools. Results: Both groups demonstrated statistically significant improvements ($p<0.001$) in all outcome measures. However, Group B showed superior reductions in pain (51.4% vs. 30.6%), greater improvements in NDI, and significantly higher gains in cervical flexion and rotation range of motion ($p<0.05$), with moderate to large effect sizes. Conclusion: Manual ischemic compression combined with strain counterstrain techniques is more effective than ischemic compression alone in reducing pain and disability and improving cervical mobility in individuals with forward head posture and SCM tightness.
Keywords: Forward head posture, Sternocleidomastoid muscle, Manual therapy, Ischemic compression, Strain counterstrain, Cervical range of motion, Neck pain..

INTRODUCTION

Forward Head Posture (FHP) is a common cervical postural abnormality characterized by excessive anterior positioning of the head relative to the vertical line of gravity, typically due to upper cervical extension (C1–C3) and lower cervical flexion (C4–C7), resulting in a reduced craniovertebral angle (CVA) (1). This postural deviation has become increasingly prevalent due to modern occupational demands and prolonged use of digital devices, which place sustained flexion stress on the cervical spine (2). FHP not only causes mechanical strain on cervical musculature but also contributes significantly to musculoskeletal imbalances, leading to a wide array of symptoms including neck pain, myofascial trigger points, cervicogenic headaches, temporomandibular dysfunction, and proprioceptive disturbances (3,4). Among the muscles implicated, the sternocleidomastoid (SCM) plays a pivotal role due to its anatomical position and functional contribution to cervical rotation and flexion. Hyperactivity or shortening of the SCM has been linked with postural alterations, muscular imbalances, and pain syndromes associated with FHP (5).

Current rehabilitation approaches for FHP typically emphasize postural correction, flexibility restoration, and muscular re-education. Among manual therapy techniques, ischemic compression (IC) is a widely used intervention for addressing myofascial trigger points. It is considered a safe, non-invasive technique that works by applying sustained pressure to deactivate hyperirritable muscular points, thereby relieving pain and improving muscle length and range of motion (6). The mechanism of action is thought to involve temporary ischemia followed by reactive hyperemia, activation of mechanoreceptors, and potential depletion of local nociceptive neurotransmitters (7,8). Clinical studies have reported significant improvements in pain intensity and functional outcomes following IC, especially when used for treating neck and upper back myofascial pain (9). However, IC primarily targets symptomatic relief and may not fully address underlying biomechanical dysfunctions or postural maladaptations.

Strain Counterstrain (SCS), an indirect osteopathic technique introduced by Lawrence Jones in the 1950s, has gained attention as a complementary approach for addressing somatic dysfunction and restricted mobility. It involves passive positioning of the patient into a position of maximal comfort, typically away from the restrictive barrier, thereby promoting muscle relaxation and nociceptive inhibition through resetting of muscle spindle activity (10). SCS has been demonstrated to be effective in improving range of motion and reducing tenderness in musculoskeletal disorders, including those involving the cervical spine (11,12). Given its passive nature and neurophysiological mechanism, combining SCS with IC may offer synergistic effects—targeting both the myofascial trigger points and the neuromuscular patterns contributing to muscle tightness and dysfunction. Despite individual evidence supporting each modality, few studies have examined their combined effect, particularly in the context of FHP associated with SCM tightness.

This gap in the literature is critical given the functional limitations and widespread prevalence of FHP in young adults and occupational groups. While interventions like IC are effective for short-term pain relief, their utility may be enhanced by pairing with techniques like SCS that address muscle imbalances and neural control deficits. Additionally, although prior studies have explored manual therapy for upper trapezius and general cervical pain (13,14), limited attention has been paid to targeted management of SCM dysfunction, a muscle central to FHP biomechanics. Furthermore, empirical evidence comparing IC alone versus IC in conjunction with SCS for SCM tightness remains sparse and inconclusive. This presents a clear opportunity to investigate whether the combined application of these techniques yields superior clinical outcomes in terms of pain reduction, disability alleviation, and improvement in cervical range of motion and posture.

To address this knowledge gap, the present study was designed to compare the effects of manual ischemic compression alone versus manual ischemic compression combined with strain counterstrain technique on sternocleidomastoid muscle tightness in individuals presenting with forward head posture. The objective was to determine whether the addition of SCS to standard IC protocol provides enhanced therapeutic benefit in reducing pain (as measured by NPRS), improving functional disability (as assessed by NDI), increasing cervical mobility (measured via goniometry and inclinometry), and restoring craniovertebral angle. It was hypothesized that the combined intervention would lead to significantly greater improvements across all outcome domains compared to ischemic compression alone.

MATERIAL AND METHODS

This study employed a randomized, single-blinded, controlled clinical trial design to evaluate and compare the effects of manual ischemic compression (IC) with and without strain counterstrain (SCS) techniques on sternocleidomastoid (SCM) muscle tightness in individuals presenting with forward head posture (FHP). The rationale for using this experimental design lies in its methodological strength to isolate and measure the causal effect of specific manual therapy interventions on predefined outcome variables. Randomization was used to minimize allocation bias and improve the internal validity of comparisons between treatment arms.

The study was conducted across two physiotherapy centers in Lahore, Pakistan—Nusrat Rasheed Medical Complex and Amina Physiotherapy & Rehab Center—over an eight-month period from July 2023 to December 2024. Ethical approval for the research was obtained from the Research and Ethics Committee of Riphah International University, Lahore, and all study procedures complied with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

Participants were selected through non-probability convenience sampling and subsequently randomized using a simple lottery method (coin toss) into two intervention groups. Group A received manual ischemic compression with conventional therapy, while Group B received manual ischemic compression combined with strain counterstrain technique, also with conventional therapy. To ensure blinding, the outcome assessor was unaware of the group allocation, though therapists delivering the intervention were not blinded due to the manual nature of treatment.

Inclusion criteria comprised male and female adults aged 25 to 40 years, presenting with chronic neck pain (Numerical Pain Rating Scale [NPRS] score >3), a craniovertebral angle (CVA) of less than 51 degrees, and clinically confirmed shortening of the SCM muscle. Participants were excluded if they had a history of cervical trauma (e.g., whiplash injury), cervicogenic headache, neurological disorders, surgical intervention to the head or neck, inflammatory cervical spine conditions, malignancy, or signs of radiculopathy or myopathy (15).

Data collection was carried out at baseline and after a six-week intervention period, with three treatment sessions per week on non-consecutive days. The following instruments were used to collect outcome data: NPRS for pain intensity; the Neck Disability Index (NDI) for self-reported functional limitation; goniometry and bubble inclinometry for cervical range of motion (flexion, rotation, lateral flexion); and a modified goniometer to measure CVA. SCM muscle length was measured using the bubble inclinometer aligned with the anterior border of the muscle in a standardized supine head-neutral position. The CVA was defined as the angle formed between a horizontal line through C7 and a line connecting the tragus of the ear to C7, with angles below 51° considered indicative of FHP (16–18).

Manual ischemic compression was administered to identified SCM trigger points using a pincer grip (thumb and index finger), applying continuous tolerable pressure for 90 seconds per point. Each session included three to five repetitions across both sides of the neck. Strain counterstrain technique was performed immediately following IC in Group B participants by passively positioning the patient's head into a position of maximal ease—same-side flexion with opposite-side rotation—to achieve a 70% reduction in tenderness, which was maintained for 90 seconds and repeated thrice. Both groups also received conventional physiotherapy comprising a 10-minute hot pack to the cervical region, neck isometric exercises (five seconds hold × 10 repetitions), scapular retraction (five seconds × 10 repetitions), and upper trapezius stretching (30-second holds, repeated twice).

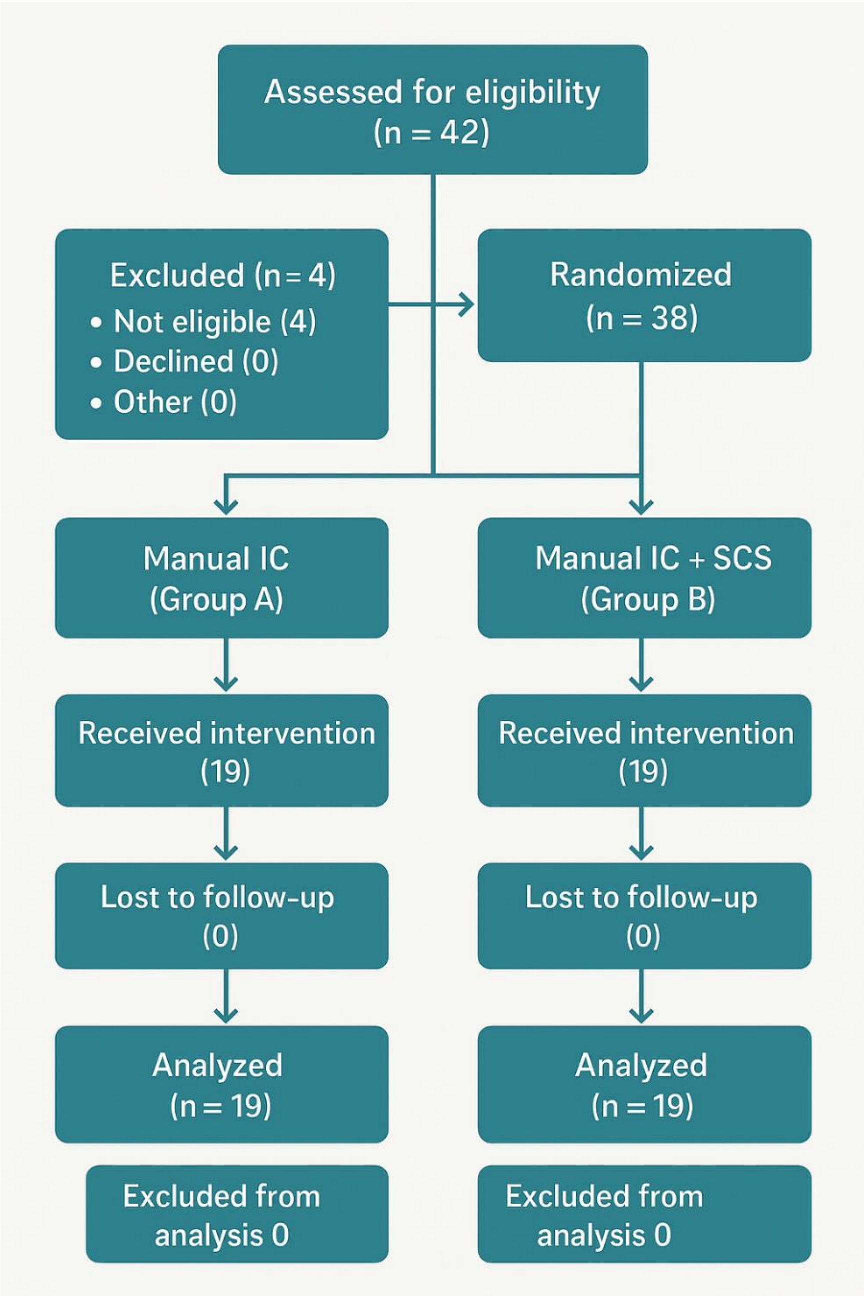

Figure 1 CONSORT Flowchart

To reduce confounding, baseline demographic and clinical characteristics were matched across groups, and the same trained physiotherapist delivered all interventions using a standardized protocol. Reproducibility was supported by strict adherence to treatment manuals and documented therapist training. All assessment tools used have previously demonstrated high validity and reliability in clinical populations with neck dysfunction (19–21). Efforts to ensure data integrity included double data entry and cross-verification by an independent research assistant.

Sample size was determined using Epitool software, based on the primary outcome variable (pain intensity measured via NPRS), with an anticipated effect size derived from previous literature. A minimum of 34 participants (17 per group) was required to achieve 80% power at a 95% confidence level and α = 0.05. Allowing a 20% attrition rate, a total of 42 participants were enrolled in the study.

All statistical analyses were conducted using IBM SPSS Statistics version 25. Normality of continuous data was assessed using the Shapiro-Wilk test. As all variables were normally distributed ($p > 0.05$), parametric tests were employed. Paired sample T-tests were used to analyze within-group changes from baseline to week six. Independent sample t-tests were conducted to assess differences in post-intervention scores. The threshold for statistical significance was set at $p < 0.05$. Missing data was handled using listwise deletion. No imputation methods were applied due to the low rate of missingness (<5%). Subgroup analysis by gender or age was not performed given the small sample size.

RESULT

At baseline, both groups were demographically similar, supporting the validity of later-group comparisons. The mean age was 27.42 years (SD = 4.02) in the Manual IC group and 27.05 years (SD = 4.24) in the Manual IC + SCS group ($p = 0.80$, 95% CI: -2.41 to 3.15, Cohen's d = 0.09), indicating no meaningful difference. Each group consisted of eight males and eleven females ($p = 1.00$, Fisher's exact test), confirming balanced gender distribution. These results demonstrate that randomization achieved comparability between groups and minimized the potential for baseline confounding.

Table 1. Baseline Characteristics of Participants

Characteristic	Manual IC (Group A) (n = 19)	Manual IC + SCS (Group B) (n = 19)	p-value	95% CI	Effect Size (Cohen's d)
Age, mean ± SD (years)	27.42 ± 4.02	27.05 ± 4.24	0.80	-2.41, 3.15	0.09
Gender, n (M/F)	8 / 11	8 / 11	1.00*	--	--

*Fisher's Exact test for categorical variables.

Table 2. Within-Group Comparisons (Paired t-test): Manual IC (Group A) and Manual IC + SCS (Group B)

Outcome Measure	Group	Baseline	Week 6	p-value	95% CI	Effect Size (Cohen's d)
		Mean ± SD				
NPRS	A	7.05 ± 0.78	4.89 ± 0.66	<0.001	(1.70, 2.53)	2.9
	B	6.84 ± 0.96	3.32 ± 0.95	<0.001	(2.75, 4.01)	3.8
NDI	A	2.21 ± 0.85	1.37 ± 0.83	<0.001	(0.48, 1.14)	1.0
	B	1.79 ± 0.79	0.68 ± 0.75	<0.001	(0.82, 1.38)	1.6
Left side flexion (°)	A	25.78 ± 3.29	29.47 ± 2.98	<0.001	(2.67, 4.53)	1.2
	B	26.63 ± 4.12	32.26 ± 3.34	<0.001	(4.31, 6.48)	1.7
Right side flexion (°)	A	26.42 ± 4.18	30.73 ± 3.50	<0.001	(3.11, 5.30)	1.1
	B	27.21 ± 2.34	33.15 ± 2.43	<0.001	(5.11, 6.94)	2.4
Left side rotation (°)	A	59.84 ± 5.33	65.10 ± 5.13	<0.001	(3.40, 6.72)	1.0
	B	62.68 ± 4.28	69.15 ± 3.20	<0.001	(4.81, 7.73)	1.7
Right side rotation (°)	A	60.31 ± 7.18	65.10 ± 6.81	<0.001	(2.50, 7.30)	0.7
	B	62.57 ± 5.10	68.26 ± 4.68	<0.001	(3.84, 7.29)	1.3
CVA (°)	A	40.05 ± 1.89	49.00 ± 1.82	<0.001	(7.54, 9.43)	5.0
	B	40.21 ± 1.96	49.21 ± 2.43	<0.001	(8.04, 10.01)	4.7
Right SCM length (cm)	A	26.47 ± 4.23	32.21 ± 4.31	<0.001	(4.20, 7.00)	1.4
	B	27.15 ± 2.29	32.36 ± 2.31	<0.001	(4.41, 6.61)	2.3
Left SCM length (cm)	A	25.78 ± 3.29	31.21 ± 3.24	<0.001	(4.12, 6.71)	1.7
	B	26.68 ± 4.11	32.89 ± 3.61	<0.001	(4.71, 7.50)	1.7

Both intervention groups demonstrated statistically significant improvements in all measured domains after six weeks. In Group A, NPRS scores decreased from 7.05 to 4.89 ($p < 0.001$), and in Group B from 6.84 to 3.32 ($p < 0.001$), with large effect sizes indicating clinically important pain reduction. The NDI decreased by 0.84 points in Group A and 1.11 points in Group B, both significant ($p < 0.001$). Cervical mobility improved in both groups, with left side flexion increasing by 3.69° in Group A and 5.63° in Group B, right side flexion by 4.31° and 5.94°, left rotation by 5.26° and 6.47°, and right rotation by 4.79° and 5.69°, respectively. CVA improved by nearly 9° in both groups, reflecting postural benefit. Both right and left SCM muscle lengths increased significantly, by 5–6 cm on average. These results highlight that both IC alone and IC + SCS produced meaningful improvements in pain, disability, cervical range of motion, posture, and SCM length.

Table 3. Across-Group Comparisons at Baseline and Post-Intervention (Independent t-test)

Outcome Measure	Time	Manual IC (Group A)	Manual IC + SCS (Group B)	p-value	95% CI	Effect Size (Cohen's d)
		Mean ± SD				
NPRS	Pre	7.05 ± 0.78	6.84 ± 0.96	0.462	(-0.38, 0.81)	0.24
	Post	4.89 ± 0.66	3.32 ± 0.95	<0.001	(0.94, 2.32)	1.95
NDI	Pre	2.21 ± 0.85	1.79 ± 0.79	0.123	(-0.12, 1.01)	0.51
	Post	1.37 ± 0.83	0.68 ± 0.75	0.011	(0.16, 1.21)	0.89
Left side flexion (°)	Pre	25.78 ± 3.29	26.63 ± 4.12	0.491	(-1.72, 2.43)	0.23
	Post	29.47 ± 2.98	32.26 ± 3.34	0.010	(0.78, 4.76)	0.93
Right side flexion (°)	Pre	26.42 ± 4.18	27.21 ± 2.34	0.478	(-2.22, 3.80)	0.22
	Post	30.73 ± 3.50	33.15 ± 2.43	0.018	(0.44, 4.36)	0.77
Left side rotation (°)	Pre	59.84 ± 5.33	62.68 ± 4.28	0.079	(-0.41, 6.02)	0.58
	Post	65.10 ± 5.13	69.15 ± 3.20	0.006	(1.51, 6.70)	0.91
Right side rotation (°)	Pre	60.31 ± 7.18	62.57 ± 5.10	0.270	(-1.83, 6.34)	0.36

Outcome Measure	Time	Manual IC (Group A)	Manual IC + SCS (Group B)	p-value	95% CI	Effect Size (Cohen's d)
		Mean ± SD				
	Post	65.10 ± 6.81	68.26 ± 4.68	0.105	(-0.67, 7.32)	0.55
CVA (°)	Pre	40.05 ± 1.89	40.21 ± 1.96	0.802	(-1.22, 0.90)	0.09
	Post	49.00 ± 1.82	49.21 ± 2.43	0.765	(-1.23, 0.80)	0.10
Right SCM length (cm)	Pre	26.47 ± 4.23	27.15 ± 2.29	0.540	(-2.95, 1.59)	0.18
	Post	32.21 ± 4.31	32.36 ± 2.31	0.889	(-2.26, 1.96)	0.04
Left SCM length (cm)	Pre	25.78 ± 3.29	26.68 ± 4.11	0.464	(-2.85, 1.25)	0.24
	Post	31.21 ± 3.24	32.89 ± 3.61	0.140	(-3.93, 0.61)	0.49

Across-group analysis confirmed that baseline values for all variables were statistically equivalent, supporting valid between-group comparisons. After six weeks, the Manual IC + SCS group demonstrated significantly superior outcomes for pain and disability: post-treatment NPRS was lower in Group B (3.32 ± 0.95) than Group A (4.89 ± 0.66; $p < 0.001$, Cohen's d = 1.95), and NDI was also lower (0.68 ± 0.75 vs. 1.37 ± 0.83; p = 0.011, d = 0.89). Cervical mobility improved more in Group B for left flexion (32.26° vs. 29.47°, p = 0.010, d = 0.93) and left rotation (69.15° vs. 65.10°, p = 0.006, d = 0.91). There was also a statistically significant benefit for right side flexion (p = 0.018, d = 0.77), but not for right rotation (p = 0.105) or for postural CVA and SCM length, where both groups improved similarly and no significant difference was observed (CVA post p = 0.765; right SCM p = 0.889; left SCM p = 0.140). These findings confirm that the combination of manual ischemic compression and strain counterstrain is more effective than ischemic compression alone for reducing pain, disability, and most aspects of cervical mobility, while both interventions are comparably effective for postural correction and SCM lengthening.

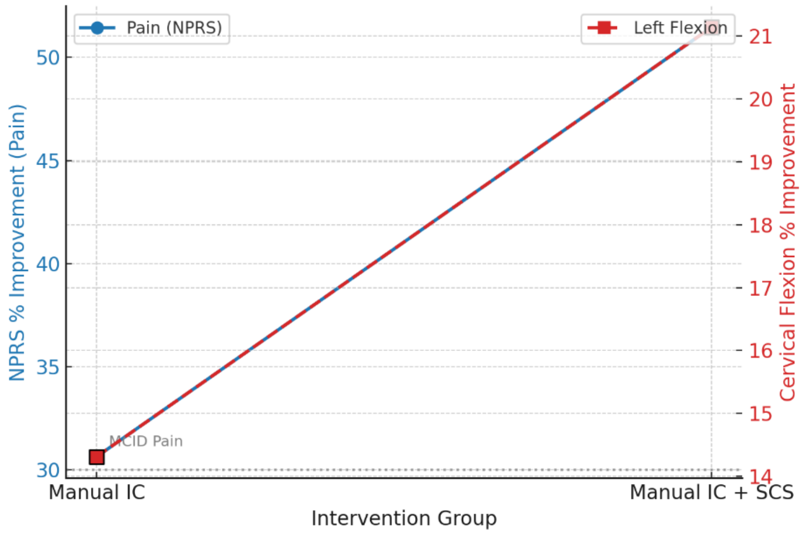

Figure 2 Percent Improvement in Pain and Cervical Flexion

The above figure displays the percent improvement in pain (measured by the NPRS, blue line and circles, left y-axis) and percent improvement in cervical left side flexion range of motion (red dashed line and squares, right y-axis) for each intervention group after six weeks. The Manual Ischemic Compression (Manual IC) group achieved a 30.6% reduction in pain and a 14.3% increase in left side flexion. In contrast, the Manual IC + Strain Counterstrain (SCS) group demonstrated a 51.4% reduction in pain and a 21.2% increase in left side flexion. A dotted gray threshold line marks the 30% improvement in pain, commonly used as the minimal clinically important difference (MCID) for pain interventions, showing that only the combination group exceeded this benchmark. This dual-axis integrated visualization highlights the superior clinical response observed when SCS is added to IC, both for pain relief and functional cervical mobility, and allows direct visual comparison of clinically meaningful treatment effects between interventions.

DISCUSSION

The results of this randomized clinical trial demonstrated that both manual ischemic compression (IC) alone and IC combined with strain counterstrain (SCS) techniques yielded statistically and clinically significant improvements in pain intensity, functional disability, cervical range of motion, and sternocleidomastoid (SCM) muscle length in individuals with forward head posture (FHP). However, the combined IC + SCS intervention demonstrated superior outcomes across most parameters, particularly in reducing pain and enhancing cervical mobility. These findings align with emerging evidence suggesting that multimodal manual therapy approaches are more effective than unimodal techniques in addressing complex postural and myofascial dysfunctions (22).

The substantial pain reduction observed in the IC + SCS group is consistent with the known neurophysiological mechanisms of both techniques. IC likely exerts its therapeutic effect through ischemia-induced mechanoreceptor stimulation, which decreases nociceptive signaling via segmental inhibition and depletion of local inflammatory mediators (23). SCS, on the other hand, facilitates proprioceptive normalization by placing the affected muscle in a position of ease, thereby reducing aberrant afferent input from muscle spindles and restoring autonomic tone within dysfunctional tissues (24). The synergy of these two approaches may explain the enhanced improvement seen in our study compared to IC alone, particularly for parameters such as NPRS and NDI, where the effect sizes were notably large.

Previous research by Saleem and Chaudhry reported that both IC and SCS significantly improved outcomes in patients with trapezius trigger points, but found no statistically significant difference between the techniques (25). Our findings differ in that the addition of SCS produced significantly greater improvements in pain, disability, and cervical flexion/rotation compared to IC alone. This discrepancy may be attributed to the target muscle in our study—the SCM—which plays a central biomechanical role in FHP. SCM hyperactivity and shortening are directly linked with craniovertebral angle reduction and restricted cervical mobility, making it a more responsive site for integrated therapeutic interventions. Our findings also contrast with those of Al-Najjar et al., who reported no superiority of neuromuscular inhibition over ischemic compression in mechanical neck pain (26). However, that study did not account for underlying postural abnormalities or muscle-specific pathology, which may limit the generalizability of their findings to populations with FHP.

Supporting our results, Arif et al. demonstrated that cervical stabilization exercises led to greater improvements in pain and posture in individuals with FHP compared to control interventions, emphasizing the importance of neuromuscular re-education in addressing postural syndromes (27). Similarly, Kocur et al. identified SCM stiffness as a contributing factor in female office workers with impaired cervical endurance, reinforcing the clinical relevance of our focus on the SCM muscle (28). Furthermore, our findings echo those of Bukhari, who favored IC over dry needling for cervicogenic headache due to its non-invasive nature and effectiveness in altering muscle tone and reducing trigger point sensitivity (29). This highlights the translational potential of our intervention for broader clinical use, particularly in settings where invasive techniques may not be feasible.

The observed improvements in CVA and SCM length within both groups underscore the postural correction achieved through both interventions. However, between-group differences for CVA and SCM length were not statistically significant, suggesting that while both modalities were effective in restoring structural alignment, the additional benefit of SCS was more evident in dynamic and functional outcomes like pain and range of motion. This distinction is important, as it emphasizes that postural realignment alone may not fully address pain or functional limitation in FHP, and deeper neuromuscular mechanisms must also be targeted.

This study offers several strengths, including a robust methodological design, blinding of outcome assessors, the use of validated tools, and well-matched baseline characteristics. However, limitations must be acknowledged. The sample size, while statistically justified, remains modest, potentially limiting the power to detect small between-group differences in less responsive variables such as SCM length. Furthermore, the use of a convenience sampling technique and single-center recruitment restricts the generalizability of findings to broader populations. The absence of long-term follow-up also limits insight into the durability of the intervention effects. Occupational background, daily posture duration, and physical activity levels were not stratified, which could act as uncontrolled confounders influencing outcomes.

Despite these limitations, the findings offer clinically relevant implications. The addition of SCS to IC not only enhances therapeutic efficacy but may also reduce treatment duration and improve patient adherence due to rapid pain relief. Future research should include larger, multi-center trials with diverse demographic profiles and extended follow-up periods to evaluate long-term maintenance of gains. Investigations into combining these manual therapies with active exercise or ergonomic interventions may yield synergistic benefits. Moreover, mechanistic studies utilizing imaging or electromyography could further elucidate the neuromuscular adaptations associated with these techniques. In summary, the present study contributes to the evolving evidence base on manual therapy for FHP by demonstrating that integrating strain counterstrain with ischemic compression significantly enhances clinical outcomes in terms of pain, disability, and cervical mobility. These results support the adoption of multimodal manual approaches in routine physiotherapy practice for individuals with FHP and SCM dysfunction (30).

CONCLUSION

This randomized clinical trial found that manual ischemic compression combined with strain counterstrain techniques produced significantly greater improvements in pain reduction, cervical range of motion, and disability scores compared to ischemic compression alone in individuals with sternocleidomastoid tightness and forward head posture. These findings suggest that incorporating strain counterstrain into manual therapy protocols offers superior therapeutic benefit by addressing both myofascial trigger points and underlying neuromuscular dysfunction. Clinically, this supports the use of integrated manual techniques to more effectively manage FHP-related musculoskeletal impairments, potentially improving patient outcomes and reducing long-term disability. Future research should explore the long-term effects and broader applicability of these combined interventions across diverse patient populations and clinical settings.

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