



Article

Evaluating the Effects of Scapular Stabilization and Thoracic Extension Exercises on Pain, Functional Disability, Cervical Mobility, and Postural Alignment in Young Adults with Text Neck Syndrome

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ABSTRACT

Background: Text Neck Syndrome, increasingly prevalent among young adults due to prolonged handheld device use, results in altered cervical biomechanics, forward head posture (FHP), and associated musculoskeletal pain. Despite growing interest, limited evidence directly compares region-specific rehabilitation strategies such as scapular stabilization versus thoracic extension exercises for managing this syndrome. **Objective:** To compare the effects of scapular stabilization and thoracic extension exercises on pain intensity, cervical range of motion (ROM), neck disability, and craniovertebral angle (CVA) in young adults with Text Neck Syndrome. **Methods:** A randomized controlled trial was conducted on 36 participants aged 19–30 years with clinically diagnosed Text Neck Syndrome and FHP. Participants were randomized into two equal groups: scapular stabilization (Group A) and thoracic extension exercises (Group B), performed thrice weekly for six weeks. Primary outcomes included Visual Analogue Scale (VAS), Neck Disability Index (NDI), CVA (via photogrammetry/ImageJ), and cervical ROM (via goniometry). Ethical approval was obtained from the Riphah College of Rehabilitation and Allied Health Sciences, and the study adhered to the Declaration of Helsinki. Statistical analysis was performed using SPSS v26, employing paired and independent sample tests. **Results:** Both groups showed statistically significant improvements in VAS, NDI, ROM, and CVA ($p < 0.001$). Group A demonstrated superior pain reduction (VAS mean difference = -4.40 vs. -3.66 ; $p = 0.012$) and left lateral flexion ROM (mean difference = 4.73 ; $p = 0.008$). No significant between-group differences were observed in CVA and NDI, though both improved clinically. **Conclusion:** Scapular stabilization exercises were more effective in reducing pain and enhancing specific cervical mobility compared to thoracic extension exercises, although both improved overall function and posture. These findings support incorporating scapular-focused protocols into clinical rehabilitation for young adults with Text Neck Syndrome.

Keywords: Text Neck Syndrome; Forward Head Posture; Scapular Stabilization Exercises; Thoracic Extension; Cervical Range of Motion; Craniovertebral Angle; Neck Disability Index.

INTRODUCTION

The pervasive use of handheld digital devices has introduced a new array of musculoskeletal challenges, particularly among young adults, with one of the most prominent being Text Neck Syndrome. This condition, characterized by sustained neck flexion and forward head posture (FHP) during prolonged device use, results in repetitive mechanical stress on cervical structures and is now regarded as

a modern-day epidemic (1). The anterior positioning of the head, often maintained for hours daily while using smartphones or tablets, significantly increases the gravitational load on the cervical spine, leading to muscular fatigue, postural misalignment, and chronic neck pain (2). The biomechanical strain is further exacerbated by poor ergonomic habits, such as viewing devices at waist or lap level, contributing to deviations in

the craniovertebral angle (CVA) and associated discomfort in the cervical and upper thoracic regions (6). Although the prevalence of neck pain among young individuals is rising globally, clinical understanding remains limited regarding the most effective interventions for correcting these postural deviations and alleviating symptoms.

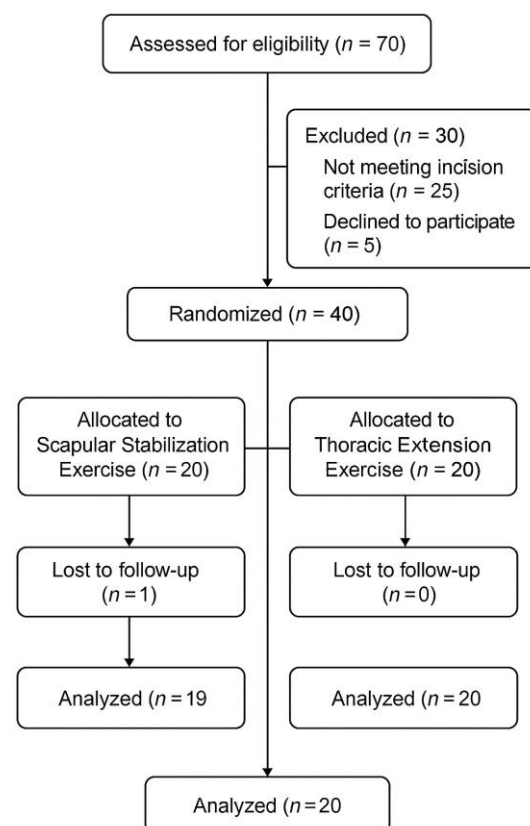
Research indicates that FHP not only alters cervical alignment but also contributes to compensatory thoracic kyphosis and scapular dyskinesis, leading to broader disruptions in musculoskeletal function (13). The interdependence between cervical and thoracic spine mechanics implies that dysfunction in one region may perpetuate maladaptive changes in the other (15). Several therapeutic approaches have emerged to address these abnormalities, with thoracic extension exercises aimed at restoring upright posture and scapular stabilization exercises targeting shoulder girdle mechanics to support cervical alignment. While both interventions show promise in clinical settings, the evidence comparing their efficacy in managing the functional impairments of Text Neck Syndrome remains inconclusive. Thoracic extension exercises, which emphasize mobilizing and strengthening the posterior thoracic muscles, may indirectly facilitate cervical alignment by reducing thoracic kyphosis (30). On the other hand, scapular stabilization exercises focus on improving muscle balance and proprioceptive control in the upper back and shoulders, potentially reducing cervical strain and enhancing functional mobility (23).

Although both modalities have demonstrated individual benefits in improving CVA, reducing pain, and enhancing cervical range of motion (ROM), comparative trials are scarce. Most existing studies either evaluate cervical-focused rehabilitation strategies or assess multi-component programs without isolating thoracic or scapular contributions (20,21). This lack of comparative analysis represents a critical knowledge gap, as clinicians remain uncertain about which intervention yields superior outcomes for young adults with posture-induced cervical dysfunction. Furthermore, with increasing reports of device-related musculoskeletal disorders among younger populations, identifying targeted and effective exercise interventions is imperative to inform preventative and rehabilitative strategies. To address this gap, the current study aims to compare the effects of scapular stabilization exercises versus thoracic extension exercises on pain, disability, ROM, and CVA in individuals with Text Neck Syndrome. By systematically evaluating these two distinct intervention protocols within a controlled framework, the study seeks to determine whether one approach offers statistically and clinically significant advantages over the other in managing the biomechanical and symptomatic manifestations of this condition. This leads to the central research hypothesis: scapular stabilization and thoracic extension exercises yield differential impacts on pain, functional disability, cervical mobility, and postural alignment in young adults with Text Neck Syndrome, with potential superiority in one modality over the other.

MATERIALS AND METHODS

This randomized controlled trial was conducted among young adults aged 19 to 30 years presenting with symptoms of Text Neck Syndrome and forward head posture. Participants were

recruited from the student populations of Riphah International University and the University of Lahore through a convenience sampling method. Eligibility criteria required participants to have a craniovertebral angle (CVA) of less than 53° , report a history of neck pain within the last three months, and use smartphones for a minimum of three hours daily. Both males and females meeting these criteria were included. Individuals were excluded if they had undergone cervical or thoracic spine surgery in the past three months, presented with pathological conditions such as rheumatoid arthritis or congenital spinal abnormalities, or exhibited severe psychiatric or neurological conditions. Ethical approval for the study was obtained from the ethical committee of Riphah College of Rehabilitation and Allied Health Sciences. All participants provided written informed consent prior to enrollment, and their confidentiality was protected by assigning anonymized identifiers to data. The study was conducted in accordance with the ethical standards of the Declaration of Helsinki.



Data collection occurred at two time points: before the intervention (baseline) and after six weeks of treatment. A single experienced physiotherapist with over five years of clinical practice in musculoskeletal rehabilitation administered all interventions to ensure protocol consistency. SPSS software version 26 was used for statistical analysis. Data normality was evaluated using the Shapiro-Wilk test. Paired sample t-tests were applied to analyze within-group differences pre- and post-intervention, while independent sample t-tests compared the changes between groups. A p-value of less than 0.05 was considered statistically significant. Missing data were managed by excluding incomplete records from analysis, and no imputation was performed. No confounding variables or sensitivity analyses were applicable due to the study's controlled and homogeneous sample design. Participants were randomized

into two equal groups of 18 using sealed opaque envelopes: Group A received scapular stabilization exercises, and Group B performed thoracic extension exercises. All participants underwent baseline treatment, including the application of a hot pack for 7–10 minutes and active cervical range of motion exercises. Each group followed their assigned intervention for 40 minutes per session, three times per week, over a six-week period. The primary outcomes included pain intensity, cervical range of motion (ROM), craniovertebral angle (CVA), and neck-related disability. Pain intensity was assessed using the Visual Analogue Scale (VAS), a validated and reliable tool for evaluating subjective pain levels (51). Cervical ROM was measured with a universal goniometer, which has demonstrated high inter-rater and intra-rater reliability in clinical settings (52). Neck-related disability was evaluated using the Neck Disability Index (NDI), a ten-item questionnaire scored on a 50-point scale where higher scores indicate greater functional impairment (50). The CVA was assessed via photogrammetry using Image J software, with lateral photographs captured from 1.5 meters to calculate the angle between the horizontal line from C7 to the tragus of the ear (53).

RESULTS

A total of 36 participants were enrolled and equally randomized into two intervention arms: Group A (scapular stabilization exercises) and Group B (thoracic extension exercises). The

Table 1: Within-Group Comparison of Pain, Disability, and Posture

Outcome	Group A (Pre)	Group A (Post)	Group B (Pre)	Group B (Post)	p-value (A)	p-value (B)
VAS	7.60 ± 1.40	3.20 ± 1.20	8.00 ± 1.36	4.33 ± 1.11	<0.001	<0.001
NDI	21.40 ± 7.36	12.66 ± 5.19	25.13 ± 7.48	15.86 ± 6.31	<0.001	<0.001
CVA	41.66 ± 4.20	53.53 ± 5.48	40.66 ± 3.26	54.13 ± 6.94	<0.001	<0.001

Table 2: Within-Group Comparison of Cervical Range of Motion

ROM Measure	Group A (Pre)	Group A (Post)	Group B (Pre)	Group B (Post)	p-value (A)	p-value (B)
Flexion	39.26 ± 6.50	54.00 ± 9.10	37.26 ± 6.44	56.60 ± 5.38	<0.001	<0.001
Extension	32.33 ± 6.32	49.26 ± 5.02	32.33 ± 6.32	47.73 ± 4.72	<0.001	<0.001
Left Lateral Flexion	33.46 ± 5.16	47.66 ± 5.30	32.66 ± 5.72	42.93 ± 3.65	<0.001	<0.001
Right Lateral Flexion	33.06 ± 6.04	44.86 ± 0.51	32.66 ± 5.52	45.13 ± 1.40	<0.001	<0.001
Right Rotation	55.86 ± 5.33	73.33 ± 8.79	56.20 ± 5.42	72.00 ± 7.02	<0.001	<0.001
Left Rotation	55.00 ± 6.23	70.73 ± 8.38	58.46 ± 5.01	69.93 ± 4.30	<0.001	<0.001

Table 3: Statistically Significant Between-Group Comparisons

Outcome	Group A (Post)	Group B (Post)	Mean Difference	p-value
VAS	3.20 ± 1.20	4.33 ± 1.11	-1.13	0.012
Left Lateral Flexion	47.66 ± 5.30	42.93 ± 3.65	4.73	0.008

Left lateral flexion showed a marked increase in Group A (33.46 ± 5.16 to 47.66 ± 5.30) compared to Group B (32.66 ± 5.72 to 42.93 ± 3.65), and this difference was statistically significant in the between-group comparison ($p = 0.008$). Right lateral flexion improved comparably in both groups. Rotational ROM improved significantly within both groups as well. Group A improved right rotation from 55.86 ± 5.33 to 73.33 ± 8.79 and left rotation from 55.00 ± 6.23 to 70.73 ± 8.38. Group B showed similar trends with right rotation from 56.20 ± 5.42 to 72.00 ± 7.02 and left rotation from 58.46 ± 5.01 to 69.93 ± 4.30. No significant between-group differences were detected for rotation measures.

baseline characteristics, including age and gender, were comparable across both groups. The mean age in Group A was 26.00 ± 3.02 years and in Group B was 24.66 ± 3.06 years. Males comprised 60.0% of Group A and 46.7% of Group B. Significant within-group improvements were observed in all primary outcomes—pain (VAS), disability (NDI), and craniovertebral angle (CVA). In Group A, the VAS score reduced from 7.60 ± 1.40 to 3.20 ± 1.20 ($p < 0.001$), while in Group B, it decreased from 8.00 ± 1.36 to 4.33 ± 1.11 ($p < 0.001$). Between-group comparison post-intervention revealed a statistically significant greater reduction in pain in Group A (mean difference = -1.13, $p = 0.012$). NDI scores improved significantly in both groups: from 21.40 ± 7.36 to 12.66 ± 5.19 in Group A and from 25.13 ± 7.48 to 15.86 ± 6.31 in Group B ($p < 0.001$ for both). Although the reduction in NDI was greater in Group B, the between-group difference was not statistically significant ($p = 0.141$). CVA, representing postural alignment, increased from 41.66 ± 4.20 to 53.53 ± 5.48 in Group A and from 40.66 ± 3.26 to 54.13 ± 6.94 in Group B ($p < 0.001$ for both), again with no statistically significant difference between groups ($p = 0.795$). Both interventions led to significant improvements in all measured cervical ROM parameters. Cervical flexion increased from 39.26 ± 6.50 to 54.00 ± 9.10 in Group A and from 37.26 ± 6.44 to 56.60 ± 5.38 in Group B ($p < 0.001$ for both). Extension improved similarly, with Group A reaching 49.26 ± 5.02 and Group B reaching 47.73 ± 4.72 post-treatment.

Among the post-intervention outcomes, only VAS and left lateral flexion ROM demonstrated statistically significant differences between groups. Scapular stabilization was more effective in reducing pain ($p = 0.012$), and showed greater gains in left lateral flexion ROM ($p = 0.008$). All other outcome differences between groups, including cervical flexion, extension, rotation, NDI, and CVA, did not reach statistical significance.

The results demonstrate that both scapular stabilization and thoracic extension exercise programs significantly improve pain, cervical mobility, postural alignment, and disability in patients with Text Neck Syndrome. However, scapular

stabilization exercises were found to be superior in reducing pain and enhancing specific cervical motion (left lateral flexion). These findings suggest the potential for targeted scapular training to enhance rehabilitation strategies for postural neck dysfunction, particularly in younger populations who are most affected by prolonged handheld device usage

DISCUSSION

The current study was conducted to evaluate and compare the effectiveness of scapular stabilization exercises and thoracic extension exercises on pain, disability, cervical range of motion (ROM), and craniovertebral angle (CVA) in young adults with Text Neck Syndrome. The findings revealed that while both exercise protocols led to statistically significant improvements in all measured outcomes, scapular stabilization exercises were notably superior in reducing pain and improving left lateral flexion ROM. These results support the hypothesis that targeting the scapular region, a biomechanically integral area in maintaining cervical and upper thoracic posture, can yield clinically meaningful benefits in managing symptoms associated with forward head posture and text neck.

Previous studies have emphasized the multifactorial etiology of text neck, linking it to sustained cervical flexion during prolonged mobile device use, leading to altered biomechanics, muscular imbalances, and postural dysfunction (1, 6, 13). The present study aligns with existing literature that recognizes the therapeutic value of postural correction and muscle re-education in mitigating these effects. For instance, the work of Bharal et al. demonstrated that neck stabilization exercises combined with Contrology training significantly improved CVA and reduced pain, suggesting that postural retraining through targeted muscle activation is a cornerstone of text neck rehabilitation (34). Our study further expands on this premise by isolating and comparing two specific kinetic chains—scapular and thoracic—and their impact on cervical outcomes.

Mechanistically, scapular stabilization likely confers its benefits through neuromuscular re-education of the trapezius, serratus anterior, and rhomboid musculature, which act as dynamic anchors for the cervical spine. Improved scapular positioning reduces compensatory cervical loading and facilitates more efficient head posture and movement patterns (23, 25). On the other hand, thoracic extension exercises work by counteracting thoracic kyphosis and realigning spinal segments to indirectly influence cervical mechanics (29, 30). While both interventions improved CVA and cervical mobility, the slightly better postural gains observed in the thoracic group may reflect this spinal alignment influence. However, the more pronounced pain reduction in the scapular group suggests that active stabilization and proprioceptive retraining of the shoulder girdle may exert more immediate neuromuscular benefits, especially in symptomatic individuals.

These outcomes are corroborated by studies such as those by Kang et al., who reported significant improvements in ROM and CVA using combined scapular and thoracic interventions (5, 56). However, unlike combination protocols, our study design intentionally separated these exercise modalities to evaluate their isolated contributions. This distinction is critical for clinical

application, especially in scenarios where individualized or resource-limited interventions are needed. Additionally, Shiravi et al. found scapular stabilization with abdominal control feedback more effective in reducing neck pain than exercises alone, indicating the value of proprioceptive engagement in managing mechanical neck dysfunction (57).

Despite its strengths, including a randomized controlled design, protocol consistency, and use of validated assessment tools, the study is not without limitations. The relatively small sample size limits statistical power and generalizability. The study population was restricted to young adults, which may not reflect older populations or those with chronic postural adaptations. Moreover, while six weeks of intervention was sufficient to elicit significant changes, long-term follow-up was not conducted, leaving questions about sustained outcomes unanswered. These limitations suggest a need for further research involving larger, more diverse populations and extended follow-up durations. Including electromyographic (EMG) analysis or real-time kinematic tracking could also provide more granular insights into muscle activation patterns and spinal segmental behavior.

Clinically, the findings highlight that both scapular and thoracic training should be considered viable strategies in the rehabilitation of text neck syndrome, with scapular stabilization exercises offering particular advantages in pain management. Rehabilitation professionals may consider integrating these exercises into posture correction programs, especially for patients whose symptoms are exacerbated by shoulder girdle dysfunction or occupational demands involving repetitive forward head positions. Future studies might explore combining these modalities or incorporating ergonomic education and digital behavior modifications to optimize outcomes.

In conclusion, this study demonstrates that while both scapular stabilization and thoracic extension exercises significantly improve function and alignment in patients with Text Neck Syndrome, scapular-focused interventions provide superior pain relief and selected mobility benefits. These insights contribute valuable evidence to guide clinical decision-making and emphasize the importance of regionally targeted therapeutic strategies in the management of postural cervical disorders.

CONCLUSION

This randomized controlled trial demonstrated that both scapular stabilization and thoracic extension exercises significantly improved pain, cervical range of motion, neck disability, and postural alignment—as measured by craniovertebral angle—in young adults with Text Neck Syndrome. Notably, scapular stabilization exercises produced superior outcomes in pain reduction and specific mobility gains, underscoring their clinical utility in targeted rehabilitation for postural cervical dysfunction. These findings support the integration of scapular-focused protocols in early intervention strategies for device-related musculoskeletal disorders, with implications for preventing chronicity and enhancing function in affected populations. Future research should explore long-term outcomes, larger cohorts, and multimodal interventions to refine evidence-based rehabilitation approaches for Text Neck Syndrome.

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