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Effect of Maitland Mobilization Combined with Kendall Corrective Exercise on Pain and Postural Alignment of Patients with Upper Cross Syndrome: Pilot Study

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ABSTRACT

Upper Cross Syndrome (UCS) is a prevalent postural dysfunction resulting from muscle imbalances that causes forward head posture, rounded shoulders and thoracic kyphosis. Although manual therapy and corrective exercises are frequently performed, studies comparing the two have not been conducted extensively.To determine the feasibility and effectiveness of Maitland mobilizations alongside Kendall exercises in patients with UCS.A pilot single-blinded randomized controlled trial was performed involving 28 subjects (14 in each group). Group A was subjected to Maitland mobilizations alongside Kendall exercises, while Group B underwent only Kendall exercises for four weeks (three sessions/week). Pain, Craniovertebral angle (CVA), thoracic kyphosis and rounded shoulders were measured. Descriptive analysis and preliminary comparisons were made.Feasibility was established based on recruitment, retention rate (100%) and compliance (>90%). Both groups responded well, but group Had better responses. Group A had a higher pain reduction than Group B (-4.66 ± 0.82 versus -2.84 ± 0.75). Group A experienced significant improvement in CVA (+6.6°) than Group B (+2.7°).The combination of Maitland mobilization and Kendall exercises appears more effective than exercises alone in improving pain and postural alignment in UCS. Findings support feasibility and justify larger randomized controlled trials.

INTRODUCTION

Musculoskeletal complaints are often associated with muscular imbalance and, in the long term, usually lead to joint dysfunction (Neme, 2022). Dr. Janda proposed an intriguing concept of classification of muscles into two types – postural and phasic muscles in 1988. The Postural (or tonic) muscles are responsible for maintaining the erect posture and usually are hypertonic. Most of the phasic muscles and almost all other muscles are hypotonic (Pathan *et al.*, 2022). These muscular imbalances, one of which is known as Upper Cross Syndrome (UCS), affect the neck, shoulder, and upper thoracic region (Khawar *et al.*, 2022). Upper cross syndrome is a common posture impairment characterized by patterns of muscle imbalance involving tightness of the upper trapezius, levator scapulae, and pectoralis major and pectoralis minor muscles, accompanied by weakness of the deep cervical flexors, lower trapezius, and serratus anterior muscle. It typically results in forward head posture, rounded shoulders, and thoracic hyperkyphosis. (Usman *et al.*, 2024).

The population of young adults with generally sedentary lifestyles has a higher risk of developing UCS due to their posture, including prolonged sitting in front of a computer, reading/studying in a slouched posture, television viewing, smartphone use, carrying heavy backpacks, and adopting uncomfortable postures at work. The exposure of this continued bad posture can lead to neck and upper back pain (Ganvir & Kadam; Shinwari *et al.*, 2024). The incidence of UCS is becoming increasingly common among young adults and employed groups due to prolonged periods of continuous sitting and exposure to electronic devices. However, there are differences in reported rates based on various studies. Studies have shown that among medical students, UCS has been observed at an incidence of 37-46%, while other professions such as computer professionals and laundry workers, the incidence rate is 28-34% (Javed *et al.*, 2022; Sikander *et al.*, 2024). The study clearly indicates that UCS is becoming a serious problem regarding health care. For treating UCS, both manual treatment and specific exercises need to be employed. In Manual Therapy, Maitland Mobilization involves the oscillatory motion which makes the pain variable and enhances the range of motion and optimizes the neurophysiological response of the restricted joint and levels.(Outeda *et al.*, 2022).

These two methods can be undertaken alongside exercise approaches such as Kendall exercises, which concentrate on strengthening of weak muscles such as deep neck flexors and trapezius, as well as stretching of tight muscles such as pectoralis major and trapezius hence addressing the muscular imbalances in UCS (Rahul *et al.*, 2024; Ullah *et al.*, 2026). The combination of manual therapy and exercises leads to synergism that contributes to the correction of the condition, reducing pain and restoring functions in patients suffering from UCS. There

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are several physiotherapeutic interventions used clinically, but no clear agreement has been reached on the best manual therapy approach to use in managing UCS. In particular, no study has compared the effect of Maitland mobilization approach in combination with Kendall exercises on UCS patients.

MATERIALS AND METHODS

The current study was designed as a pilot single-blinded RCT to explore the feasibility, acceptability, and preliminary efficacy of Maitland mobilizations along with Kendall exercises among adult patients with UCS. The CONSORT guidelines for feasibility and pilot studies were followed in the current trial. The main objective of this trial was not to conduct a hypothesis test but to examine study procedures, recruitment potential, compliance rate, and variability of outcomes measures that would help in conducting a definitive trial in the future. The study was carried out at My Health Wellness Center, Peshawar, which is a physiotherapy and rehabilitation center offering outpatient treatment for musculoskeletal disorders. Study subjects were selected through non-probability purposive sampling according to inclusion/exclusion criteria. Participants were recruited from clinic referral and direct patient screening based on symptoms of posture and neck problems. The trial was prospectively registered at ClinicalTrials.gov, NCT07588061

This was a pilot feasibility study, therefore, no sample size calculation was performed for power of hypothesis test. Instead, the sample size was determined based on pilot study recommendations. A total of 28 participants were recruited and equally allocated to two groups (14 per group). This sample size was considered adequate to: Assess recruitment and retention rates, Evaluate intervention feasibility and adherence, Estimate variability in outcome measures (VAS, CVA, posture indices), Provide preliminary effect size estimates for future sample size calculation.

Inclusion Criteria

- Age 18 to 45 years
- Neck and/or upper thoracic pain for > 6 weeks
- Pain Severity: VAS > 5 (Afzal *et al.*, 2023)
- Pain aggravated with prolonged postures
- Adult diagnose with Upper Cross Syndrome

Diagnostic criteria: Upper Cross Syndrome would be considered if people have thoracic kyphosis > 40°, craniovertebral angle < 50° and acromion-to-couch distance > 2.5 cm with respect to normal reference values.

Exclusion criteria

- History of surgery or trauma to neck or shoulders
- Recurrent inflammatory diseases like Rheumatoid arthritis, Gout
- Neurological disease impairing upper limb functioning, and
- Cardiovascular diseases
- Congenital problems e.g.; torticollis and Scoliosis
- Disc prolapse and other spine conditions
- Currently on any medication or physical therapy sessions (Usman *et al.*, 2024)

Clinical Outcome Measures

- **Pain intensity**: Visual Analogue Scale (VAS) (Bjelkarøy *et al.*, 2024; Syinta & Komalasari, 2024)
- **Forward head posture**: Craniovertebral angle (CVA) using mobile protractor application (Hazar *et al.*, 2015; Singla *et al.*, 2017)
- **Thoracic kyphosis**: Flexicurve ruler method (Atta *et al.*, 2025; Mandal & Ganguly, 2019; Mingels, 2020; Rezaei *et al.*, 2025; Rodrigues *et al.*, 2009)
- **Rounded shoulder posture**: Vernier caliper (acromion-to-couch distance) (Ahmed *et al.*, 2024; Hussain *et al.*, 2022)

Randomization and Group Allocation

Subjects who fulfilled the inclusion criteria and gave their informed consent were assigned randomly to either the experimental group or the control group through a process known as lottery. The number of allocation slips corresponding to both groups was equal and were put in an opaque box. Every participant was then required to select one slip from the box and assignment to groups depended on what was selected.

- **Group A (Experimental Group):** The experimental group received both Maitland mobilization and the Kendall exercises.
- **Group B (Control Group):** The control group received Kendall exercises only.

Blinding

This study was a single-blinding technique where due to nature of physiotherapy techniques, the subjects and the treating therapist could not be blinded. Nevertheless, the outcome evaluator involved in recording initial and post-intervention data was unaware of treatment allocations.

Intervention protocol

The participants in the experimental group underwent a combined intervention of Kendall corrective exercises and Maitland mobilization techniques. The treatment program was specifically designed to address muscular imbalance, postural dysfunction, pain, and restricted cervical and thoracic mobility associated with Upper Cross Syndrome (UCS). Each treatment session included warm-up exercises, strengthening and stretching exercises based on the Kendall approach, Maitland mobilization techniques, and cool-down activities.

Kendall Exercises

The strengthening component targeted weak postural muscles commonly affected in UCS. Deep cervical flexor strengthening was performed in the supine position with chin tuck while maintaining the head on the floor. Lower trapezius strengthening was performed in the prone position by lifting the arms in a "Y" position with thumbs

pointing upward while squeezing the scapulae downward. Serratus anterior strengthening was performed. In prone position hands are placed under shoulders with elbow in extension, back and legs are kept straight with toes touching the ground. Body is lowered until an arm lies parallel to ground. Then reverse this movement and raise the body until the arms are extended. All strengthening exercises were performed for 3 sets of 10 repetitions.

Figure 1: strengthening exercise for serratus anterior

Figure 2: strengthening exercise for deep neck flexor

Stretching exercises targeted shortened muscles associated with faulty posture. Upper trapezius stretching was performed in sitting by tilting the head toward one side with gentle overpressure using the hand. Levator scapulae stretching was carried out by rotating the head approximately 45 degrees to the opposite side followed by downward flexion toward the axilla with gentle assistance. Stretching for the pectoralis major and minor muscles was performed by positioning the patient's hands on the occipital region while the therapist stood behind and gently pulled both elbows backward. All stretching exercises were performed for 3 sets of 10 repetitions.

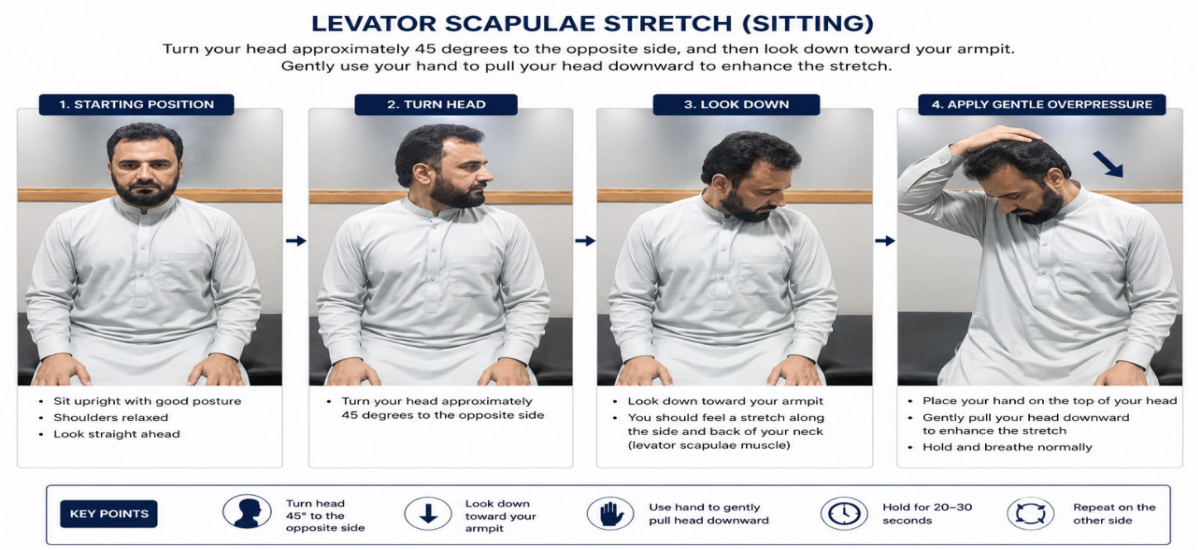

Figure 3: stretching exercise for levator scapulae

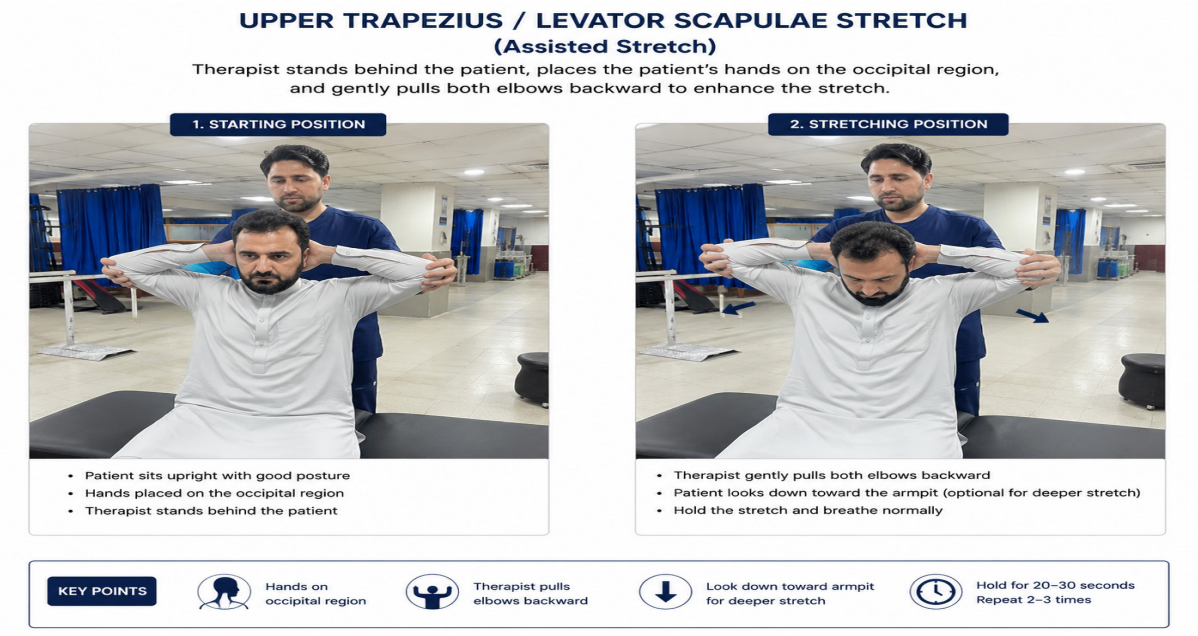

Figure 4: stretching exercise for pectoralis muscle

Figure 5: stretching exercise for Upper trapezius

Maitland Mobilization

Maitland mobilization techniques were applied to the cervical spine and upper thoracic spine (T1–T3) to improve joint mobility and reduce pain. For the cervical spine, participants were positioned prone with neutral cervical alignment. Central posterior-to-anterior (PA) mobilizations were applied rhythmically over the spinous processes using the therapist's thumbs or fingers, while unilateral PA mobilizations were applied over the articular pillars in cases of unilateral pain or restriction.

For the upper thoracic spine, participants remained in the prone position while central PA mobilizations were delivered over the spinous processes using the hypothenar eminence reinforced by the opposite hand. Unilateral PA mobilizations were applied over the transverse processes when asymmetrical stiffness was present. Mobilizations were done at a rate of 2-3 oscillations/second for 50-60 seconds per each spinal segment.

Warm-Up and Cool-Down Exercises

Each treatment started with warm-up exercises that included AROM exercises for cervical (flexion, extension, side bending, and rotation), and shoulder mobility exercises (shoulder rolls, swinging arms).

Each exercise in the warm-up protocol was done for 10 repetitions.

Table 1: Treatment Session Plan

Parameters	Experimental group	Control group
Duration	4 weeks	4 weeks
Frequency	3 season per week	3 season per week
Cool down	5 min	5 min
Warmup	5min	5 min
Total time/duration	35-40 mints	30-35mints

After each session, cool-down exercises were done to include stretches of the upper trapezius muscles, levator scapulae muscles, and diaphragm breathing exercise. The stretching exercises were done for 2 repetitions while the breathing exercise was done for 10 repetitions.

Analysis was carried out using IBM SPSS version 26 software. Since it was a pilot study, the main focus during the analysis process was on the descriptive statistics, feasibility results and estimation of effect size. Continuous variables were described by mean ± SD while categorical variables were described by frequency and percentages. The normality of data distribution was measured by the Shapiro-Wilk test. Within group change analysis for preliminary comparison was done using paired sample t-test while the between group difference was evaluated by independent sample t-test. Nevertheless, results were interpreted based on the estimation of effect size (Cohen's d) and confidence intervals, where appropriate, along with feasibility results like recruitment, retention and adherence rates, rather than only the p-value. Significance level of $p \leq 0.05$ was used only for the purpose of describing general trends in the data.

The study was initiated after obtaining ethical approval from the Research Ethics Review Committee of Ibadat International University, Islamabad (Ref. No. IIUI/RERC/ADT/2026/04/282) before the commencement of data collection. Written informed consent was obtained from all participants before their enrollment in the study. while permission to conduct study was taken from My Health Wellness Center, Peshawar. The trial was prospectively registered at ClinicalTrials.gov under registration number NCT07588061, ensuring transparency and adherence to recognized standards for clinical research.

RESULT AND DISCUSSION

28 participants in total were randomly divided into two groups (14 each). Participants could be enrolled for the trial within the time frame expected, making the recruitment of the participants quite feasible. 100% retention was noted since all participants completed the intervention without any dropout. Intervention was highly adhered to by all participants who had attended at least 90% of the scheduled sessions. There were no adverse effects noted during the course of the experiment indicating the safety of the interventions used. Prior to intervention, both the groups were similar in terms of their demographic and clinical profile.

Table 2: Baseline Characteristics of Participants

Variable	Group A (n=14) Mean ± SD	Group B (n=14) Mean ± SD
Age (years)	28.1 ± 4.3	27.6 ± 3.9
VAS (Pain)	6.83 ± 0.75	6.67 ± 0.82
CVA (degrees)	44.3 ± 2.2	44.6 ± 2.4
Thoracic Kyphosis (°)	46.8 ± 3.1	47.2 ± 2.9
Rounded Shoulder (cm)	3.12 ± 0.42	3.08 ± 0.39

Table 3: Within-Group Changes (Pre vs Post Intervention)

Outcome	Group A Pre	Group A Post	Group B Pre	Group B Post
VAS	6.83 ± 0.75	2.17 ± 0.75	6.67 ± 0.82	3.83 ± 0.75
CVA (°)	44.3 ± 2.2	50.9 ± 2.3	44.6 ± 2.4	47.3 ± 2.0
Kyphosis (°)	46.8 ± 3.1	38.2 ± 2.8	47.2 ± 2.9	42.6 ± 2.5
Rounded Shoulder (cm)	3.12 ± 0.42	2.21 ± 0.31	3.08 ± 0.39	2.62 ± 0.33

Table 3 shows within-group changes. In Group A, VAS reduced from 6.83 ± 0.75 to 2.17 ± 0.75, CVA increased from 44.3° ± 2.2 to 50.9° ± 2.3, thoracic kyphosis decreased from 46.8° ± 3.1 to 38.2° ± 2.8, and rounded shoulder improved from 3.12 ± 0.42 cm to 2.21 ± 0.31 cm. In Group B, improvements were smaller, with VAS decreasing from 6.67 ± 0.82 to 3.83 ± 0.75, CVA improving from 44.6° ± 2.4 to 47.3° ± 2.0, kyphosis reducing from 47.2° ± 2.9 to 42.6° ± 2.5, and rounded shoulder improving from 3.08 ± 0.39 cm to 2.62 ± 0.33 cm. Both interventions improved pain and posture in UCS, but Group A showed greater overall improvement, suggesting added benefit of Maitland mobilization with Kendall exercises.

Table 4: Between-Group Post-Intervention Comparison

Outcome	Group A (Mean ± SD)	Group B (Mean ± SD)	Mean Difference
VAS	2.17 ± 0.75	3.83 ± 0.75	-1.66
CVA (°)	50.9 ± 2.3	47.3 ± 2.0	+3.6
Kyphosis (°)	38.2 ± 2.8	42.6 ± 2.5	-4.4
Rounded Shoulder (cm)	2.21 ± 0.31	2.62 ± 0.33	-0.41

Post-intervention results showed better outcomes in Group A compared to Group B. Pain intensity was lower in Group A (2.17 ± 0.75) than in Group B (3.83 ± 0.75) with a mean difference of -1.66. CVA was higher in Group A (50.9° ± 2.3) compared to Group B (47.3° ± 2.0), showing improved head posture (+3.6° difference). Thoracic kyphosis was lower in Group A (38.2° ± 2.8) than in Group B (42.6° ± 2.5), indicating better spinal alignment (-4.4° difference). Rounded shoulder distance was also reduced in Group A (2.21 ± 0.31 cm) compared to Group B (2.62 ± 0.33 cm) with a difference of -0.41 cm.

Table 5: Mean Change Scores (Pre–Post Difference)

Outcome	Group A Δ Mean	Group B Δ Mean
VAS	-4.66 ± 0.82	-2.84 ± 0.75
CVA (°)	+6.6 ± 1.2	+2.7 ± 1.1
Kyphosis (°)	-8.6 ± 1.4	-4.6 ± 1.2
Rounded Shoulder (cm)	-0.91 ± 0.21	-0.46 ± 0.19

Table 5 presents the mean change scores, showing greater improvement in Group A across all outcomes. Pain was reduced more in Group A (-4.66 ± 0.82) compared to Group B (-2.84 ± 0.75). CVA increased significantly in Group A (+6.6 ± 1.2) versus Group B (+2.7 ± 1.1), indicating better correction of forward head posture. Thoracic kyphosis decreased more in Group A (-8.6 ± 1.4) than in Group B (-4.6 ± 1.2), reflecting greater spinal alignment improvement. Rounded shoulder posture also improved more in Group A (-0.91 ± 0.21 cm) compared to Group B (-0.46 ± 0.19 cm).

Discussion

The current pilot study was conducted to investigate the effectiveness and feasibility of utilizing Maitland mobilization together with the Kendall approach versus using the Kendall approach alone in patients with Upper Cross Syndrome (UCS). It has been shown that both treatments were effective in reducing pain and improving posture; nonetheless, the treatment using Maitland mobilization along with the Kendall approach yielded more significant results for pain relief and posture improvement. The substantial decrease in pain experienced by both groups is aligned with the growing scientific research advocating for exercise therapy in UCS treatment. According to a narrative systematic literature review conducted by Chaudhuri *et al.* (2023), muscle imbalance correction programs for UCS are highly efficient in alleviating musculoskeletal pain and restoring proper posture through neuromuscular balance and

the deactivation of overly active muscles like the upper trapezius and pectoralis major.(Chaudhuri *et al.*, 2023). In a similar manner, Sepehri *et al.* (2024), in their systematic review and meta-analysis, found that therapeutic exercises have been proven to effectively decrease forward head position and pain through enhancing deep cervical flexors' activity and scapula stability(Sepehri *et al.*, 2024). The above findings are consistent with the current research, where both experimental and control groups recorded significant improvement in their VAS scores.

Nonetheless, the subjects in the experimental group in the current study had significantly higher pain relief, indicating another advantage of Maitland mobilization. Such results are consistent with those found in research by Rani and Kaur (2022), who carried out a randomized controlled experiment and found that cervical mobilization along with postural exercises resulted in significant improvement in pain and function in individuals with cervical postural dysfunction as compared to exercise intervention alone (Rani & Kaur, 2023). Higher pain relief in the current study can be attributed to the neurophysiological mechanisms involved in Maitland mobilization, including activation of mechanoreceptors, nociception suppression, and pain pathway modulation. When looking at postural correction, both groups improved in terms of craniovertebral angle, thoracic kyphosis, and rounded shoulders, but the improvement was greater in the group receiving combined treatment. However, the improvement in CVA is especially crucial since it is one of the defining characteristics of UCS. According to Sepehri *et al.*, therapeutic exercises have been shown to help improve CVA due to strengthening of the deep cervical flexors (Sepehri *et al.*, 2024). In addition, Chaudhuri *et al.* pointed out that scapulothoracic stabilization exercises improve cervical posture by addressing muscular imbalances within the shoulder girdle (Chaudhuri *et al.*, 2023). The results of the current study can be aligned with the aforementioned studies, showing improvements in posture in response to Kendall exercise.

Moreover, the thoracic kyphosis correction was greater in the experiment group. The same result was obtained by Rani *et al.* (2022), stating that thoracic mobilization along with exercises for posture helps in bettering the sagittal plane alignment of the spine in people suffering from posture disorder (Rani & Kaur, 2023). Better thoracic movement because of manual therapy allows greater spine extension and avoids the development of cervical flexion posture pattern. The same was true for rounded shoulders, which had even more improved results in the experimental group. According to Chaudhuri *et al.* (2023), stretching of the pectoralis major muscle and the strengthening of the scapular stabilizers lead to a significant reduction of rounded shoulder posture due to restoration of scapulohumeral rhythm. Moreover, according to Sepehri *et al.* (2024), interventions that include not only mobility work but also muscle activation lead to better results than interventions which do not include exercise. Noteworthy is that the current study also showed great feasibility, as shown by 100% retention, adherence, and lack of adverse effects. This shows that there is potential to implement multimodal therapy with the combination of manual therapy and exercise programs in physiotherapy settings for outpatient care. High adherence rates and tolerability were similarly seen in clinical studies examining multimodal treatments for UCS (Rani & Kaur, 2022) (Rani & Kaur, 2023). However, despite all these positive results, the research still suffers from several limitations related to its being a pilot study, among them the small number of subjects and the relatively brief time during which the experiment was conducted. Nevertheless, pilot experiments like this one are indispensable when it comes to determining effect sizes.

CONCLUSION

This pilot randomized controlled trial showed that Kendall exercises alone and in conjunction with Maitland mobilization successfully decreased pain and enhanced postural alignment. Nevertheless, it is evident that the combination of both interventions outperforms the individual interventions in terms of changes made to the craniovertebral angle, thoracic kyphosis, rounded shoulder posture, and pain intensity. In addition, it is established that the intervention program is not only safe but also feasible. the findings provide important preliminary information about the use of the combination of mobilization and Kendall exercises.

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