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COMPARATIVE EFFECTS OF MYOFASCIAL TRIGGER POINT RELEASE, THERAPEUTIC ULTRASOUND, AND CONVENTIONAL EXERCISES ON PAIN, POSTURE, AND FUNCTION IN PATIENTS WITH UPPER CROSSED SYNDROME: A RANDOMIZED CONTROLLED TRIAL

Physiotherapy

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ABSTRACT

Background: Upper crossed syndrome (UCS) is a postural dysfunction characterised by tightness of the upper trapezius, levator scapulae, sternocleidomastoid, and pectoral muscles alongside weakness of the deep cervical flexors and scapular stabilisers, producing a forward head, rounded shoulders, and increased thoracic kyphosis. It is highly prevalent among desk-based and smartphone-using populations and is a common cause of chronic neck-shoulder pain and disability. **Objective:** This study aimed to compare the effects of myofascial trigger point (MTrP) release and therapeutic ultrasound (US), each combined with conventional corrective exercises, against conventional corrective exercises alone on pain intensity, craniovertebral angle (CVA), pressure pain threshold (PPT), and neck disability in patients with UCS. **Methods:** In this three-arm, single-blind, parallel-group randomized controlled trial, 90 participants with clinically diagnosed UCS were allocated to Group A (MTrP release plus conventional exercises), Group B (US plus conventional exercises), or Group C (conventional exercises alone), 30 per group, for 6 weeks. Outcomes were recorded at baseline and at 6 weeks using the Visual Analogue Scale (VAS), Neck Disability Index (NDI), CVA on lateral photographic view, and digital algometry. **Results:** All three groups showed statistically significant within-group improvement in VAS, NDI, CVA, and PPT from baseline to 6 weeks ($p<0.001$). Between-group comparison showed significantly greater improvement in Group A compared with Groups B and C ($p<0.05$), with Group B showing significantly greater improvement than Group C. **Conclusion:** Myofascial trigger point release combined with conventional exercises produced superior short-term improvements in pain, posture, and function compared with ultrasound-exercise combination or exercise alone, supporting its inclusion as a first-line adjunct in the physiotherapy management of upper crossed syndrome.

KEYWORDS

Upper crossed syndrome; myofascial trigger point release; therapeutic ultrasound; corrective exercise; posture; craniovertebral angle

INTRODUCTION

Upper crossed syndrome (UCS), first described within Janda's model of muscle imbalance, refers to a predictable pattern of overactive and shortened muscles crossing with underactive and lengthened muscles around the shoulder girdle and cervical spine.[1] The overactive group comprises the upper trapezius, levator scapulae, sternocleidomastoid, and pectoralis major and minor, while the underactive group comprises the deep cervical flexors, serratus anterior, rhomboids, and lower trapezius.[2-4] This imbalance produces the characteristic postural appearance of a forward head posture, rounded and protracted shoulders, and increased thoracic kyphosis.[4]

The global rise in sedentary occupations and prolonged smartphone and computer use has been strongly associated with a higher prevalence of forward head posture and mechanical neck pain.[6] Musculoskeletal disorders of the neck and shoulder girdle remain among the leading causes of years lived with disability worldwide, with substantial associated healthcare and occupational costs.[5] Within this burden, UCS-related dysfunction is frequently implicated as a precursor to chronic mechanical neck pain, tension-type headache, and shoulder impingement.[1,4]

At the tissue level, sustained overactivity of the involved muscles predisposes to the formation of myofascial trigger points (MTrPs) — hyperirritable nodules within taut bands of skeletal muscle that produce localised and referred pain on palpation.[3] MTrPs are considered a principal peripheral pain generator in myofascial pain syndrome and are commonly identified in the upper trapezius and levator scapulae of patients with UCS.[3]

Several corrective exercise protocols targeting scapular and cervical stabilisers have demonstrated favourable effects on posture and muscle activation in UCS.[8,9] Comprehensive corrective exercise programmes combining stretching of shortened muscles with strengthening of weakened stabilisers have been shown to improve alignment and movement pattern over 8-week interventions.[9] Similarly, structured exercise protocols incorporating ergonomic advice have produced measurable postural change on photogrammetric analysis in occupational populations.[10] A multimodal approach combining muscle energy technique, stabilisation exercise, and postural correction has also outperformed a single-technique comparator in a randomized trial of UCS.[11]

Manual release of MTrPs, whether through sustained ischemic compression, pressure release, or trigger point release technique, has been reported to reduce pain intensity and increase pressure pain threshold in the upper trapezius across several randomized trials.[12,13,14] A pilot randomized trial comparing motor control training with soft-tissue therapy in women with UCS reported comparable improvements in pain and cervical range of motion between approaches, suggesting both mechanisms may be clinically relevant but leaving their relative and combined efficacy incompletely defined.[7] Adjacent modalities such as pressure-release technique, dry needling, and superficial acupuncture directed at upper trapezius MTrPs have likewise shown benefit for pain and disability, reinforcing the trigger point as a legitimate treatment target in this population.[15]

Therapeutic ultrasound is a widely available electrophysical modality proposed to reduce pain and facilitate soft-tissue extensibility through thermal and non-thermal (mechanical, cavitational) effects on the muscle and connective tissue surrounding a trigger point.[16] High-power pain-threshold ultrasound applied directly over active MTrPs of the upper trapezius has been shown to reduce pain and improve active cervical lateral bending in randomized, double-blind trials.[16] Conventional pulsed ultrasound has similarly outperformed placebo ultrasound for myofascial pain of the upper trapezius.[17] More recent work combining ultrasound with manual myofascial release or with ultrasound-guided hydro dissection has extended these findings, though comparative data against exercise-only or MTrP-release-only regimens specific to UCS remain limited.[18,19,20]

Conventional corrective exercise remains the most extensively researched intervention for UCS and related chronic neck pain, with deep cervical flexor training and myofascial release each supported by systematic review evidence for improving pain and function.[26,24] Muscle energy technique has similarly demonstrated meta-analytic support in related musculoskeletal pain conditions.[25] However, exercise-alone protocols address motor control and muscle length but do not directly target the peripheral trigger point pain generator, which may limit the speed or magnitude of early pain relief.[3,21]
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Despite the individual evidence supporting MTrP release, ultrasound, and corrective exercise, few randomized trials have directly compared all three approaches within a single UCS cohort using standardised posture, pain, and disability outcomes, and existing comparative work has largely been conducted in isolated upper-trapezius myofascial pain

rather than in the composite postural presentation of UCS.[22,23] This gap limits clinicians' ability to select an evidence-based first-line adjunct to exercise therapy in this population.

The present study therefore aimed to compare the effects of myofascial trigger point release combined with conventional corrective exercise, therapeutic ultrasound combined with conventional corrective exercise, and conventional corrective exercise alone, on pain intensity, craniovertebral angle, pressure pain threshold, and neck-related disability in patients with upper crossed syndrome. It was hypothesised that both adjunctive interventions would produce greater improvement than exercise alone, with MTrP release producing the greatest overall improvement.

METHODOLOGY

Study design and setting

This was a single-blind (assessor-blinded), three-arm, parallel-group randomized controlled trial conducted in the outpatient physiotherapy department in GEM HOSPITAL, Perungudi, Chennai over a period of 3 months, and reported in accordance with the CONSORT 2010 guideline for parallel-group trials.[27] Ethical approval was obtained from the Institutional Ethics Committee and the trial was prospectively registered (PERIHS/IHEC/2026/15). Written informed consent was obtained from all participants prior to enrolment.

Participants

Participants were recruited from the outpatient department and screened for a clinical diagnosis of upper crossed syndrome based on postural observation and palpation, consistent with Janda's diagnostic criteria.[1,4]

Inclusion criteria:

- Age 20–45 years, either sex
- Clinically observed forward head posture and rounded shoulders with at least one palpable active MTrP in the upper trapezius or levator scapulae
- Craniovertebral angle < 50° on lateral photographic assessment
- Neck/shoulder pain of at least mild intensity (VAS ≥ 3/10) for a minimum of 4 weeks
- Willingness to attend all treatment sessions and provide informed consent

Exclusion criteria:

- Cervical or shoulder trauma, fracture, or surgery within the preceding 6 months
- Cervical radiculopathy, myelopathy, or diagnosed cervical disc pathology
- Systemic inflammatory or rheumatological disease, malignancy, or fibromyalgia
- Pregnancy, cardiac pacemaker, or other contraindication to ultrasound therapy
- Physiotherapy or manual therapy for the neck/shoulder region within the preceding 3 months

Sample size and randomization

Sample size was estimated a priori using G*Power (effect size f = 0.35, α = 0.05, power = 0.80, 3 groups), yielding a minimum of 27 participants per group; this was inflated to 30 per group (total N = 90) to allow for an anticipated 10% attrition.

Eligible participants were randomly allocated in a 1:1:1 ratio to Group A, Group B, or Group C using a computer-generated random number sequence with allocation concealment via sequentially numbered, sealed, opaque envelopes, in keeping with CONSORT recommendations for parallel-group trials.[27] The outcome assessor was blinded to group allocation; blinding of the treating therapist and participants was not feasible given the nature of the manual and electrophysical interventions.

Outcome measures

Pain intensity was measured using the 10-cm Visual Analogue Scale (VAS), a validated ratio-scale measure of chronic and experimental pain.[29] Neck-related disability was measured using the Neck Disability Index (NDI), a validated and widely used self-report questionnaire.[28] Forward head posture was quantified as the craniovertebral angle (CVA) measured on a standardised lateral photograph with the tragus of the ear and the spinous process of C7 as reference landmarks, a smaller angle indicating greater forward head posture.[4] Pressure pain threshold (PPT) over the most tender upper trapezius MTrP was recorded in kg/cm² using a hand-held digital algometer, averaged across three trials.[3] All outcomes were recorded at baseline (week 0) and immediately after the intervention period (week 6) by an assessor blinded to group allocation.

Procedure and treatment parameters

All participants received a structured programme over 6 weeks, 3 sessions per week (18 sessions total), delivered by a qualified physiotherapist. Group allocation determined the adjunctive intervention added to a common base of conventional corrective exercise.

Group A — Myofascial trigger point release + conventional exercise

Active MTrPs in the upper trapezius, levator scapulae, and pectoralis major were identified by palpation for a taut band, tenderness, and reproduction of referred pain.[3] Manual trigger point release was applied using sustained ischemic compression: firm digital pressure was applied to each identified MTrP until the therapist felt a reduction in tissue tension or the participant's reported discomfort eased, held for 90 seconds per point, repeated for 2 rounds per point, once per session, 3 sessions per week for 6 weeks.[12,13,14] This was followed immediately by the same conventional exercise protocol described for Group C.

Group B — Therapeutic ultrasound + conventional exercise

Continuous therapeutic ultrasound was applied over the identified MTrPs of the upper trapezius and levator scapulae using a 5 cm² transducer head, frequency 1 MHz, intensity 1.0–1.5 W/cm², in circular strokes, for 6–8 minutes per session, 3 sessions per week for 6 weeks, using aquasonic gel as the coupling medium.[16,17] Parameters were selected in line with high-power pain-threshold and conventional ultrasound protocols previously reported for upper trapezius myofascial pain.[16,18,19] This was followed immediately by the same conventional exercise protocol described for Group C.

Group C — Conventional exercises alone

The conventional exercise protocol, common to all three groups, comprised static stretching of the upper trapezius, levator scapulae, sternocleidomastoid, and pectoralis major/minor (3 repetitions × 30-second hold per muscle), followed by strengthening of the deep cervical flexors (chin-tuck/cranio-cervical flexion, 3 sets × 10 repetitions with progressive hold time), lower trapezius and serratus anterior (scapular retraction and wall push-plus exercises, 3 sets × 10 repetitions), and postural correction training with ergonomic advice for workstation and smartphone use.[8,9,10,26] The programme was delivered 3 sessions per week for 6 weeks under therapist supervision, with a home exercise component encouraged on non-treatment days.

Statistical Analysis

Data were analysed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics (mean ± standard deviation for continuous variables; frequency and percentage for categorical variables) were computed for all baseline demographic and clinical characteristics.

Normality of distribution for each outcome variable was assessed using the Shapiro–Wilk test. Baseline between-group comparability was assessed using one-way ANOVA for continuous variables and the chi-square test for categorical variables.

Within-group change from baseline to week 6 for each outcome (VAS, NDI, CVA, PPT) was analysed using the paired-samples t-test (or Wilcoxon signed-rank test where normality was not met). Between-group comparison of post-treatment values and of change scores was analysed using one-way ANOVA, followed by Bonferroni-adjusted post-hoc pairwise comparisons where the omnibus test was significant.

A repeated-measures ANOVA was additionally used to examine the interaction effect between group allocation and time for each outcome. Statistical significance was set at $p < 0.05$ for all analyses, and 95% confidence intervals are reported for between-group mean differences.

RESULTS

Participant flow and baseline characteristics

Of 104 patients screened, 90 met eligibility criteria and were randomized (30 per group); 6 participants were lost to follow-up (2 per group), giving a final analysed sample of 84 (28 per group), an attrition rate of 6.7%. Baseline demographic and clinical characteristics were comparable across groups ($p > 0.05$ for all comparisons), confirming successful randomization (Table 1).

Table 1. Baseline demographic and clinical characteristics of the three groups.

Variable	Group A (MTrP release + Ex) (n=28)	Group B (US + Ex) (n=28)	Group C (Exercise only) (n=28)	p-value
Age (years), mean ± SD	28.4 ± 5.6	27.9 ± 6.1	28.7 ± 5.3	0.812
Sex, M/F, n	11/17	12/16	10/18	0.775
BMI (kg/m²), mean ± SD	23.6 ± 2.4	23.9 ± 2.7	23.4 ± 2.2	0.694
Symptom duration (months), mean ± SD	7.2 ± 2.8	6.9 ± 3.1	7.5 ± 2.6	0.701

Within-group changes (baseline vs. week 6)

All three groups demonstrated statistically significant within-group improvement from baseline to week 6 across all four outcome measures ($p < 0.001$ for all comparisons within each group), indicating that each intervention combination was effective (Table 2).

Table 2. Within-group comparison of outcome measures at baseline and week 6.

Outcome	Group	Baseline (mean ± SD)	Week 6 (mean ± SD)	Within-group p-value
VAS (0–10)	A	6.8 ± 1.1	2.1 ± 0.9	<0.001
	B	6.7 ± 1.0	3.2 ± 1.0	<0.001
	C	6.9 ± 1.2	4.0 ± 1.1	<0.001
NDI (%)	A	38.6 ± 6.2	14.2 ± 5.1	<0.001
	B	37.9 ± 5.8	19.6 ± 5.4	<0.001
	C	38.4 ± 6.5	23.8 ± 6.0	<0.001
CVA (degrees)	A	44.3 ± 3.1	51.6 ± 2.9	<0.001
	B	44.6 ± 3.3	49.1 ± 3.0	<0.001
	C	44.1 ± 3.0	47.4 ± 2.8	<0.001
PPT (kg/cm²)	A	2.1 ± 0.4	3.9 ± 0.5	<0.001
	B	2.2 ± 0.4	3.3 ± 0.5	<0.001
	C	2.1 ± 0.3	2.8 ± 0.4	<0.001

Between-group comparison

One-way ANOVA of week-6 change scores showed a significant main effect of group for all four outcomes (VAS: $F(2,81) = 28.4$, $p<0.001$; NDI: $F(2,81) = 24.7$, $p<0.001$; CVA: $F(2,81) = 19.3$, $p<0.001$; PPT: $F(2,81) = 22.1$, $p<0.001$). Bonferroni-adjusted post-hoc comparisons showed that Group A improved significantly more than both Group B and Group C on every outcome ($p<0.05$), and Group B improved significantly more than Group C on every outcome ($p<0.05$) (Table 3). The repeated-measures ANOVA confirmed a significant Group × Time interaction for all outcomes ($p<0.001$), indicating that the rate of improvement over the 6 weeks differed by treatment group.

Table 3. Bonferroni-adjusted post-hoc between-group mean differences in change scores *p<0.05.

Comparison	VAS mean diff (95% CI)	NDI mean diff (95% CI)	CVA mean diff (95% CI)	PPT mean diff (95% CI)
A vs B	-1.1 (-1.6, -0.6) *	-5.4 (-7.9, -2.9) *	2.5 (1.1, 3.9) *	0.6 (0.4, 0.8) *
A vs C	-1.9 (-2.4, -1.4) *	-9.6 (-12.1, -7.1) *	4.2 (2.8, 5.6) *	1.1 (0.9, 1.3) *
B vs C	-0.8 (-1.3, -0.3) *	-4.2 (-6.7, -1.7) *	1.7 (0.3, 3.1) *	0.5 (0.3, 0.7) *

DISCUSSION

This study compared the short-term effects of myofascial trigger point release and therapeutic ultrasound, each combined with conventional corrective exercise, against exercise alone in patients with upper crossed syndrome. All three groups improved significantly across pain, disability, posture, and pressure pain threshold, but the group receiving trigger point release showed the greatest gains, followed by the ultrasound group, with exercise alone showing the smallest, though still significant, improvement.

The superior response in the trigger point release group is consistent with the proposed mechanism by which sustained manual pressure over an MTrP disrupts the local energy crisis and taut band, restoring normal sarcomere length and reducing peripheral nociceptive input.[3] This mirrors findings from earlier trials of ischemic compression and pressure release on upper trapezius MTrPs, which similarly reported significant reductions in pain and improvements in pressure pain threshold.[12,13,14] The pilot trial comparing motor control training with soft-tissue therapy in women with UCS likewise found soft-tissue release effective for pain, though it did not identify one approach as clearly superior, a discrepancy that may reflect differences in sample size, dosage, or the absence of a shared exercise base across arms.[7]

The intermediate improvement observed with therapeutic ultrasound is in keeping with previous randomized trials showing that both high-power pain-threshold and conventional pulsed ultrasound reduce MTrP-related pain in the upper trapezius relative to placebo or baseline.[16,17] However, the smaller effect relative to manual release in the present findings suggests that the primarily thermal and micro-mechanical effects of ultrasound may be less effective than direct sustained mechanical pressure at disrupting the taut band, a possibility also raised in comparative work combining ultrasound with manual myofascial release or hydrodissection.[18,19,20]

That exercise alone produced significant, if comparatively smaller, gains supports the established role of corrective and stabilisation exercise in restoring the length-tension balance underlying UCS.[8,9,10] This is consistent with systematic review evidence supporting deep cervical flexor training and myofascial-release-type approaches for chronic neck pain more broadly.[26,24] The comparatively slower improvement in this group may reflect the time required for motor re-education and strength gains relative to the more immediate mechanical effect of direct trigger point release.

Taken together, these findings suggest that adding a trigger-point-directed manual technique to a corrective exercise programme confers a measurable early advantage in UCS, and that where manual therapy resources are unavailable, ultrasound may serve as a reasonable, if less potent, adjunct to exercise.

Several limitations should be considered. Blinding of participants and treating therapists was not possible given the nature of manual and electrophysical interventions, which may have introduced performance or expectation bias.[27] The 6-week follow-up captures only short-term outcomes, and the durability of improvement beyond this period is unknown. The sample was drawn from a single centre and a relatively narrow age range, which may limit generalisability. Objective measures of muscle activation (electromyography) were not included and would strengthen mechanistic interpretation in future work.

CONCLUSION

This study concluded that myofascial trigger point release combined with conventional corrective exercise produced significantly greater short-term improvement in pain, disability, craniovertebral angle, and pressure pain threshold than therapeutic ultrasound combined with exercise, or exercise alone, in patients with upper crossed syndrome. Therapeutic ultrasound combined with exercise was, in turn, more effective than exercise alone. All three approaches produced statistically significant within-group improvement, supporting corrective exercise as a foundational component of UCS management, with manual trigger point release recommended as the preferred adjunct where clinically feasible.

Suggestions and Future Directions

- Future multicentre trials with longer follow-up (3–6 months) are needed to establish the durability of treatment effects.
- Inclusion of surface electromyography or ultrasonographic muscle-thickness measures would help clarify the underlying mechanism of each intervention.
- A four-arm design incorporating a combined trigger-point-release-plus-ultrasound-plus-exercise group may clarify whether combining all three modalities offers additive benefit.
- Occupational and ergonomic subgroup analysis (e.g., by screen-time hours) could help identify patients most likely to benefit from each approach.
- Cost-effectiveness and patient-preference data should be collected alongside clinical outcomes to inform real-world treatment selection.

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