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Effect of Myofascial Trigger Release and Thoracic Mobility Exercises on Chest Expansion and Posture among Upper Cross Syndrome Subjects

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ABSTRACT

Background: Upper Cross Syndrome (UCS) is a common postural disorder characterized by forward head posture, rounded shoulders, and increased thoracic kyphosis resulting from muscle imbalance. These postural alterations restrict thoracic mobility and chest expansion, thereby affecting respiratory efficiency. Myofascial Trigger Release (MTR) and thoracic mobility exercises have individually demonstrated beneficial effects; however, limited evidence exists regarding their combined effect on chest expansion and posture in individuals with UCS.

Aim: To determine the effect of Myofascial Trigger Release and thoracic mobility exercises on chest expansion and posture among subjects with Upper Cross Syndrome.

Methodology: A single-group pre-test and post-test experimental study was conducted among 30 subjects aged 18–40 years diagnosed with Upper Cross Syndrome. Participants received Myofascial Trigger Release targeting the pectoralis major, sternocleidomastoid, upper trapezius, and levator scapulae muscles along with thoracic mobility exercises for eight weeks. Chest expansion was assessed using a chest caliper at the axillary and xiphoid levels, while thoracic kyphosis angle was measured using Kinovea software. Statistical analysis was performed using IBM SPSS Statistics Version 20. Descriptive statistics and paired sample *t*-tests were used to compare pre- and post-intervention values.

Results: Significant improvements were observed following the intervention. Mean axillary chest expansion increased from 2.40 ± 0.14 cm to 3.30 ± 0.17 cm, while xiphoid chest expansion improved from 2.10 ± 0.14 cm to 3.00 ± 0.17 cm. The mean thoracic kyphosis angle decreased from 48.00 ± 1.44° to 42.50 ± 1.53°. Paired sample *t*-tests demonstrated statistically significant differences for all outcome measures ($p < 0.001$).

Conclusion: The findings indicate that the combination of Myofascial Trigger Release and thoracic mobility exercises is effective in improving chest expansion and reducing thoracic kyphosis in individuals with Upper Cross Syndrome. This combined intervention may be considered an effective physiotherapy approach for enhancing thoracic mobility, postural alignment, and respiratory function in this population.

Keywords: Upper Cross Syndrome, Myofascial Trigger Release, Thoracic Mobility Exercises, Chest Expansion, Thoracic Kyphosis, Posture, Kinovea, Physiotherapy.

INTRODUCTION

Upper crossed syndrome is a common musculoskeletal disorder that is characterized by weakness and tightness in the upper back, shoulders, and neck muscles.[1]Muscles such as the levator scapulae, suboccipital muscles, pectoralis major and minor, and upper trapezius are tight, whereas the rhomboids, middle and lower trapezius, serratus anterior, and deep neck flexors are weak.[2]It is characterized as a postural dysfunction or imbalance when the middle and lower trapezius muscles are inhibited while the upper trapezius and pectoralis muscles are overactive. This leads to a scapula that is primarily winging, raised, prolonged, and abducted.[3].Postural changes include forward head posture, increased cervical lordosis and thoracic kyphosis, and elevated and protracted shoulders.

This pattern of imbalances causes joint dysfunction, specifically at the atlanto-occipital joint, C4-C5 segment, cervicothoracic joint, glenohumeral joint, and T4-T5 segments.[4]Frequent complaints of headaches, interscapular pain, and neck pain are caused by poor posture.[3]Muscle tightness or spasm, restricted range of motion, exhaustion, arthritis brought on by unequal joint wear over time, migraines, a higher chance of disc herniation, and diminished performance all lower quality of life.[4]In the lower cervical and upper thoracic spine regions, osteoarthritis will develop early as a result of biomechanical variation and posture imbalance. Shoulder impingement that is functional is another consequence of upper crossed syndrome[3].

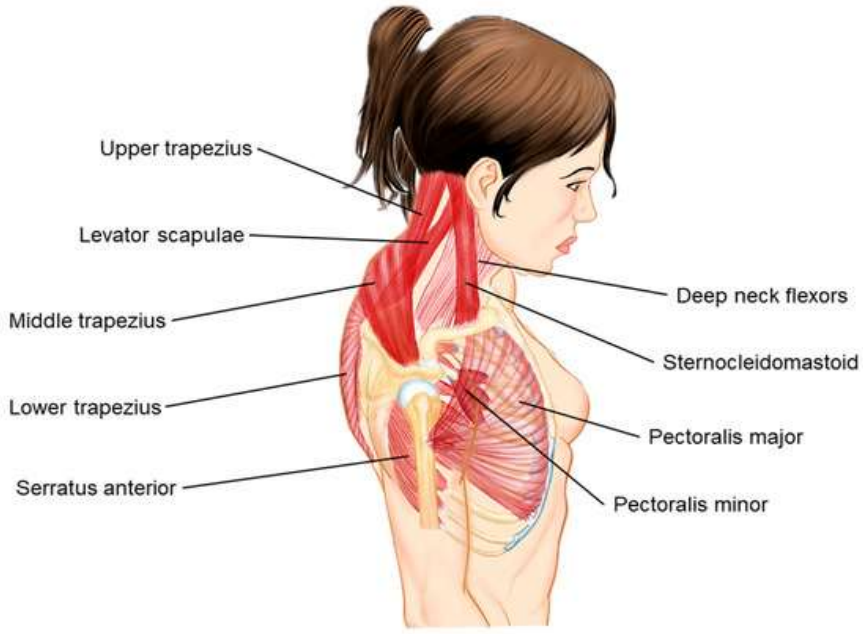


FIGURE-1: forward head posture and rounded shoulders

An annual 30% increase in the prevalence of upper crossed syndrome and the neck discomfort it causes makes it the fourth most common cause of disability. As per the 2010 Global Burden of Disease Report, neck pain ranks 21st out of all disorders considered. An estimated 6-48% of adults had pain in one of these muscles, according to the global report on GBD, which found that the incidence of neck discomfort was 4.9%.[5]

Incidence of Upper Crossed Syndrome has an incidence of 68% in healthcare professionals, 66.7% in multiparous women, and 55.6% among software professionals. It also affects 31.8% of office workers and 28% of laundry workers, mainly due to poor posture, repetitive tasks, and prolonged sitting.
Prevalence of Upper Crossed Syndrome shows a prevalence of 68.22% in healthcare workers, with common symptoms like neck pain (77.57%) and forward head posture (77.57%). Prevalence is also reported as 67% in IT professionals, 37.1% in students, and 28% in laundry workers, indicating it's widespread across various populations [6,7,8,9,10,11,12,13]

PATHOMECHANICS

Upper Crossed Syndrome (UCS) is characterized by a distinct pattern of muscle imbalance involving tightness of the pectoralis major and minor, upper trapezius, and levator scapulae, along with weakness of the deep cervical flexors, lower trapezius, and rhomboids[14]. This imbalance leads to postural deviations such as forward head posture, rounded shoulders, and increased thoracic kyphosis, resulting in a collapsed anterior chest wall. The exaggerated thoracic kyphosis alters the normal biomechanics of the rib cage, restricting thoracic extension and limiting rib mobility.
During normal respiration, the ribs move through pump-handle and bucket-handle mechanisms to increase anteroposterior (AP) and transverse diameters respectively; however, in UCS, the pump-handle mechanism is predominantly affected due to stiffness of the upper ribs and reduced anterior elevation of the sternum [15]. Tightness of the pectoralis minor further contributes by maintaining the scapula in a protracted position and depressing the rib cage, thereby limiting anterior chest expansion [16]. Additionally, altered posture places the diaphragm at a mechanical disadvantage, reducing its efficiency and promoting shallow, upper chest breathing [17,18].
Consequently, there is a significant reduction in anteroposterior chest expansion, while transverse expansion is also reduced to a lesser extent due to generalized thoracic stiffness. Overall, these biomechanical and muscular alterations lead to decreased thoracic mobility, reduced chest expansion, and impaired respiratory efficiency in individuals with Upper Crossed Syndrome.

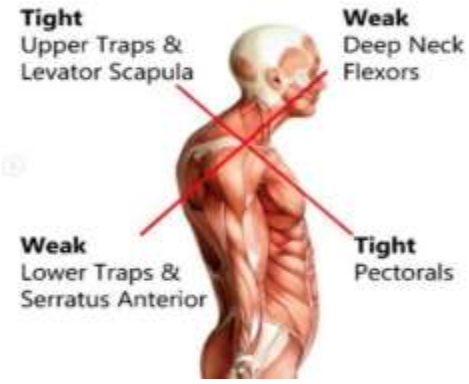


FIGURE-2: Postural imbalances

CHEST CALIPER

Chest expansion using a chest caliper is measured by assessing the change in thoracic diameter, either anteroposterior or transverse, between maximum inspiration and maximum expiration, with the difference between these two readings representing chest expansion. [19]

THORACIC MOBILITY EXERCISES

Thoracic mobility plays a vital role in maintaining proper posture and efficient respiratory function. The thoracic spine and rib cage together facilitate chest wall movement during respiration. Any restriction in thoracic mobility can lead to decreased chest expansion, altered breathing patterns, and postural abnormalities. In conditions such as Upper Crossed Syndrome (UCS), reduced thoracic mobility is commonly observed due to muscle tightness and joint stiffness, particularly involving the pectoral muscles and thoracic extensors [20,21,22].

Thoracic mobility exercises are designed to improve the flexibility and movement of the thoracic spine and rib cage. These exercises include thoracic extension, rotation, and lateral flexion movements, which help restore normal spinal curvature and rib mobility. Improved thoracic mobility facilitates better chest wall expansion and enhances overall respiratory function [23].

MYOFASCIAL TRIGGER RELEASE

Myofascial trigger release (MTR) is a manual therapy technique widely used in physiotherapy to address myofascial pain and muscle tightness associated with postural dysfunctions such as Upper Crossed Syndrome (UCS). Myofascial trigger points are defined as hyperirritable spots located within taut bands of skeletal muscle that are painful on compression and can produce referred pain, muscle stiffness, and restricted range of motion. In UCS, trigger points commonly develop in the upper trapezius, levator scapulae, and pectoral muscles due to prolonged poor posture and sustained muscular imbalance

The application of myofascial trigger release aims to deactivate these trigger points, reduce muscle tension, and restore normal muscle length and function. This is achieved through sustained pressure, stretching, or manual techniques that improve local blood circulation, reduce neuromuscular excitability, and break down fascial adhesions.[24]

In individuals with UCS, tightness of the pectoralis major and minor contributes to anterior chest wall restriction and rounded shoulder posture, while trigger points in the upper trapezius and levator scapulae contribute to neck pain and forward head posture. Myofascial trigger release helps in reducing this tightness, thereby improving scapular positioning and facilitating thoracic extension. This indirectly enhances chest expansion by allowing greater rib cage mobility and improved pump-handle movement.

Myofascial trigger release is an effective therapeutic technique in the management of Upper Crossed Syndrome. By addressing muscle tightness, reducing trigger point activity, and improving soft tissue flexibility, it contributes to improved posture, enhanced thoracic mobility, and increased chest expansion. Its integration with exercise-based interventions provides a holistic approach to restoring normal musculoskeletal and respiratory function.[25,26,27]

KINOVEA SOFTWARE

Kinovea is a free, open-source software used in physiotherapy to assess posture and movement through video analysis. It offers a non-invasive and cost-effective alternative to radiographic methods for measuring spinal alignment, including thoracic kyphosis. By using 2D photogrammetry, lateral images are analyzed, marking landmarks like C7 and T12 to calculate the kyphotic angle, similar to the Cobb angle. This method helps clinicians easily assess postural deviations such as Upper Crossed Syndrome (UCS).

Kinovea software serves as an effective tool to measure thoracic kyphosis in individuals with UCS, allowing objective evaluation of postural changes before and after intervention. Its ease of use, reliability,

and non-invasive nature make it an appropriate choice for assessing the effectiveness of physiotherapy interventions aimed at improving posture and chest expansion.[28,29,30]

REVIEW OF LITERATURE

Xuanming Hu, Guiying Bao, Xi Quan et al. (2025) conducted a randomized controlled trial to examine the effect of neuromuscular combined with biomechanical scapular stabilizer exercises on Upper Crossed Syndrome (UCS) in Chinese secondary school students aged 15–18 years. Participants were divided into three groups: neuromuscular combined with biomechanical exercise (NCBE), biomechanical exercise (BE), and a control group. The intervention was performed three times per week for eight weeks. Outcome measures included forward head angle, rounded shoulder distance, Visual Analog Scale (VAS), Neck Disability Index (NDI), and strength of scapular stabilizing muscles. Both NCBE and BE groups showed significant improvements in posture, pain, and muscle strength compared to the control group; however, the NCBE group demonstrated superior results. The study concluded that combined neuromuscular and biomechanical exercises are more effective than biomechanical exercises alone in managing UCS.[31]

Guo et al. (2025) conducted a randomized controlled trial to evaluate the effect of cervical and thoracic "Daoyin" training on posture and pulmonary function in college-aged individuals with upper crossed syndrome (UCS). Participants diagnosed with UCS, characterized by forward head posture, rounded shoulders, and associated muscular imbalance, underwent an 8-week Daoyin training program consisting of 45-minute sessions, five times per week, while the control group continued routine activities. Outcome measures included forward head angle, forward shoulder angle, pain (VAS), neck disability index (NDI), pulmonary function (FEV1/FVC, MVV), cervical range of motion, and anxiety levels. The results demonstrated significant improvements in posture, pain reduction, cervical function, and pulmonary parameters in the intervention group compared to controls. The study concluded that cervical and thoracic Daoyin training is an effective, safe, and non-pharmacological intervention for improving posture and respiratory function in young adults with UCS.[32]

Kaur et al. (2019) investigated the effect of myofascial release and stretching in individuals with upper crossed syndrome (UCS), a condition characterized by forward head posture, rounded shoulders, and muscle imbalances in the cervical and shoulder regions. The study included young adult participants diagnosed with UCS and implemented an intervention program comprising myofascial release techniques and targeted stretching exercises for tight muscles such as the pectoralis, upper trapezius, and levator scapulae over a period of several weeks. Outcome measures included pain assessed using the Visual Analog Scale (VAS), postural parameters, range of motion (ROM), and functional ability of the cervical and shoulder regions, evaluated before and after the intervention. The results demonstrated significant improvements in pain reduction, posture, and functional outcomes, with myofascial release showing comparatively greater effectiveness than stretching alone. The study concluded that both interventions are beneficial in managing UCS, with myofascial release providing superior clinical outcomes.[33]

Ganvir and Kadam (2023) investigated the effect of scapular stabilization exercises with and without thoracic mobilization on neck pain and range of motion in individuals with upper crossed syndrome (UCS). The study included young adults aged 18–25 years diagnosed with UCS, characterized by forward head posture, rounded shoulders, and associated neck pain due to muscular imbalance. Participants were divided into two groups, where one group received scapular stabilization exercises combined with thoracic mobilization, while the other group performed scapular stabilization exercises alone over a period of four weeks, four days per week. Outcome measures included pain assessed using the Visual Analog Scale

(VAS) and cervical range of motion (ROM) measured using a goniometer, evaluated before and after the intervention. The results demonstrated that both groups showed significant improvement in pain reduction and ROM; however, the group receiving combined thoracic mobilization exhibited greater improvements. The study concluded that integrating thoracic mobilization with scapular stabilization exercises is more effective in managing neck pain and improving cervical mobility in individuals with upper crossed syndrome.(34)

Jeong and Lee (2024) conducted a randomized controlled trial to evaluate the effects of telerehabilitation combining diaphragmatic breathing re-education and shoulder stabilization exercises on neck pain, posture, and function in young adult men with upper crossed syndrome (UCS). The study included participants in their 20s and 30s diagnosed with UCS, characterized by forward head posture, rounded shoulders, and associated neck pain and functional limitations. Subjects were randomly assigned to an experimental group receiving a telerehabilitation program consisting of diaphragmatic breathing exercises along with shoulder stabilization, and a control group performing shoulder stabilization exercises alone, over a period of four weeks with three sessions per week. Outcome measures included pain pressure threshold (PPT), craniovertebral angle (CVA), round shoulder posture (RSP), shoulder tilt degree (STD), Neck Disability Index (NDI), and Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST), assessed before and after the intervention. The results demonstrated significant improvements in both groups; however, the experimental group showed greater enhancement in pain reduction, posture, and functional outcomes. The study concluded that combining diaphragmatic breathing with shoulder stabilization through telerehabilitation is an effective approach for managing UCS in young adults.(35)

Ali et al. (2017) compared the effectiveness of stretching exercises and muscle energy techniques (MET) in individuals with upper crossed syndrome (UCS), a condition characterized by forward head posture, rounded shoulders, and muscle imbalance. Young adult participants with UCS were divided into two groups receiving either stretching exercises or MET over several weeks. Outcome measures included pain (VAS), cervical range of motion (ROM), and postural assessment evaluated before and after intervention. Both groups showed improvement; however, the MET group demonstrated greater effectiveness in reducing pain and improving mobility and posture. The study concluded that MET is more effective than stretching exercises in the management of UCS.(36)

.**González-Gálvez et al. (2019)** investigated the effect of structured thoracic mobility exercises in individuals with postural abnormalities characterized by reduced thoracic mobility and chest expansion. Participants, primarily young to middle-aged adults, underwent a thoracic mobility exercise program including extension and rib cage mobility exercises over several weeks. Outcome measures included pulmonary function (FEV1, FVC), chest wall expansion, and thoracic mobility assessed pre- and post-intervention. The results showed significant improvements in pulmonary function and chest expansion. The study concluded that thoracic mobility exercises are effective in enhancing respiratory efficiency and thoracic movement in individuals with postural abnormalities.(37)

Abd El-Rahem et al. investigated the effect of diaphragmatic release on neck pain and chest expansion in patients with upper crossed syndrome (UCS), a condition characterized by forward head posture, rounded shoulders, and muscle imbalance. Adult participants with UCS underwent diaphragmatic release therapy over a period of several sessions. Outcome measures included neck pain assessed using the Visual Analog Scale (VAS) and chest expansion measured before and after the intervention. The results demonstrated significant reduction in pain and improvement in chest expansion. The study concluded that

diaphragmatic release is an effective intervention for improving respiratory function and reducing neck pain in individuals with UCS.[38]

Chang et al. (2023) conducted a narrative systematic review to evaluate the effectiveness of various treatments for upper crossed syndrome (UCS), a condition characterized by forward head posture, rounded shoulders, and muscle imbalance. The review included multiple studies involving young to middle-aged adults with UCS and analyzed interventions such as corrective exercises, muscle energy techniques, soft tissue mobilization, and postural correction strategies. Outcome measures commonly assessed were pain (VAS), neck disability (NDI), and postural parameters. The findings indicated that these physiotherapy interventions significantly improve pain, posture, and functional outcomes. The study concluded that a combination of exercise and manual therapy approaches is effective in the management of UCS.[39]

Sepehri et al. (2024) conducted a systematic review and meta-analysis to evaluate the effects of various therapeutic exercises on postural abnormalities in individuals with upper crossed syndrome (UCS). The review included multiple studies involving young to middle-aged adults with UCS, characterized by forward head posture, rounded shoulders, and thoracic hyperkyphosis. Interventions analyzed included strengthening, stretching, shoulder stabilization, and comprehensive corrective exercise programs targeting muscle imbalances. Outcome measures included forward head angle, rounded shoulder angle, and thoracic kyphosis. The findings demonstrated that therapeutic exercises significantly improve postural alignment, with comprehensive exercise programs showing the greatest effectiveness. The study concluded that targeted exercise interventions are essential for correcting postural deviations in individuals with UCS.[40]

Chaudhuri et al. (2023) conducted a systematic review and meta-analysis to evaluate the effectiveness of physiotherapeutic interventions in individuals with upper crossed syndrome (UCS). The review included multiple studies involving young to middle-aged adults with UCS, characterized by forward head posture, rounded shoulders, and thoracic kyphosis. Interventions analyzed included exercise therapy, scapular stabilization, muscle energy techniques, myofascial release, and ergonomic correction programs. Outcome measures included craniovertebral angle, kyphotic angle, pain (VAS), cervical range of motion, muscle activity, and functional disability. The findings indicated that physiotherapy interventions significantly improve posture, reduce pain, and enhance function; however, the quality of evidence was low to moderate. The study concluded that combined exercise and manual therapy approaches are effective for managing UCS, with a need for further high-quality research.[41]

NEED OF THE STUDY

Upper Cross Syndrome (UCS) is one of the most common postural problems seen today, especially among students, office workers, and individuals who spend long hours using computers or mobile devices. It is characterized by forward head posture, rounded shoulders, and increased thoracic kyphosis due to an imbalance between tight and weak muscles. The pectoralis major, sternocleidomastoid, levator scapulae, and upper trapezius muscles often become shortened and tight, while the deep cervical flexors and scapular stabilizing muscles become weak. These muscle imbalances alter normal spinal alignment, reduce scapular stability, and may lead to pain, muscle tightness, restricted movement, and difficulty performing daily activities.

The postural changes associated with UCS can also affect breathing by altering the movement of the thoracic spine and rib cage. Increased thoracic kyphosis decreases the mobility of the chest wall and limits the normal expansion of the rib cage during inspiration. As a result, the bucket-handle and pump-handle

movements of the ribs become restricted, reducing chest expansion and making breathing less efficient. If left untreated, these changes may contribute to reduced respiratory muscle efficiency, decreased thoracic flexibility, and further deterioration of posture and physical function.

Myofascial Trigger Release (MTR) is widely used in physiotherapy to relieve muscle tightness by releasing trigger points and improving the flexibility of muscles and fascia. Likewise, thoracic mobility exercises help restore normal movement of the thoracic spine and rib cage, increase chest expansion, and improve overall posture. When these interventions are combined, they may provide greater benefits by reducing muscle tightness, improving thoracic mobility, enhancing respiratory function, and promoting better postural alignment than either approach alone.

Although previous studies have demonstrated the individual effectiveness of myofascial release techniques and thoracic mobility exercises, only a few have examined their combined effect on chest expansion and posture in individuals with Upper Cross Syndrome. Since both muscle tightness and thoracic stiffness play an important role in this condition, combining these treatment approaches may offer a more comprehensive and effective rehabilitation strategy. Therefore, the present study aims to evaluate the effect of Myofascial Trigger Release of the pectoralis major, sternocleidomastoid, levator scapulae, and upper trapezius muscles along with thoracic mobility exercises on chest expansion and posture among individuals with Upper Cross Syndrome.

AIM OF THE STUDY

Effect of myofascial trigger release and thoracic mobility exercises on chest expansion and posture among upper cross syndrome subjects.

HYPOTHESIS OF THE STUDY

Null Hypothesis (H_0): There is no significant difference between the pre-test and post-test values of axillary chest expansion, xiphoid chest expansion, and thoracic kyphosis angle following the intervention

Alternative Hypothesis (H_1): There is a significant difference between the pre-test and post-test values of axillary chest expansion, xiphoid chest expansion, and thoracic kyphosis angle following the intervention

OBJECTIVES OF THE STUDY

- To find the effect of myofascial trigger release technique and thoracic mobility exercises on chest expansion using chest caliper among upper cross syndrome subjects.
- To find the effect of myofascial trigger release technique and thoracic mobility exercises on posture using kinovea software among upper cross syndrome subjects.

MATERIALS AND METHODOLOGY

MATERIALS:

Participant information sheet ,informed consent form
Case recording sheet
Pen and paper
Chest caliper
Couch
Foam roller



FIGURE 3
Chest caliper



FIGURE 4
foam roller

METHODOLOGY

Study setup:

Sri Venkateswara institute of medical sciences, SVIMS, Tirupati

Single group Pre and post test Experimental study.

Sample size:30

A total of 30 subjects with a confirmed diagnosis of upper cross syndrome was included.

SAMPLING METHOD: Convenience sampling

INCLUSION CRITERIA

- Age 18 to 40 years
- Both genders
- Upper cross syndrome subjects (Desk workers,students)
- Having symptoms including cervical muscle shortening and weakness, increased thoracic kyphosis
- Postural screening using kinovea software was performed.
- Thoracic kyphosis angle more than 45 degrees.

EXCLUSION CRITERIA

- A history of trauma or surgery to the cervical vertebrae
- Neurological diseases
- Severe spinal deformity
- Muscle diseases
- Currently undergoing other rehabilitation treatments related to the shoulder, neck,

or posture.

- Patients with history of upper limb fractures and dislocations was excluded.
- Subjects not willing to participate in the study

Out come measures

Chest caliper

Posture- kinovea software

- Chest expansion was measured at two levels. Upper chest expansion at the Axillary level and lower chest expansion at the level of the xiphoid process.

STUDY PROCEDURE

The present study was conducted after obtaining approval from the **Institutional Ethics Committee (IEC),Sri Venkateswara Institute of Medical Sciences(SVIMS),Tirupati(IEC Approval No.1963**). Participants who fulfilled the inclusion and exclusion criteria and expressed willingness to participate were enrolled in the study after providing written informed consent.

Following recruitment, demographic information including age, gender, occupation, height, weight, and Body Mass Index (BMI) was recorded using a standardized data collection form. Baseline assessment was then performed for all outcome measures before initiating the intervention. Chest expansion was measured using a chest caliper at predetermined anatomical levels under standardized conditions. Thoracic kyphosis angle was assessed using digital photographs analyzed with Kinovea software, while additional clinical examination was performed to confirm the presence of Upper Cross Syndrome. All assessments were conducted by the same examiner to minimize measurement bias.

The intervention consisted of Myofascial Trigger Release (MTR) applied to the pectoralis major, sternocleidomastoid, levator scapulae, and upper trapezius muscles, followed by thoracic mobility exercises. The myofascial trigger release technique was performed to reduce muscle tightness, deactivate trigger points, improve fascial mobility, and restore normal muscle extensibility. Thoracic mobility exercises were then administered to improve thoracic spine flexibility, increase rib cage mobility, enhance chest expansion, and promote normal postural alignment. Each treatment session was carried out under the supervision of a qualified physiotherapist according to a standardized treatment protocol. The intervention was provided for a period of 8 weeks, with participants attending regular treatment sessions as per the study protocol. Participants were encouraged to maintain their usual daily activities while avoiding any additional physiotherapy interventions during the study period.

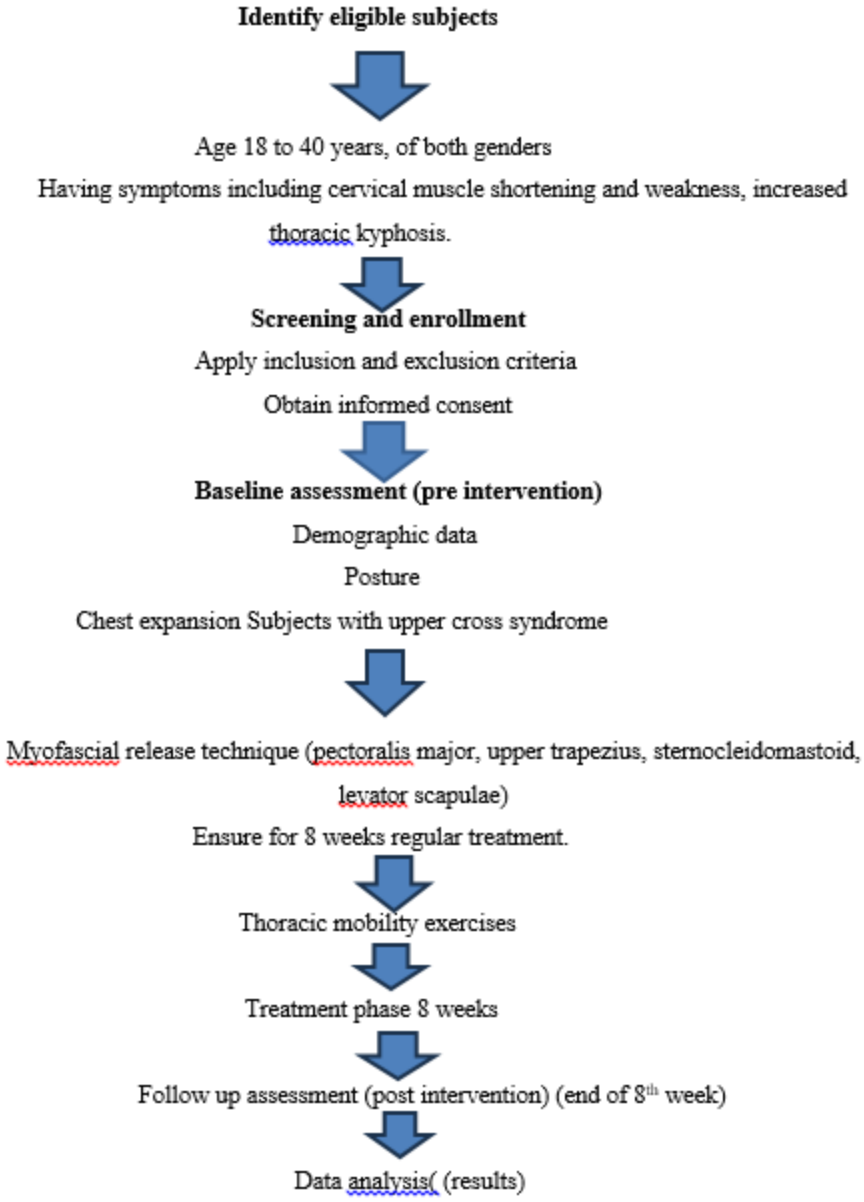
At the completion of the 8-week intervention period, all outcome measures were reassessed using the same assessment procedures and instruments employed during the baseline evaluation. Chest expansion measurements and thoracic kyphosis angle were recorded under identical testing conditions to ensure consistency. The pre-intervention and post-intervention values were compared to determine the effectiveness of the intervention on chest expansion and posture among individuals with Upper Cross Syndrome.

For the assessment of thoracic kyphosis angle, Kinovea software was utilized because of its high accuracy, ease of use, and excellent reliability in postural analysis. Standardized digital photographs were captured with participants standing in a relaxed posture from the lateral view. Anatomical landmarks were identified before photography to ensure accurate angle measurement. The photographs were subsequently analyzed using Kinovea software to calculate the thoracic kyphosis angle. Kinovea is one of the most recent and reliable motion analysis software programs used in physiotherapy research. Previous studies have

demonstrated that Kinovea has excellent intra-rater and inter-rater reliability, with an Intraclass Correlation Coefficient (ICC) of approximately **0.99** for measuring spinal postural angles from digital photographs. Therefore, it is considered a valid, reliable, non-invasive, and cost-effective tool for assessing thoracic posture in both clinical practice and research settings.

STUDY ALGORITHM

EFFECT OF MYOFASCIAL TRIGGER RELEASE AND THORACIC MOBILITY EXERCISES ON CHEST EXPANSION,POSTURE ON UCS



Treatment protocol

Table 1

WEEKS	FREQUENCY	TYPE	TIME

1-4 WEEKS	2 SESSIONS	MYOFASCIAL TRIGGER RELEASE OF PECTORALIS MAJOR ,STERNOCLEIDOMASTOID,UPPER TRAPEZIUS,LEVATOR SCAPULAE	6 MINS

Table 2

WEEKS	FREQUENCY	INTENSITY	TYPE	TIME
1-8WEEKS	5 SESSIONS	3SETS,10REPS	THORACIC MOBILITY EXERCISES	20 MINS



Figure 5
Cat -cow stretch



figure 6
Thoracic Rotations



Figure 7
Quadruped t-spine rotation



figure 8
wall angles



Figure 9
Child pose



figure 10
Foam roller thoracic extension



FIGURE 11
MYOFASCIAL TRIGGER RELEASE
OF UPPER TRAPEZIUS



FIGURE 12
WALL ANGLES

STATISTICAL ANALYSIS

The statistical analysis of the collected data was performed using IBM SPSS Statistics Version 20. Descriptive and inferential statistical analyses were carried out using SPSS, while the tables and graphical representations of the results were prepared using Microsoft Excel for clear presentation and interpretation of the findings.

RESULTS

Descriptive Statistics

- Mean & Standard deviation for Continuous variables, namely Age, Height, Weight, BMI, Axillary, Xiphoid, and Thoracic Kyphosis scores
- Frequency distribution for categorical variable such as Gender and Occupation

Inferential Statistics

- Intra Group Analysis (or within-group analysis) – Paired Samples t-test

Outcome Measure: Axillary, Xiphoid, and Thoracic Kyphosis scores

II. ANALYSIS

1. Descriptive Statistics

Table 3 Descriptive Statistics of Continuous Variables

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**SD**
Age	30	20.00	38.00	27.67	5.36

Height	30	155.00	179.00	165.80	7.78
BMI	30	20.50	24.50	22.50	1.39
Axillary_Pre_cm	30	2.20	2.60	2.40	0.14
Axillary_Post_cm	30	3.00	3.60	3.30	0.17
Xiphoid_Pre_cm	30	1.90	2.30	2.10	0.14
Xiphoid_Post_cm	30	2.70	3.30	3.00	0.17
Thoracic_Kyphosis_Pre_deg	30	46.00	50.00	48.00	1.44
Thoracic_Kyphosis_Post_deg	30	40.00	45.00	42.50	1.53

The above descriptive statistics table shows that the mean age of the participants was 27.67 ± 5.36 years, with ages ranging from 20 to 38 years. The mean height was 165.80 ± 7.78 cm (range: 155–179 cm), while the mean BMI was 22.50 ± 1.39 kg/m² (range: 20.50–24.50 kg/m²). For the outcome measures, the mean axillary chest expansion increased from 2.40 ± 0.14 cm at pre-test to 3.30 ± 0.17 cm at post-test. Similarly, the mean xiphoid chest expansion improved from 2.10 ± 0.14 cm to 3.00 ± 0.17 cm. The mean thoracic kyphosis angle decreased from 48.00 ± 1.44° before the intervention to 42.50 ± 1.53° after the intervention, indicating an improvement in thoracic posture.

Table 4

Frequency Distribution of Gender

Gender	**Frequency**	**Percent**
Female	17	57%
Male	13	43%
Total	**30**	**100%**

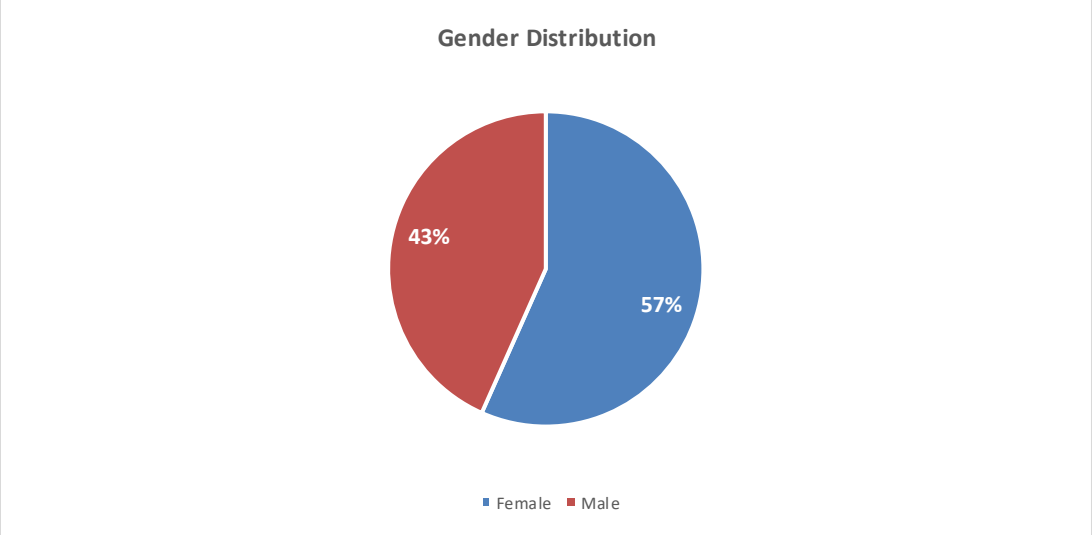


Figure 13

The above gender distribution of the participants shows that among the 30 participants, 17 (57%) were females and 13 (43%) were males. This indicates that females constituted a slightly higher proportion of the study sample than males.

Table 5
Frequency Distribution of Occupation

Occupation	Count	Percent
Housewife	8	27%
IT Employee	8	27%
Student	14	47%
Total	**30**	**100%**

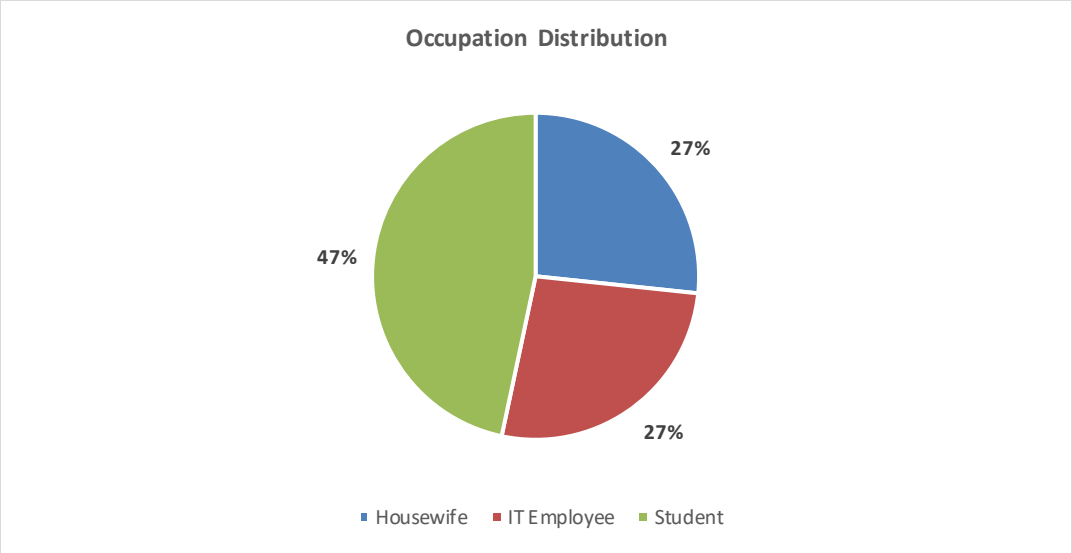


Figure 14

From the above occupational distribution of the participants, it can be clearly seen that the majority of the participants were students (47%), followed by housewives (27%) and IT employees (27%). This indicates that students formed the largest occupational group included in the study.

2. Inferential Statistics

2.1 Intra-Group Analysis (or Within-Group Analysis)

2.1.1 Paired Sample t-test for Axillary Chest Expansion, Xiphoid Chest Expansion, and Thoracic Kyphosis Angle

HYPOTHESES:

Null Hypothesis (H_0): There is no significant difference between the pre-test and post-test values of axillary chest expansion, xiphoid chest expansion, and thoracic kyphosis angle following the intervention

Alternative Hypothesis (H_1): There is a significant difference between the pre-test and post-test values of axillary chest expansion, xiphoid chest expansion, and thoracic kyphosis angle following the intervention

Table 6
Paired t-test Output

Paired Samples Test						
Pair	**Outcome Measure**	**N**	**Mean**	**SD**	**t**	**P-value**
Pair 1	Axillary_Pre_cm	30	2.40	0.14	-59.36	0.000

	Axillary_Post_cm	30	3.30	0.17		
Pair 2	Xiphoid_Pre_cm	30	2.10	0.14	-59.36	0.000
	Xiphoid_Post_cm	30	3.00	0.17		
Pair 3	Thoracic_Kyphosis_Pre_deg	30	48.00	1.44	59.24	0.000
	Thoracic_Kyphosis_Post_deg	30	42.50	1.53		

Interpretation:

Axillary Chest Expansion:

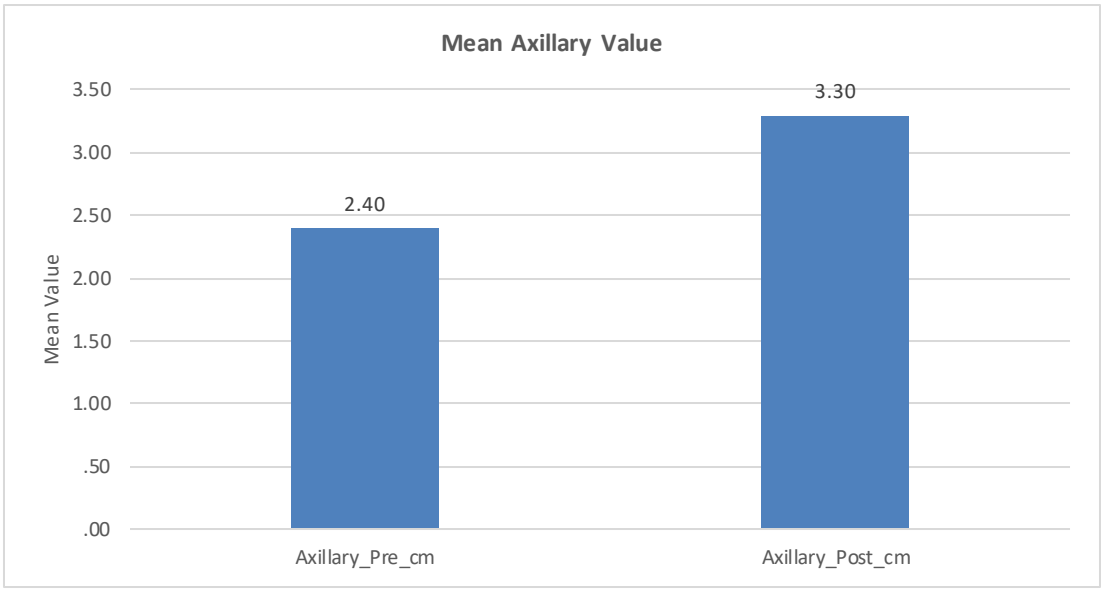


Figure 15

Since the p-value obtained from the Paired t-test is less than 0.05, the null hypothesis is rejected at the 5% level of significance ($t = -59.36$, $p = 0.000 < 0.05$). In addition, the mean axillary chest expansion increased from 2.40 cm (SD = 0.14) in the pre-test to 3.30 cm (SD = 0.17) in the post-test. Hence, the evidence is sufficient to conclude that the intervention is significantly effective in improving axillary chest expansion among the study participants.

Xiphoid Chest Expansion:

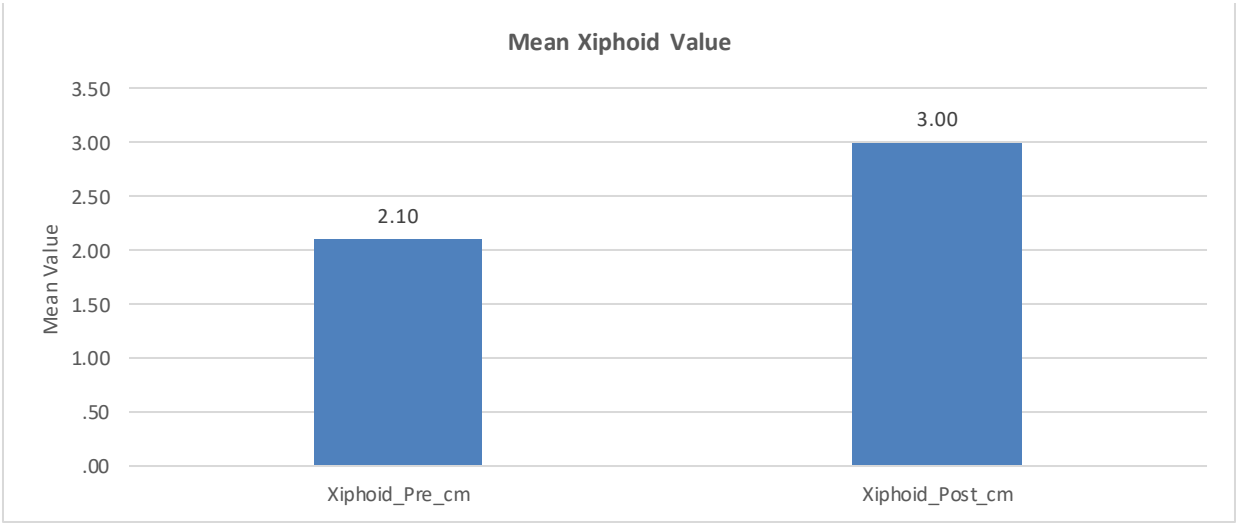


Figure 16

Since the p-value obtained from the paired t-test is less than 0.05, the null hypothesis is rejected at the 5% level of significance ($t = -59.36$, $p = 0.000 < 0.05$). In addition, the mean xiphoid chest expansion increased from 2.10 cm (SD = 0.14) in the pre-test to 3.00 cm (SD = 0.17) in the post-test. Hence, the evidence is sufficient to conclude that the intervention is significantly effective in improving xiphoid chest expansion among the study participants.

Thoracic Kyphosis Angle:

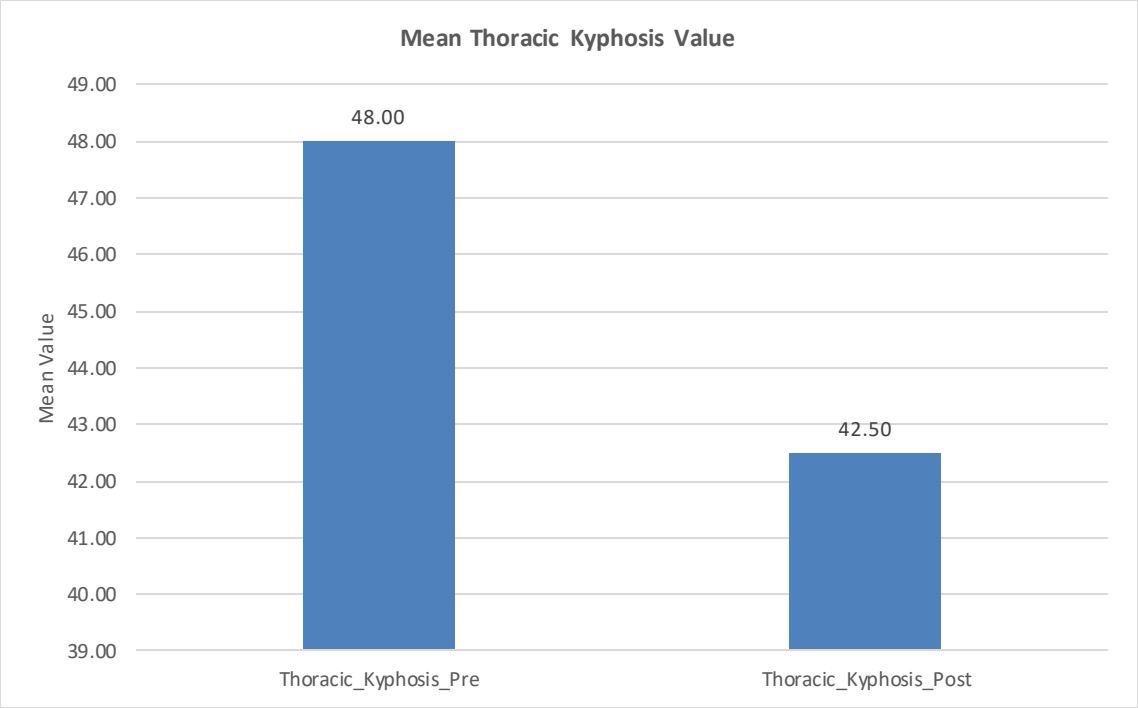


Figure 17

Since the p-value obtained from the paired t-test is less than 0.05, the null hypothesis is rejected at the 5% level of significance ($t = 59.24$, $p = 0.000 < 0.05$). In addition, the mean thoracic kyphosis angle decreased from 48.00° (SD = 1.44) in the pre-test to 42.50° (SD = 1.53) in the post-test. Hence, the evidence is sufficient to conclude that the intervention is significantly effective in reducing thoracic kyphosis angle among the study participants.

DISCUSSION

The present study was undertaken to determine the **e**ffect of Myofascial Trigger Release (MTR) and thoracic mobility exercises on chest expansion and posture **a**mong 30 subjects with Upper Cross Syndrome (UCS). **U**pper Cross Syndrome is one of the most frequently observed postural disorders in individuals with prolonged sedentary lifestyles, especially students, office workers, IT professionals, and individuals who spend prolonged hours using computers and smartphones. It is characterized by forward head posture, rounded shoulders, increased thoracic kyphosis, shortening of the pectoralis major, upper trapezius, levator scapulae, and sternocleidomastoid muscles, along with weakness of the deep cervical flexors, lower trapezius, serratus anterior, and rhomboids. These muscular imbalances alter the biomechanics of the cervical spine, thoracic spine, and shoulder girdle, ultimately affecting posture, respiratory function, and physical performance.

The findings of the present study demonstrated a significant improvement in chest expansion and thoracic posture following eight weeks of Myofascial Trigger Release combined with thoracic mobility exercises. The improvements observed may be explained by the combined effects of reducing myofascial restrictions, improving muscle extensibility, increasing thoracic spinal mobility, enhancing rib cage movement, and restoring normal postural alignment.

Upper Cross Syndrome, first described by **Janda (1988)**, is characterized by predictable muscle imbalance involving tightness of the pectoralis major, upper trapezius, levator scapulae, and sternocleidomastoid muscles with weakness of the deep cervical flexors, lower trapezius, serratus anterior, and rhomboids. These muscular imbalances produce forward head posture, rounded shoulders, and increased thoracic kyphosis, resulting in altered scapular mechanics, reduced thoracic mobility, neck pain, and impaired respiratory function. Janda emphasized that correction of muscle imbalance requires simultaneous stretching or release of shortened muscles and strengthening of weakened muscles. This concept forms the theoretical basis for combining myofascial trigger release with thoracic mobility exercises in the present study.(42)

Several studies have demonstrated that increased thoracic kyphosis negatively influences respiratory mechanics. **Kebaetse, McClure, and Pratt (1999)** investigated the effect of thoracic posture on shoulder function and reported that excessive thoracic flexion significantly reduced shoulder range of motion and altered scapular kinematics. The authors explained that increased thoracic kyphosis changes the orientation of the scapula and rib cage, restricting normal thoracic expansion. Their findings indicate that thoracic posture plays an essential role in maintaining both upper limb function and respiratory efficiency. These observations support the rationale of the present study, in which improvement in thoracic posture was expected to enhance chest expansion.(43)

The influence of thoracic posture on pulmonary function has also been investigated by **Culham and Peat (1993)**, who reported that increased thoracic kyphosis reduces chest wall compliance and pulmonary capacity. According to their findings, thoracic deformity limits rib movement during inspiration, decreases thoracic expansion, and increases the work of breathing. These findings suggest that improving thoracic alignment may positively influence respiratory mechanics. The present study therefore incorporated thoracic mobility exercises to improve thoracic extension and rib cage mobility.(44)

The effectiveness of thoracic mobility exercises has been reported in several clinical studies. **Lee et al. (2015)** investigated the effects of thoracic mobilization and thoracic extension exercises on respiratory function and chest expansion. Their results demonstrated significant improvements in chest expansion, forced vital capacity, and thoracic mobility following intervention. The authors concluded that restoration of thoracic movement improves rib mobility and respiratory muscle function. These findings are consistent with the theoretical basis of the present study, where thoracic mobility exercises were expected to improve chest expansion by restoring normal thoracic biomechanics.(45)

Similarly, **Kim and Lee (2017)** examined the effects of thoracic extension exercises in individuals with forward head posture and rounded shoulders. They observed significant reductions in thoracic kyphosis angle together with improvements in cervical posture and scapular alignment. The authors suggested that increasing thoracic extension restores normal spinal curvature, thereby reducing compensatory cervical flexion and shoulder protraction. These observations support the use of thoracic mobility exercises as part of comprehensive management for Upper Cross Syndrome.(46)

Myofascial Trigger Release has become an increasingly accepted intervention for treating musculoskeletal dysfunction associated with myofascial trigger points.

Ajimsha, Al-Mudahka, and Al-Madzhar (2014) conducted a systematic review evaluating the effectiveness of myofascial release techniques. The review concluded that myofascial release significantly improves pain, range of motion, muscle flexibility, and functional performance in various musculoskeletal conditions. The authors proposed that sustained manual pressure reduces fascial adhesions, improves collagen extensibility, enhances local circulation, and decreases abnormal muscle tension. These physiological effects provide a scientific explanation for the reduction in muscle tightness expected following MTR in individuals with Upper Cross Syndrome.(47)

Further evidence supporting myofascial interventions was provided by **Barnes (1997)**, who described how sustained fascial release restores normal fascial mobility and reduces abnormal tension transmitted through the musculoskeletal system. Improved fascial mobility allows restoration of normal joint movement and postural alignment. Since fascial restrictions frequently involve the pectoralis major, sternocleidomastoid, upper trapezius, and levator scapulae in individuals with Upper Cross Syndrome, release of these structures may facilitate improved thoracic posture and respiratory mechanics.(48)

Several authors have emphasized the relationship between posture and respiratory function. **Szczygieł et al. (2015)** reported that individuals with increased thoracic kyphosis demonstrate significantly lower chest expansion and reduced respiratory efficiency compared with healthy individuals. The authors concluded that thoracic mobility should be considered an important component of rehabilitation programmes designed to improve respiratory function. These findings support the inclusion of thoracic mobility exercises in the present study.(49)

The assessment of thoracic posture in the present study was performed using **Kinovea software**, a digital motion analysis programme that has gained popularity in physiotherapy research because of its excellent reliability and accessibility. **Puig-Diví et al. (2019)** reported that Kinovea demonstrates excellent intra-rater and inter-rater reliability for measurement of joint angles and postural assessment when standardized photographic procedures are followed. Reliability coefficients approaching ICC = 0.99 have been reported for digital angle measurements, making Kinovea a valid alternative to expensive motion analysis systems. Therefore, the use of Kinovea in the present study provides objective and reliable assessment of thoracic kyphosis angle.(50)

CONCLUSION

This study included 30 UCS subjects and treated with myofascial trigger release and thoracic mobility exercises. Chest expansion in subjects with UCS was measured using chest caliper and thoracic kyphosis is measured through kinovea software at the baseline and at the end of the 8 weeks.

Based on the results of the Paired-Samples t-test, it can be concluded that the intervention was significantly effective in improving all the outcome measures among the study participants. In particular, significant increases were observed in both Axillary and Xiphoid Chest Expansion, while a significant reduction was found in the Thoracic Kyphosis Angle after the intervention ($p < 0.05$). These findings suggest that the intervention effectively improved chest expansion and improved thoracic posture in the study participants. Hence the alternate hypothesis is accepted and the null Hypothesis is rejected.

LIMITATIONS AND RECOMMENDATIONS

Study Limitations

1. The study included a relatively small sample size of only 30 participants, which may limit the generalizability of the findings to the wider population with Upper Cross Syndrome.

2. A single-group pre-test and post-test experimental design was used without a control group; therefore, the observed improvements cannot be attributed solely to the intervention with complete certainty.
3. The study duration was limited to eight weeks, and no long-term follow-up was conducted to determine whether the improvements in chest expansion and posture were maintained over time.
4. Participants were recruited using convenient sampling from a single institution, which may introduce selection bias and reduce the external validity of the study.
5. The study primarily assessed chest expansion and thoracic kyphosis angle. Other important respiratory parameters such as pulmonary function tests (FEV_1, FVC, PEFR), respiratory muscle strength, and quality of life were not evaluated.
6. Thoracic kyphosis was assessed using Kinovea software, which, although reliable and valid, is an indirect two-dimensional photographic assessment and may not provide the same level of precision as radiographic measurements.

Future Recommendations

1. Future studies should include a larger sample size to improve the reliability and generalizability of the findings.
2. Randomized controlled trials comparing Myofascial Trigger Release and Thoracic Mobility Exercises with other physiotherapy interventions should be conducted to establish stronger evidence.
3. Long-term follow-up studies are recommended to evaluate the sustainability of treatment effects on chest expansion, posture, and functional outcomes.
4. Future research should include objective pulmonary function tests such as FEV_1, FVC, PEFR, Maximum Voluntary Ventilation (MVV), and respiratory muscle strength to better understand the respiratory benefits of the intervention.
5. Comparative studies may be conducted to determine the individual and combined effects of Myofascial Trigger Release, thoracic mobilization, diaphragmatic breathing exercises, scapular stabilization exercises, and corrective exercise programs.

Future studies should investigate the effectiveness of these interventions in different age groups, occupational populations, athletes, and individuals with varying severities of Upper Cross Syndrome.

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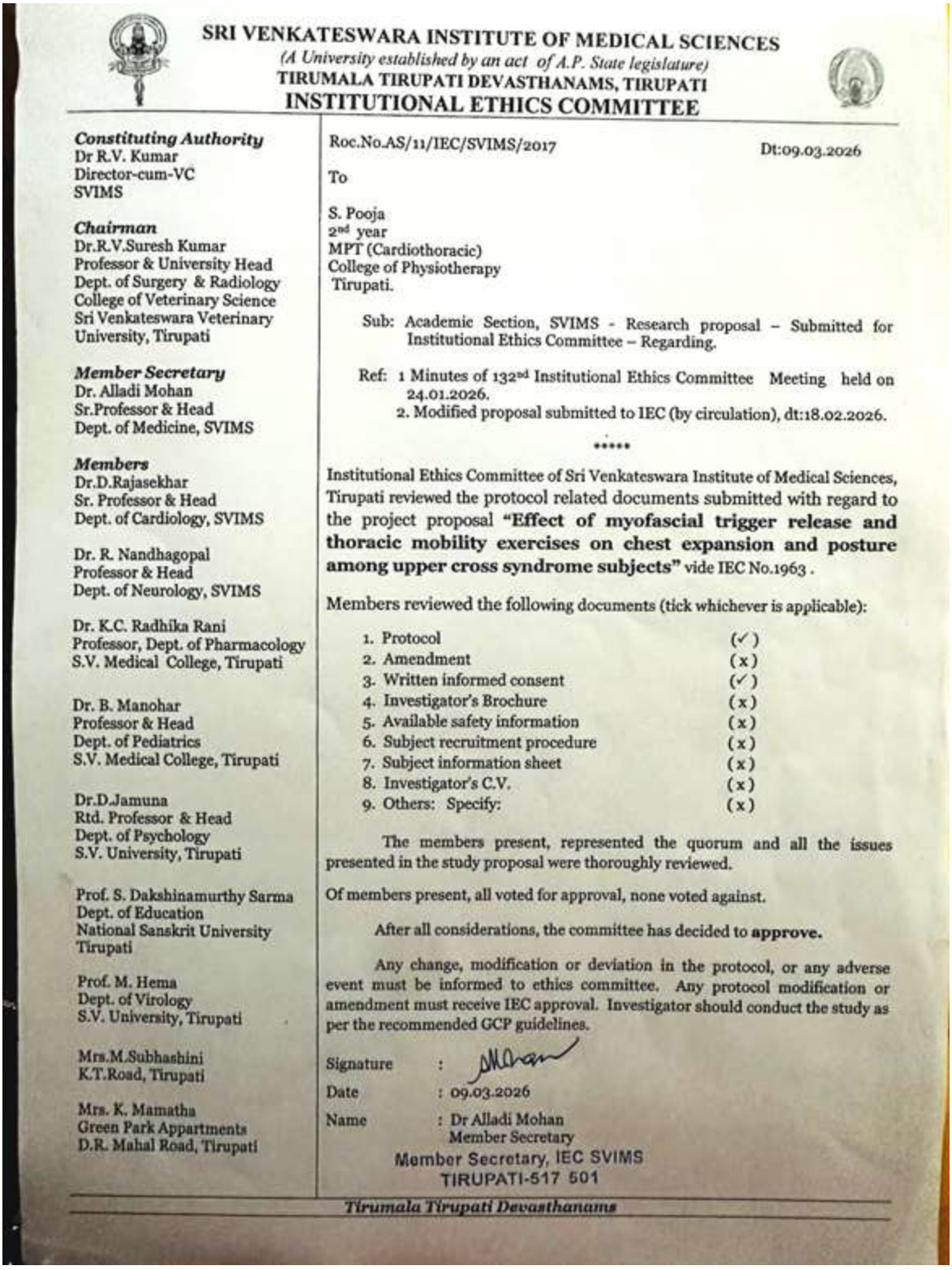
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ANNEXURES

ANNEXURE-1

IEC-CERTIFICATE



SRI VENKATESWARA INSTITUTE OF MEDICAL SCIENCES
(A University established by an act of A.P. State legislature)
TIRUMALA TIRUPATI DEVASTHANAMS, TIRUPATI
INSTITUTIONAL ETHICS COMMITTEE

Constituting Authority
Dr R.V. Kumar
Director-cum-VC
SVIMS

Chairman
Dr.R.V.Suresh Kumar
Professor & University Head
Dept. of Surgery & Radiology
College of Veterinary Science
Sri Venkateswara Veterinary
University, Tirupati

Member Secretary
Dr. Alladi Mohan
Sr.Professor & Head
Dept. of Medicine, SVIMS

Members
Dr.D.Rajasekhar
Sr. Professor & Head
Dept. of Cardiology, SVIMS

Dr. R. Nandhagopal
Professor & Head
Dept. of Neurology, SVIMS

Dr. K.C. Radhika Rani
Professor, Dept. of Pharmacology
S.V. Medical College, Tirupati

Dr. B. Manohar
Professor & Head
Dept. of Pediatrics
S.V. Medical College, Tirupati

Dr.D.Jamuna
Rtd. Professor & Head
Dept. of Psychology
S.V. University, Tirupati

Prof. S. Dakshinamurthy Sarma
Dept. of Education
National Sanskrit University
Tirupati

Prof. M. Hema
Dept. of Virology
S.V. University, Tirupati

Mrs.M.Subhashini
K.T.Road, Tirupati

Mrs. K. Mamatha
Green Park Appartments
D.R. Mahal Road, Tirupati

Roc.No.AS/11/IEC/SVIMS/2017 Dt:09.03.2026

To

S. Pooja
2nd year
MPT (Cardiothoracic)
College of Physiotherapy
Tirupati.

Sub: Academic Section, SVIMS - Research proposal – Submitted for Institutional Ethics Committee – Regarding.

Ref: 1 Minutes of 132nd Institutional Ethics Committee Meeting held on 24.01.2026.
2. Modified proposal submitted to IEC (by circulation), dt:18.02.2026.

*****

Institutional Ethics Committee of Sri Venkateswara Institute of Medical Sciences, Tirupati reviewed the protocol related documents submitted with regard to the project proposal **"Effect of myofascial trigger release and thoracic mobility exercises on chest expansion and posture among upper cross syndrome subjects"** vide IEC No.1963 .

Members reviewed the following documents (tick whichever is applicable):

1.	Protocol	(✓)
2.	Amendment	(x)
3.	Written informed consent	(✓)
4.	Investigator's Brochure	(x)
5.	Available safety information	(x)
6.	Subject recruitment procedure	(x)
7.	Subject information sheet	(x)
8.	Investigator's C.V.	(x)
9.	Others: Specify:	(x)

The members present, represented the quorum and all the issues presented in the study proposal were thoroughly reviewed.

Of members present, all voted for approval, none voted against.

After all considerations, the committee has decided to **approve.**

Any change, modification or deviation in the protocol, or any adverse event must be informed to ethics committee. Any protocol modification or amendment must receive IEC approval. Investigator should conduct the study as per the recommended GCP guidelines.

Signature :
Date : 09.03.2026
Name : Dr Alladi Mohan
Member Secretary

Member Secretary, IEC SVIMS
TIRUPATI-517 501

Tirumala Tirupati Devasthanams

ANNEXURE-II

CONSENT FORM

I _____ {name} voluntarily give consent to participate in the study entitled **EFFECT OF MYOFASCIAL TRIGGER RELEASE AND THORACIC MOBILITY EXERCISES ON CHEST EXPANSION AND POSTURE AMONG UPPER CROSS SYNDROME SUBJECTS.** .In doing so I affirm that:

- I have been given full information in my native language about the study and have understood the purpose and nature of the study and the potential risks to me resulting from my participation in the study
- I have been given ample opportunity to ask questions, which have been answered to my satisfaction.
- I understand that my participation in the study is purely voluntary and that unwillingness/refusal to participate will not adversely affect the medical care due to me
- I have been assured that there is no additional medical expenditure to be incurred by me on account of my participation in the study
- That I faced no coercion to sign this consent form.
- I have been informed that not withstanding my signing this consent, I can withdraw from the study at any point of time, without it compromising in any way, the medical care to which I am entitled

Signature of patient :	Signature of Witness :	Signature of Investigator:
Name of patient :	Name of Witness :	Name of Investigator :
Date :	Date :	Date :
Place :	Place :	Place:

<u>సమ్మతిపత్రం</u>

అధ్యయనం పేరు "EFFECT OF MYOFASCIAL TRIGGER RELEASE AND THORACIC MOBILITY EXERCISES ON CHEST EXPANSION AND POSTURE AMONG UPPER CROSS SYNDROME."

నేను _____(పేరు) _____ ఈ అధ్యయనంలో పాల్గొనడానికి స్వచ్ఛందమై నసమ్మ తిఇవ్వడానికి, నేను దానిని ధృవీకరిస్తున్నాను:

- నేను అధ్యయనం గురించి నా స్థానిక భాషలో నాకు పూర్తి సమాచారం ఇవ్వబడింది మరియు అధ్యయనం యొక్క ఉద్దేశ్యం మరియు స్వభావం మరియు అధ్యయనంలో
- నేను పాల్గొనడం వల్ల నాకు సంభవించే ప్రమాదాలను అర్థం చేసుకున్నాను.నేను ప్రశ్నలు అడగడానికి నాకు తగినంత అవకాశం ఇవ్వబడింది, ఇది నా సంతృప్తికి సమాధానం ఇవ్వబడింది.

- నేను అధ్యయనంలో నా భాగస్వామ్యం పూర్తిగా స్వచ్ఛందంగా ఉందని మరియు పాల్గొనడానికి ఇష్టపడకపోవడం / తిరస్కరించడం నా వల్ల వైద్యసంరక్షణను ప్రతికూలంగా ప్రభావితం చేయదని నేను అర్థం చేసుకున్నాను.
- నేను అధ్యయనంలో నేను పాల్గొనడం వల్ల నాకు అదనపు వైద్యఖర్చులు ఉండవని నాకు హామీ ఇవ్వబడింది.
- ఈ సమ్మతిపత్రం లో సంతకం చేయడానికి నా పై ఎటువంటి ఒత్తిడి చేయలేదు.
- నేను ఈ సమ్మతి పై సంతకం చేసినప్పటికీ, ఏ సమయంలో నైనా నేను ఈ అధ్యయనం నుండి వైదొలగగలనని నాకు సమాచారం ఇవ్వబడింది, అది ఏ విధంగానైనా రాజీపడకుండా, వైద్యంలో అంతరాయం ఉండవని నాకు హామీ ఇవ్వబడింది.

రోగి సంతకం:	సాక్షి సంతకం:	పరిశోధకుని సంతకం:
రోగి పూర్తిపేరు:	సాక్షి పూర్తిపేరు:	పరిశోధకుని పేరు:
స్థలము:	స్థలము:	స్థలము:
తేదీ:	తేదీ:	తేదీ:

ANNEXURE- 3
ASSESSMENT
DEMOGRAPHIC DETAILS

Name:	
Age & Gender	
Occupation:	
OP Number	
BMI	

Chest Expansion Measurement

Level	Pre (cm)	Post (cm)
Axillary Level		
Xiphoid Level		

Thoracic Kyphosis Angle (Kinovea)

Measurement	Pre (°)	Post (°)
Kyphosis Angle		

ANNEXURE- 4

MASTER CHART

Subjec	age	Occupation	Height_	BMI	Axillary_	Axillary	Xiphoi	Xiphoic	Thoracic	Thora
1	23/m	Student	155	20.5	2.2	3	1.9	2.7	46	41
2	32/f	Housewife	157	21.3	2.3	3.2	2	2.9	47	41
3	22/f	student	159	22.1	2.4	3.4	2.1	3.1	48	43
4	28/m	ITEmployee	161	22.9	2.5	3.3	2.2	3	49	43
5	25/f	Student	163	23.7	2.6	3.5	2.3	3.2	50	45
6	22/f	STUDENT	165	24.5	2.2	3.2	1.9	2.9	46	40
7	23/m	Student	167	20.5	2.3	3.1	2	2.8	47	42
8	23/f	Student	169	21.3	2.4	3.3	2.1	3	48	42
9	25/f	Student	171	22.1	2.5	3.5	2.2	3.2	49	44
10	20/m	Student	173	22.9	2.6	3.4	2.3	3.1	50	44
11	28/m	IT Employee	175	23.7	2.2	3.1	1.9	2.8	46	41
12	30/f	IT Employee	177	24.5	2.3	3.3	2	3	47	41
13	34/f	Housewife	179	20.5	2.4	3.2	2.1	2.9	48	43
14	26/m	IT Employee	155	21.3	2.5	3.4	2.2	3.1	49	43
15	36/f	IT Employee	157	22.1	2.6	3.6	2.3	3.3	50	45
16	30/f	Housewife	159	22.9	2.2	3	1.9	2.7	46	40
17	38/f	Housewife	161	23.7	2.3	3.2	2	2.9	47	42
18	32/f	Housewife	163	24.5	2.4	3.4	2.1	3.1	48	42
19	34/m	IT Employee	165	20.5	2.5	3.3	2.2	3	49	44
20	38/m	IT Employee	167	21.3	2.6	3.5	2.3	3.2	50	44
21	23/f	Student	169	22.1	2.2	3.2	1.9	2.9	46	41
22	26/m	Student	171	22.9	2.3	3.1	2	2.8	47	41
23	26/m	IT Employee	173	23.7	2.4	3.3	2.1	3	48	43
24	28/f	Housewife	175	24.5	2.5	3.5	2.2	3.2	49	43
25	32/f	Housewife	177	20.5	2.6	3.4	2.3	3.1	50	45
26	35/f	Housewife	179	21.3	2.2	3.1	1.9	2.8	46	40
27	22/m	Student	155	22.1	2.3	3.3	2	3	47	42
28	20/m	Student	157	22.9	2.4	3.2	2.1	2.9	48	42
29	23/f	Student	159	23.7	2.5	3.4	2.2	3.1	49	44
30	26/m	Student	161	24.5	2.6	3.6	2.3	3.3	50	44