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Original Article

DOI: 10.55735/37ahde75

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The Healer Journal of Physiotherapy and Rehabilitation Sciences

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Journal homepage: www.thehealerjournal.com

Effects of Thoracic Mobilisation in Addition to Routine Physical Therapy on Pain, Range of Motion and Functional Disability in Patients with Frozen Shoulder

Nama Khan[1*], Kinza Iqbal[2], Areeba Tariq[3], Amna Arshad[4], Ihsan Karim[5], Mariam Tariq[6], Abdul Basit[7]

[1*]University Institute of Physical Therapy, University of Lahore, Lahore, Pakistan [2]University of Health Sciences, Lahore, Pakistan [3]Mamji Hospital, Karachi, Pakistan [4]Abasyn University, Islamabad, Pakistan [5]Ammar Medical Complex, Muridke, Pakistan [6]Independent Medical College, Faisalabad, Pakistan [7]Midland Doctors Hospital, Muzaffarabad, Pakistan

KEYWORDS

Adhesive capsulitis
Functional disability
Range of motion
Thoracic mobilisation

DECLARATIONS

Conflict of Interest: None
Funding Source: None

CORRESPONDING AUTHOR

Nama Khan
University Institute of Physical Therapy, University of Lahore, Lahore, Pakistan
namakh1234@gmail.com

ABSTRACT

Background: Adhesive capsulitis or frozen shoulder is a prevalent musculoskeletal condition characterised by limited shoulder joint mobility, pain, and functional impairment. While the conventional physical therapy is the standard approach for managing this condition. **Objective:** To assess the effects of thoracic mobilisation combined with traditional physical therapy on pain intensity, shoulder range of motion, and functional limitations in patients with adhesive capsulitis. **Methodology:** This trial was conducted at the Punjab Medical Centre and the University Teaching Hospital, Lahore, Pakistan, in nine months. About 38 patients suffering from adhesive capsulitis with a minimum duration of three months, aged between 45 to 65 years, both genders were recruited in this study. Individuals diagnosed with congenital deformities, cardiovascular diseases, rotator cuff tears, neurological disorders, thoracic outlet syndrome, diabetes mellitus, any rheumatologic condition, cervical radiculopathy, or a history of fractures or tumours were excluded. Participants were randomly assigned to one of two equal groups to ensure unbiased comparison between the interventions by employing computer-generated random numbers, one of which was the physiotherapy group, and the other was the joint mobilisation and physiotherapy group. A paired sample t-test was employed to determine whether there is a statistically significant difference between the means of the two related groups, while an independent t-test was employed to compare the means of two independent groups. **Results:** The experimental group experienced significantly greater reductions in pain, enhancements in shoulder abduction and external rotation, and improvements in functional ability compared to the control group. Statistical analysis revealed that these differences were significant ($p<0.001$) and were maintained at the three-month follow-up evaluation. **Conclusion:** The addition of thoracic mobilisation to conventional physical therapy yields superior outcomes in reducing pain and disability and improving mobility in patients with adhesive capsulitis.

How to cite the article: Khan N, Iqbal K, Tariq A, Arshad A, Karim I, Tariq M, Basit A. Effects of Thoracic Mobilisation in Addition to Routine Physical Therapy on Pain, Range of Motion and Functional Disability in Patients with Frozen Shoulder. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2025;5(2):25-33.

INTRODUCTION

Adhesive capsulitis, which is also commonly known as frozen shoulder, is a common musculoskeletal disorder that eventually leads to disability of the shoulder and tends to restrict the range of movements of the joint due to pain.[1] The underlying cause and the pathophysiology of adhesive capsulitis are still unknown. Commonly, it happens when the capsule contracts and the tendons tend to restrict the movements happening at the glenohumeral joint.[2] Previously conducted studies have shown women to be affected more as compared to men, especially after the age of 40 years.[3] Frozen shoulder has been known to consist of three stages. It tends to evolve progressively. Stage I is known as the freezing stage, which is relatively painful and is known to last for two to nine months. Stage two has been known to last for around twelve months with a certain reduction in pain and restricted range of motion. The last stage, stage three, is known as the recovery stage, in which the restricted range of motions tends to return to normal.[3, 4]

The goal of the treatment of adhesive capsulitis is to aid in reducing the discomfort and to avoid the hindrance created due to restricted range of motions through physiotherapy techniques and, in severe cases, also taking help with steroid intra-articular injections. The therapy sessions have been known to consist of electrotherapy, heat therapy, anti-inflammatory and analgesics, steroids, therapeutic and mobilisation techniques. It has been observed that by implementing these, the patients suffering from adhesive capsulitis tend to recover early.[5-8] Thoracic vertebral management has been observed to be beneficial for patients suffering from frozen shoulder.[9] Movements at the glenohumeral joint tend to be restricted due to commonly occurring hypomobility at the thoracic segments of the spine.[10]

Numerous previously conducted studies showed us that manipulation of the thoracic spine is beneficial for reducing pain and decreasing the disability of the shoulder joint.[11] From the already existing literature, thoracic manipulation has shown significant improvement in the blood circulation of the upper region and upper extremity and tends to imply the relationship between functional capabilities of the shoulder joint and thoracic manipulation.[12,13] There have been various treatment options for adhesive capsulitis. It includes steroidal anti-inflammatory medications, rehabilitation under supervision, oral corticosteroids, supra-scapular blocks, intra-articular injections, distension arthrography, closed manipulation, open surgical release and arthroscopic capsular release.[14]

Physiotherapy interventions might involve various ranges of treatments like exercises, electrotherapy and manual therapy approaches, for example, soft tissue manipulation, joint mobilisation and neuromuscular therapies and many more.[15] Reduction in pain is achieved by employing massage, deep heat, icing, and ultrasound therapy. Magneto therapy, transcutaneous electrical nerve stimulation, laser therapy, mobilisation and home-based exercise program.[16] Various discussions conducted in the physical therapy community recently have focused on the thoracic spine mobilisation for patients with various shoulder ailments.[14]

The major objective of our current study was to determine that if we add thoracic movement to routine physical therapy would aid people with adhesive capsulitis in their suffering of pain, range of motion and their ability to perform activities of daily living. Our randomised controlled trial has been performed to ensure that the results are correct and fair to prove this hypothesis. The major goal is to find out whether this additional interventional approach is beneficial for patients with frozen shoulder or not, and whether it tends to improve their outcomes. Our current study aimed to scrutinise the effects of thoracic mobilisation in combination with the routine physical therapy on their pain, range of motion and their functional disability among the patients diagnosed with adhesive capsulitis. Underdeveloped countries like Pakistan are the dire need of such interventions that can work on these issues in the most economically efficient manner.

Adhesive capsulitis has been recognised as a prevalent musculoskeletal disorder that tends to induce pain and limit the mobility at the shoulder joint, and then leads to considerable functional impairment. Physical therapy interventions have been frequently employed as a preliminary intervention for frozen shoulder, yet the impending accompanying benefits of thoracic

mobilisation in improving pain reduction, range of motion and functional impairments remain indeterminate. Our current study tends to overcome this uncertainty regarding this. The objective of our current study was to scrutinise the probable advantages of including thoracic mobilisation into the standardised physical therapy interventions for patients diagnosed with adhesive capsulitis while aiming at enhancing the outcomes of treatment. The results of our current study might potentially contribute to enhancing the standard of care for patients suffering from frozen shoulder and guide clinical decision-making.

METHODOLOGY

This randomized controlled trial was conducted on Punjab Medical Center and University Teaching Hospital, Lahore, Pakistan. Our study was completed after nine months of approval of its synopsis. The sample size of our current study was calculated to be 32 participants in each group employing pain as an outcome measure after adding 20% dropout the sample size would be 38 participants in each group. The sampling technique employed was the non-purposive random sampling technique. Patients suffering either with unilateral or bilateral adhesive capsulitis following the capsular pattern, aged between 45 to 65 years of age, both genders, males and females, were recruited in this study.

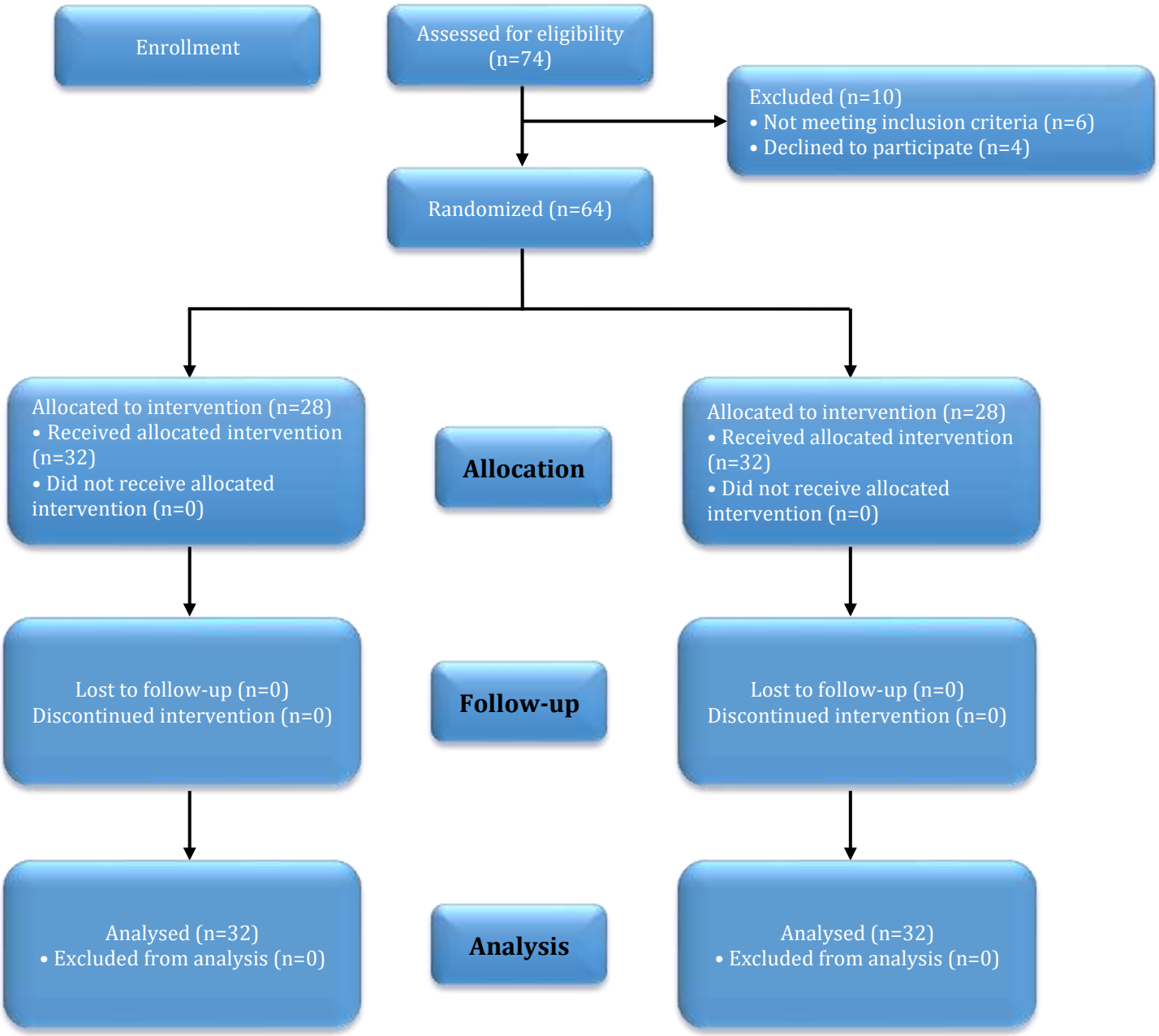
Participants were considered eligible for this study if they had experienced symptoms consistent with adhesive capsulitis for a minimum duration of three months. To ensure the accuracy of results and the safety of participants, specific exclusion criteria were applied. Individuals diagnosed with congenital deformities, cardiovascular diseases, rotator cuff tears, neurological disorders, thoracic outlet syndrome, diabetes mellitus, any rheumatologic condition, cervical radiculopathy, or a history of fractures or tumours were not included in the study.[13] The range of motion (ROM) of the shoulder joint was measured using a universal goniometer, a standard and reliable tool for evaluating joint mobility.[17]

The research was conducted in strict adherence to the ethical standards and protocols established by the Ethics Committee of the University of Lahore. The rights, privacy, and safety of all participants were given high priority. Each participant provided written informed consent before enrollment. The study team ensured that participants were fully informed about the procedures and purpose of the research. They were reassured that there would be no potential risks or adverse effects associated with participation, and that their data would be handled with complete confidentiality. All identifying details were anonymised to protect the participants' privacy throughout the research process.

Participants were selected from the outpatient department of the University Teaching Hospital and Punjab Medical Centre, Lahore, both affiliated with the Department of Physical Therapy. Only those individuals who met the predefined inclusion criteria were invited to participate. Once enrolled, participants were randomly assigned to one of two equal groups to ensure unbiased comparison between the interventions. This randomisation process was critical for maintaining the integrity of the study and reducing the potential for selection bias. Our current study was single-blinded as the assessor was blinded. The participants were randomised into the two groups by employing computer-generated random numbers.[18] The baseline data were collected at the first follow-up. The data was collected by employing a questionnaire and a universal goniometer. The recruited patients were then allocated randomly into one of the treatment groups, one of which was the only physiotherapy exercise group and the other was the joint mobilisation and physiotherapy exercise group.

The participants underwent the standardised physiotherapy regimen, completing ten repetitions of each movement twice regularly. The patients were given complete guidance on enhancing and improving the strength of their scapula-thoracic and rotator cuff muscles. The patients were also directed to complete these exercises twice daily while they were being supervised and monitored by a physiotherapist. At the beginning of each session, a heat pack was applied to reduce the discomfort. The participants were guided and were given instructions to stick to the given home-based exercise plan for one complete year after the treatment. The prescribed physiotherapy plan consisted of a set of targeted exercises, including shoulder flexion, shoulder abduction, internal rotation of the shoulder, shoulder extension, and adduction of the shoulder. External rotation of the shoulder in the

Figure 1: CONSORT Diagram



prone position and wall and table push-ups. The exercise plan was estimated to be performed for 20 minutes. The experimental group received joint mobilisation in addition to the physiotherapy exercises. The joint mobilisation involved glenohumeral distraction, glenohumeral joint caudal glide, glenohumeral joint posterior glide, and glenohumeral joint anterior glide. These mentioned applications were implemented at a frequency of two to three cycles per second throughout one to two minutes. For the first two weeks of our current study, comprising 6 sessions, rhythmic oscillations of grade I or grade II were exclusively applied to the patient in the resting position. While in the rest of the weeks, the focus of the treatment was diverted towards the constrained positions that tend to maximise the contact between joint surfaces. In addition to this, the oscillation techniques of grade III and IV were employed, considering the patient's threshold of pain and the ability of patient to tolerate the treatment. This mobilisation group underwent thirty minutes per session, and they attended 3 sessions per week at the clinical facility. Data was entered in the Statistical Package for Social Sciences version 23. The tests of normality were calculated by Kolmogorov-Smirnov test, which showed that a p-value greater than 0.05 would be significant. A paired sample t-test was employed to determine whether there is a statistically significant difference between the means of the two related groups, while an independent t-test was employed to compare the means of two independent groups.

RESULTS

The tests of normality were performed and were

measured by Kolmogorov- Smirnova represented by a significant p-value greater than 0.05. It showed that the data is normally distributed; therefore data was parametric. Table 1 represents the statistical information of two genders, A and B, considering their age. The data consists of a total of thirty-two participants for both genders. The mean age for gender A was 56.69 years with a standard deviation of 6.47, while the mean age for gender B was 55.06 years with a standard deviation of 6.26. Table 2 shows the mean score for the variable Baseline Visual Analogue Score (VAS) Group A was 7.40, which indicates a comparatively higher average value. The baseline scores for group A and group B were 7.40 and 7.18, respectively. At the 1st follow-up, the score of Group A decreased to 5.312, while the score of Group B decreased to 3.43, and after 2nd follow up the score further decreased to 1.96 and 0.78, respectively.

Table 3 shows baseline scores for flexion, which tend to improve till the last week, for Pair 1, which increased at the 8th week, indicating improved flexion performance. Mean flexion scores of pair 2 at the 8th week also suggest substantial progress. Mean flexion scores of pair 3 at the 8th week also indicate continued improvement. The mean score of flexion of pair 4 at the last follow-up demonstrates ongoing advancement in flexion performance. Table 4 shows that Group A, which is the control group, had a higher average VAS score as compared to Group B, which was the experimental group. These results suggest to us that the experimental group had experienced a reduction in pain and discomfort when compared to the control group.

DISCUSSION

The results of our current randomised trial conclude that including thoracic mobilisation in the standard physical therapy program for patients with adhesive capsulitis has beneficial effects on them, as shown by the findings of our current study. Combining thoracic mobilisation with a conventional physical therapy program gave us noteworthy improvements in levels of pain, range of motion and functional disability as compared to conventional physical therapy alone.

Table 1: VAS group comparison (paired sample t-test)

Groups		VAS	Mean	Std. Deviation	Std. Error Mean
Pair 1	Group A	Baseline	7.40	1.45	0.25
		8th week	5.31	1.46	0.25
Pair 2	Group B	Baseline	7.18	1.46	0.25
		8th week	3.43	1.58	0.28
Pair 3	Group A	8th week	5.31	1.46	0.25
		16th week	1.96	1.14	0.20
Pair 4	Group B	8th week	3.43	1.58	0.28
		16th week	0.78	0.75	0.13

Table 2: Flexion group comparison (paired sample t-test)

Flexion			Mean	Std. Deviation	Std. Error Mean
Pair 1	Group A	Baseline	19.21	3.65	0.64
		8th week	31.40	2.93	0.51
Pair 2	Group B	Baseline	16.5	3.25	0.57
		8th week	41.46	5.04	0.89
Pair 3	Group A	8th week	31.40	2.93	0.51
		16th week	51.84	3.09	0.54
Pair 4	Group B	8th week	41.46	5.04	0.89
		16th week	60.90	2.50	0.44

Table 4: Group statistics, VAS score (independent t-test)

	Groups	Mean	Std. Deviation	Std. Error Mean
VAS Group 1	Group A	7.40	1.45	0.25
	Group B	7.18	1.46	0.25
VAS Group 2	Group A	5.31	1.46	0.25
	Group B	3.43	1.58	0.28
VAS Group 3	Group A	1.96	1.14	0.20
	Group B	0.78	0.75	0.13

Table 5: VAS (independent sample t-test)

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of Difference	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
VAS Group 1	Equal variances assumed	0.00	0.977	0.598	62	0.55	0.21	0.36	-0.5121	0.94
	Equal variances not assumed	0.59	61.99	0.55	0.21		0.36	-0.51	0.94	
VAS Group 2	Equal variances assumed	0.23	0.62	4.90	62	0	1.87	0.38	1.11	2.63
	Equal variances not assumed			4.90	61.64	0	1.87	0.38	1.11	2.63
VAS Group 3	Equal variances assumed	2.23	0.14	4.89	62	0	1.18	0.24	0.70	1.67
	Equal variances not assumed			4.89	53.36	0	1.18	0.24	0.70	1.67

The results of our current study prove that employing mobilisation techniques aimed at the thoracic spine tends to lead to improved outcomes and tends to facilitate more effective treatment management of adhesive capsulitis.

A randomised controlled trial conducted by El Melhat AM investigated the effectiveness of incorporating thoracic spine manipulation into the treatment of adhesive capsulitis. Their research demonstrated that the addition of thoracic manipulation led to more significant clinical improvements compared to physical therapy alone. These enhancements included greater pain relief and improved joint function. The findings from their study are consistent with the outcomes of our current research, which also supports the use of thoracic spine mobilisation as an effective adjunct to standard physiotherapy in treating frozen shoulder.[19] Similarly, Saman Jahangir and co-researchers carried out a randomised controlled trial aimed at examining

the role of thoracic manipulation in enhancing shoulder range of motion and reducing pain in patients diagnosed with adhesive capsulitis. Their study concluded that combining thoracic spine techniques with conventional therapy was more effective than using physical therapy alone. Improvements were observed in terms of pain reduction, functional ability, and shoulder mobility, all of which align with the results obtained in our investigation.[13]

Another related study by Bilal U focused on evaluating the additional benefits of thoracic manipulation on pain levels, range of motion, and functional disability in frozen shoulder patients. His findings showed that patients who received thoracic manipulation in conjunction with traditional physical therapy experienced greater recovery, particularly in shoulder mobility and functional tasks.[20] Our current research mirrors these findings, supporting the argument that thoracic manipulation provides added value when managing adhesive capsulitis. Further evidence comes from a study by da Silva AC, which highlighted improvements in shoulder function and pain reduction following thoracic spine manipulation.[10]

Hua A observed enhanced reaching capabilities and increased shoulder range of motion in patients with adhesive capsulitis following thoracic mobilisation.[21] These studies collectively support the conclusions drawn from our trial, affirming the effectiveness of thoracic manipulation in improving clinical outcomes for frozen shoulder. It is substantial to note that our current study employed a rigorous randomised trial design which incorporated appropriate case selection, randomisation and objective assessments.

The methodological strengths enhanced the validity and reliability of our study's findings. However, further studies are recommended to substantiate and expand these findings. Further studies might tend to explore the long-term effects of thoracic mobilisation, standardised and optimal treatment protocols and potential mechanisms underlying the observed improvements. Adding to these, further investigations need to be done to find more cost-effective ways to satisfy patients with frozen shoulder, considering combining thoracic mobilisation with routine physical therapy. Further studies are needed to provide insights for the clinical practice of this combination.

Despite all the positive results of this current study and positive contributions to comprehending the effects of thoracic mobilisation for patients with adhesive capsulitis, it is essential to recognise some limitations of our study. Our current sample might have a relatively small sample size, which would have limited the generalizability of the results. A sample size with a larger population would have provided a more representative and diverse population, which tends to increase the external validity of the results of the study.

Future researchers are advised to work on a larger sample size for more generalizable results. The participants of our current study were recruited from a specific demographic and clinical setup up which also might have limited the generalizability of the results for other populations or settings. Deviations in the severity of the disease, characteristics of the patients and access to healthcare resources might have influenced the outcomes of the treatment. The duration of the follow-ups in our study may have been limited. Future researchers are advised to conduct RCTs with a longer follow-up period that would allow for a more comprehensive evaluation of the sustainability of the treatment and the potential for relapse.

CONCLUSION

Our current randomised trial concludes that including thoracic mobilisation in the standard physical therapy program for patients with adhesive capsulitis has beneficial effects on them, as shown by the findings of our current study. The amalgamation of thoracic mobilisation with a conventional physical therapy program gave us noteworthy improvements in levels of pain, range of motion and functional disability as compared to conventional physical therapy alone. The results of this study prove that employing mobilisation techniques aiming at the thoracic spine tends to lead to improved outcomes and tends to facilitate more effective treatment management of adhesive capsulitis.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.
Competing interests: None
Funding: No funding source is involved.
Authors' contributions: All authors read and approved the final manuscript.
CONSORT Guidelines: All methods were performed following the relevant guidelines.

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