INTERNATIONAL JOURNAL OF
PHYSICAL THERAPY RESEARCH & PRACTICE

AN OFFICIAL JOURNAL OF SAUDI PHYSICAL THERAPY ASSOCIATION

Original Article

Comparison of Kaltenborn Mobilization With Muscle Energy Technique In Patients With Adhesive Capsulitis: A Randomized Clinical Trial

Muhammad Zohai[1], Sahreen Anwar[2*]

[1.] Department of Physical Therapy, Lahore University of Biological and Applied Sciences, Lahore, Pakistan.
[2.] University Institute of Physical Therapy, University of Lahore, Lahore, Pakistan.

*Corresponding Author: Sahreen.anwar@uipt.uol.edu.pk

Article info

Received : **Mar. 12, 2025**
Accepted : **Apr. 24, 2025**
Published : **Apr. 30, 2025**

To Cite: Anwar, S., & Zohaib, M. Comparison Of Kaltenborn Mobilization With Muscle Energy Technique In Patients With Adhesive Capsulitis: A Randomized Clinical Trial. International Journal of Physical Therapy Research &Amp; Practice, 4(4), 209–229. https://doi.org/10.62464/ijoprp.v4i4.103

Abstract

Background: Adhesive capsulitis is a disabling condition that significantly affects individuals of all ages. Manual therapy is one of the most effective approaches to treat this condition. This study compares the effectiveness of Kaltenborn mobilization and Muscle energy techniques on pain, disability, and Range of motion in patients with Adhesive Capsulitis. **Methods:** This was a parallel-arm, single-blinded randomized clinical trial. Seventy-six patients with adhesive capsulitis were randomly assigned to two groups through computer software. The outcome variables were pain measured by the Numeric Pain Rating Scale (NPRS), shoulder range of motion measured by a Goniometer, and disability measured by the Shoulder Pain and Disability Index (SPADI). The measurements were taken at baseline and in the 4th week after the intervention. The analysis was done through a paired t-test using SPSS version 26. **Results:** The results of this randomized clinical trial exhibited that Kaltenborn mobilization resulted in a significant difference in pain, shoulder range of motion, and functional mobility in patients with adhesive capsulitis (p-value <0.05). The within-group comparison showed improvement in both groups; however, between-group comparison showed greater improvement in the Kaltenborn group. **Conclusion:** The results of this randomized clinical trial exhibited that Kaltenborn mobilization resulted in a significant difference in pain, shoulder range of motion, and functional mobility in patients with adhesive capsulitis (p-value <0.05). The within-group comparison showed improvement in both groups however between-group comparison showed greater improvement in the Kaltenborn group.

Keywords: Adhesive capsulitis, Kaltenborn, Muscle Energy Techniques.

Introduction

Shoulder pain is considered as one of the most repeatedly occurring non-traumatic complaints that start from the arm, neck, and shoulder region (Kadi et al., 2017). The shoulder girdle is the biomechanical link between the trunk and upper limb and plays an important biomechanical role in the activities of daily life of an individual (T, 2000). In the general population, the prevalence of frozen shoulder is 2% to 5% and it is two to four times higher in the case of diabetic patients (Willmore et al., 2022). Complete recovery takes place in 39% of people, clinical limitation exists in 59% of people,

while restriction in range of motion exists in 7% of patients suffering from frozen shoulder. Chronic loss of shoulder mobility exists in 15% of the patients (Kwaees & Charalambous, 2014).

This condition is associated with shoulder pain, stiffness, and restricted glenohumeral range of motion (Wang et al., 2013). Most commonly, loss of range of motion begins in the external rotation (Manske & Prohaska, 2008). Traditionally, adhesive capsulitis is divided into primary and secondary types. Primary adhesive capsulitis indicates an idiopathic condition, while secondary adhesive capsulitis may be due to any underlying cause, such as diabetes, bicep tendinopathy, trauma, or surgery (D'Orsi et al., 2012). The most commonly involved risk factor in the frozen shoulder is diabetes, which affects both males and females in equal ratios. Females, after having thyroid problems and post-mastectomy, are more prone to adhesive capsulitis as compared to males (Ali et al., 2018; Deshmukh et al., 2013). The risk of a frozen shoulder increases significantly with the presence of HLA-B27 in an individual (Sharma & Patel, 2020).

There are three stages of a frozen shoulder: the freezing stage, the frozen stage, and the thawing stage. Physical Therapy interventions such as passive joint mobilization, modalities, and muscle energy techniques, seem to be very effective in pain relieving and gaining a range of motion in patients with frozen shoulders (Lamplot et al., 2018). The application of sustained stretch in joint mobilization was introduced by Kaltenborn mobilization, applied at the mid and end range of the patient's joint (D'Orsi et al., 2012). Three grades (I- III) are applied in Kaltenborn mobilization. Grade I is used to decrease pain and is applied as a minor-intensity distraction of the joint capsule. Grade II stretches the periarticular tissue and is referred to as "taking up the slack". To gain Range of motion, Grade III is applied which causes enough stretch in the joint capsule (Do Moon et al., 2015). In a study to compare Kaltenborn mobilization with routine physical therapy for patients suffering from frozen shoulder, it was concluded that Kaltenborn mobilization showed significant improvement in pain and range of motion of the shoulder joint (Rezwan et al., 2021).

The muscle energy technique is a noninvasive procedure that usually targets soft tissue to stretch or lengthen the muscles that lack flexibility and consequently relax the muscles (Gill et al., 2018). In previous literature, there is enough evidence available on the Muscle energy technique in improving pain and range of motion in patients with Adhesive capsulitis. According to a study muscle energy technique was more effective for patients with Adhesive capsulitis as compared to passive stretching (Iqbal et al., 2020). In another study on the effectiveness of the Muscle energy technique and Capsular stretching in patients with Adhesive capsulitis, it was concluded that the Muscle energy technique is more effective in increasing the Range of motion in patients with Adhesive capsulitis (Sharma & Patel, 2020). The Muscle energy technique was also found to be more effective in patients with diagnosed cases of adhesive capsulitis as compared to Cyriax's deep friction technique (Vijayan & Jayabharathi, 2019).

This is a novel technique, easy to use and cost-effective. This study will compare the effects of these two techniques and will also see the effects of Kaltenborn mobilization. The rationale of this study is to increase awareness of Kaltenborn mobilization and to increase its Clinical recommendation.

Methodology

Participants and Study Design

This study was a single-blinded Randomized control trial. The study was conducted at the Department of Physical Therapy, Mayo Hospital, Lahore after the approval of the ethical committee. The duration of this study was ten months from 2022-2023.

Patients from both genders between the ages group 40 to 60 years, with unilateral limb involvement and diagnosed cases of adhesive capsulitis were included in the study. The patients with acute inflammation, fracture or surgical fixation history, and rotator cuff pathologies were excluded from the study.

Outcome assessments

The data was collected through the Numeric pain rating scale for pain (NPRS), which is a subjective tool. The pain is rated from 0 (no pain) to 10 (worst pain) (Michener et al., 2011). The range of motion was measured through a Goniometer which is a reliable tool for the measurement of range of motion. The disability was measured through the Shoulder Pain and Disability Index-Urdu version (SPADI-U). The SPADI consists of 13 items that evaluate two domains; one is a 5-item subscale that assesses pain and the other is an 8-item subscale that measures disability on a likert scale (Breckenridge & McAuley, 2011).

Procedure

After initial screening according to the inclusion criteria, written informed consent was taken before recruitment in the study and a clear explanation about the study was given to all the patients. Seventy-two patients were recruited according to the inclusion criteria and were randomly divided into two groups through computer-generated random number tables: group 1 and Group 2 using computer computer-generated random number table. The patients were blinded about the group to which they were assigned. Outcomes were measured before the treatment and at four weeks to reflect longer-term outcomes. Participant recruitment is given in Figure 1.

Interventions

Group 1: Patients in group 1 received Kaltenborn mobilization. The patient was instructed to lie in a supine position and a moist heat pack was given to the patient at the shoulder joint for 15 minutes. After stabilizing the Scapula with the towel, the therapist stood facing the lateral side of the patient's upper arm. He grasped the patient's elbow and forearm with the right hand from the ventral side and with the left hand grasped the patient's humeral head distal to the acromion and then glide was given in the caudal direction with the thumb. The glide was applied for 30 seconds per set, 15 sets per session. After each set patient was relaxed in a neutral position for 10 seconds.

Group 2: Patients in this group 2 received muscle energy techniques (post-isometric relaxation). At first moist heat therapy was given and then muscle energy techniques for restricted glenohumeral abduction, external rotation, and internal rotation were performed.

MET for Glenohumeral restricted Abduction

The therapist stood facing the patient, placing one hand over the top of the patient's involved shoulder and the other hand on the medial side of the arm, and directed the patient to press the elbow towards the body. The therapist resisted movement for 15 seconds and then asked the patient to relax. The new range was then gained in abduction.

MET for Glenohumeral restricted Internal rotation

To apply METs for internal rotation the Patient was instructed to adopt the sitting position. The patient's shoulder was placed in 90 degrees of abduction and internal rotation in pain-free range. The therapist placed one hand over the patient's involved shoulder and the other hand on the extensor surface of the forearm. The patient was asked to press against the hand for 15 seconds and then instructed to relax and the range was gained.

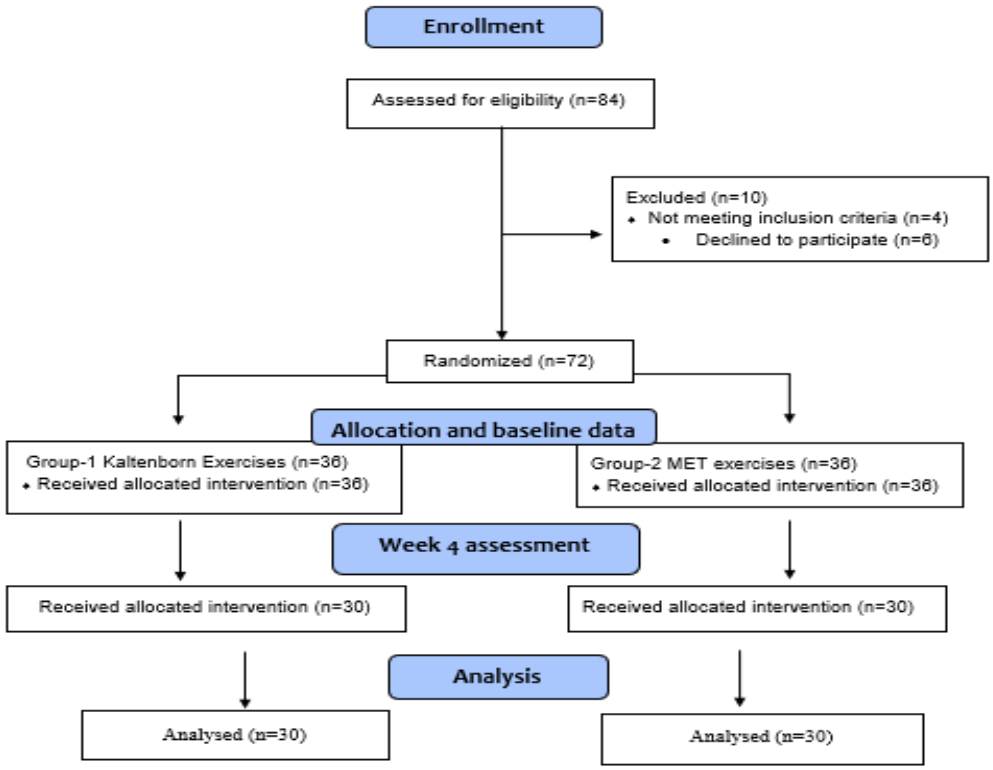

Figure 1: CONSORT flow diagram

MET for Glenohumeral restricted External rotation

To apply METs for external rotation the Patient was instructed to adopt the sitting position. The patient's shoulder was placed in 90 degrees of abduction and external rotation in pain-free range. The therapist placed one hand over the patient's involved shoulder and the other hand on the extensor surface of the forearm. The therapist clasped the patient's hand in his own and asked the patient to press over it while he resisted that movement. The patient was asked to press against the hand for 15 seconds and then instructed to relax

and the range was gained.

Sample Estimation

A sample size of 72 patients, 36 in each group was estimated by using a 5% level of significance, 90% power of the study using the following formula with an expected mean value of internal rotation in muscle energy technique as 70.60±7.54 and in Kaltenborn mobilization as 63.9±11.765,

$2\,\delta^2\,(Ƶ1\text{-}\alpha + Ƶ1\text{-}\beta)^2\, n = (\mu1 - \mu2)^2$

δ^2= variance, Z1-α = confidence level 95% =1.96 Z1-β = power of test 90%, μ1= population mean I = 70.60, μ2= population mean II.

Ethical Considerations

Ethical protocols were strictly followed to ensure participant safety and confidentiality, and ethical approval was obtained from the ethical review committee of the Department of Physical Therapy on 23/04/22, Ref No: DPT/ERB/05. Written informed consent was taken from every individual participating in this study before performing any physical examination. In the consent form, it was mentioned that the participants were involved with the physiotherapist for a specific period of treatment up to follow-up, and they can stop the treatment anytime during the plan.

Data Analysis

The normality of data was checked by the Kolmogorov-Smirnov test with Lilliefors correction. The qualitative variables were presented in frequencies and percentages whereas mean and standard deviation were used to express the mean difference between quantitative variables. Since the data was normally distributed, a parametric paired t-test was used to compare the mean scores between Group 1 and Group 2 (control group). The statistical significance level in this study was $P < 0.05$. Data analysis was performed using the Statistical Package for Social Sciences (SPSS) software version 26.

Results

Clinical and demographic characteristics of the patient

There were 12 male and 18 female patients in the Kaltenborn group and 12 male and 18 female patients in the METs group. However, in the Kaltenborn group, patients have a mean age of 49.66±5.17 years, and in the METs group, patients have a mean age of 48.33±5.25 years. (Table 1**)**

Table 1: Demographics and Baseline Characteristics (n=72)

Variables	Group 1 Kaltenborn Group	Group 2 MET Group
Gender	No (%)	No (%)
• Male	12(40%)	12(40%)
• Females	18(60%)	18(60%)
Age (years) Mean ± SD	49.66±5.17	48.33±5.25
NPRS	8.23±0.93	8.26±1.05
SPADI	93±11.19	93±11.19
Abduction	96±18.86	93.66±18.47
Internal rotation	38.83±11.04	39.16±10.91
External rotation	32±15.68	32±15.68

**NPRS: numeric pain rating scale; **SPADI: shoulder pain and disability index*

Intergroup analysis:

A paired T-test was used for intergroup analysis of both groups 1 and 2 showed that there was a statistically significant difference found before and after the treatment as the P -P-value for all variables within the group analysis was less than 0.05.

Commented [1]: Please provide the ethical approval number, date, and approving body name here.

Table 2: Within-group difference for Pain, Range of Motion, and Shoulder functions (SPADI)

Variables	Groups	Time point	Mean ± Std Dev	95% CI		T	p-value
				Lower	Upper		
NPRS*	Group 1	Pre	8.23±0.93	5.956	6.776	31.757	0.000
		Post	1.86±0.82				
	Group 2	Pre	8.26±1.05	3.944	4.655	24.731	0.000
		Post	3.96±0.81				
SPADI**	Group 1	Pre	93.±11.19	71.433	76.566	58.970	0.000
		Post	19±5.47				
	Group 2	Pre	93±11.19	46.944	51.721	42.241	0.000
		Post	43.66±5.71				
Abduction ROM in degrees	Group 1	Pre	96±18.86	-10.980	-9.019	-20.857	0.000
		Post	106±19.22				
	Group 2	Pre	93.66±18.47	-4.987	-4.212	-24.291	0.000
		Post	98.26±18.73				
Internal rotation in degrees	Group 1	Pre	38.83±11.04	-10.069	-9.796	-149.000	0.000
		Post	48.76±10.94				
	Group 2	Pre	39.16±10.91	-4.521	-3.811	-24.026	0.000
		Post	43.33±10.93				
External rotation in degrees	Group 1	Pre	32±15.68	-9.772	-9.227	-71.173	0.000
		Post	41.50±15.75				
	Group 2	Pre	32±15.68	-3.443	-2.623	-15.130	0.000
		Post	35.03±15.65				

*-NPRS: Numeric pain rating scale; SPADI: Shoulder pain and disability index

An Independent T-test was used for intragroup analysis and showed a comparison between Kaltenborn and MET group for post-NPRS, SPADI, and ROM in abduction, internal rotation, and external rotation. The independent T-test for between-group analysis showed post-treatment NPRS and SPADI in both groups showed a significant difference (p value less than 0.05), whereas the post-treatment value for ROM in abduction, internal rotation, and external rotation was not found significant (p value more than 0.05).

Table 3: Independent T-Test Pre and post Treatment (between group analysis)

Variable	Groups	Mean± SD	t	95% Confidence Interval of the Difference		P-value
				Lower	Upper	
Pre-treatment values						
NPRS*	Group 1	8.23±0.93	-0.130	-0.546	0.480	0.897
	Group 2	8.26±1.05	-0.130	-0.546	0.480	
SPADI**	Group 1	93±11.19	0.000	-5.782	5.782	1.000
	Group 2	93±11.19	0.000	-5.782	5.782	
Abduction (degrees)	Group 1	96±18.86	0.484	-7.316	11.982	0.630
	Group 2	93.66±18.47	0.484	-7.316	11.982	

Int rotation (degrees)	Group 1	38.83±11.04	-0.118	-6.006	5.339	
	Group 2	39.16±10.91	-0.118	-6.006	5.339	0.907
Ext rotation (degrees)	Group 1	32±15.68	0.000	-8.104	8.104	
	Group 2	32±15.68	0.000	-8.104	8.104	1.000
Post treatment values						
NPRS	Group 1	1.86±0.82	-9.991	-2.520	-1.679	
	Group 2	3.96±0.81	-9.991	-2.520	-1.679	0.000
SPADI	Group 1	19±5.47	-17.070	-27.559	-21.774	
	Group 2	43.66±5.71	-17.070	-27.559	-21.774	0.000
Abduction (degrees)	Group 1	106±19.22	1.578	-2.076	17.543	
	Group 2	98.26±18.73	1.578	-2.077	17.543	0.120
Int rotation (degrees)	Group 1	48.76±10.94	1.923	-0.221	11.087	
	Group 2	43.33±10.93	1.923	-0.221	11.087	0.059
Ext rotation (degrees)	Group 1	41.50±15.75	1.595	-1.647	14.581	
	Group 2	35.03±15.64	1.595	-1.647	14.581	0.116

NPRS: Numeric Pain Rating Scale; SPADI: Shoulder Pain and Disability Index

Discussion

The aim of the study was to compare the effects of Kaltenborn mobilization and Muscle energy technique to reduce pain and improve range of motion and functional status in patients suffering from frozen shoulder. The results of this study revealed that both techniques were effective in reducing pain and increasing range of motion and functional status, but Kaltenborn was more effective than the Muscle energy technique.

A study reported that the muscle energy technique is more effective than Kaltenborn mobilization in improving flexion and abduction ROM in adhesive capsulitis however it reported that rotation was not improved. The results of the current study reported that Kaltenborn mobilizations showed improvement in pain, disability, and an increase in all ROMs (abduction, internal rotation, and external rotation) in patients with adhesive capsulitis (Umar et al. 2023). Unlike the current study, research conducted by MF Alam et.al, 2024 summarized that a supervised protocol that includes mobilization and other exercises can be an alternative protocol used for the treatment of frozen shoulder without profound adverse effects. It compares the effects of the combination of Maitland's mobilization protocol and muscle energy techniques (METs) with a self-directed non-supervised general home exercise program (HEP) in frozen shoulder patients (Alam et al. 2024).

A study in 2022 by F Afzal, reported that METs are superior to Kaltenborn for the management of pain and disability although both techniques are effective in the treatment of adhesive capsulitis which contradicts the findings of the current study (Afzal F. 2022). This was probably because Muscle energy techniques may address the limitation caused by the muscles around the shoulder, but capsular restriction responded more to the Kaltenborn oscillations.

Another study conducted by M Ali et.al. concluded that Maitland Mobilization is more effective in reducing pain and improving function and disability among patients with adhesive capsulitis as compared to MET for Pain, ROM, and shoulder functions (Ali et al. 2022). The results of this study support our results as Kaltenborn mobilization was superior to muscle energy technique in improving pain and disability in patients with adhesive capsulitis.

A study conducted on the effectiveness of the Muscle energy technique and Capsular stretching in patients with Adhesive capsulitis in July 2020 reported that the Muscle energy technique is more effective in increasing the Range of motion in patients with Adhesive capsulitis as compared to Capsular stretching P value was less than 0.05. In contrast, the current study, in contrast, showed that Kaltenborn showed more improvement in ROM patients with adhesive capsulitis (Sharma and Patel 2020).

A study conducted by N Mathur and colleagues in 2019 compared Maitland mobilization and Muscle energy techniques and found that there was a significant improvement in patients who received the Muscle energy technique compared to those who received Maitland mobilization, which was in contrast to the current study findings (Mathur N et al. 2019).

The findings of the current are consistent with a study by M Iqbal et.al the effects of Muscle energy technique and Passive stretching were compared in patients with diagnosed Adhesive capsulitis, the data revealed that muscle energy technique was more effective for the patients with Adhesive capsulitis although this study also reported an improvement in pain intensity, disability, and ROM post-treatment when treated with Muscle energy technique however, Kaltenborn was reportedly more beneficial (Kotagiri et al. 2019; Pattnaik S).

Limitations

The patients in this study were obtained solely from the Department of Physiotherapy, Mayo Hospital, Lahore, which limits the generalization of the study. The sample size was not large enough to generalize our results to other populations. Also, the study allowed all movements during daily activities and was therefore unable to control the diverse motions of each patient. Some shy, hesitant, and illiterate people did not give me answers to my questions and were less responsive. Lastly, 12 patients were dropped as they were not able to continue the session. So, data was analyzed by a total of 60 patients instead of 72 patients.

Conclusion

This study concluded that Kaltenborn mobilization may be effective in improving pain and increasing range of motion along with functional mobility in patients with adhesive capsulitis.

Future Research

The scope of the study is to find out the effects on a larger sample population. Further research is required to determine the long-lasting effects of the treatment by taking follow-up assessments of longer duration.

Author Contributions

All authors significantly contributed to the work reported, including conception, study design, execution, data acquisition, analysis, and interpretation. They actively participated in drafting, revising, or critically reviewing the manuscript, provided final approval of the version to be published, agreed on the journal submission, and accepted accountabilities for all aspects of the work.

Data Availability Statement

The authors will transparently provide the primary data underpinning the findings or conclusions of this article, without any unjustified reluctance. If need from editorial team.

Funding

The author/s have not received any funding for. This study.

Conflicts of Interest

The authors declare no potential conflicts of interest related to the research, writing, or publication of this work.

Reference

Afzal, F. (2022). Effectiveness of Kaltenborn Joint Mobilization Technique Versus Muscle Energy Technique on Pain and Disability in Patients with Shoulder Adhesive Capsulitis. Journal of Clinical and Research News, 6, 134–140.

Alam, M. F., Azharuddin, M., & Zaki, S. (2024). Effectiveness of shoulder mobilization combined with muscle energy technique in the management of adhesive capsulitis: A randomized control trial. Sports Journal of Sports Medicine, 24, 35–42.

Ali, B., Arsh, A., Khalil, A. A., & Zahoor, M. (2018). Prevalence of shoulder pain and adhesive capsulitis in post-mastectomy patients. Journal of Medical Sciences, 26, 194–197.

Ali, M., Hashim, M., Waseem, I., Manzoor, S., & Ahmad, I. (2022). Comparison of Maitland Mobilization and Muscle Energy Technique on Pain, Range of Motion and Functions in Adhesive Capsulitis. Pakistan BioMedical Journal, 129–133.

Breckenridge, J. D., & McAuley, J. H. (2011). Shoulder Pain and Disability Index (SPADI). Journal of Physiotherapy, 57, 197.

D'Orsi, G. M., Via, A. G., Frizziero, A., & Oliva, F. (2012). Treatment of adhesive capsulitis: A review. Muscles, Ligaments and Tendons Journal, 2, 70.

Deshmukh, A., Deo, S., Salgia, A. K., & Agarwal, T. (2013). A rare, unusual case presentation of tuberculosis of the shoulder joint. Journal of Orthopaedic Case Reports, 3, 23.

Do Moon, G., Lim, J. Y., Da Yoo, K., & Kim, T. H. (2015). Comparison of Maitland and Kaltenborn mobilization techniques for improving shoulder pain and range of motion in frozen shoulders. Journal of Physical Therapy Science, 27, 1391–1395.

Gill, M. A., Gohel, B. P., & Singal, S. K. (2018). Effect of muscle energy technique on pain and function in adhesive capsulitis—An interventional study. International Journal of Health Sciences and Research, 8, 133–137.

Iqbal, M., Riaz, H., Ghous, M., & Masood, K. (2020). Comparison of Spencer muscle energy technique and passive stretching in adhesive capsulitis: A single-blind randomized control trial. Journal of the Pakistan Medical Association, 70, 2113–2118.

Kadi, R., Milants, A., & Shahabpour, M. (2017). Shoulder anatomy and normal variants. Journal of the Belgian Society of Radiology, 101(Suppl. 1).

Kotagiri, S., Mathur, N., Balakavi, G., & Songa, A. K. (2019). The effectiveness of muscle energy technique and mobilization to improve the shoulder range of motion in frozen shoulder. International Archives of Integrated Medicine, 6(1).

Kwaees, T. A., & Charalambous, C. P. (2014). Surgical and non-surgical treatment of frozen shoulder: Survey on surgeons' treatment preferences. Muscles, Ligaments and Tendons Journal, 4(4), 420–424.

Lamplot, J. D., Lillegraven, O., & Brophy, R. H. (2018). Outcomes from conservative treatment of shoulder idiopathic adhesive capsulitis and factors associated with developing contralateral disease. Orthopaedic Journal of Sports Medicine, 6(7), 2325967118785169.

Manske, R. C., & Prohaska, D. (2008). Diagnosis and management of adhesive capsulitis. Current Reviews in Musculoskeletal Medicine, 1, 180–189.

Michener, L. A., Snyder, A. R., & Leggin, B. G. (2011). Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. Journal of Sport Rehabilitation, 20, 115–128.

Pattnaik, S., Kumar, P., Sarkar, B., & Oraon, A. K. (2023). Comparison of Kaltenborn mobilization technique and muscle energy technique on range of motion, pain, and function in subjects with chronic shoulder adhesive capsulitis. Hong Kong Physiotherapy Journal, 43, 149–159.

Rezwan, A., Shahriar, T., Rasal, A., Rahman, M., Haque, T., et al. (2021). Study on effectiveness of Kaltenborn mobilization techniques grade III in patients with frozen stage of adhesive capsulitis of shoulder joint. European Journal of Medical and Health Sciences, 3, 50–53.

Sharma, H., & Patel, S. (2020). Effectiveness of muscle energy technique versus capsular stretching among

patients with adhesive capsulitis. International Journal of Research and Review, 7, 2454–2237.
T, G C. (2000). Functional anatomy of the shoulder. Journal of Athletic Training, 35, 248–255.
Umar, M., Anwar, A., Khan, N., Marryam, M., & Rashid, H. (2023). Effectiveness of Kaltenborn mobilization versus muscle energy technique on shoulder range of motion in adhesive capsulitis. Journal of Rehabilitation Medicine and Clinical Communications, 27.
Vijayan, V., & Jayabharathi, S. (2019). A comparative study on effectiveness of muscle energy technique versus Cyriax's deep friction technique in adhesive capsulitis. Indian Association of Biomedical Scientists Journal, 39, 622–627.
Wang, K., Ho, V., Hunter-Smith, D. J., Beh, P. S., Smith, K. M., et al. (2013). Risk factors in idiopathic adhesive capsulitis: A case control study. Journal of Shoulder and Elbow Surgery, 22, e24–e29.
Willmore, E. G., Millar, N. L., & van der Windt, D. (2022). Post-surgical physiotherapy in frozen shoulder: A review. Shoulder & Elbow, 14, 438–451.