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IMPACT OF SCAPULAR STABILIZATION TRAINING IN FROZEN SHOULDER PATIENTS WITH SCAPULAR DYSKINESIS

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ABSTRACT

Introduction: Frozen shoulder, also known as adhesive capsulitis, is a chronic inflammatory condition of the synovium and surrounding soft tissues characterized by pain, stiffness, and restricted movement of the glenohumeral joint. The condition is associated with fibrosis due to increased collagen production, fibroplasia, and myofibroblast activity. Frozen shoulder affects approximately 2–5% of the general population. Scapular stabilizing muscles play a crucial role in maintaining proper scapular alignment and shoulder function in patients with frozen shoulder.

Aim of the Study: The aim of this study was to evaluate the impact of scapular stabilizer exercises in improving shoulder range of motion (ROM), reducing disability, and decreasing scapular winging in patients with frozen shoulder.

Materials and Methods: Eighty participants were allocated into two groups at random: experimental (n = 40) and control (n = 40) groups. Prior to the study, informed consent were obtained. While the control group only received conventional physiotherapy, the experimental group was also given scapular stabilizer exercises. For six weeks, 45-minute interventions were administered three times a week. Shoulder range of motion, pain, disability, and scapular winging were among the outcome measures. Descriptive statistics, independent t-tests, and paired t-tests were used to examine the data.

Results: The results demonstrated that scapular stabilizer exercises combined with conventional physiotherapy produced significant improvements in shoulder ROM ($P < 0.05$), reduced pain and disability, and decreased scapular winging after six weeks of intervention in both groups, with greater improvement observed in the experimental group.

Conclusion: In patients with frozen shoulder, scapular stabilizer exercises along with conventional physiotherapy significantly enhance range of motion and lessen pain, disability, and scapular winging.

Keywords: Frozen shoulder, scapular stabilizer exercises, scapular winging, range of motion, disability, pain, rehabilitation

INTRODUCTION

Frozen shoulder, also known as adhesive capsulitis, was first described by Ernest Amory Codman in 1934[1]. It is characterized by the gradual onset of shoulder pain, stiffness, and restricted range of motion (ROM) of the glenohumeral joint. Frozen shoulder is associated with chronic inflammation and fibrosis of the synovial membrane and surrounding soft tissues, resulting from increased collagen deposition, fibroplasia, and myofibroblast proliferation. The condition affects approximately 2–5% of the general population and is more common in women, particularly between 40 and 60 years of age[2,3] . Frozen shoulder is classified into primary (idiopathic) and secondary types, with secondary frozen shoulder commonly associated with systemic conditions such as diabetes mellitus, affecting nearly 10–36% of patients[4].

Patients with frozen shoulder commonly experience pain that worsens at night and interferes with daily activities. Shoulder abduction is often restricted due to supraspinatus weakness and tightness of the long head of the biceps tendon. Both active and passive ROM are significantly reduced, often by nearly 30 degrees[5,6]. Clinically, frozen shoulder progresses through three stages: the freezing stage, frozen stage, and thawing stage, which may persist for up to 30 months[7].

Diagnosis is primarily based on clinical examination and patient history. However, imaging modalities such as magnetic resonance imaging (MRI) may be used to assess structural changes and exclude other causes of shoulder pain and stiffness[8]. A characteristic finding during examination is a firm and leathery end feel at the end range of movement[9].

In this study, shoulder ROM, including flexion, abduction, and internal and external rotation, was measured using a Digital HALO goniometer. Pain, disability, and functional limitations were evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Scapular winging was assessed using the Lateral Scapular Slide Test (LSST)[10].

The primary goals in the management of frozen shoulder are pain reduction, restoration of ROM, and improvement of functional activities. Physiotherapy interventions commonly include stretching exercises, strengthening exercises, electrotherapy modalities, and joint mobilization techniques[11].

Scapular stabilization exercises are effective in restoring normal scapular control, improving muscle strength, and reducing scapular winging. These exercises also contribute to improved shoulder abduction and external rotation. Although previous studies have investigated scapular alterations in patients with frozen shoulder, most treatment protocols have focused mainly on pain relief and ROM improvement, with less emphasis on scapular stabilization exercises[12,13].

Therefore, this study aimed to evaluate the effectiveness of scapular stabilization exercises combined with conventional physiotherapy compared to conventional physiotherapy alone in patients with frozen shoulder. The study hypothesized that scapular stabilization exercises would strengthen and balance the scapular stabilizing muscles, reduce scapular winging, improve shoulder ROM, and enhance overall functional recovery in individuals with frozen shoulder.

MATERIALS AND METHODOLOGY

Methods

All participants were informed about the purpose and procedures of the study, and written informed consent was obtained prior to participation.The research was conducted at RPIIT College and Civil Hospital, Panipat and Karnal, over a duration of one year.

Subject Selection Criteria

A total of 80 patients diagnosed with frozen shoulder were recruited for the study. Participants were randomly allocated into two groups:

Group A: 40 participants

Group B: 40 participants

Inclusion Criteria	Exclusion Criteria:
Male and female participants	Previous surgery on the affected shoulder
Age between 40 and 60 years	Any musculoskeletal disorder involving the affected shoulder
Patients in the frozen stage (4–12 months) or thawing stage (12–24 months) of frozen shoulder confirmed through physical examination	Elbow injury or surgery on the affected side
Limited active range of motion (ROM) of the shoulder joint, including abduction, flexion, internal rotation, and external rotation	Pulmonary disease or History of cardiac surgery

Study Design and Intervention

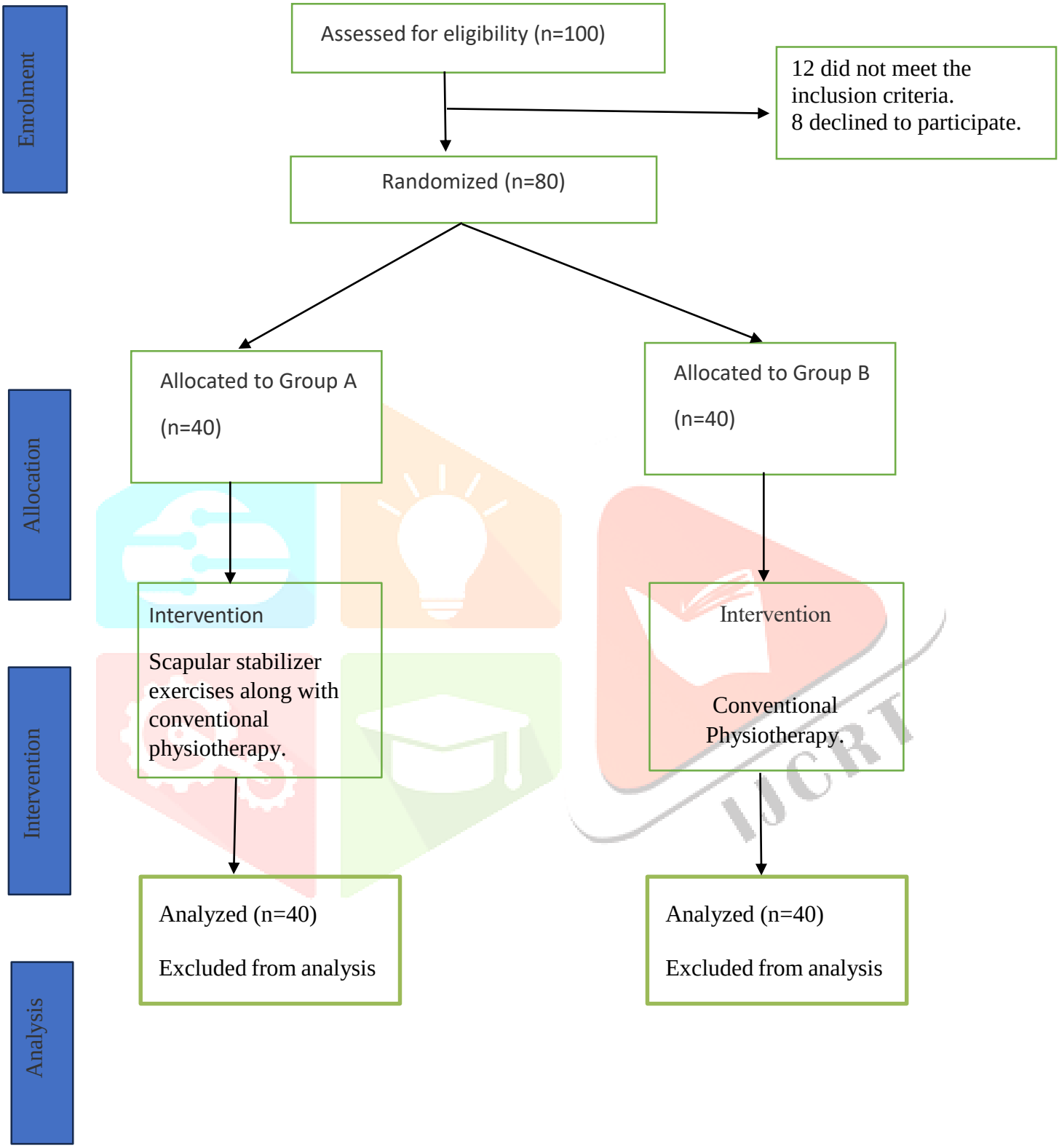
The study followed a pre-test and post-test experimental design.

Group A received scapular stabilizer exercises along with conventional physiotherapy.

Group B received conventional physiotherapy alone.

Each treatment session lasted for 45 minutes and was conducted three times per week for six weeks.

CONSORT FLOW CHART:



INTERVENTION PROCEDURE

Scapular Stabilizer Exercises:

Scapular Retraction with Thera-Band[13]

Participants were instructed to maintain a relaxed head and neck posture while squeezing the shoulder blades backward against the resistance provided by a Thera-Band.

Modified Prone Cobra Exercise[14]
Participants were positioned prone on a treatment bench with their arms resting beside the body and fingers pointing toward the toes. They were instructed to extend the trunk and lift the chest approximately 10 cm off the bench while maintaining scapular retraction.

Physioball Scapular Exercise[15]
Participants were instructed to place one hand on a physioball positioned against a wall. They were asked to gently retract and depress the shoulders, then roll the hand upward and downward over the ball while maintaining proper shoulder alignment.

Wall Push-Ups[16]
Participants stood facing a wall with their hands placed at chest level and shoulder-width apart. They were instructed to move their feet backward until the heels lifted slightly off the ground. The upper body was then lowered toward the wall by bending the elbows, followed by pushing back to the starting position. The exercise was performed for 10 repetitions in 3 sets.
All scapular stabilization exercises were performed with a 10-second hold, repeated 10 times for 3 sets.

Conventional Therapy[17]
Both groups received conventional physiotherapy, which included:

- Finger ladder exercises
- Shoulder wheel exercises
- Wand exercises
- Thera-Band exercises
- Ultrasound therapy applied at 1 MHz frequency, continuous mode, and intensity of 0.8 W/cm² for 8 minutes

Outcome Measures

Lateral Scapular Slide Test (LSST)[16]
The Lateral Scapular Slide Test, described by Kibler, was used to assess static scapular positioning clinically. Measurements were taken between the inferior angle of the scapula and the nearest thoracic spinous process in three different arm positions:

1. Neutral shoulder position
2. Shoulder abducted to 45° with the hand placed on the hip
3. Shoulder abducted to 90°

According to Kibler, the affected side demonstrates a greater scapular distance compared to the unaffected side. A bilateral difference greater than 1.5 cm (15 mm) was considered indicative of scapular asymmetry.

HALO Digital Goniometer[18]
Shoulder range of motion (ROM), including flexion, abduction, internal rotation, and external rotation, was assessed using a HALO Digital Goniometer. Measurements were performed with participants in the supine position according to the procedure described by Norkin and White, taking into account anatomical landmarks and thoracic extension during shoulder flexion.

Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire[19]
The DASH questionnaire was used to evaluate upper extremity disability and symptoms. It consists of 30 items assessing the patient's functional status and symptoms related to the arm, shoulder, and hand.

- Twenty-one items evaluate difficulty in performing daily activities.
- Five items assess pain, weakness, stiffness, and activity-related discomfort.
- Four items assess the impact on social activities, work, sleep, and psychological well-being.

STATISTICAL ANALYSIS

SPSS (Windows version 29.0) was used for analyzing the data. The mean and standard deviation for demographic and outcome variables were calculated using descriptive statistics. A paired t-test was used to determine the significant difference within variables, and an Independent test was used to determine significant differences between the variables such as range of motion (Halo Digital goniometer), Disability and pain (DASH questionnaire), and winging of the scapula (LSST). The significance value was set to $p<0.05$.

RESULTS

Table 1 found that the mean age was 49.02 in experimental and control groups, and the mean age was 49. The u value is 800.00 and P>0.05, indicating that participants' distributions were homogeneous. Table/fig 2 was to find the gender distribution within the group. It found that in both groups, female is more common than male in percentage

Group	Mean	SD	U-value	P value
Experimental Group	49.02	4.02	800.00	1.00
Control Group	49	3.78		

Table 1: Comparison of age distribution within the group.

Variable	Experimental group		Control group	
Gender	Female	Male	Female	Male
Percent	65%	35%	57.5%	42.5%

Table 2: Comparison of gender distribution within the group

Experimental group		Mean				Mean Diff		t Value	P Value	Inference
		Pre	SD	Post	SD	Mean	SD			
Range Of Motion	Flexion	95.5	11.08	133	12.06	-38.37	4.29	-56.5	0.00	Significant
	Abduction	92.6	16.67	132.1	16.00	-39.50	3.16	-79.0	0.00	Significant
	Internal Rotation	18.2	4.01	49.1	6.59	-30.87	5.04	-38.6	0.00	Significant
	External Rotation	21.1	6.35	54.0	5.68	-32.87	4.51	-46.0	0.00	Significant
DASH		72.2	7.42	37.0	5.40	35.25	5.05	44.0	0.00	Significant
Lateral Scapula Slide Test	LSST Neutral	1.82	0.14	.87	0.24	0.95	0.22	27.0	0.00	Significant
	LSST 45 degree	1.96	0.17	1.02	0.14	0.94	0.23	25.7	0.00	Significant
	LSST 90 Degree	2.70	0.32	1.11	0.17	1.59	0.30	33.1	0.00	Significant

Table 3: Comparison of pre and post-test of ROM, DASH, and LSST within the experimental group (Group A)

Control Group		Mean				Mean Diff		T Value	P Value	Inference
		Pre	SD	Post	SD	Mean	SD			
Range Of Motion	Flexion	92.0	8.90	123.1	10.04	-30.1	4.00	-47.6	0.00	Significant
	Abduction	90.2	9.67	119.6	9.29	-29.3	3.95	-47.0	0.00	Significant
	Internal Rotation	18.3	3.27	43.2	6.25	-24.8	6.04	-26.0	0.00	Significant
	External Rotation	19.2	4.74	39.2	7.97	-20.0	4.66	-27.0	0.00	Significant
	DASH	70.1	6.04	48.6	5.65	21.5	4.11	33.0	0.00	Significant
LSST	LSST Neu	1.80	0.17	1.67	0.18	0.12	0.20	3.7	0.00	Significant
	LSST 45	1.94	0.28	1.77	0.26	0.17	0.24	4.5	0.00	Significant
	LSST 90	2.68	0.28	2.27	0.35	0.41	0.27	9.4	0.00	Significant

Table 4: Comparison of pre and post-test of ROM, DASH, Lateral scapular slide test within the control group (Group B)

Variable	Group	Mean	Std deviation	Mean diff	Std dev diff	t value	P value	Inference
Flexion pre	Experiment	95.50	11.08	2.50	2.18	1.11	0.26	Not Significant
	Control	93.00	8.90					
Flexion post	Experiment	133.87	12.06	10.75	2.01	4.33	0.00	Significant
	Control	123.12	10.04					
Abduction pre	Experiment	92.62	16.67	2.37	7.00	0.77	0.43	Not Significant
	Control	90.25	9.67					
Abduction post	Experiment	132.12	16.00	12.50	6.71	4.27	0.00	Significant
	Control	119.62	9.29					
IR pre	Experimental	18.25	4.01	-0.12	0.73	-0.15	0.87	Not Significant
	Control	18.37	3.27					
IR post	Experiment	49.12	6.59	5.87	0.33	4.08	0.00	Significant
	Control	43.25	6.25					
ER pre	Experiment	21.12	6.35	1.87	1.61	1.49	0.13	Not Significant
	Control	19.25	4.74					
ER post	Experiment	54.00	5.68	14.75	2.28	9.52	0.00	Significant
	Control	39.25	7.97					
DASH pre	Experiment	72.25	7.42	2.12	1.37	1.40	0.16	Not Significant
	Control	70.12	6.04					
DASH post	Experiment	37.00	5.40	-11.62	-0.25	-9.39	0.00	Significant
	Control	48.62	5.65					
LSST	Experiment	1.82	0.14	0.02	-0.03	0.63	0.52	Not

neutral pre	Control	1.80	0.17					Significant
LSST neutral post	Experiment	0.87	0.24	-0.08	0.06	-16.96	0.00	Significant
	control	1.67	0.18					
LSST 45-degree pre	Experiment	1.96	0.17	0.02	-0.10	0.37	0.70	Not Significant
	Control	1.94	0.28					
LSST 45-degree post	Experiment	1.02	0.14	-0.74	-0.11	-15.66	0.00	Significant
	Control	1.77	0.26					
LSST 90-degree pre	Experiment	2.70	0.32	0.01	0.04	0.25	0.79	Not Significant
	Control	2.68	0.28					
LSST 90-degree post	Experiment	1.11	0.17	-1.15	-0.18	-18.37	0.00	Significant
	Control	2.27	0.35					

Table 5: Comparison of pre and post-test of ROM, DASH, LSST between the experiment and control group.

Table 3 Shows that Group A (Experimental group) improved significantly in ROM, DASH, and LSST. Also showed significant improvement in ROM, DASH, and LSST in Group B (Control group) (**Table 4**). Analysis of paired 't-tests within the group revealed statistically significant improvements in all three parameters for Group A (Experimental group); ROM- flexion (133±12.06), abduction (132.1±16.00), internal rotation (49.1±6.59), external rotation (54.0±5.68), DASH (37.0±5.40) and LSST- Neutral (0.87±0.24), 45 degrees (1.02±0.14), 90 degrees (1.11±0.17), then Group B ROM-flexion (123.1±10.04), abduction (119±9.29), internal rotation (43.2±6.25), external rotation (39±7.97), DASH (48.6±5.65) and LSST- Neutral (1.67±0.18), 45 degree (1.77±0.26), 90 degree (2.27±0.35). The p-value was found significant using a paired t-test after 6 weeks of intervention. The calculated p-value is less than the threshold for statistical significance, which is 0.00 ($p>0.05$). Therefore, there is a statistically significant improvement in ROM and reduced disability, pain, and scapula winging after 6 weeks of scapular stabilizer exercise combined with conventional therapy in patients with frozen shoulders. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted.

In **Table 5**, the Analysis of independence tests between the groups shows statistically no significance in all the ROM, DASH, and LSST parameters pre-values for both Group A and Group B. P value >0.05. Hence, the null hypothesis was accepted, and the alternate hypothesis was rejected. And showed significant improvement in all the ROM, DASH, and LSST variables post values in both Group A and Group B. P value is <0.05. Hence, the null hypothesis was rejected, and the alternate hypothesis was accepted.

DISCUSSION

Frozen shoulder, also known as adhesive capsulitis, is a common and painful condition of the shoulder joint characterized by structural changes that restrict both active and passive movements of the shoulder. Assessment of shoulder joint range of motion is commonly performed using a goniometer, while upper extremity disability and functional limitations are evaluated using the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. Scapular movement and scapulohumeral rhythm play a vital role in shoulder rehabilitation. Previous studies on patients with frozen shoulder have demonstrated altered scapular kinematics, including increased scapular upward rotation and reduced external rotation.

The present experimental study was conducted on 80 participants diagnosed with frozen shoulder, who were randomly divided into two groups consisting of 40 participants each. The findings of the study revealed that the mean age of participants in the experimental group was approximately 50 years,

while the mean age in the control group was 49 years. Similar findings were reported by Soha F. Khallaf et al. (2018), who observed a mean participant age of 47.3 years.

In the experimental group, females constituted 65% of the participants, whereas males accounted for 35%. In the control group, 57.5% of participants were female and 42.5% were male. These findings are consistent with previous literature, including studies by Arshad et al., which reported that frozen shoulder commonly affects individuals between 30 and 70 years of age, with a higher prevalence among females compared to males.

Statistical analysis was performed using the Mann–Whitney U test to determine the homogeneity between the two groups. The mean age of participants in the experimental group was 49.02 ± 4.028 years, while the control group had a mean age of 49 ± 3.789 years. The obtained U value was 800.00 with a p-value greater than 0.05, indicating that both groups were comparable and homogenous at baseline.

The results of the present study demonstrated a statistically significant improvement in the experimental group receiving scapular stabilizer exercises along with conventional physiotherapy compared to the control group receiving conventional physiotherapy alone. Significant improvements were observed in shoulder range of motion (ROM). In shoulder flexion, the mean pre-treatment value increased from 95.5 ± 11.08 to 133 ± 12.06 post-treatment ($p = 0.00$). Shoulder abduction improved from 92.6 ± 16.67 pre-treatment to 132.1 ± 16.00 post-treatment ($p = 0.00$). Internal rotation increased from 18.2 ± 4.01 to 49.1 ± 6.59 ($p = 0.00$), while external rotation improved from 21.1 ± 6.35 to 54.0 ± 5.68 ($p = 0.00$). Similar findings were reported by Moezy A et al. (2014), who found statistically significant improvements in shoulder abduction, flexion, and external rotation following a six-week intervention program.

The study also demonstrated significant improvement in functional disability as measured by the DASH questionnaire. The mean DASH score decreased from 72.2 ± 7.42 before treatment to 37.0 ± 5.40 after treatment, with a p-value of 0.00, indicating a substantial reduction in disability and improvement in functional activities. Comparable findings were reported by Hee-Yeon Yoon et al. (2012), who observed significant improvement in DASH scores following intervention.

Furthermore, significant improvements were observed in scapular winging as measured by the Lateral Scapular Slide Test (LSST). In the neutral position, the mean LSST value improved from 1.82 ± 0.14 pre-treatment to 0.87 ± 0.24 post-treatment ($p = 0.00$). At 45° shoulder abduction, the mean value decreased from 1.96 ± 0.17 to 1.02 ± 0.14 ($p = 0.00$). Similarly, at 90° shoulder abduction, the mean value improved from 2.70 ± 0.32 to 1.11 ± 0.17 ($p = 0.00$). These findings are consistent with the study conducted by Shankar et al. (2016), which reported statistically significant improvements in LSST measurements following therapeutic intervention.

Shankar et al. (2016) reported that scapular stabilization exercises facilitate activation of important periscapular muscles, including the serratus anterior, lower trapezius, and rhomboid muscles. These exercises help restore the altered force couple mechanism caused by scapular malalignment[20] and improve scapular stability.

Similarly, Irem Düzgün et al. (2019) suggested that, following improvement in scapular mobility, strengthening exercises targeting the middle trapezius, lower trapezius, and serratus anterior muscles should be incorporated to enhance scapular stability and shoulder function. In a systematic review conducted by Celik, scapular stabilization exercises were found to be more effective in reducing pain and improving shoulder range of motion compared to glenohumeral exercises alone in patients with frozen shoulder[15].

Previous studies investigating scapular alterations in individuals with restricted shoulder mobility have primarily focused on pain management and restoration of range of motion. However, Lin JJ et al. emphasized that overactivity of the upper trapezius muscle may lead to compensatory scapular movements in patients with frozen shoulder due to reduced glenohumeral mobility. Therefore, strengthening of the lower trapezius muscle is considered essential for effective rehabilitation of the affected shoulder[23,24].

Jyothi N et al. (2015) stated that the normal ratio between glenohumeral and scapulothoracic movement is approximately 2:1. Early scapular elevation primarily depends on the coordinated action of the serratus anterior, levator scapulae, rhomboids, and lower fibers of the trapezius muscle[24]. The rhomboids, levator scapulae, and lower trapezius muscles work together to counterbalance the upward pull generated by the serratus anterior and rotator cuff muscles, thereby stabilizing the scapula during shoulder movement. This stabilization allows the scapula to function effectively as the rotational base

during shoulder abduction up to approximately 100 degrees. Beyond this range, upward rotation of the scapula and activation of the lower fibers of the serratus anterior become increasingly important[19,20,24].
The upper fibers of the trapezius contribute minimally to scapular rotation and mainly oppose the downward pull of the deltoid muscle. In addition to producing upward scapular rotation, the serratus anterior plays a crucial role in scapular stabilization and initiation of shoulder abduction[20].
In frozen shoulder, capsular tightness leads to restricted glenohumeral joint mobility. As a result, external rotation of the humeral head becomes limited, and during shoulder elevation the humeral head tends to move posteriorly beneath the acromion. Consequently, the scapula reaches its maximum range of motion earlier than the humerus during arm elevation, leading to altered scapulohumeral rhythm and compensatory scapular movements.
Jyothi N et al. (2015) reported that since all SITS (rotator cuff) muscles originate from the scapula, the function of the rotator cuff during shoulder elevation is indirectly dependent on proper scapular stabilization. They further explained that full and efficient movement of the rotator cuff at the glenohumeral joint can be achieved only when the scapulothoracic joint is adequately stabiliz[23].
Lan Tang et al. (2021) demonstrated that scapular stability exercises based on scapular dyskinesis (SD) are more effective than conventional rehabilitation programs in the management of shoulder periarthritis. Their findings highlight the importance of reducing muscle imbalance to improve shoulder function, decrease pain, and reduce disability while preserving normal scapular force coupling mechanisms[21].
Michael et al. (2000) stated that altered function of scapular stabilizing muscles is often associated with overuse injuries and poor shoulder girdle biomechanics. Such dysfunction may result in scapular malalignment, disturbed scapulohumeral rhythm, and weakness of scapulothoracic muscles, ultimately contributing to overall shoulder dysfunction. The muscles most commonly affected include the lower scapular stabilizers, such as the serratus anterior, rhomboids, and the middle and lower fibers of the trapezius[25].

LIMITATION AND RECOMMENDATION

The present study suggests the need for follow-up assessments to evaluate the long-term effects of the intervention. Therefore, further research is recommended to compare the effectiveness of scapular stabilizer exercises combined with conventional therapy versus conventional therapy alone. It is also advised that future studies include a larger sample size and a longer duration of intervention to obtain more robust and generalizable results

CONCLUSION

The effectiveness of scapular stabilizer exercise combined with conventional therapy is superior to conventional therapy alone in increasing ROM, lowering disability and pain, and decreasing scapular winging. Results showed significant improvement in ROM flexion, abduction, and internal and external rotation ($P<0.05$). Significant improvement in DASH ($P<0.05$). Significant improvement LSST in three different positions ($P<0.05$).
In this study, participants in the scapular stabilizer exercise with the conventional therapy showed more significant improvement than the conventional therapy group alone. This indicates that Scapular stabilizer exercise with conventional therapy can be a practical therapeutic approach for Frozen shoulder.

REFERENCES

1. Varun Naik, Sandeep Bhagwat, Tanvi Pathania, Farhana Bootwala. Effectiveness of matrix rhythm therapy in frozen shoulder concerning ROM and pain- An experimental study. Int J Appl Res 2018;4(1):73-76.
2. Cavalleri, E. & Servadio, A. & Berardi, Anna & Tofani, Marco & Galeoto, Giovanni. (2020). The Effectiveness of Physiotherapy in Idiopathic or Primary Frozen Shoulder: a Systematic Review and Meta-Analysis. Muscle Ligaments and Tendons Journal. 10. 24. 10.32098/mltj.01.2020.04.
3. Widyaningrum, Ni Luh Gadung, Adnan Faris Naufal, and Elif Nur Efendi. "Physiotherapy Management of Frozen Shoulder Dextra EC Dextra Shoulder Osteoarthritis Case." *FISIO MU: Physiotherapy Evidences* 4.3 (2023): 133-139. DOI: https://10.0.93.109/fisiomu.v4i3.21968.
4. Konarski, Wojciech, et al. "Current concepts of natural course and managing frozen shoulder: A clinical overview." *Orthopedic Reviews* 12.4 (2020). doi: 10.4081/or.2020.8832
5. Aggarwal, Amita & Saxena, Kritika & Palekar, Tushar & Rathi, Manisha. (2020). Instrument assisted soft tissue mobilization in adhesive capsulitis: A randomized clinical trial. Journal of Bodywork and Movement Therapies. 26. Doi: 10.1016/j.jbmt.2020.12.039.
6. Mishra, Neeti & Mishra, Anil & Goti, Kruti. (2020). Effect of capsular stretch versus sleeper stretch on pain, ROM and shoulder functions in patients with adhesive capsulitis - a comparative study. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0904.1897
7. Ramadan, D., Serry, Z., & Ghallab, M. A. (2022). Comparison between effect of reflexology and Maitland mobilization in treatment of frozen shoulder of diabetic patients type II. International Journal of Health Sciences, 6(S1), 1661-1668. https://doi.org/10.53730/ijhs.v6nS1.4922
8. Lin, Ping, et al. "Effect of proprioceptive neuromuscular facilitation technique on the treatment of frozen shoulder: a pilot randomized controlled trial." BMC Musculoskeletal Disorders 23.1 (2022): 367. https://doi.org/10.1186/s12891-022-05327-4.
9. Ebrahimzadeh MH, Moradi A, Bidgoli HF, Zarei B. The Relationship between Depression or Anxiety Symptoms and Objective and Subjective Symptoms of Patients with Frozen Shoulder. Int J Prev Med. 2019 Mar 15;10:38. doi: 10.4103/ijpvm.IJPVM_212_17. PMID: 30967924; PMCID: PMC6425770.
10. Rajpurohit, Bhavana, and Deepak Anap. "Scapular dyskinesis among patients with shoulder dysfunction–A Cross Sectional Study." VIMS JOURNAL OF PHYSICAL THERAPY 3.1 (2021): 39-46.

11. Cadogan, Angela & Mohammed, Khalid. (2016). Shoulder pain in primary care: FrozenMoezy, Azar & Sepehrifar, Saeed & Solaymani-Dodaran, Masoud. (2014). https://doi.org/10.1071/HC15018
12. Satapathy, Ashutosh & Mandla, Srinivasulu. (2021). A Study to Compare the Effectiveness of Capsular Stretching Versus Scapulothoracic Exercise in Patients with Adhesive Capsulitis of Shoulder. DOI:10.26463/rjpt.1_2_3.
13. Moezy, Azar, Saeed Sepehrifar, and Masoud Solaymani Dodaran. "The effects of scapular stabilization based exercise therapy on pain, posture, flexibility and shoulder mobility in patients with shoulder impingement syndrome: a controlled randomized clinical trial." Medical journal of the Islamic Republic of Iran 28 (2014): 87.
14. Khallaf, Soha F., et al. "Efficacy of ultrasonography-guided intra-articular steroid injection of the shoulder and excercising in patients with adhesive capsulitis: Glenohumeral versus subacromial approaches." The Egyptian Rheumatologist 40.4 (2018): 277-280. https://doi.org/10.1016/j.ejr.2018.01.005.
15. Duzgun, Irem, et al. "Which method for frozen shoulder mobilization: manual posterior capsule stretching or scapular mobilization?." *Journal of musculoskeletal & neuronal interactions* 19.3 (2019): 311.
16. Yoon, Hee-Yeon. "Effects of low-intensity scapular stabilization exercise in arthroscopic shoulder surgery patients." *Journal of Korean Physical Therapy* 24.3 (2012): 229-234
17. Tabassum, Mushfiqua. Effectiveness of scapular stabilization exercise with conventional physiotherapy among adhesive capsulitis patients attended at Center for the Rehabilitation of the Paralysed (CRP). Diss. Bangladesh Health Professions Institute, Faculty of Medicine, the University of Dhaka, Bangladesh., 2018.
18. The effects of scapular stabilization based exercise therapy on pain, posture, flexibility and shoulder mobility in patients with shoulder impingement syndrome: A controlled randomized clinical trial. Medical journal of the Islamic Republic of Iran. 28. 87. shoulder. Journal of primary health care. 8. 44-51. 10.1071/HC15018.
19. Abd Elhamed, Huda B., et al. "Effect of strengthening lower trapezius muscle on scapular tipping in patients with diabetic frozen shoulder: a randomized controlled study." Biomed Res 29.3 (2018): 442-447.
20. Shankar, Pradeep, Prabhakaran Jayaprakasan, and Renuka Devi. "Effect of scapular stabilisation exercises for type 2 scapular dyskinesis in subjects with shoulder impingement." *International Journal of Physiotherapy* (2016): 106-110. Doi: https://doi.org/10.15621/ijphy/2016/v3i1/88921
21. Tang, Lan, et al. "Scapular stabilization exercise based on the type of scapular dyskinesis versus traditional rehabilitation training in the treatment of periarthritis of the shoulder:

study protocol for a randomized controlled trial." Trials 22.1 (2021): 1-11. https://doi.org/10.1186/s13063-021-05654-2

22. Voight, Michael L., and Brian C. Thomson. "The role of the scapula in the rehabilitation of shoulder injuries." *Journal of athletic training* 35.3 (2000): 364.
23. Correll, Sarah, et al. "Reliability and validity of the halo digital goniometer for shoulder range of motion in healthy subjects." International journal of sports physical therapy 13.4 (2018): 707. DOI: 10.26603/ijspt20180707
24. Jyothi, N. "Effect of High Grade Mobilisation Techniques and Scapular Stabilization Exercises in Frozen Shoulder." (2015). DOI: 10.21608/MJCU.2021.153774
25. Voight, Michael L., and Brian C. Thomson. "The role of the scapula in the rehabilitation of shoulder injuries." *Journal of athletic training* 35.3 (2000): 364.