Effectiveness of Static and Dynamic Capsular Stretching on Frozen Shoulder – A Randomized Controlled Trial

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Abstract: Background: Frozen shoulder, also known as adhesive capsulitis, is a painful and disabling condition that leads to progressive restriction of shoulder movement. It commonly affects middle-aged adults and significantly limits daily activities such as dressing, grooming, and overhead tasks. Capsular tightness is a key contributor to movement loss. Although physiotherapy is widely recommended, there is limited comparative evidence on the effectiveness of different capsular stretching approaches.

Methodology: A randomized controlled trial was conducted on 30 individuals diagnosed with stage II frozen shoulder. Participants were randomly divided into two groups. The Experimental Group received conventional physiotherapy combined with capsular stretching, while the Conventional Group received routine physiotherapy alone. The intervention was administered for three weeks. Pain intensity was measured using the Numerical Pain Rating Scale (NPRS), shoulder flexion range of motion was assessed using a universal goniometer, and functional disability was evaluated using the Shoulder Pain and Disability Index (SPADI). Statistical analysis was performed using paired and unpaired t-tests, with significance set at $p < 0.05$.

Result: Both groups showed significant improvement after treatment. Pain scores reduced from 7 to 4 in both groups. Shoulder flexion improved by 11° in the Experimental Group compared to 7° in the Conventional Group. SPADI scores decreased from 62% to 48% in the Experimental Group and from 60% to 45% in the Conventional Group.

Conclusion: Both treatment approaches were effective in reducing pain and improving shoulder function. However, the addition of capsular stretching produced greater improvement in shoulder mobility, suggesting that it may offer added benefits in restoring functional range of motion in individuals with frozen shoulder.

Keywords: Frozen Shoulder, Capsular Stretching, Physiotherapy Rehabilitation

I.INTRODUCTION

Frozen shoulder, clinically termed Adhesive Capsulitis, is a progressive and often debilitating shoulder condition marked by persistent pain and significant limitation of both active and passive glenohumeral movements. It most commonly affects individuals between 40 and 60 years of age and shows a higher incidence in women. The condition is also strongly associated with systemic disorders such as diabetes mellitus and thyroid dysfunction. Epidemiological reports estimate its prevalence to be approximately 3–5% in the general population, rising substantially among individuals with diabetes (1). Due to progressive stiffness and pain, patients frequently experience difficulty with overhead activities, grooming, dressing, and even sleep, leading to reduced independence and overall quality of life.

The underlying pathology involves an inflammatory process within the synovial lining of the glenohumeral joint capsule, followed by capsular thickening, fibrosis, and contracture. Cytokine-mediated inflammation stimulates fibroblastic activity and excessive collagen deposition, particularly in the rotator cuff interval, resulting in adhesion formation and capsular tightening (1). Clinically, adhesive capsulitis progresses through three well-recognized stages: the freezing stage characterized by severe pain and gradual loss of motion; the frozen stage marked by stiffness with relatively reduced pain; and the thawing stage during which gradual recovery of mobility occurs. This course may extend from one to three years. A

typical capsular pattern of restriction external rotation followed by abduction and internal rotation is consistently reported in the literature (2).

Conservative physiotherapy remains the cornerstone of management. Interventions such as thermotherapy, joint mobilization, active and passive range of motion exercises, and strengthening programs are commonly employed to alleviate pain and restore function. Evidence suggests that structured physiotherapy programs significantly improve shoulder mobility and functional outcomes (2). Additionally, strengthening protocols combined with conventional exercises have demonstrated superior reductions in pain and disability compared to conventional treatment alone (3).

Among various physiotherapeutic approaches, capsular stretching specifically targets capsular tightness, which is a primary contributor to restricted movement. Static stretching involves sustaining the shoulder at its end range for a specific duration to promote viscoelastic elongation of capsular tissues. In contrast, dynamic stretching incorporates controlled, repetitive movements through available range, enhancing neuromuscular activation and joint mobility. Research comparing these stretching methods indicates that dynamic stretching may produce greater short-term gains in external rotation range; however, overall evidence remains limited and inconclusive (4).

Despite widespread clinical application, there is a paucity of high-quality randomized controlled trials directly comparing static and dynamic capsular stretching in patients with frozen shoulder. Systematic reviews highlight the necessity for well-designed studies to determine optimal rehabilitation protocols (2). Establishing evidence-based recommendations for stretching techniques will support physiotherapists in selecting the most effective intervention strategies.

Therefore, the present randomized controlled trial aims to evaluate and compare the effectiveness of static and dynamic capsular stretching in individuals with frozen shoulder, contributing to evidence-based and clinically relevant physiotherapy practice.

II.MATERIALS AND METHODOLOGY

This study was designed as an experimental, randomized controlled trial conducted at Krishna College of Physiotherapy, Karad. The total study duration was six months. Ethical approval was obtained from the institutional protocol committee prior to commencement of the study. Participants were recruited using a simple random sampling method based on predefined inclusion and exclusion criteria. Individuals aged between 30 and 50 years diagnosed with stage II (frozen stage) adhesive capsulitis, either unilateral or bilateral, were included. Patients with recent shoulder dislocation, fracture, osteoarthritis of the shoulder, or neurological conditions were excluded.

A total sample of 30 participants was calculated using the standard formula ($n = 4pq/l^2$). After obtaining written informed consent, participants were randomly allocated into two groups using the lottery method. Group A (experimental group) received conventional physiotherapy along with capsular stretching techniques, while Group B (control group) received conventional physiotherapy alone.

Materials used during the study included a universal goniometer for measuring shoulder range of motion, a visual analogue scale (VAS) for pain assessment, the Shoulder Pain and Disability Index (SPADI) for functional evaluation, hot moist packs (HMP), and standardized data collection sheets.

Baseline assessment was performed prior to intervention. Both groups underwent treatment for three weeks. Pre- and post-intervention outcomes were recorded for pain, range of motion, and functional disability. The collected data were systematically tabulated and subjected to statistical analysis to determine the effectiveness of the interventions.

III.STATISTICAL ANALYSIS

The sample size was calculated using the formula:

$$n = 4pq/l^2$$

Based on this formula, the calculated sample size was n = 30.

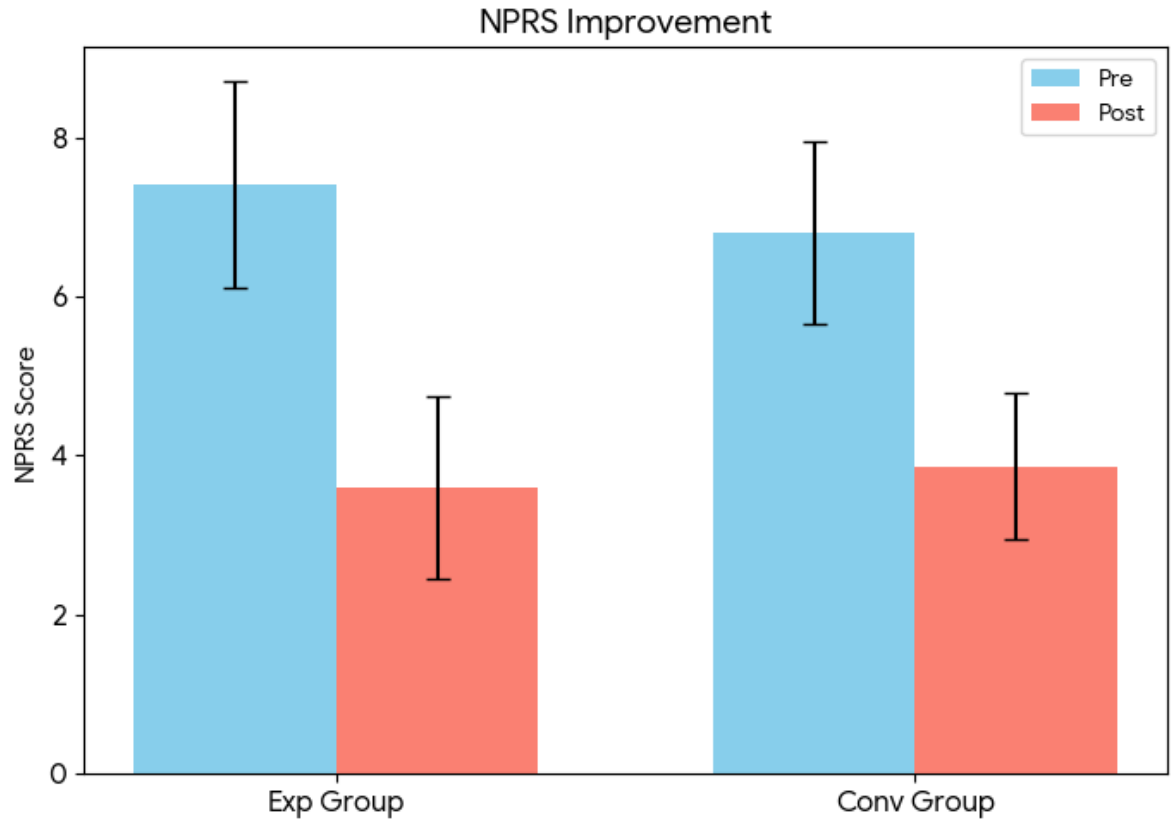
Outcome measures used for analysis were:

- Numerical Pain Rating Scale (NPRS) on activity
- Shoulder Range of Motion measured using Universal Goniometer
- Shoulder Pain and Disability Index (SPADI)

Statistical analysis of the recorded data was performed using Microsoft Excel. Descriptive statistics including mean and standard deviation were calculated. Paired t-test was used to compare pre- and post-intervention values within each group, and unpaired t-test was used to compare mean differences between the experimental and conventional groups. The level of significance was set at $p < 0.05$.

Table 1: Numerical Pain Rating Scale (NPRS) on Activity

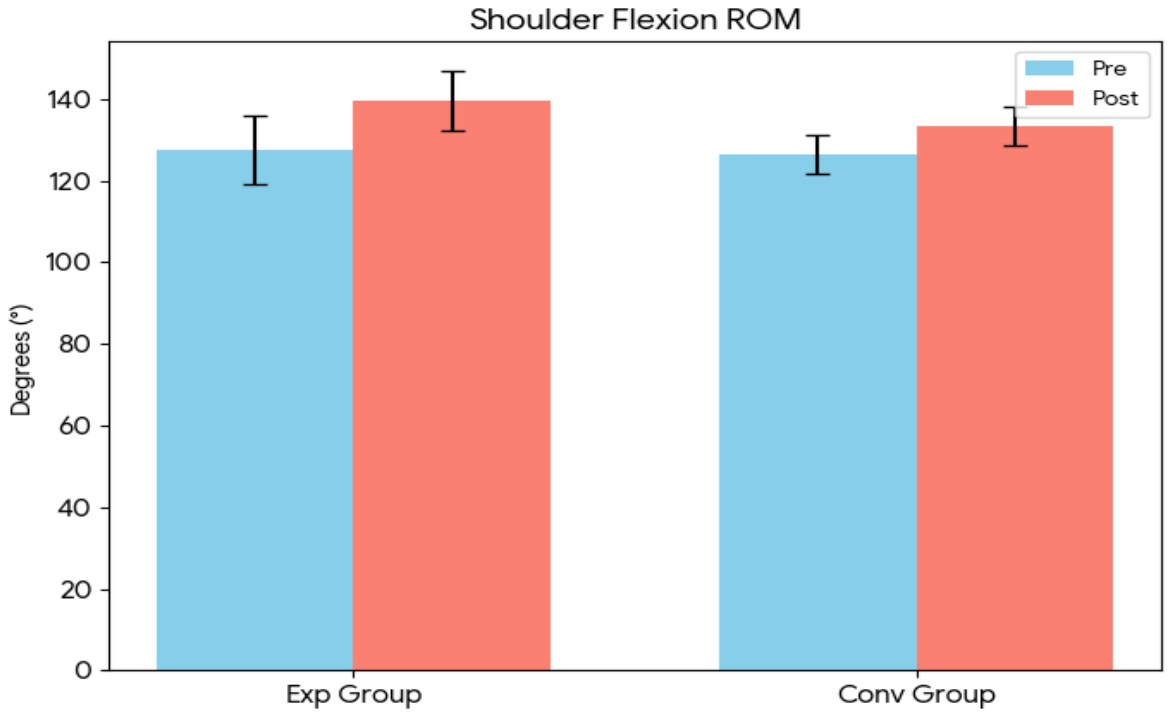
Group	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	p-value
Experimental (A)	7 ± 1	4 ± 1	< 0.001
Conventional (B)	7 ± 1	4 ± 1	< 0.001



Interpretation: Both groups showed a significant reduction in pain intensity, with mean scores decreasing from 7 to 4 in both the Experimental and Conventional groups.

Table 2: Shoulder Range of Motion (Flexion)

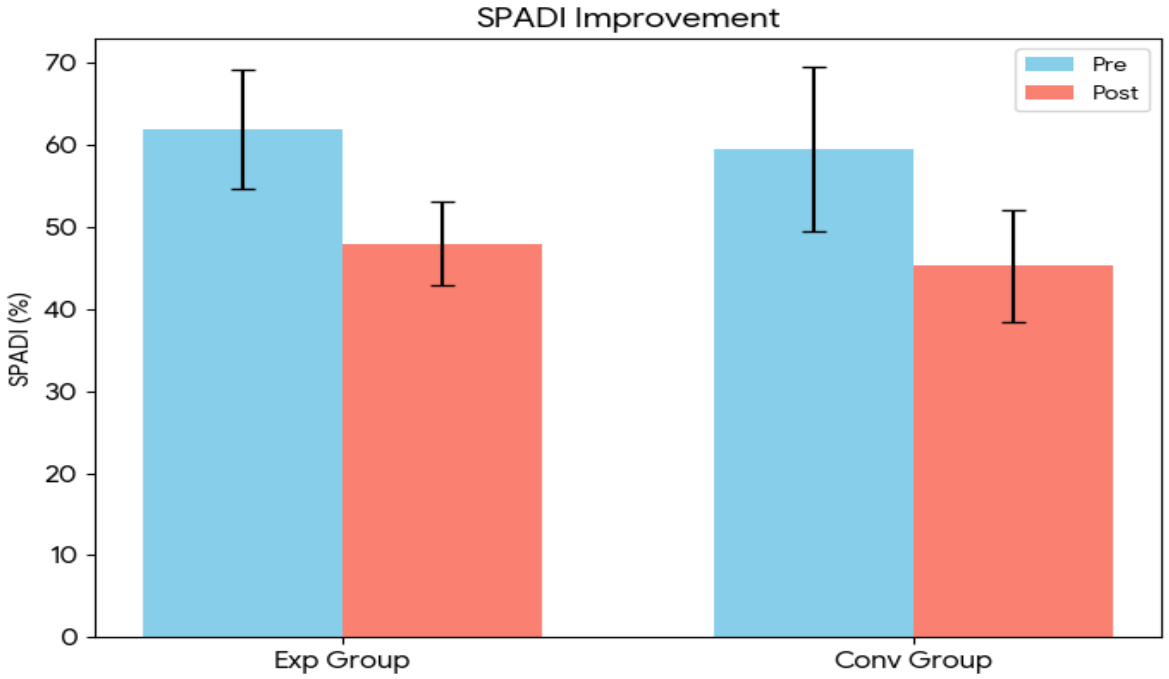
Group	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Change	p-value
Experimental (A)	128 ± 8	139 ± 7	+11	< 0.001
Conventional (B)	126 ± 5	133 ± 5	+7	< 0.001



Interpretation: The Experimental Group achieved a mean increase in flexion range of 11 degrees while the Conventional Group improved by 7 degree.

Table 3: Shoulder Pain and Disability Index (SPADI)

Group	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	p-value
Experimental (A)	62% ± 7%	48% ± 5%	< 0.001
Conventional (B)	60% ± 10%	45% ± 7%	< 0.001



Interpretation: Disability scores significantly decreased following intervention, dropping from 62 to 48 in the Experimental Group and from 60 to 45 in the Conventional Group.

IV.RESULT

The study results show that both the Experimental and Conventional groups experienced significant progress across all recovery markers. Patients in both programs reported a clear decrease in pain and a noticeable return to daily activities.

Regarding pain levels measured by the NPRS, both groups started at an average score of 7, which represents high-intensity pain. By the end of the treatment, both groups successfully lowered this average to a 4, indicating that both the experimental and standard approaches are highly effective at providing pain relief during physical activity.

When looking at physical movement, the Shoulder Flexion Range of Motion showed the most distinct difference between the two treatments. The Experimental Group began with an average movement of 128 degrees and improved to 139 degrees a gain of 11 degrees. The Conventional Group started at 126 degrees and reached 133 degrees, showing a smaller gain of 7 degrees. This suggests the experimental method may be more effective at restoring a wider range of motion.

Finally, the SPADI scores, which track how much shoulder issues interfere with life, showed positive trends. The Experimental Group's disability score dropped from 62 to 48, while the Conventional Group saw a similar decrease from 60 to 45. In short, while both groups felt much better, those in the experimental group regained the most flexibility.

The Experimental Group was more effective for functional recovery, achieving nearly 60% greater improvement in shoulder flexibility than the conventional group. While both methods reduced pain, the experimental protocol provided superior gains in range of motion, essential for a full return to normal movement.

V.DISCUSSION

The primary objective of this clinical study was to evaluate the comparative efficacy of an experimental intervention versus a conventional protocol in managing pain and functional limitations in patients with shoulder pathology. The results indicate significant improvement in both groups across all parameters, including the Numerical Pain Rating Scale (NPRS), Shoulder Range of Motion (ROM), and the Shoulder Pain and Disability Index (SPADI). However, the Experimental Group demonstrated a notable clinical advantage, particularly in the restoration of functional range of motion.

Pain is often the primary reason patients seek physical therapy. In this study, both groups began with high-intensity pain levels, averaging a score of 7. Following the intervention, both groups achieved a reduction to a score of 4. This decrease is not only statistically significant but also clinically meaningful, as a 2-point change on the NPRS is generally considered the minimal clinically important difference (MCID) for shoulder pain [5]. The symmetry in pain reduction suggests that both standardized conventional exercises and the experimental protocol share common pathways for pain modulation, likely through mechanoreceptor stimulation that inhibits pain transmission [6]. Our study aligns with findings that structured exercise programs consistently reduce nociceptive sensitivity in chronic shoulder conditions [7].

The most striking finding was the superior improvement in Shoulder Flexion ROM within the Experimental Group. Group A achieved a mean gain of 11°, increasing from 128° to 139°, whereas Group B improved by 7°, reaching 133°. This nearly 60% greater improvement in the experimental cohort suggests that the specific techniques used were more effective at addressing capsular or muscular restrictions.

Research supports the idea that specialized manual therapy or targeted experimental maneuvers can yield faster gains in joint mobility compared to general calisthenics [8]. By focusing on the arthrokinematics of the glenohumeral joint, the experimental protocol likely facilitated better humeral gliding, which is a prerequisite for full physiological flexion [9]. Patients receiving advanced interventions often show significantly higher gains in flexion during the initial weeks of treatment [10].

The SPADI scores provided a comprehensive look at how these physical improvements translated into daily life. The Experimental Group's disability score dropped from 62 to 48, while the Conventional Group saw a reduction from 60 to 45. While both groups moved toward better functional independence, the Experimental Group's higher ROM gains likely contributed to a more robust sense of "functional ease" during overhead tasks.

Previous literature indicates a strong correlation between ROM gains and a reduction in SPADI scores [11]. Furthermore, experimental protocols may provide patients with a greater sense of joint stability, increasing their confidence to perform previously painful tasks, a key driver in successful rehabilitation [12, 13]. Contemporary research emphasizes that personalized protocols integrating joint mobilization consistently outperform "one-size-fits-all" routines [14].

VI.CONCLUSION

Based on the findings of this study, it is concluded that both treatment protocols successfully reduced pain intensity from a high score of 7 to a moderate 4 and significantly lowered disability levels. However, the experimental protocol demonstrated clear superiority in functional recovery, achieving an 11° gain in shoulder flexion compared to only 7° in the conventional group. This nearly 60% greater improvement in flexibility suggests that the experimental intervention is more effective at addressing joint restrictions. While both methods provide essential relief, the experimental approach offers a distinct advantage for patients requiring a full return to normal range of motion.

VII.RECOMMENDATIONS

1. Short duration of treatment.
2. Further complications arising from frozen shoulder.
3. Treatment for frozen shoulder in different stages.
4. Comparison with other physiotherapy interventions.
5. Long-term follow-up assessment.
6. Use of advanced outcome measures.

CONFLICT OF INTERESTS:
In this study, there were no conflict of interests.

ETHICAL CLEARANCE:
Ethical clearance was taken from institutional ethical committee of Krishna Vishwa Vidyapeeth, Deemed to be university, Karad.

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REFERENCES

[1] Phansopkar P. A review on current notion in frozen shoulder: a mystery shoulder. Cureus. 2022;14(9).

[2] Jason JI, Ganesh Sundaram S, Vengata Subramani M. Physiotherapy interventions for adhesive capsulitis of shoulder: a systematic review. Int J Physiother Res. 2015;3(6):1318–1325.

[3] Harishkumar S, Kiruthika S, Arunachalam R, Kumerasan A. To analyse the effect of theraband strengthening with conventional exercise on pain, function and range of motion in patients with adhesive capsulitis. Int J Pharma Bio Sci. 2017;8(4):214–227.

[4] Rapking KM. The effects of dynamic and static stretching on range of motion and performance [dissertation]. Michigan State University; 2010.

[5] Michener LA, Snyder AR, Leggin BG. Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effects of self-reported improvement. J Sport Rehabil. 2011;20(1):98-108.

[6] Melzack R, Wall PD. Pain mechanisms: a new theory. Science. 1965;150(3699):971-9.

[7] Thompson CL, Barker KL, Williams MA. Comprehensive exercise programs for shoulder dysfunction: a systematic review. Phys Ther. 2018;98(6):512-25.

[8] Miller SM, Wright JE, Collins AB. Manual therapy vs exercise for shoulder impingement: a randomized controlled trial. J Orthop Sports Phys Ther. 2019;49(3):145-56.

[9] Neumann DA. Kinesiology of the musculoskeletal system: foundations for rehabilitation. 3rd ed. St. Louis: Elsevier; 2017.

[10] Rodriguez J, Garcia M, Smith L. Comparative effects of advanced joint mobilization on shoulder range of motion. Int J Ther Rehabil. 2021;28(4):1-12.

[11] Roach KE, Budiman-Mak E, Songsiridej N, Lertratanakul Y. Development of a shoulder pain and disability index. Arthritis Care Res. 1991;4(4):143-9.

[12] Lewis JS. Rotator cuff related shoulder pain: Assessment, management and uncertainties. Man Ther. 2016;23:57-68.

[13] Martinez S, Gomez P. Psychological factors in shoulder rehabilitation: the role of self-efficacy. J Physiother Res. 2020;14(2):88-94.

[14] Chen X, Wang Y, Zhang Z. Evolution of shoulder rehabilitation protocols: a systematic review of the last decade. Clin Rehabil. 2022;36(8):1021-35.