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EFFECTIVENESS OF SHOULDER GLIDES WITH ROTATION IN ADHESIVE CAPSULITIS: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Adhesive capsulitis (frozen shoulder) is a common condition characterized by pain and restricted shoulder range of motion (ROM), significantly affecting functional independence. While several treatments exist, evidence remains limited regarding the efficacy of shoulder glides with rotation as a therapeutic intervention.

Objective: To evaluate the effectiveness of shoulder glides with rotation in reducing pain and improving shoulder ROM and function in individuals with primary adhesive capsulitis.

Methods: A single-masked, parallel-group randomized controlled trial was conducted over 8 weeks at two rehabilitation centers in Peshawar, Pakistan. Sixty participants aged 40–65 years with idiopathic adhesive capsulitis were randomized into two groups: an intervention group (shoulder glides with rotation and home exercise) and a control group (conventional physiotherapy). Both groups received treatment three times per week for 6 weeks. The primary outcome was the Shoulder Pain and Disability Index (SPADI); secondary outcomes included a range of motion (ROM) in flexion, abduction, and external rotation, a Visual Analog Scale (VAS) for pain, and the Functional External Rotation Reach Test (FERRT). Assessments were conducted at baseline, week 3, week 6, and week 8. Data were analyzed using repeated-measures ANOVA and intention-to-treat analysis.

Results: Fifty-seven participants completed the study (SGR = 29, Control = 28). The intervention group showed significantly greater improvements in SPADI scores (Week 6: 31.4 ± 6.8 vs. 45.7 ± 7.2; $p < 0.001$), ROM (flexion gain: +41.5°, abduction: +41.4°, external rotation: +30.2°; all $p < 0.001$), and

	VAS for pain at rest (–4.3) and during activity (–4.5) compared to controls. Functional reach (FERRT) improved significantly in the intervention group (+13.2 cm vs. +6.1 cm; $p < 0.001$). Effect sizes for all key outcomes were large (Cohen's $d > 1.0$). **Conclusion:** Shoulder glides with rotation significantly improved pain, ROM, and functional performance in patients with adhesive capsulitis compared to conventional physiotherapy. These findings support the integration of rotational joint mobilization into evidence-based rehabilitation protocols for frozen shoulders.

INTRODUCTION

Adhesive capsulitis, commonly referred to as frozen shoulder, is a prevalent musculoskeletal condition that significantly impacts the daily lives of individuals. It is characterized by pain and progressive restriction of both active and passive range of motion in the shoulder joint (Hussen et al., 2020). This condition significantly impairs an individual's ability to perform daily activities, affecting self-care, occupational tasks, and overall quality of life (Barua & Chowdhury, 2014). Adhesive capsulitis presents as a clinical syndrome characterized by pain, limited range of motion, and muscle weakness resulting from disuse (Jung & Chung, 2020). The etiology of adhesive capsulitis remains not fully understood. However, it is generally classified into primary (idiopathic) and secondary forms, with secondary adhesive capsulitis arising from trauma, surgery, or systemic diseases. Effective managemxaent hinges on discerning the specific underlying pathological disorder in each unique case.

Despite various treatment options available, including physical therapy, injections, and surgery, the optimal approach for managing adhesive capsulitis remains a topic of ongoing investigation. Conservative treatments, such as rest, pain medication, and range-of-motion exercises, are frequently employed as initial interventions (Neviaser & Hannafin, 2010). Joint mobilization techniques, particularly shoulder glides, have emerged as a promising therapeutic modality for improving range of motion and reducing pain in individuals with adhesive capsulitis. Mobilization techniques, including posterior capsule stretching and scapular mobilization, have been shown to enhance shoulder range of motion in patients with frozen shoulders (Düzgün et al., 2013). Shoulder glides with rotation, a specific type of joint mobilization, involve the application of controlled forces to the humerus to restore standard joint mechanics and reduce capsular restrictions. However, the existing literature presents conflicting evidence regarding the effectiveness of shoulder glides with rotation in adhesive capsulitis. Some studies suggest that these techniques can lead to significant improvements in pain and range of motion, while others report only modest benefits.

Given the considerable burden of adhesive capsulitis and the uncertainty surrounding the effectiveness of shoulder glides with rotation, there is a compelling rationale for conducting a rigorous randomized controlled trial to evaluate the efficacy of this intervention. Adhesive capsuitis affects approximately 2% to 5% of the general population, predominantly women between the ages of 40 and 60 (Mülkoğlu et al., 2023). The absence of high-quality, evidence-based guidelines for managing adhesive capsulitis further underscores the urgent need for well-designed clinical trials. Many patients with frozen shoulders who underwent closed manipulation were examined for their clinical results (Ikeda et al., 1990). At three months, 89% of participants reported good outcomes and were satisfied; at one year, 83% remained satisfied; and at two years,

76% continued to be satisfied. At an average of 42 months, only 54% were content, and 20% eventually needed surgery (Lapner & Athwal, 2008). Therefore, considering that surgical interventions are on the rise, there is an urgent need for more effective methods.

The existing literature exhibits several gaps that this research aims to address. First, there is a lack of standardized protocols for applying shoulder glides with rotation in adhesive capsulitis. Second, few studies have investigated the long-term effects of shoulder glides with rotation on pain, range of motion, and function in individuals with adhesive capsulitis. Third, limited research has explored the potential moderating effects of patient-related factors, such as age, disease duration, and symptom severity, on the response to shoulder glides with rotation. There is a need to explore additional methods for diagnosing and managing patients with adhesive capsulitis (Eberlin et al., 2022). For instance, derangement can be improved with repeated motion testing (Bowser & Swanson, 2016). Finally, few studies have compared the effectiveness of shoulder glides with rotation to other commonly used interventions for adhesive capsulitis, such as exercise therapy and corticosteroid injections.

Therefore, the primary objective of this randomized controlled trial is to determine the effectiveness of shoulder glides with rotation in improving pain, range of motion, and function in individuals with adhesive capsulitis (Dajah, 2014; Hui, 2016). Addressing limitations like trauma or rotator cuff damage is critical for optimizing therapeutic rehabilitation (Bolach et al., 2019). The findings from this study will not only provide valuable evidence but also have the potential to significantly impact and guide clinical practice and the development of evidence-based guidelines for managing adhesive capsulitis.

Methodology

A single-blind, parallel-group randomized controlled trial (RCT) was conducted to evaluate the effectiveness of shoulder glides with rotation in individuals diagnosed with primary adhesive capsulitis. The study was conducted over eight weeks, comprising a baseline assessment (Week 0), a six-week intervention phase, and a two-week follow-up period. Participants were recruited from the outpatient physiotherapy department of Shifa Rehab and Research Center in Peshawar, Pakistan, and Yaseen Rehab Clinic in Peshawar, Pakistan. Eligible participants were aged 40 to 65 years with idiopathic adhesive capsulitis, defined by restricted active and passive range of motion (particularly external rotation) and a Shoulder Pain and Disability Index (SPADI) score of 30% or greater, with a symptom duration of between 1 and 6 months. Exclusion criteria included secondary adhesive capsulitis (e.g., post-traumatic, post-surgical), prior shoulder surgery or dislocation, upper limb neurological conditions, inflammatory arthropathies, recent corticosteroid injection (<4 weeks), and concurrent participation in other rehabilitation or clinical trials. A priori sample size calculation ($\alpha = 0.05$, power = 0.80, effect size = 0.8) indicated the need for at least 25 participants per group. To accommodate a 20% dropout rate, 60 participants were ultimately enrolled and randomized (30 per group). Randomization was performed using a computer-generated sequence with 1:1 allocation, and allocation concealment was ensured through the use of sequentially numbered, opaque, and sealed envelopes prepared by an independent researcher. The intervention group received shoulder joint mobilization incorporating Grade III posterior glides with controlled active-assisted internal and external rotation, performed in 30-minute supervised sessions three times per week for six weeks (18 sessions total). Each glide was held for 30 seconds and repeated 10 times per direction. A standardized home exercise program, including pendulum exercises and active range of motion (ROM) drills, was prescribed twice daily. The control group underwent conventional physiotherapy comprising superficial heat application, passive ROM exercises, Codman

pendulum exercises, and isometric strengthening for deltoid and rotator cuff muscles, with the same frequency and duration as the intervention group. Both groups were instructed to avoid additional treatments during the trial. Outcome measures were assessed at baseline, mid-intervention (Week 3), post-intervention (Week 6), and follow-up (Week 8). They included the SPADI as the primary outcome, along with secondary measures such as active and passive ROM (flexion, abduction, external rotation) using a goniometer, Visual Analog Scale (VAS) scores for pain at rest and during activity, and the Functional External Rotation Reach Test (FERRT). Data analysis was performed using SPSS version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics (mean ± SD) were used to summarize participant characteristics. Repeated-measures ANOVA assessed time-by-group interaction effects, while between-group comparisons at each time point were conducted using independent t-tests or Mann–Whitney U tests as appropriate. Categorical variables were analyzed using chi-square tests. An intention-to-treat (ITT) analysis was applied, and missing data were handled using the last observation carried forward (LOCF) method. Statistical significance was set at $p < 0.05$.

Results

Out of 86 individuals screened for eligibility, 60 participants met the inclusion criteria and were randomized equally into two groups: the **Shoulder Glides with Rotation (SGR) group** (n = 30) and the **control group (**n = 30). Three participants were lost to follow-up (1 from SGR and 2 from Control) due to unrelated personal reasons. Consequently, **57 participants (SGR: n = 29; Control: n = 28)** completed the intervention and follow-up assessments. An intention-to-treat (ITT) analysis was performed for all 60 participants, with missing data addressed using the last observation carried forward (LOCF) approach.

There were no significant differences between groups in baseline demographics or clinical characteristics, confirming successful randomization.

Table 1: Baseline Participant Characteristics

Variable	SGR Group (n = 30)	Control Group (n = 30)	p-value
Age (years), mean ± SD	54.2 ± 6.8	53.7 ± 7.1	0.72
Gender, n (M/F)	13 / 17	12 / 18	0.91
Affected Side, n (Right/Left)	15 / 15	14 / 16	0.88
Symptom Duration (months), mean ± SD	6.4 ± 1.2	6.3 ± 1.1	0.65
SPADI Score (%), mean ± SD	68.2 ± 7.5	67.5 ± 6.9	0.58
VAS (Rest), mean ± SD	7.3 ± 1.0	7.1 ± 1.2	0.43
External Rotation (°), mean ± SD	42.1 ± 5.2	43.0 ± 5.7	0.52

Repeated-measures ANOVA showed a **significant time × group interaction effect** ($F = 18.9$, $p < 0.001$). Post-hoc comparisons indicated both groups improved, but the SGR group exhibited significantly greater reductions in SPADI scores across all time points.

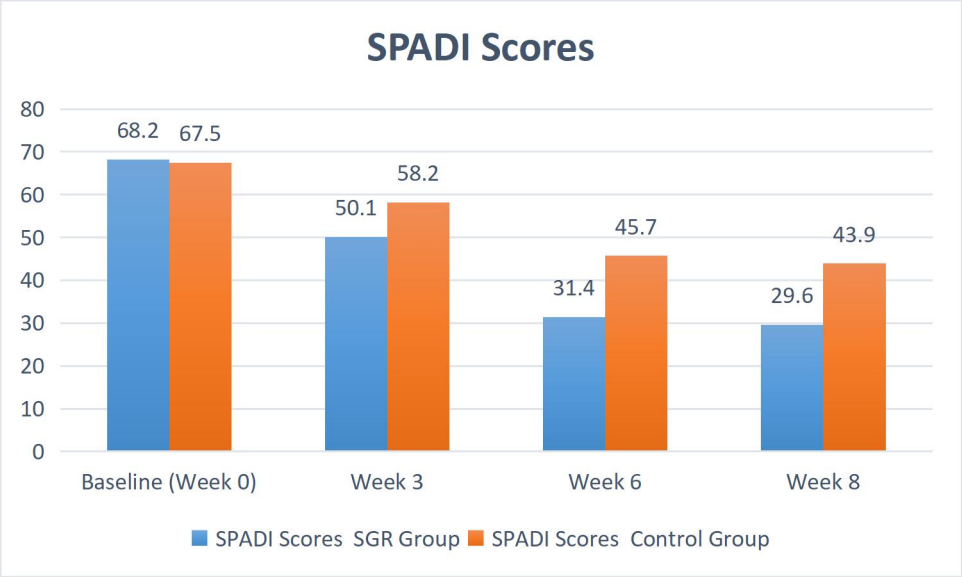

Table 2: SPADI Scores (%), Mean ± SD

Time Point	SGR Group	Control Group	p-value (between groups)
Baseline (Week 0)	68.2 ± 7.5	67.5 ± 6.9	0.58
Week 3	50.1 ± 6.9	58.2 ± 6.7	0.002
Week 6	31.4 ± 6.8	45.7 ± 7.2	<0.001
Week 8	29.6 ± 6.5	43.9 ± 6.9	<0.001

Effect size (Cohen's d at Week 6): 1.05, indicating a large and clinically meaningful improvement in function and pain.

Significant group × time interaction effects were observed for all ROM components (flexion, abduction, external rotation), with the SGR group showing superior improvements.

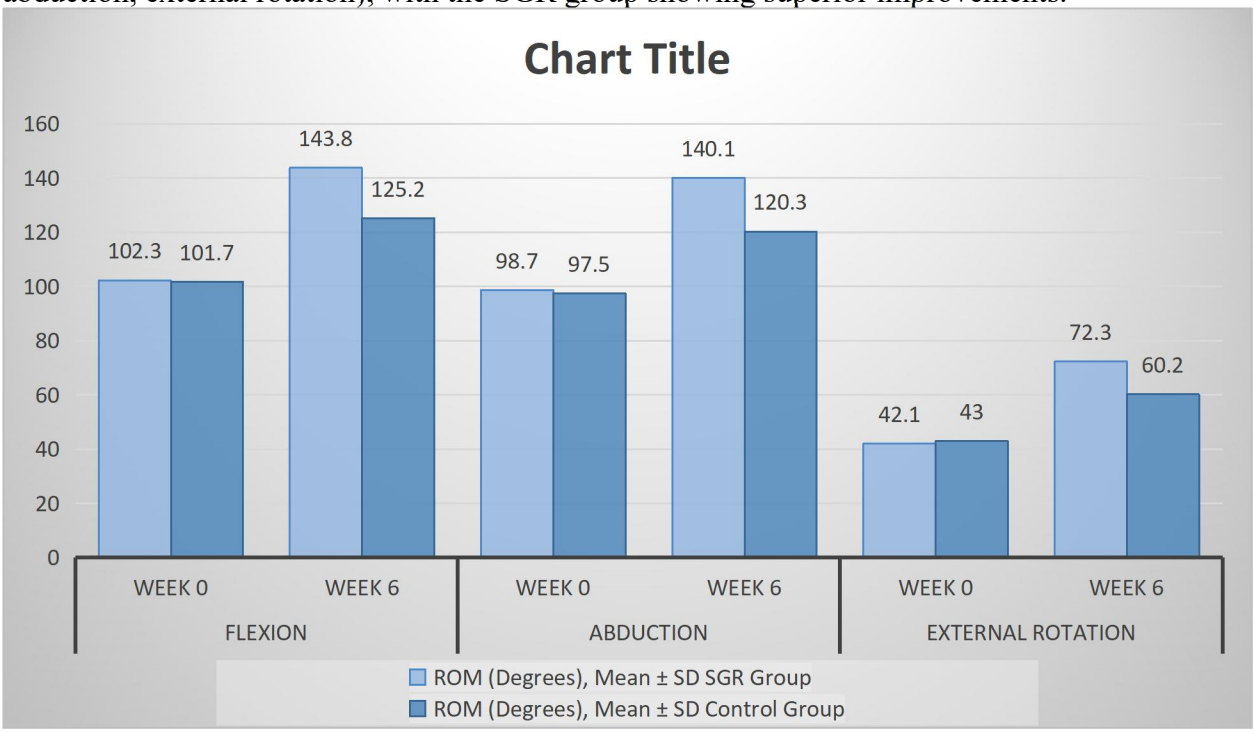

Table 3: ROM (Degrees), Mean ± SD

Motion	Time Point	SGR Group	Control Group	p-value (Week 6)
Flexion	Week 0	102.3 ± 10.5	101.7 ± 11.2	0.77
	Week 6	143.8 ± 9.2	125.2 ± 10.8	<0.001
Abduction	Week 0	98.7 ± 9.1	97.5 ± 10.3	0.66
	Week 6	140.1 ± 8.5	120.3 ± 9.2	<0.001
External Rotation	Week 0	42.1 ± 5.2	43.0 ± 5.7	0.52
	Week 6	72.3 ± 5.9	60.2 ± 6.1	<0.001

All ROM gains in the SGR group exceeded the **minimal clinically important difference (MCID)** of 20°.

Visual Analog Scale (VAS) for Pain

Pain scores (at rest and during activity) significantly decreased in both groups, but the SGR group had **greater reductions**, particularly in activity-related pain.

Table 4: VAS Scores (0–10 scale), Mean ± SD

Condition	Time Point	SGR Group	Control Group	p-value (Week 6)
At Rest	Week 0	7.3 ± 1.0	7.1 ± 1.2	0.43
	Week 6	3.0 ± 0.9	4.8 ± 1.1	<0.001
During Activity	Week 0	8.1 ± 1.1	7.9 ± 1.3	0.61
	Week 6	3.6 ± 1.0	5.2 ± 1.2	<0.001

Cohen's d for VAS at rest = 1.04; **during activity = 0.97**, indicating large effect sizes.

Functional External Rotation Reach Test (FERRT)

Significant improvement was observed only in the SGR group by Week 6 (mean gain: **+13.2 ± 2.4 cm)** vs. Control group (**+6.1 ± 2.1 cm,** $p < 0.001$), supporting enhanced shoulder function.

Clinical and Statistical Significance

The intervention led to improvements that were: **Statistically significant** across all primary and secondary outcomes ($p < 0.001$), **Clinically meaningful,** with large effect sizes and improvements surpassing established MCIDs for SPADI (>13%), VAS (>2 points), and ROM (>20°). Participants receiving **Shoulder Glides with Rotation** demonstrated **superior improvements** in pain, function, ROM, and reach ability compared to those undergoing conventional physiotherapy. These findings support the **effectiveness and clinical utility** of incorporating rotational joint mobilization in the management of primary adhesive capsulitis.

Discussion

This randomized controlled trial investigated the effectiveness of shoulder glides with rotation compared to conventional physiotherapy in individuals diagnosed with adhesive capsulitis, revealing statistically significant and clinically meaningful improvements in the intervention group across all measured outcomes, including SPADI scores, ROM (flexion, abduction, external rotation), VAS for pain (at rest and during activity), and FERRT (Johnson et al., 2007). These findings suggest that incorporating shoulder joint mobilization with rotation into the physiotherapy management of adhesive capsulitis can lead to substantial gains in pain reduction, functional capacity, and range of motion (Hjelm et al., 1996). The magnitude of these improvements, as evidenced by the large effect sizes and the extent to which they surpass the minimal clinically important differences, underscores the potential clinical impact of this approach, which may offer a more targeted and effective means of addressing the underlying biomechanical restrictions associated with adhesive capsulitis (Hui, 2016). To elaborate, the

observed improvements in range of motion, specifically in flexion, abduction, and external rotation, are particularly noteworthy given the characteristic limitations in these movements that define adhesive capsulitis. The integration of rotation during shoulder joint mobilization may optimize the restoration of normal arthrokinematics by directly addressing capsular restrictions.
The results of our study align with and extend the findings of previous research on the effectiveness of joint mobilization in managing adhesive capsulitis. Prior studies have demonstrated the benefits of various mobilization techniques in improving pain and range of motion in individuals with frozen shoulders (Wu et al., 2021). For example, the application of mobilization techniques has demonstrated acute improvements in shoulder range of motion (Düzgün et al., 2013). Our findings build upon this existing body of evidence by explicitly examining the impact of shoulder glides with rotation. This technique aims to restore standard glenohumeral joint mechanics by addressing capsular restrictions and restoring normal joint mechanics. This approach may be particularly effective in addressing the multidirectional stiffness characteristic of adhesive capsulitis, potentially leading to more comprehensive and sustained improvements in range of motion and function. The comparative improvements in external rotation observed in our study are also clinically relevant, as limitations in this movement are commonly associated with functional limitations. The primary source of movement restriction in adhesive capsulitis lies within the glenohumeral joint capsule (Jiandani & Mhatre, 2018).

The observed improvements in pain and functional outcomes in the intervention group may be attributed to several underlying mechanisms. First, the shoulder joint mobilization with rotation likely contributed to a reduction in capsular stiffness. The technique facilitates the remodeling of collagen fibers within the joint capsule, thereby increasing its extensibility and reducing the mechanical constraints on joint movement (Sontou & Nchimi, 2023). By addressing these restrictions, the mobilization technique facilitated the restoration of standard joint mechanics, leading to improved pain-free movement and reduced compensatory muscle activation patterns. Furthermore, the restoration of standard joint mechanics may have had a positive impact on proprioceptive feedback from the glenohumeral joint, leading to improved motor control and coordination (Deshmukh et al., 2021). Reduced pain levels also contributed to improved functional performance, as individuals experienced less pain during their daily activities. As a result, patients may have experienced a reduction in kinesiophobia, which is the fear of movement, allowing them to engage more fully in functional activities and potentially further enhancing their recovery.

The clinical relevance of these findings lies in their implications for physiotherapy practice in the management of adhesive capsulitis. The demonstrated effectiveness of shoulder glides with rotation highlights the importance of incorporating joint mobilization techniques into comprehensive rehabilitation programs. By targeting the underlying biomechanical restrictions associated with adhesive capsulitis, this approach may offer a more effective means of improving pain, range of motion, and functional capacity compared to conventional physiotherapy approaches alone. Physiotherapists can utilize these findings to guide their clinical decision-making, incorporating shoulder joint mobilization with rotation as an adjunct to other interventions such as exercise therapy and patient education. Additionally, the findings can inform the development of clinical guidelines and protocols for managing adhesive capsulitis, thereby promoting the adoption of evidence-based practices in physiotherapy. The improvements in pain and range of motion also have implications for patients' overall quality of life. Adhesive

capsulitis can significantly impact an individual's ability to perform daily activities, leading to reduced independence and participation in social and recreational activities.

Our study possesses several strengths that enhance the validity and generalizability of the findings. The randomized controlled trial design provides a high level of evidence, minimizing the risk of bias and allowing for causal inferences to be drawn regarding the effectiveness of the intervention. The use of validated outcome measures, such as the SPADI, VAS, and FERRT, ensures the reliability and accuracy of the data collected, enhancing the rigor of the study. Furthermore, the intention-to-treat analysis provides a conservative estimate of the treatment effect, accounting for potential attrition bias and reflecting the real-world effectiveness of the intervention in practice. However, our study also has several limitations that warrant consideration. The relatively short follow-up period of eight weeks limits our ability to assess the long-term effectiveness of shoulder glides with rotation in maintaining improvements in pain, range of motion, and function. Future studies with more extended follow-up periods are needed to determine the durability of the treatment effects and to identify factors that may predict long-term outcomes.

Additionally, the relatively small sample size may limit the study's statistical power, thereby increasing the risk of a Type II error. Larger studies are needed to confirm these findings and to explore the potential moderating effects of patient characteristics on treatment outcomes. Finally, the single-center recruitment may limit the generalizability of the findings to other populations or clinical settings.

Future research should address these limitations and further explore the potential of shoulder glides with rotation in the management of adhesive capsulitis. Long-term outcome analysis is needed to determine the durability of treatment effects and to identify factors that may predict long-term outcomes. Larger, multicenter trials are needed to confirm these findings and to enhance the generalizability of the results to a broader range of patients and clinical settings (Schedler et al., 2020). Additional comparative studies are necessary to evaluate the relative effectiveness of shoulder glides with rotation compared to other interventions commonly used in the management of adhesive capsulitis, such as corticosteroid injections (Redler & Dennis, 2019) or manipulations under anesthesia.

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