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COMPARISON OF SPENSER TECHNIQUE AND POST-ISOMETRIC RELAXATION ON PAIN, RANGE OF MOTION, AND FUNCTIONAL DISABILITY IN FROZEN SHOULDER PATIENTS

Original Research

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ABSTRACT

Background: Frozen shoulder, also known as adhesive capsulitis, is a common musculoskeletal disorder characterized by progressive pain, joint stiffness, and restricted shoulder mobility that significantly affects daily functioning. It typically occurs in middle-aged individuals and may persist for prolonged periods if not managed appropriately. Manual therapy interventions are widely used in physiotherapy practice to restore mobility and reduce pain. Among these, the Spencer Muscle Energy Technique and Post-Isometric Relaxation (PIR) are frequently applied; however, direct comparative evidence regarding their clinical effectiveness remains limited.

Objective: To compare the effects of the Spencer Muscle Energy Technique and Post-Isometric Relaxation on pain intensity, shoulder range of motion, and functional disability in patients with frozen shoulder.

Methods: A randomized comparative clinical trial was conducted involving 42 patients diagnosed with frozen shoulder. Participants were randomly assigned into two equal groups: Group A received the Spencer Muscle Energy Technique, while Group B received Post-Isometric Relaxation. Both groups underwent supervised treatment sessions three times per week for eight weeks, along with conventional physiotherapy exercises. Outcome measures included the Numeric Pain Rating Scale (NPRS) for pain assessment, the Shoulder Pain and Disability Index (SPADI) for functional evaluation, and goniometric measurement of shoulder abduction and external rotation. Assessments were performed at baseline, four weeks, and eight weeks. Data normality was assessed using the Shapiro–Wilk test, which indicated non-normal distribution; therefore, non-parametric statistical tests including the Mann–Whitney U test, Wilcoxon signed-rank test, and Friedman test were applied.

Results: Both groups demonstrated significant within-group improvements across all outcome measures over the study period ($p < 0.001$). Between-group analysis revealed that Group A showed significantly lower NPRS scores at four weeks (mean rank 25.86 vs. 17.14; $p = 0.008$) and eight weeks (mean rank 26.29 vs. 16.71; $p = 0.004$) compared with Group B. Shoulder abduction also improved significantly more in Group A at eight weeks (mean rank 31.52 vs. 11.48; $p < 0.001$). No statistically significant differences were observed between groups for SPADI pain ($p = 0.444$ at 4 weeks; $p = 0.177$ at 8 weeks), SPADI disability ($p = 1.00$ at 4 weeks; $p = 0.052$ at 8 weeks), or external rotation ($p = 0.610$ at 4 weeks; $p = 0.147$ at 8 weeks).

Conclusion: Both the Spencer Muscle Energy Technique and Post-Isometric Relaxation were effective in improving pain, shoulder mobility, and functional disability in individuals with frozen shoulder. However, the Spencer technique demonstrated comparatively greater effectiveness in reducing overall pain and improving shoulder abduction, suggesting its potential advantage as a targeted manual therapy intervention in frozen shoulder rehabilitation.

Keywords: Adhesive Capsulitis, Muscle Energy Techniques, Pain Measurement, Range of Motion Articular, Rehabilitation, Shoulder Pain, Shoulder Joint.

INTRODUCTION

Adhesive capsulitis, commonly referred to as frozen shoulder, is a disabling musculoskeletal disorder characterized by the gradual onset of shoulder pain, progressive stiffness, and marked restriction in both active and passive glenohumeral range of motion. It represents a significant clinical concern due to its prolonged course and the considerable functional impairment it imposes on affected individuals. Epidemiological studies estimate that frozen shoulder affects approximately 2–5% of the general population, with a higher prevalence among individuals between the fifth and sixth decades of life. Women are reported to be more frequently affected than men, and the condition often involves the non-dominant upper limb (1,2). The clinical course of adhesive capsulitis can substantially limit the performance of daily activities, occupational tasks, and overall quality of life, thereby creating both personal and socioeconomic burdens. Although the exact pathophysiological mechanisms underlying frozen shoulder remain incompletely understood, current evidence suggests that the disorder involves a chronic inflammatory process followed by fibro-proliferative changes within the glenohumeral joint capsule. These pathological changes lead to thickening and contracture of the capsule, particularly in the rotator interval and the coracohumeral ligament, ultimately producing the characteristic capsular restriction of shoulder movements (1–3). Clinically, this capsular pattern manifests as a progressive limitation in external rotation, followed by abduction and internal rotation, accompanied by pain and functional disability (1,4,5). Histological investigations further support the presence of synovial inflammation, capsular fibrosis, and collagen remodeling, which together contribute to joint stiffness and restricted mobility.

The natural history of adhesive capsulitis is commonly described as progressing through three overlapping stages: the painful "freezing" stage, the stiff "frozen" stage, and the recovery or "thawing" stage. These phases may extend over a prolonged period, typically ranging from one to three years, during which patients experience varying degrees of pain and restricted motion (2,6). Despite its self-limiting nature in some individuals, many patients continue to experience persistent limitations that interfere with functional independence and occupational productivity. Consequently, early and effective therapeutic interventions are essential to reduce pain, restore joint mobility, and prevent long-term disability. Management strategies for frozen shoulder are diverse and often tailored according to the stage and severity of the condition. Conservative approaches remain the cornerstone of treatment and typically include pharmacological therapy, intra-articular corticosteroid injections, physical therapy interventions, and structured exercise programs. In cases where conservative management fails, invasive procedures such as manipulation under anesthesia or arthroscopic capsular release may be considered (7). Among conservative modalities, physiotherapy interventions play a pivotal role in restoring shoulder function through pain modulation, capsular stretching, and improvement of joint mobility. Manual therapy techniques have gained considerable attention in recent years due to their ability to directly influence soft tissue extensibility and joint mechanics (8).

One commonly utilized manual therapy intervention is the Spencer technique, a form of muscle energy technique specifically designed to improve glenohumeral joint mobility through sequential mobilization of the shoulder joint. This technique involves a series of controlled movements combined with patient-generated muscle contractions, which aim to enhance capsular elasticity, reduce joint stiffness, and facilitate improved range of motion. The therapeutic effects are believed to arise from neurophysiological mechanisms such as reflex muscle relaxation, increased joint lubrication, and mechanical stretching of periarticular structures (8,9). Clinical evidence suggests that the Spencer technique can significantly improve shoulder mobility and reduce pain in patients with adhesive capsulitis. Another widely applied manual therapy intervention is post-isometric relaxation, which is based on the principle of muscle energy techniques involving gentle isometric contraction followed by relaxation and passive stretching. This approach utilizes the physiological phenomenon of autogenic inhibition mediated through Golgi tendon organ activation, allowing the muscle to relax after contraction and enabling greater elongation of shortened or hypertonic tissues. Post-isometric relaxation has been widely used in musculoskeletal rehabilitation to decrease muscle tension, enhance joint mobility, and improve functional movement patterns (9). In the context of frozen shoulder, this technique may help alleviate muscular guarding and capsular tightness that contribute to movement restriction.

Although both the Spencer technique and post-isometric relaxation are commonly employed in physiotherapy practice for the management of adhesive capsulitis, evidence comparing their relative effectiveness remains limited. Previous investigations have demonstrated that manual mobilization techniques, including Spencer technique and other mobilization approaches such as Gong mobilization, can significantly improve shoulder range of motion and functional outcomes, with some studies suggesting superior improvements with certain mobilization strategies (10). However, the comparative impact of Spencer technique and post-isometric relaxation on pain reduction, range of motion restoration, and functional disability has not been extensively explored. The lack of direct comparative evidence limits the ability of clinicians to determine which intervention may provide greater therapeutic benefit in patients with frozen shoulder (8,10). Given the substantial functional impairment associated with adhesive capsulitis and the widespread use of manual therapy techniques in its management, identifying the most effective intervention is essential for evidence-based clinical decision-making. Understanding the differential effects of these therapeutic approaches may assist physiotherapists in optimizing treatment protocols aimed at improving patient outcomes and accelerating functional recovery. Therefore, the present study seeks to address this gap in the literature by investigating whether the Spencer technique or post-isometric relaxation provides superior improvements in pain intensity, shoulder range of motion, and functional disability among individuals diagnosed with frozen shoulder. The objective of this study is to compare the effectiveness of the Spencer Muscle Energy Technique and post-isometric relaxation in reducing pain, enhancing shoulder mobility, and improving functional ability in patients with adhesive capsulitis (8–10).

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METHODS

The present study was conducted using a single-blind randomized controlled trial design with two parallel intervention groups. The research was carried out at Johar Medicare Complex, Lahore, over a period of eight months. The trial aimed to evaluate and compare the therapeutic effectiveness of the Spencer technique and post-isometric relaxation in individuals diagnosed with adhesive capsulitis of the shoulder. Prior to participant recruitment, a statistical power analysis was performed using G*Power software (version 3.1.9.4) to estimate the required sample size. The calculation was based on an independent samples t-test with a predetermined effect size (d) of 1.116, an alpha level (α) of 0.05, a statistical power (1−β) of 0.95, and an allocation ratio of 1:1. The analysis indicated that a total of 44 participants would be sufficient to detect statistically significant differences between the two intervention groups. Accordingly, 44 eligible participants were recruited and randomly assigned to two groups, with 22 participants allocated to each intervention arm. Participants were selected according to predefined eligibility criteria to ensure the homogeneity and clinical relevance of the study population. Individuals aged between 40 and 65 years with a clinical diagnosis of primary adhesive capsulitis were considered for inclusion. Only those presenting with stage II (frozen stage) or stage III (thawing stage) adhesive capsulitis were recruited, as these stages are characterized by marked joint stiffness and functional restriction where physiotherapy interventions are considered particularly beneficial. Participants were required to have a symptom duration of at least three months, significant restriction in passive glenohumeral range of motion, and a baseline pain intensity score of five or higher on the Numeric Pain Rating Scale (NPRS). Patients with secondary causes of frozen shoulder, including traumatic injury, post-surgical stiffness, rotator cuff tears, or systemic conditions affecting shoulder mobility, were excluded from the study. Additional exclusion criteria included the presence of neurological deficits affecting upper limb function, recent intra-articular corticosteroid injections within the previous three months, systemic inflammatory disorders, or any medical condition that contraindicated manual therapy interventions. Individuals who were unable to comply with the treatment protocol or follow-up assessments were also excluded.

Participant recruitment was carried out using a simple random sampling approach. Random allocation was implemented through a computer-generated randomization sequence to ensure unbiased group assignment. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes prepared prior to participant enrollment. Each envelope contained the group assignment and was opened only after the participant had been formally enrolled in the study. The trial followed a single-blind design in which the outcome assessor remained blinded to group allocation in order to reduce measurement bias. Participants received verbal and written information regarding the purpose and procedures of the study before enrollment, and written informed consent was obtained from all individuals prior to participation. Both groups underwent a structured four-week intervention program consisting of three treatment sessions per week, resulting in a total of twelve supervised sessions. Each treatment session was conducted by a licensed physiotherapist trained in manual therapy techniques. In order to maintain consistency between groups, all participants received a standardized conventional physiotherapy program in addition to their assigned intervention. This baseline physiotherapy protocol included the application of moist heat therapy to reduce pain and muscle stiffness, passive and active stretching exercises targeting the shoulder capsule, Codman's pendulum exercises to facilitate joint mobility, and scapulothoracic range of motion exercises designed to improve shoulder girdle mechanics. These conventional therapeutic exercises were provided to both groups to ensure that any observed differences in outcomes could be attributed primarily to the specific manual therapy techniques under investigation.

Participants assigned to the experimental group (Group A) received the Spencer technique as the primary manual therapy intervention. The Spencer technique is a structured muscle energy mobilization method involving a sequence of seven stages designed to mobilize the glenohumeral joint through controlled movement patterns. These stages typically include shoulder extension, flexion, circumduction with compression, circumduction with distraction, abduction with internal rotation, adduction with external rotation, and lymphatic pumping techniques. Each movement is performed within the patient's comfortable range while incorporating gentle patient-generated muscle contractions followed by therapist-assisted mobilization. The technique aims to improve capsular flexibility, reduce periarticular stiffness, and restore physiological joint motion. Participants in the comparison group (Group B) received the post-isometric relaxation technique. This intervention was applied to the most restricted shoulder movements identified during clinical assessment. The technique involved asking the participant to perform a gentle isometric contraction of the affected muscle group against the therapist's resistance for several seconds, followed by relaxation and passive stretching of the targeted muscle. This contract-relax sequence was repeated several times to facilitate muscle relaxation through autogenic inhibition mechanisms mediated by the Golgi tendon organs. The procedure was designed to decrease muscular hypertonicity, reduce protective muscle guarding, and allow gradual improvement in joint mobility.

Outcome measures were recorded at three different time points: baseline assessment prior to the initiation of treatment, immediately after completion of the four-week intervention program, and at an eight-week follow-up to evaluate short-term retention of treatment effects. Pain intensity was assessed using the Numeric Pain Rating Scale (NPRS), a widely validated tool that allows participants to rate their pain on a scale ranging from 0 (no pain) to 10 (worst imaginable pain). Active shoulder range of motion was measured using a universal goniometer for shoulder flexion, abduction, and external rotation. Functional disability associated with shoulder pain was evaluated using the Shoulder Pain and Disability Index (SPADI), a validated patient-reported outcome measure consisting of pain and disability subscales that quantify the impact of shoulder dysfunction on daily activities. Collected data were entered and analyzed using statistical software to determine the effectiveness of the interventions. Descriptive statistics were used to summarize demographic and baseline characteristics of the participants. Inferential statistical analysis was performed to compare changes in outcome measures within and between groups across different time points. Appropriate statistical tests, including independent samples t-tests and repeated measures analysis of variance (ANOVA), were applied to evaluate treatment effects. A significance level of $p < 0.05$ was considered statistically significant.

Ethical considerations were carefully addressed throughout the study. Ethical approval for the research protocol was obtained from the Institutional Ethical Review Committee of The Superior University, Lahore. The study was conducted in accordance with recognized ethical guidelines for research involving human participants. All participants were informed about the purpose, procedures, potential risks, and expected benefits of the study prior to enrollment. Written informed consent was obtained from each participant, and confidentiality of personal and medical information was strictly maintained. Participants were also informed of their right to withdraw from the study at any stage without any consequences to their ongoing medical care.

RESULTS

A total of 42 participants completed the study, with 21 participants in each group. At baseline, the two groups demonstrated broadly comparable demographic and anthropometric characteristics. In Group A, the mean age was 45.81 ± 9.56 years (range: 34–65), whereas in Group B it was 50.95 ± 5.45 years (range: 44–65). Sex distribution was identical in both groups, with a mean coded value of 1.57 ± 0.51. Mean body weight was 79.33 ± 8.34 kg in Group A and 77.67 ± 7.07 kg in Group B, while mean height was 5.376 ± 0.145 feet and 5.386 ± 0.193 feet, respectively. The recorded body mass index values were also similar between groups, with mean coded values of 3.333 ± 0.483 in Group A and 3.238 ± 0.436 in Group B. Assessment of baseline normality using the Shapiro–Wilk test showed that all principal outcome variables departed significantly from a normal distribution in both groups. For most baseline variables, the Shapiro–Wilk statistic was 0.484 with $p = 0.000$, while the pre-intervention SPADI disability score in Group B showed a statistic of 0.341 with $p = 0.000$. On this basis, non-parametric methods were applied for inferential analysis.

Between-group analysis showed that baseline pain intensity, disability, and range of motion were comparable across the two groups. For the Numeric Pain Rating Scale (NPRS), the mean rank at baseline was identical in both groups at 21.50, with $p = 1.00$. At four weeks, Group A demonstrated lower pain scores than Group B, reflected by mean ranks of 25.86 versus 17.14, with $p = 0.008$. This difference remained evident at the eight-week follow-up, where mean ranks were 26.29 in Group A and 16.71 in Group B, with $p = 0.004$. Similar baseline equivalence was observed for the SPADI pain subscale, where mean ranks were 21.00 in Group A and 22.00 in Group B ($p = 0.710$). At four weeks, mean ranks were 22.76 and 20.24, respectively ($p = 0.444$), and at eight weeks they were 23.79 and 19.21 ($p = 0.177$), indicating no statistically significant difference between groups for this outcome. For SPADI disability, baseline mean ranks were 23.00 in Group A and 20.00 in Group B, with $p = 0.220$. At four weeks, both groups had identical mean ranks of 21.50, with $p = 1.00$. At eight weeks, mean ranks were 18.29 in Group A and 24.71 in Group B, with $p = 0.052$. For external rotation, baseline mean ranks were 20.50 in Group A and 22.50 in Group B, with $p = 0.474$. At four weeks, the mean ranks were 22.19 and 20.81, respectively, with $p = 0.610$. For abduction, baseline values were also identical, with mean ranks of 21.50 in both groups and $p = 1.00$. At four weeks, mean ranks were 23.19 in Group A and 19.81 in Group B, with $p = 0.244$. By eight weeks, a marked between-group difference emerged for abduction, with Group A showing a mean rank of 31.52 compared with 11.48 in Group B, yielding $p < 0.001$.

Within-group analysis demonstrated statistically significant improvements over time in the overall sample across all principal outcomes. NPRS scores decreased significantly from baseline to four weeks ($p < 0.001$), from baseline to eight weeks ($p < 0.001$), and from four weeks to eight weeks ($p < 0.001$). Similar patterns were observed for the SPADI pain subscale, which improved significantly from baseline to four weeks, baseline to eight weeks, and four weeks to eight weeks, with all comparisons yielding $p < 0.001$. The SPADI disability subscale also showed significant improvement across the same intervals, again with $p < 0.001$ for all comparisons. External rotation increased significantly from baseline to four weeks ($p < 0.001$), from baseline to eight weeks ($p < 0.001$), and from four weeks to eight weeks ($p < 0.001$). Abduction likewise improved significantly from baseline to four weeks ($p < 0.001$) and from baseline to eight weeks ($p < 0.001$), whereas the change between four and eight weeks was not statistically significant ($p = 0.653$), indicating that most gains in abduction occurred during the treatment phase and were subsequently maintained. Repeated-measures analysis using the Friedman test further confirmed significant temporal changes in all outcomes across the three assessment points. For pain intensity measured by NPRS, mean ranks decreased from 13.08 at baseline to 7.33 at four weeks and 3.49 at eight weeks, with $p < 0.001$. For SPADI pain, mean ranks declined from 13.35 at baseline to 8.23 at four weeks and 3.93 at eight weeks, also with $p < 0.001$. SPADI disability improved from a mean rank of 10.95 at baseline to 7.01 at four weeks and 3.87 at eight weeks, with $p < 0.001$. In contrast, shoulder mobility outcomes showed increasing mean ranks over time. External rotation rose from 4.67 at baseline to 9.08 at four weeks and 12.25 at eight weeks, with $p < 0.001$. Abduction increased from 4.80 at baseline to 8.85 at four weeks and 9.12 at eight weeks, again with $p < 0.001$.

Correlation analysis showed strong associations between several pain and disability measures across time points. Baseline NPRS was strongly positively correlated with baseline SPADI pain (r = 0.826, p < 0.001; 95% CI: 0.691 to 0.901). Baseline NPRS showed inverse correlations with baseline SPADI disability (r = -0.566, p < 0.001; 95% CI: -0.739 to -0.310), four-week SPADI disability (r = -0.417, p = 0.006; 95% CI: -0.637 to -0.124), and eight-week SPADI disability (r = -0.356, p = 0.021; 95% CI: -0.593 to -0.054). NPRS at four weeks was strongly correlated with NPRS at eight weeks (r = 0.782, p < 0.001; 95% CI: 0.621 to 0.875). SPADI pain at four weeks showed a very strong positive correlation with SPADI pain at eight weeks (r = 0.870, p < 0.001; 95% CI: 0.765 to 0.927). Likewise, SPADI disability at four weeks was strongly correlated with SPADI disability at eight weeks (r = 0.809, p < 0.001; 95% CI: 0.664 to 0.891). Baseline SPADI pain also showed significant inverse associations with baseline SPADI disability (r = -0.701, p < 0.001; 95% CI: -0.826 to -0.498), four-week SPADI disability (r = -0.569, p < 0.001; 95% CI: -0.741 to -0.314), and eight-week SPADI disability (r = -0.522, p < 0.001; 95% CI: -0.710 to -0.254). Overall, the data showed that both intervention groups improved over time in pain intensity, shoulder-related disability, and range of motion. Between-group differences were evident for NPRS at four and eight weeks and for shoulder abduction at eight weeks, whereas SPADI pain, SPADI disability, and most external rotation comparisons did not demonstrate statistically significant differences between groups based on the values reported.

Table 1: Descriptive Statistics Table

Group	Variables	N	Minimum	Maximum	Mean	Std. Deviation
Group A	age	21	34	65	45.81	9.558
	gender	21	1	2	1.57	.507
	weight	21	65	95	79.33	8.339
	height	21	5.2	5.6	5.376	.1446
	BMI	21	3.0	4.0	3.333	.4830
Group B	age	21	44	65	50.95	5.445
	gender	21	1	2	1.57	.507
	weight	21	69	95	77.67	7.066
	height	21	5.1	5.9	5.386	.1931
	BMI	21	3.0	4.0	3.238	.4364

Table 2: Normality of the study

Group	Vaiables	Shapiro-Wilk		
		Statistic	**df**	**Sig.**
Group A	**Pre NPRS**	.484	21	.000
	Pre Pain scale SPADI	.484	21	.000
	Pre SPADI (Disability scale)	.484	21	.000
	Pre ER	.484	21	.000
	Pre ABD	.484	21	.000
Group B	**Pre NPRS**	.484	21	.000
	Pre Pain scale SPADI	.484	21	.000
	Pre SPADI (Disability scale)	.341	21	.000
	Pre ER	.484	21	.000
	Pre ABD	.484	21	.000

Table 3: Man-Whitney U test

Variables	Group	N	Mean Rank	Sum of Ranks	P-Value
NPRS_Pre	Group A	21	21.50	451.50	1.00
	Group B	21	21.50	451.50	
NPRS_Post4weeks	Group A	21	25.86	543.00	0.008
	Group B	21	17.14	360.00	
Post8weeks_NPRS	Group A	21	26.29	552.00	0.004
	Group B	21	16.71	351.00	
Prepainscale_SPADI	Group A	21	21.00	441.00	0.710
	Group B	21	22.00	462.00	
SPADIPost4Weeks_Painscale	Group A	21	22.76	478.00	0.444
	Group B	21	20.24	425.00	
Post8weeksSPADI_Painscale	Group A	21	23.79	499.50	0.177
	Group B	21	19.21	403.50	
PreSPADI_Disabilityscale	Group A	21	23.00	483.00	0.220
	Group B	21	20.00	420.00	
DisabilityScale_SPADI4weeks	Group A	21	21.50	451.50	1.00
	Group B	21	21.50	451.50	
Post8Weeks_SPADIDisabilityscale	Group A	21	18.29	384.00	0.52
	Group B	21	24.71	519.00	
Pre_ER	Group A	21	20.50	430.50	0.474
	Group B	21	22.50	472.50	
ERPost_4weeka	Group A	21	22.19	466.00	0.610
	Group B	21	20.81	437.00	
ER_Post8weeks	Group A	21	23.74	498.50	<0.001
	Group B	21	19.26	404.50	
Pre_ABD	Group A	21	21.50	451.50	1.00
	Group B	21	21.50	451.50	
ABDPost4weeks	Group A	21	23.19	487.00	0.244
	Group B	21	19.81	416.00	
ABD_Post8weeks	Group A	21	31.52	662.00	<0.001
	Group B	21	11.48	241.00	

Table 4: Wilcoxon Signed Rank Test

Variables	Ranks	Mean Rank	Sum of Ranks	P-Value
NPRS_Post4weeks - NPRS_Pre	Negative Ranks	19.00	703.00	<0.001

	Positive Ranks	.00	.00	
Post8weeks_NPRS - NPRS_Pre	Negative Ranks	21.50	903.00	<0.001
	Positive Ranks	.00	.00	
Post8weeks_NPRS - NPRS_Post4weeks	Negative Ranks	18.00	630.00	<0.001
	Positive Ranks	.00	.00	
SPADIPost4Weeks_Painscale - Prepainscale_SPADI	Negative Ranks	17.50	595.00	<0.001
	Positive Ranks	.00	.00	
Post8weeksSPADI_Painscale - Prepainscale_SPADI	Negative Ranks	21.00	861.00	<0.001
	Positive Ranks	.00	.00	
Post8weeksSPADI_Painscale - SPADIPost4Weeks_Painscale	Negative Ranks	19.50	741.00	<0.001
	Positive Ranks	.00	.00	
DisabilityScale_SPADI4weeks - PreSPADI_Disabilityscale	Negative Ranks	18.50	666.00	<0.001
	Positive Ranks	.00	.00	
Post8Weeks_SPADIDisabilityscale - PreSPADI_Disabilityscale	Negative Ranks	20.00	780.00	<0.001
	Positive Ranks	.00	.00	
Post8Weeks_SPADIDisabilityscale - DisabilityScale_SPADI4weeks	Negative Ranks	16.50	528.00	<0.001
	Positive Ranks	.00	.00	
ERPost_4weeka - Pre_ER	Negative Ranks	.00	.00	<0.001
	Positive Ranks	19.00	703.00	
ER_Post8weeks - Pre_ER	Negative Ranks	.00	.00	<0.001
	Positive Ranks	20.50	820.00	
ER_Post8weeks - ERPost_4weeka	Negative Ranks	.00	.00	<0.001
	Positive Ranks	17.00	561.00	
ABDPost4weeks - Pre_ABD	Negative Ranks	.00	.00	<0.001
	Positive Ranks	19.00	703.00	
ABD_Post8weeks - Pre_ABD	Negative Ranks	10.50	136.50	<0.001
	Positive Ranks	26.43	766.50	
ABD_Post8weeks - ABDPost4weeks	Negative Ranks	34.00	442.00	0.653
	Positive Ranks	14.00	378.00	

Table 5: Friedman test

Variables	Mean Rank	P-Value
NPRS_Pre	13.08	<0.001
NPRS_Post4weeks	7.33	<0.001
Post8weeks_NPRS	3.49	<0.001
Prepainscale_SPADI	13.35	<0.001

SPADIPost4Weeks_Painscale	8.23	<0.001
Post8weeksSPADI_Painscale	3.93	<0.001
PreSPADI_Disabilityscale	10.95	<0.001
DisabilityScale_SPADI4weeks	7.01	<0.001
Post8Weeks_SPADIDisabilityscale	3.87	<0.001
Pre_ER	4.67	<0.001
ERPost_4weeka	9.08	<0.001
ER_Post8weeks	12.25	<0.001
Pre_ABD	4.80	<0.001
ABDPost4weeks	8.85	<0.001
ABD_Post8weeks	9.12	<0.001

Table 6: Kruskal-Wallis test

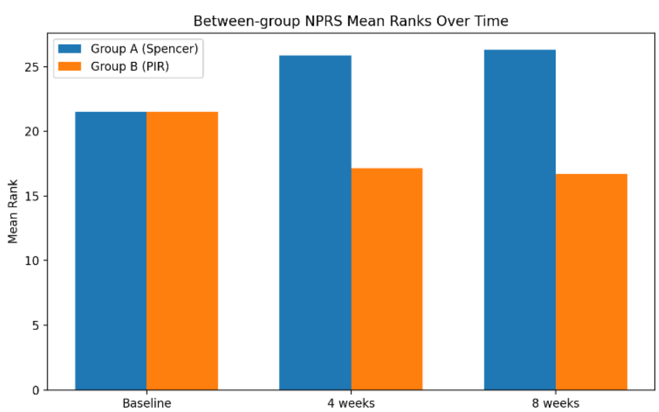
Variables	Group	N	Mean Rank	P-Value
NPRS_Pre	Group A	21	21.50	1.00
	Group B	21	21.50	
NPRS_Post4weeks	Group A	21	25.86	0.008
	Group B	21	17.14	
Post8weeks_NPRS	Group A	21	26.29	0.004
	Group B	21	16.71	
Prepainscale_SPADI	Group A	21	21.00	0.710
	Group B	21	22.00	
SPADIPost4Weeks_Painscale	Group A	21	22.76	0.44
	Group B	21	20.24	
Post8weeksSPADI_Painscale	Group A	21	23.79	0.177
	Group B	21	19.21	
PreSPADI_Disabilityscale	Group A	21	23.00	0.220
	Group B	21	20.00	
DisabilityScale_SPADI4weeks	Group A	21	21.50	1.00
	Group B	21	21.50	
Post8Weeks_SPADIDisabilityscale	Group A	21	18.29	0.052
	Group B	21	24.71	
Pre_ER	Group A	21	20.50	0.474
	Group B	21	22.50	
ERPost_4weeka	Group A	21	22.19	0.610
	Group B	21	20.81	

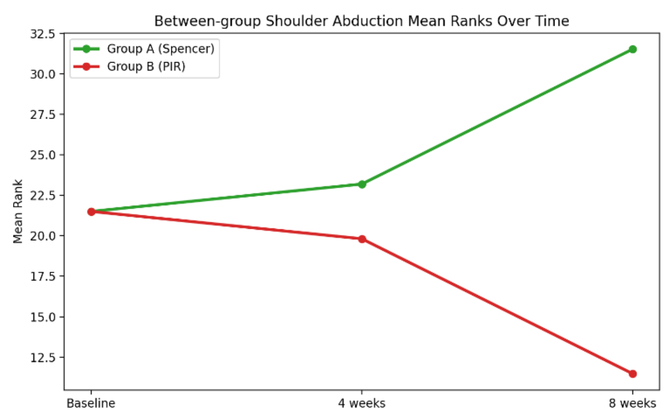
ER_Post8weeks	Group A	21	23.74	0.147
	Group B	21	19.26	
Pre_ABD	Group A	21	21.50	1.00
	Group B	21	21.50	
ABDPost4weeks	Group A	21	23.19	0.244
	Group B	21	19.81	
ABD_Post8weeks	Group A	21	31.52	<0.001
	Group B	21	11.48	

Table 7: Correlation

Correlation Pair	Pearson's (r)	p-value	95% CI Lower	95% CI Upper
NPRS_Pre ↔ NPRS_Post4weeks	.267	.087	-.043	.526
NPRS_Pre ↔ Post8weeks_NPRS	.090	.572	-.221	.382
NPRS_Pre ↔ Prepainscale_SPADI	.826	<.001	.691	.901
NPRS_Pre ↔ SPADIPost4Weeks_Painscale	.000	1.000	-.304	.304
NPRS_Pre ↔ Post8weeksSPADI_Painscale	-.011	.943	-.314	.294
NPRS_Pre ↔ PreSPADI_Disabilityscale	-.566	<.001	-.739	-.310
NPRS_Pre ↔ DisabilityScale_SPADI4weeks	-.417	.006	-.637	-.124
NPRS_Pre ↔ Post8Weeks_SPADIDisabilityscale	-.356	.021	-.593	-.054
NPRS_Post4weeks ↔ Post8weeks_NPRS	.782	<.001	.621	.875
NPRS_Post4weeks ↔ Prepainscale_SPADI	.288	.065	-.021	.542
NPRS_Post4weeks ↔ SPADIPost4Weeks_Painscale	.194	.219	-.119	.468
NPRS_Post4weeks ↔ Post8weeksSPADI_Painscale	.135	.393	-.178	.420
NPRS_Post4weeks ↔ PreSPADI_Disabilityscale	-.246	.116	-.510	.065
NPRS_Post4weeks ↔ DisabilityScale_SPADI4weeks	-.105	.510	-.395	.207
NPRS_Post4weeks ↔ Post8Weeks_SPADIDisabilityscale	-.256	.102	-.517	.056
Post8weeks_NPRS ↔ Prepainscale_SPADI	.247	.115	-.065	.510
Post8weeks_NPRS ↔ SPADIPost4Weeks_Painscale	.092	.564	-.219	.384
Post8weeks_NPRS ↔ Post8weeksSPADI_Painscale	.061	.699	-.248	.358
Post8weeks_NPRS ↔ PreSPADI_Disabilityscale	-.163	.302	-.443	.150
Post8weeks_NPRS ↔ DisabilityScale_SPADI4weeks	-.090	.572	-.382	.221
Post8weeks_NPRS ↔ Post8Weeks_SPADIDisabilityscale	-.232	.139	-.499	.080
Prepainscale_SPADI ↔ SPADIPost4Weeks_Painscale	.044	.783	-.264	.343
Prepainscale_SPADI ↔ Post8weeksSPADI_Painscale	.013	.937	-.293	.315
Prepainscale_SPADI ↔ PreSPADI_Disabilityscale	-.701	<.001	-.826	-.498

Prepainscale_SPADI ↔ DisabilityScale_SPADI4weeks	-.569	<.001	-.741	-.314
Prepainscale_SPADI ↔ Post8Weeks_SPADIDisabilityscale	-.522	<.001	-.710	-.254
SPADIPost4Weeks_Painscale ↔ Post8weeksSPADI_Painscale	.870	<.001	.765	.927
SPADIPost4Weeks_Painscale ↔ PreSPADI_Disabilityscale	.144	.362	-.169	.428
SPADIPost4Weeks_Painscale ↔ DisabilityScale_SPADI4weeks	.079	.617	-.231	.373
SPADIPost4Weeks_Painscale ↔ Post8Weeks_SPADIDisabilityscale	.103	.517	-.209	.393
Post8weeksSPADI_Painscale ↔ PreSPADI_Disabilityscale	.194	.219	-.120	.468
Post8weeksSPADI_Painscale ↔ DisabilityScale_SPADI4weeks	.091	.565	-.220	.384
Post8weeksSPADI_Painscale ↔ Post8Weeks_SPADIDisabilityscale	.126	.428	-.187	.412
PreSPADI_Disabilityscale ↔ DisabilityScale_SPADI4weeks	.566	<.001	.310	.739
PreSPADI_Disabilityscale ↔ Post8Weeks_SPADIDisabilityscale	.396	.009	.100	.622
DisabilityScale_SPADI4weeks ↔ Post8Weeks_SPADIDisabilityscale	.809	<.001	.664	.891





DISCUSSION

The present randomized controlled trial investigated the comparative effects of the Spencer Muscle Energy Technique and Post-Isometric Relaxation on pain intensity, shoulder range of motion, and functional disability in individuals diagnosed with frozen shoulder. The findings demonstrated that both interventions produced statistically significant improvements in all primary outcomes over the eight-week observation period. Participants in both groups experienced substantial reductions in pain intensity, improvements in shoulder mobility—particularly in abduction and external rotation—and enhanced functional ability as reflected by SPADI scores. These improvements suggest that manual therapy interventions targeting capsular restriction and neuromuscular relaxation can play a meaningful role in the conservative management of adhesive capsulitis. Nevertheless, when the two interventions were compared directly, the Spencer technique demonstrated superior outcomes in certain domains, particularly overall pain reduction and improvement in shoulder abduction by the eight-week follow-up. The greater reduction in pain intensity observed with the Spencer technique may be attributed to its sequential mobilization approach, which systematically targets multiple components of the glenohumeral joint capsule. Through repeated cycles of muscle contraction and relaxation combined with controlled joint mobilization, the technique likely promotes capsular stretching, enhances synovial fluid movement, and stimulates mechanoreceptors that modulate pain perception. Such neurophysiological and mechanical mechanisms are widely recognized in manual therapy and are believed to contribute to the reduction of nociceptive input and improvement of joint mobility in adhesive capsulitis. The current findings therefore support the notion that structured muscle energy techniques can provide clinically meaningful analgesic effects when incorporated into physiotherapy protocols.

Although pain reduction and abduction mobility showed significant between-group differences, no statistically significant differences were observed between the two groups in SPADI pain scores, SPADI disability scores, or external rotation. This finding suggests that while the Spencer technique may provide stronger effects for certain biomechanical aspects of shoulder mobility, both interventions were comparably effective in improving patient-reported function and activity-related shoulder pain. Functional recovery in frozen shoulder is influenced by multiple factors including muscle coordination, joint mobility, pain tolerance, and adherence to rehabilitation exercises. Therefore, the similar functional outcomes observed between groups may reflect the contribution of the shared conventional physiotherapy program received by both groups, which included stretching exercises, scapular mobility work, and pendulum exercises designed to restore shoulder mechanics. The results of this study are generally consistent with previous investigations evaluating muscle energy techniques in the management of frozen shoulder. Previous clinical trials have reported that the Spencer technique can significantly reduce pain and enhance shoulder mobility in individuals with adhesive capsulitis, supporting its role as an effective manual therapy intervention. Similar to the present findings, earlier studies have demonstrated substantial within-group improvements in pain and range of motion following the application of Spencer-based mobilization protocols. However, some studies comparing the Spencer technique with alternative exercise-based interventions have reported equivalent outcomes between treatment groups, suggesting that the clinical superiority of this technique may depend on the nature of the comparator intervention and the duration of follow-up assessments (12).

Evidence from studies involving populations with specific clinical characteristics, such as patients with metabolic disorders associated with frozen shoulder, has also indicated meaningful reductions in pain intensity following the application of Spencer-based muscle energy techniques. These findings support the broader applicability of the technique in reducing shoulder pain across diverse patient populations. Nevertheless, variations in disability outcomes across studies have been reported. While some investigations observed greater improvements in SPADI scores with Spencer-based interventions, the present study did not identify significant between-group differences in the SPADI subscales. This divergence may reflect differences in sample characteristics, treatment protocols, and comparator interventions. It also highlights the complex relationship between objective mobility improvements and patient-perceived functional recovery (13). Systematic reviews evaluating manual therapy interventions for frozen shoulder have frequently concluded that the current evidence base remains limited, with methodological heterogeneity and relatively small sample sizes contributing to uncertainty regarding the comparative effectiveness of different techniques. Within this context, the present findings provide additional empirical evidence supporting the beneficial effects of muscle energy techniques, particularly for pain reduction and improvements in specific shoulder movements. The statistically significant improvements observed in this trial align with earlier observations suggesting that joint mobilization and muscle energy techniques may offer favorable clinical outcomes, even though the certainty of evidence has historically been considered low to moderate (14).

Comparisons with studies evaluating other physiotherapy interventions further illustrate the context-dependent effectiveness of manual therapy approaches. Research comparing Spencer-based mobilization with conventional rehabilitation protocols has demonstrated consistent pain relief across treatment groups, although variations in range-of-motion outcomes have been reported depending on the intervention applied. In some investigations, conventional physiotherapy approaches yielded comparable or greater improvements in shoulder mobility, whereas other studies reported superior outcomes with Spencer-based techniques for specific movements such as abduction. These discrepancies likely reflect differences in rehabilitation protocols, patient populations, and treatment durations (8). Evidence comparing the Spencer technique with other manual therapy approaches, such as mobilization techniques or alternative muscle energy strategies, has also demonstrated substantial within-group improvements in pain, mobility, and functional performance. However, between-group differences have not always been consistent across studies. Some investigations have reported greater improvements in disability outcomes with Spencer-based interventions, while others have found no meaningful differences between treatment approaches. The present findings align with the latter pattern, suggesting that although the Spencer technique may provide advantages for pain control and certain mobility parameters, functional outcomes measured by patient-reported disability indices may improve similarly with different manual therapy strategies (15).

Studies examining other manual therapy methods compared with post-isometric relaxation have also demonstrated variable results depending on the technique applied. Certain mobilization approaches have shown broader improvements across pain, mobility, and functional outcomes, while others have demonstrated more selective benefits. The current findings reinforce the concept that manual therapy techniques are not universally interchangeable and that their therapeutic effects may depend on specific biomechanical and neurophysiological mechanisms. In this context, the Spencer technique appeared particularly effective for pain modulation and restoration of abduction movement patterns, whereas post-isometric relaxation produced comparable improvements in perceived functional ability and activity-related pain (17). Several methodological strengths supported the reliability of the present study. The use of a randomized controlled trial design enhanced the internal validity of the findings, while the inclusion of standardized outcome measures such as the NPRS, SPADI, and goniometric range-of-motion assessments ensured objective evaluation of treatment effects. Additionally, the inclusion of a follow-up assessment at eight weeks allowed the observation of sustained therapeutic effects beyond the active treatment period, which is particularly relevant in a condition such as adhesive capsulitis where functional recovery often occurs gradually.

Despite these strengths, certain limitations should be acknowledged. The relatively modest sample size may limit the generalizability of the findings to broader clinical populations. Furthermore, although the study employed a single-blind design, complete blinding of participants and therapists was not feasible due to the nature of manual therapy interventions. The study was conducted in a single clinical setting, which may introduce contextual influences related to therapist expertise or patient characteristics. In addition, only selected shoulder movements were assessed for range of motion, whereas evaluation of additional movements such as flexion and internal rotation could have provided a more comprehensive understanding of functional recovery. The absence of long-term follow-up beyond eight weeks also limits conclusions regarding the durability of treatment effects. Future research should consider larger multi-center trials with extended follow-up periods to determine the long-term comparative effectiveness of manual therapy interventions for adhesive capsulitis. Incorporating additional outcome measures, including quality-of-life indices and objective functional performance tests, may provide a more comprehensive evaluation of rehabilitation outcomes. Comparative studies examining combinations of manual therapy with exercise-based rehabilitation programs may also help clarify optimal treatment strategies for different stages of frozen shoulder.

Overall, the findings of this study contribute to the growing body of evidence supporting the use of manual therapy techniques in the management of frozen shoulder. Both the Spencer Muscle Energy Technique and Post-Isometric Relaxation demonstrated significant clinical benefits in reducing pain, improving shoulder mobility, and enhancing functional outcomes. However, the Spencer technique appeared to provide greater improvements in overall pain reduction and shoulder abduction mobility, suggesting that it may offer additional advantages in certain clinical contexts within physiotherapy-based rehabilitation programs.

CONCLUSION

The findings of this study indicate that both the Spencer Muscle Energy Technique and Post-Isometric Relaxation are beneficial physiotherapeutic interventions for the management of frozen shoulder, contributing to meaningful improvements in pain relief, shoulder mobility, and functional ability. However, the Spencer technique demonstrated comparatively greater clinical effectiveness in reducing overall pain and enhancing shoulder abduction. These results highlight the potential value of incorporating the Spencer technique as a targeted manual therapy approach within rehabilitation programs for individuals with adhesive capsulitis. From a practical perspective, physiotherapists may consider prioritizing this technique when the primary treatment goals involve pain control and restoration of restricted shoulder movements. Overall, the study contributes to the growing body of evidence supporting manual therapy in frozen shoulder rehabilitation and provides clinically relevant insights that may assist practitioners in selecting appropriate therapeutic strategies for improved patient outcomes.

AUTHOR CONTRIBUTION

Author	Contribution
Seemab Zahra	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Hafiz Muhammad Abu Bakar Rashid	Methodology, Investigation, Data Curation, Writing - Review & Editing
Muhammad Tariq	Investigation, Data Curation, Formal Analysis, Software
Safa Razaq	Software, Validation, Writing - Original Draft
Junaid Ijaz Gondal	Formal Analysis, Writing - Review & Editing
Muhammad Abdullah Hamza	Writing - Review & Editing, Assistance with Data Curation

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