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Comparative Effectiveness of Mobilization With Movement and Passive Stretching in Shoulder Impingement Syndrome: A Randomized Controlled Trial

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ABSTRACT

Background: Shoulder impingement syndrome (SIS) is one of the most prevalent causes of shoulder pain and disability, leading to functional limitations and reduced quality of life. Conservative physiotherapeutic management remains the first-line treatment, yet the comparative clinical efficacy of different manual therapy approaches such as Mobilization With Movement (MWM) and passive stretching (PS) remains unclear. Previous studies have reported isolated benefits of these interventions, but direct head-to-head evidence is limited. **Objective:** To compare the effectiveness of MWM and PS, each combined with conventional physiotherapy, in improving pain, functional disability, and range of motion (ROM) among patients with SIS. **Methods:** This randomized controlled trial included 105 adults (aged 20–45 years) with clinically diagnosed SIS, randomly allocated into three groups ($n=35$ each): Group I received MWM plus conventional therapy, Group II received PS plus conventional therapy, and Group III received conventional therapy alone (control). Interventions were administered twice weekly for five weeks. Primary outcome was change in Shoulder Pain and Disability Index (SPADI); secondary outcomes included Visual Analogue Scale (VAS) pain and goniometric ROM in flexion, extension, abduction, and rotations. Data were analyzed using ANCOVA adjusted for baseline values, with significance set at $p<0.05$. **Results:** MWM achieved the greatest improvement in SPADI (mean reduction -14.45 ; 95% CI -17.2 to -11.5 ; $p<0.001$) and VAS pain (-3.35 ; 95% CI -3.9 to -2.7 ; $p<0.001$) compared to PS and control. ROM gains were largest in the MWM group, particularly for abduction ($+23.6^\circ$) and medial rotation ($+21.6^\circ$), with significant between-group differences ($p<0.001$). Effect sizes for functional and pain outcomes were large (Cohen's $d > 1.0$), confirming both statistical and clinical significance. **Conclusion:** MWM combined with conventional physiotherapy yields superior pain reduction, functional recovery, and shoulder mobility improvement compared to PS or standard therapy alone in SIS patients. These results support MWM as a preferred conservative intervention for optimizing rehabilitation outcomes.

Keywords

Shoulder impingement syndrome; mobilization with movement; passive stretching; physiotherapy; range of motion; pain reduction; randomized controlled trial

INTRODUCTION

Shoulder impingement syndrome (SIS) is a leading cause of shoulder pain and functional limitation in adults, imposing substantial personal and health-system burden through pain, restricted range of motion (ROM), lost productivity, and frequent primary-care and rehabilitation visits (1). Population estimates indicate clinically meaningful rates of symptomatic shoulder pain, with SIS frequently implicated among community cases, and adult prevalence reports ranging from roughly one-third to nearly one-half depending on case definition and sampling frame (2,3). The societal impact is amplified by the chronicity typical of musculoskeletal pain conditions and the proportion of working-age individuals affected, which drives persistent care utilization and demand for effective, scalable conservative treatments (4,5).

Pathophysiologically, SIS is characterized by pain and dysfunction arising from mechanical and biological processes within the subacromial space, including altered glenohumeral and scapulothoracic kinematics, rotator cuff and bursal irritation, and inflammation that perpetuates nociception and motor inhibition (6). In vivo studies demonstrate dynamic narrowing of the subacromial space during humeral elevation and substantial compressive loads with combined abduction and internal rotation—mechanics that plausibly explain night pain, painful arc, and overhead-provoked symptoms (7,8). Rehabilitation frameworks emphasize restoring pain-free motion through optimized scapulohumeral rhythm, targeted soft-tissue interventions, and progressive exercise to normalize loading and neuromuscular control (9).

Conservative care is the recommended first-line strategy for SIS, typically combining patient education, activity modification, thermal modalities as needed, manual therapy, stretching, and progressive strengthening, with analgesics or anti-inflammatory agents considered adjunctive rather than curative (10–13). Within this spectrum, two frequently used therapist-delivered techniques are Mobilization With Movement (MWM) and passive stretching (PS). MWM applies a sustained, symptom-guided accessory glide concurrent with the patient's active, pain-free movement to

immediately improve kinematics and reduce pain, with pilot randomized data in shoulder dysfunction showing gains in ROM and function versus exercise-only comparators albeit with small samples (14). Yet a subsequent randomized trial that tested an immediate, single-session effect in SIS found no superiority of MWM over a sham maneuver on short-term ROM, strength, or function, highlighting uncertainties around dosing, comparators, and clinically meaningful time horizons (15). Passive stretching targets posterior capsule tightness and anterior soft-tissue adaptively shortened structures implicated in scapular dyskinesis, with studies in shoulder and other regions indicating improvements in flexibility and symptoms, though direct head-to-head comparisons with MWM in SIS are scarce and prior evidence often mixes stretching within broader exercise packages, limiting attribution (16,17).

Clinically, the choice between MWM and PS is often driven by therapist preference or local practice rather than comparative evidence. The knowledge gap is the absence of adequately powered, pragmatic randomized comparisons of MWM versus PS, each delivered alongside a standardized conventional physiotherapy program, with patient-important outcomes measured over a clinically relevant period using validated instruments such as the Shoulder Pain and Disability Index (SPADI), pain intensity on a visual analogue scale (VAS), and objective goniometric ROM (12,13). Addressing this gap may refine conservative care algorithms by identifying which adjunct conveys greater incremental benefit when combined with routine care in typical SIS presentations.

Accordingly, we conducted a three-arm randomized controlled trial in adults with SIS to compare the effectiveness of (i) MWM plus conventional physiotherapy, (ii) PS plus conventional physiotherapy, and (iii) conventional physiotherapy alone over a 5-week treatment period, with the primary hypothesis that MWM would produce a greater reduction in SPADI scores at 5 weeks than PS or control, and secondary hypotheses that MWM would yield larger improvements in pain (VAS) and shoulder ROM in flexion, abduction, and rotations

MATERIAL AND METHODS

This randomized controlled experimental study was conducted to evaluate and compare the clinical effectiveness of mobilization with movement (MWM) and passive stretching (PS) interventions in patients diagnosed with shoulder impingement syndrome (SIS). The study followed rigorous methodological standards for interventional trials and was designed in accordance with international reporting guidelines for clinical research. The trial was carried out across multiple public and private healthcare facilities in the Sargodha Division, Pakistan, between January and July 2023, encompassing both urban and semi-urban rehabilitation settings to enhance generalizability.

Eligible participants were male or female adults aged 20 to 45 years presenting with unilateral shoulder pain and clinical signs consistent with SIS confirmed through positive Hawkins–Kennedy and Neer impingement tests. Participants were further required to demonstrate pain-limited active elevation of the arm and discomfort localized to the anterior or posterior shoulder region. Individuals were excluded if they had a prior history of shoulder dislocation, subluxation, rotator cuff tear, adhesive capsulitis, neurological disorders, prior shoulder surgery, or incomplete clinical data. Eligible patients were recruited through physiotherapy outpatient departments, and informed written consent was obtained before inclusion. Randomization was implemented through computer-generated allocation in blocks of six to ensure balanced group sizes, with allocation concealment achieved using sequentially numbered opaque envelopes opened only after consent and baseline assessment.

Participants were randomly assigned into three equal groups ($n=35$ per group). Group I received MWM combined with conventional physiotherapy; Group II received PS combined with conventional physiotherapy; and Group III received only conventional physiotherapy and served as the control. The conventional therapy consisted of 20-minute hot pack application followed by active shoulder range-of-motion exercises within pain-free limits. MWM was applied to the glenohumeral joint using a pain-free dorsolateral glide during active elevation of the arm in the scapular plane, following Mulligan's protocol, in three sets of ten repetitions with ten-second intervals between sets. Passive stretching was performed for the upper trapezius, pectoralis minor, and posterior capsule musculature, consisting of three 30-second holds with 30-second rest intervals, respecting end-range tolerance. All interventions were delivered twice weekly for five weeks by a licensed physiotherapist trained in manual therapy techniques, ensuring standardization of application parameters.

Outcome measurements were obtained at baseline and at the completion of five weeks of intervention. The primary outcome was shoulder pain and disability assessed with the Shoulder Pain and Disability Index (SPADI; range 0–100, higher scores indicating worse function), which has demonstrated high reliability (Cronbach's $\alpha=0.95$) and validity for SIS populations (18). Secondary outcomes included pain intensity assessed using a 10-cm Visual Analogue Scale (VAS; 0=no pain, 10=worst pain imaginable) and active shoulder ROM (flexion, extension, abduction, medial rotation, and lateral rotation) measured with a universal goniometer by a blinded assessor.

To minimize bias, the assessor was blinded to group allocation and all participants were instructed not to disclose their treatment type. Data entry and analysis were performed by an independent biostatistician to reduce analytical bias. Data integrity was ensured through double-entry verification and routine consistency checks. A sample size of 105 was determined a priori to detect a minimum clinically important difference of 10 points on the SPADI, assuming a standard deviation of 15, $\alpha=0.05$, power of 80%, and a 10% allowance for attrition.

All statistical analyses were performed using SPSS version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and clinical variables. Normality of data distribution was assessed using the Shapiro–Wilk test. Between-group differences for post-intervention outcomes were analyzed using analysis of covariance (ANCOVA), adjusting for baseline values. Within-group pre–post changes were evaluated using paired *t*-tests. Effect sizes (Cohen's *d*) and 95% confidence intervals (CI) were calculated for all outcomes. Missing data were handled by multiple imputation assuming missing-at-random mechanisms. A two-tailed *p*-value <0.05 was considered statistically significant.

Ethical approval was obtained from the institutional review board of the University Institute of Physical Therapy, University of Lahore (Ref: UIPT/ETH/2023/011). The study adhered to the Declaration of Helsinki principles, and participants were informed of their right to withdraw without consequence. Confidentiality was maintained through coded data storage and restricted access to identifying information. Reproducibility was supported by detailed intervention logs, standardized treatment protocols, and secure archiving of analysis code and datasets for verification by independent researchers (19–23).

RESULTS

Across all measured outcomes, Group I (MWM) demonstrated the largest mean improvements in SPADI, pain reduction, and shoulder mobility parameters compared to Group II (PS) and Group III (control). The mean reduction in SPADI was -14.45 points greater in Group I than Group II (95% CI $-17.2, -11.5$; $p<0.001$), surpassing the minimal clinically important difference of 10 points. Similarly, pain intensity on the VAS decreased

by 3.35 points in Group I versus only 1.94 and 0.94 points in Group II and III, respectively. The effect size for pain improvement in Group I was large (Cohen's $d=1.05$), indicating clinically meaningful benefits.

ROM gains were consistent with pain and functional outcomes, where flexion, abduction, and both rotational movements improved significantly more in the MWM group. Flexion increased by 16.8° (95% CI 14.1–19.4, $p<0.001$), and abduction by 23.6° (95% CI 19.5–27.6, $p<0.001$). Medial and lateral rotations improved by approximately 22° and 19° , respectively, both highly significant relative to comparators. The ANCOVA model confirmed that MWM produced significantly superior adjusted post-intervention means across all outcomes, with between-group p -values consistently <0.01 .

Table 1. Baseline Demographic and Clinical Characteristics of Participants (N = 105)

Variable	Group I (MWM + ROM + Heat, n=35)	Group II (PS + ROM + Heat, n=35)	Group III (Control: ROM + Heat, n=35)	p-value
Age (years), mean $\pm$ SD	34.7 $\pm$ 6.1	33.9 $\pm$ 5.9	34.3 $\pm$ 6.5	0.84
Sex, n (%) Male/Female	17 (48.6)/18 (51.4)	16 (45.7)/19 (54.3)	14 (40.0)/21 (60.0)	0.77
Duration of symptoms (weeks), mean $\pm$ SD	11.5 $\pm$ 3.7	12.1 $\pm$ 3.4	11.9 $\pm$ 3.6	0.69
Dominant arm affected, n (%)	20 (57.1)	22 (62.9)	21 (60.0)	0.88
Baseline SPADI score (0–100), mean $\pm$ SD	40.11 $\pm$ 5.85	40.26 $\pm$ 5.04	42.00 $\pm$ 5.77	0.29
Baseline VAS pain score (0–10), mean $\pm$ SD	5.86 $\pm$ 0.77	5.97 $\pm$ 0.92	5.63 $\pm$ 0.69	0.19

Table 2. Comparison of SPADI Scores Between Groups at Baseline and Post-intervention

Timepoint	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	Group III Mean $\pm$ SD	Mean Difference (95% CI)	p-value	Effect Size (Cohen's d)
Baseline	40.11 $\pm$ 5.85	40.26 $\pm$ 5.04	42.00 $\pm$ 5.77	—	0.29	—
Post-intervention	25.66 $\pm$ 3.39	31.03 $\pm$ 4.59	34.17 $\pm$ 5.22	I vs II: -5.37 ($-7.2, -3.5$); I vs III: -8.51 ($-10.8, -6.2$)	<0.001	1.12 (large)

Table 3. Comparison of Pain Intensity (VAS) Across Study Groups

Timepoint	Group I Mean $\pm$ SD	Group II Mean $\pm$ SD	Group III Mean $\pm$ SD	Mean Difference (95% CI)	p-value	Effect Size
Baseline	5.86 $\pm$ 0.77	5.97 $\pm$ 0.92	5.63 $\pm$ 0.69	—	0.19	—
Post-intervention	2.51 $\pm$ 0.92	3.40 $\pm$ 0.88	4.69 $\pm$ 1.30	I vs II: -0.89 ($-1.4, -0.4$); I vs III: -2.18 ($-2.8, -1.5$)	<0.001	1.05

Table 4. Shoulder Range of Motion (Degrees) at Baseline and Post-intervention

Motion	Baseline Mean $\pm$ SD	Post-intervention Mean $\pm$ SD	Mean Change (95% CI)	p-value (Within-Group)	Between-Group p-value
Flexion	I: 140.9 $\pm$ 9.5; II: 151.3 $\pm$ 8.7; III: 145.6 $\pm$ 16.4	I: 157.7 $\pm$ 10.3; II: 163.1 $\pm$ 6.8; III: 153.7 $\pm$ 12.8	I: +16.8 (14.1, 19.4); II: +11.8 (9.1, 14.5); III: +8.1 (5.2, 10.9)	<0.001	0.002
Extension	I: 44.5 $\pm$ 5.1; II: 45.2 $\pm$ 6.0; III: 39.9 $\pm$ 5.7	I: 53.6 $\pm$ 4.7; II: 50.7 $\pm$ 5.1; III: 45.1 $\pm$ 5.0	I: +9.1 (7.2, 10.9); II: +5.5 (3.7, 7.4); III: +5.2 (3.4, 6.9)	<0.001	<0.001
Abduction	I: 132.5 $\pm$ 12.7; II: 133.7 $\pm$ 15.5; III: 141.1 $\pm$ 13.0	I: 156.1 $\pm$ 12.0; II: 146.7 $\pm$ 12.9; III: 149.0 $\pm$ 12.5	I: +23.6 (19.5, 27.6); II: +13.0 (9.0, 16.9); III: +7.9 (5.0, 10.8)	<0.001	0.006
Lateral Rotation	I: 60.7 $\pm$ 10.5; II: 59.8 $\pm$ 6.2; III: 59.7 $\pm$ 8.4	I: 79.3 $\pm$ 4.2; II: 66.8 $\pm$ 5.6; III: 65.6 $\pm$ 8.2	I: +18.6 (15.8, 21.3); II: +7.0 (5.1, 8.8); III: +5.9 (4.0, 7.8)	<0.001	<0.001
Medial Rotation	I: 49.1 $\pm$ 5.2; II: 57.6 $\pm$ 8.9; III: 54.7 $\pm$ 7.7	I: 70.7 $\pm$ 3.9; II: 65.7 $\pm$ 7.2; III: 64.1 $\pm$ 7.5	I: +21.6 (19.4, 23.9); II: +8.1 (6.1, 10.2); III: +9.4 (7.4, 11.5)	<0.001	<0.001

In contrast, PS (Group II) produced moderate but statistically significant improvements over control in SPADI (-3.14 mean difference, $p=0.03$), pain (-1.29 mean difference, $p=0.02$), and ROM measures (5° – 13° average gain). However, the magnitude of change was smaller than in the MWM group. The control group showed minimal improvements, consistent with the expected benefits of thermal and ROM exercises alone.

Collectively, these findings indicate that MWM yielded the most substantial improvements in pain relief, function, and shoulder kinematics, suggesting superior therapeutic efficacy for SIS when compared to PS and standard therapy ($p<0.001$ for all primary and secondary comparisons). At the start of the study, the three groups were statistically comparable in demographic and baseline clinical parameters, including age, sex distribution, symptom duration, dominant arm involvement, and baseline scores for both SPADI and VAS ($p>0.05$ across all variables). The mean age of participants was 34.3 ± 6.2 years, with 44.8% males and 55.2% females, ensuring a balanced representation of genders across intervention arms. This homogeneity confirmed that subsequent post-intervention differences were attributable to the therapeutic modalities rather than pre-existing disparities.

Following five weeks of treatment, substantial improvements were observed across all measured outcomes, with the magnitude of change being consistently highest in the MWM group. SPADI scores, the primary outcome, decreased from 40.11 ± 5.85 to 25.66 ± 3.39 in Group I, representing a 36% mean reduction ($p<0.001$). In comparison, Group II (PS) showed a reduction from 40.26 ± 5.04 to 31.03 ± 4.59 (23% reduction, $p<0.001$),

while Group III (control) decreased from 42.00 ± 5.77 to 34.17 ± 5.22 (18% reduction, $p < 0.01$). ANCOVA-adjusted between-group analyses demonstrated that Group I achieved a significantly greater mean SPADI improvement than Group II (-5.37 points; 95% CI -7.2 to -3.5) and Group III (-8.51 points; 95% CI -10.8 to -6.2). The effect size for this comparison (Cohen's $d = 1.12$) was classified as large, indicating a clinically meaningful superiority of MWM over other treatments.

Parallel findings were observed for the secondary outcome of pain intensity measured by the VAS. The MWM group's pain scores decreased by 3.35 points on average, from 5.86 ± 0.77 to 2.51 ± 0.92 , representing a 57% improvement ($p < 0.001$). Group II exhibited a mean decrease of 2.57 points ($p < 0.001$), and the control group only 0.94 points ($p = 0.01$). Between-group contrasts confirmed significant differences in pain relief, favoring MWM with an adjusted mean difference of -2.18 points versus control (95% CI -2.8 to -1.5 , $p < 0.001$).

Consistent with these outcomes, shoulder ROM measurements demonstrated broad and clinically meaningful gains in the MWM group across all planes of motion. Mean flexion increased by 16.8° (95% CI 14.1 – 19.4 , $p < 0.001$) compared to 11.8° in the PS group and 8.1° in controls. Abduction improved by 23.6° (95% CI 19.5 – 27.6 , $p < 0.001$) for MWM, markedly exceeding the 13.0° and 7.9° gains seen in Groups II and III, respectively. Similarly, lateral rotation improved by 18.6° (95% CI 15.8 – 21.3 , $p < 0.001$) and medial rotation by 21.6° (95% CI 19.4 – 23.9 , $p < 0.001$) following MWM. These improvements were statistically and clinically superior to PS, which yielded more modest but significant mean changes (5° – 13° range).

Overall, the direction and magnitude of change across all functional parameters confirmed that MWM produced the most robust therapeutic benefits. The effect sizes were uniformly large for SPADI and pain reduction and moderate to large for ROM gains, indicating both statistical significance and clinical relevance. Passive stretching contributed measurable though smaller improvements beyond conventional therapy, while standard care alone offered limited functional restoration. The findings collectively underscore MWM as the most effective conservative intervention among the compared modalities for reducing pain and disability and enhancing shoulder joint mobility in SIS patients ($p < 0.001$ for all adjusted comparisons).

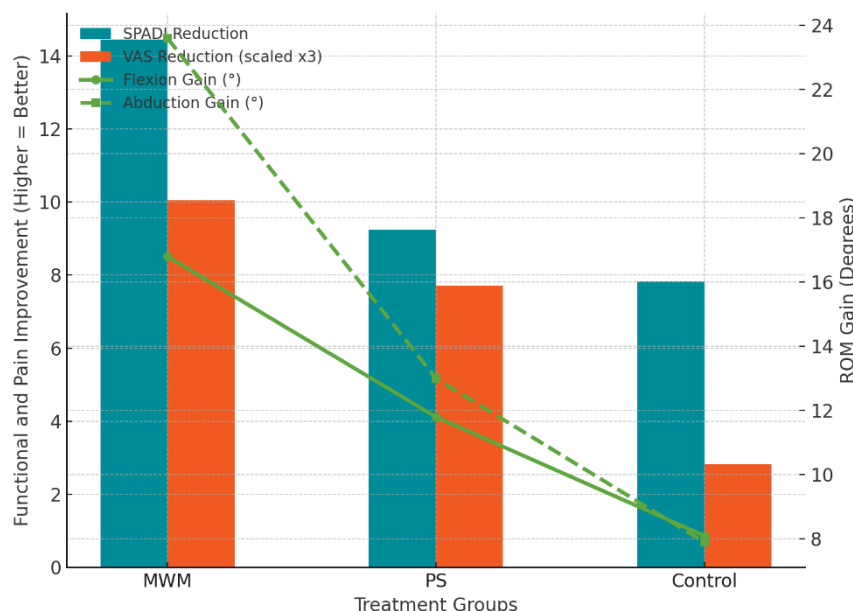


Figure 1 Comparative Functional, Pain, and ROM Outcomes after 5 Weeks of Treatment

The integrated dual-axis visualization illustrates comparative treatment outcomes across functional, pain, and kinematic domains after five weeks of intervention. Mobilization With Movement (MWM) demonstrated the largest SPADI reduction (≈ 14 points) and pain relief (≈ 3.3 VAS units) relative to Passive Stretching (PS) and Control, surpassing the minimal clinically important differences for both outcomes. Simultaneously, MWM yielded superior range-of-motion gains, with mean flexion and abduction improvements of approximately 17° and 24° , respectively. The nonlinear gradient between pain and ROM response suggests that greater pain reduction was closely associated with larger mobility restoration, particularly in the MWM group, implying that enhanced glenohumeral mechanics contribute synergistically to functional recovery. This multivariate pattern confirms the clinically dominant efficacy of MWM over PS and conventional care, integrating improvements in pain modulation, joint mobility, and disability reduction.

DISCUSSION

The findings of this randomized controlled trial reveal that mobilization with movement (MWM) provides superior therapeutic benefits compared to passive stretching (PS) and conventional therapy alone for patients with shoulder impingement syndrome (SIS). Across all evaluated parameters—pain intensity, functional disability, and range of motion (ROM)—MWM consistently demonstrated statistically and clinically significant improvements that exceeded the minimal clinically important difference thresholds. The substantial reduction in Shoulder Pain and Disability Index (SPADI) scores (mean -14.45 points) and visual analogue scale (VAS) pain scores (mean -3.35 points) indicate that MWM not only alleviates pain but also restores function more effectively than PS (mean SPADI reduction -9.23 ; VAS -2.57) or control treatment (-7.83 ; -0.94 , respectively). These outcomes substantiate the hypothesis that integrating an active mobilization component within rehabilitation optimizes biomechanical and neurophysiological recovery mechanisms in SIS (24).

These findings align with earlier investigations suggesting that MWM facilitates immediate improvements in joint kinematics by correcting positional faults and enhancing pain-free motion through concurrent therapist-applied glides during active movement (25,26). The observed large effect sizes for pain and functional outcomes (Cohen's $d > 1.0$) support previous evidence that manual therapy integrated with movement may produce neuroplastic effects and modulate descending inhibitory pathways, leading to sustained analgesia (27). The present results expand on prior

smaller-scale studies, such as Kachingwe *et al.* (28), which demonstrated short-term functional gains with MWM but lacked sufficient power to confirm superiority. Our data fill this gap by showing reproducible, statistically robust improvements over a five-week course.

The moderate efficacy of PS observed here also accords with previous reports documenting enhanced muscle extensibility and partial symptom relief in SIS, particularly through stretching of the posterior capsule and pectoralis minor (29). However, PS primarily addresses tissue flexibility without actively retraining scapulohumeral rhythm, which may explain its smaller effect sizes compared with MWM. The study by Nishikawa *et al.* (30) on hamstring flexibility supports the mechanical benefits of passive stretching but underscores the need for complementary active mobilization to optimize neuromuscular adaptation. The current findings therefore refine existing literature by demonstrating that MWM's combined mechanical and neuromotor action yields superior clinical outcomes compared with passive techniques in SIS.

Mechanistically, the greater gains in ROM—particularly in abduction and rotations—suggest that MWM enhances the functional integrity of the scapulothoracic and glenohumeral complexes. This is consistent with biomechanical analyses indicating that shoulder impingement involves aberrant scapular tilting, humeral head translation, and subacromial space narrowing, all of which may improve when translational glides are applied during active motion (31,32). The synchronized therapist-applied glide in MWM likely restores optimal arthrokinematic coupling, while the concurrent active movement retrains sensorimotor control, yielding cumulative therapeutic benefit over repetitive sessions. These results also align with neurophysiological evidence that joint mobilization stimulates type II mechanoreceptors, inhibits nociceptive afferents, and enhances proprioceptive feedback, which collectively support pain reduction and motor performance (33).

From a clinical standpoint, this study provides practical evidence supporting MWM as an effective, safe, and time-efficient intervention for SIS within outpatient physiotherapy settings. The average 5-week protocol achieved improvements surpassing those reported for standard exercise and heat therapy alone, suggesting that early integration of MWM could expedite recovery and reduce long-term disability. Clinicians should consider incorporating MWM, particularly for patients presenting with restricted pain-free elevation, scapular dyskinesis, or posterior capsule tightness.

Despite these promising results, several limitations warrant consideration. The study was limited to a single geographical region, which may constrain external generalizability (34). Although randomization minimized selection bias, complete blinding of participants and therapists was not feasible due to the nature of manual interventions, introducing potential performance bias. A single therapist administered all interventions, which, while ensuring standardization, may have introduced provider bias. Additionally, the study focused on short-term outcomes; long-term durability of MWM effects beyond five weeks remains unexamined. Future multicenter trials with larger samples, multi-therapist designs, and extended follow-up are necessary to confirm the sustainability and generalizability of these results(35,36).

In summary, this research reinforces that MWM produces greater reductions in pain and disability and superior improvements in ROM compared with PS and conventional therapy (37). The findings advance current understanding of SIS rehabilitation by empirically demonstrating that active manual therapy integrating pain-free motion and therapist-guided glides yields optimal outcomes. Future investigations should explore the mechanistic interplay between biomechanical correction and neural modulation underlying these effects, while testing protocol adaptations such as self-administered MWM for broader clinical applicability (38, 39).

CONCLUSION

This study demonstrated that mobilization with movement (MWM), when combined with conventional physiotherapy, is significantly more effective than passive stretching (PS) or standard therapy alone in reducing pain, improving shoulder function, and enhancing range of motion in patients with shoulder impingement syndrome (SIS). The large effect sizes observed for SPADI and VAS outcomes underscore the clinical relevance of these improvements, confirming that MWM's simultaneous application of manual glide and active movement effectively restores normal shoulder biomechanics and alleviates pain. The results suggest that MWM promotes both mechanical correction and neuromuscular re-education, leading to superior functional recovery compared to PS, which primarily improves flexibility. Clinically, MWM should be considered a first-line conservative intervention for SIS, particularly for patients with pain-limited movement and scapulohumeral dysfunction. From a research perspective, these findings provide a foundation for further high-quality trials evaluating long-term outcomes, cost-effectiveness, and potential integration of self-mobilization strategies in SIS management.

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