

COMPARATIVE EFFECTS OF SYMPTOM-CONTINGENT AND TIME
CONTINGENT MANUAL THERAPY ON PAIN AND FUNCTION
AMONG PATIENTS WITH MECHANICAL SHOULDER PAIN: A
RANDOMIZED CONTROLLED TRIAL

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Abstract

Background: Mechanical shoulder pain can substantially restrict daily activity and quality of life. Objective: To compare symptom-contingent manual therapy and exercise progression (SMBT) with time-contingent manual therapy and exercise progression (TMBT) for pain and shoulder-related disability.

Methods: A parallel-group randomized controlled trial was conducted at the Department of Physiotherapy, Farooq Hospital, Lahore, Pakistan. A total of 110 patients were screened and 56 eligible participants were randomized 1:1 to SMBT or TMBT. Both groups received standardized conventional physiotherapy plus phase-based manual therapy and exercise three times weekly for 12 weeks. SMBT progression required pain $\leq 3/10$ without symptom aggravation, whereas TMBT progressed according to a predetermined schedule. The blinded assessor measured pain using the Numeric Pain Rating Scale (NPRS) and shoulder-related disability using the Shoulder Pain and Disability Index (SPADI).

Results: All 56 participants completed the intervention and were analyzed. NPRS decreased from 7.14 ± 0.97 to 2.82 ± 1.33 in SMBT and from 7.14 ± 0.85 to 3.96 ± 1.37 in TMBT. Median NPRS improvement was 4.0 (IQR 4.0-5.0) versus 3.0 (IQR 2.0-4.0), respectively ($U = 175.00$, $Z = -3.674$, $p < .001$, $r = .49$). Total SPADI decreased from 69.57 ± 3.70 to 29.73 ± 4.99 in SMBT and from 68.46 ± 3.57 to 38.90 ± 3.86 in TMBT. Mean SPADI improvement was 39.84 ± 2.84 versus 29.56 ± 2.41 points, with a between-group mean difference of 10.28 points (95% CI 8.87-11.69; $t(54) = 14.613$, $p < .001$). No adverse events occurred.

Conclusion: Both approaches improved pain and disability, with greater 12-week improvement in the symptom-contingent group. Trial registration: Not registered.

INTRODUCTION

Shoulder pain is a frequent musculoskeletal problem that can limit reaching, lifting, dressing, work-related activity, sleep, and participation in recreation. Contemporary clinical guidance emphasizes careful clinical assessment, identification of functional limitations and relevant contextual factors, and nonsurgical management centered on active rehabilitation (Desmeules et al., 2025). Although diagnostic labels vary, a large proportion of non-traumatic shoulder presentations managed in physiotherapy involve pain associated with movement, reduced load tolerance, and functional limitation rather than a single clearly isolated structural lesion.

Exercise is a central component of conservative shoulder rehabilitation. Recent evidence syntheses support shoulder-specific exercise for reducing pain and improving function, although the optimal exercise type, dose, and progression strategy remain uncertain (Silveira et al., 2024). Manual therapy is also commonly incorporated into multimodal physiotherapy, particularly when pain, mobility restriction, or movement-related symptoms are prominent. However, the incremental benefit of manual therapy over exercise alone is variable across studies, and recent reviews have emphasized limitations in the quality and consistency of the evidence (Aguilar García et al., 2024; Flowers et al., 2024). These findings make the way in which rehabilitation is dosed and progressed an important clinical question.

One clinically relevant distinction concerns whether treatment progression is symptom-contingent or time-contingent. In a symptom-contingent approach, the intensity or complexity of activity is modified in response to symptoms and tissue irritability. In a time-contingent approach, progression is planned according to predetermined time- or session-based targets rather than being governed primarily by pain response. These approaches reflect different assumptions about how pain should influence rehabilitation. Time-contingent graded activity has been used in behavioral rehabilitation to increase activity despite pain, including in people with chronic shoulder complaints (Geraets et al., 2005).

Conversely, symptom-contingent strategies are often used when clinicians wish to limit symptom provocation while gradually restoring movement and load tolerance (Ristori et al., 2018).

Despite the clinical relevance of this distinction, direct evidence comparing symptom-contingent and time-contingent progression within a similar manual therapy and exercise program for mechanical shoulder pain is limited. The present study therefore compared two rehabilitation progression strategies while retaining corresponding treatment components in both groups. The primary objective was to compare change in pain intensity measured using the Numeric Pain Rating Scale (NPRS). The secondary objective was to compare change in shoulder-related pain and disability measured using the Shoulder Pain and Disability Index (SPADI). It was hypothesized that the progression strategy would influence short-term clinical outcomes.

LITERATURE REVIEW

Exercise-based rehabilitation is consistently recommended as a first-line intervention for common non-traumatic shoulder presentations. The 2025 clinical practice guideline for rotator cuff tendinopathy recommends active rehabilitation that may include motor-control and/or resistance exercise, while noting that the optimal frequency, intensity, type, and time parameters remain incompletely established (Desmeules et al., 2025). Similarly, a network meta-analysis found that shoulder-specific exercise can reduce chronic shoulder pain, but the relative value of adjunctive interventions is less consistent (Silveira et al., 2024). These observations suggest that treatment effectiveness may depend not only on the selected intervention but also on how the intervention is dosed, individualized, and progressed over time.

Manual therapy remains a common adjunct in shoulder rehabilitation. Earlier systematic evidence suggested small short-term benefits when manual therapy was added to exercise in some shoulder impingement populations (Steuri et al., 2017), and a multicenter randomized trial found that cervicothoracic manual therapy combined with exercise

produced some short-term improvements compared with exercise alone (Mintken et al., 2016). However, more recent reviews have been more cautious. Aguilar García et al. (2024) concluded that multimodal physiotherapy can be helpful but that adding manual therapy to exercise does not consistently produce superior outcomes. Flowers et al. (2024), applying strict methodological criteria, found that the available randomized evidence for manual therapy in shoulder dysfunction had substantial trustworthiness limitations. Therefore, manual therapy should be interpreted as one component of a broader rehabilitation package rather than as an isolated mechanism explaining recovery.

The distinction between symptom-contingent and time-contingent progression originates partly from behavioral approaches to pain and activity. In symptom-contingent care, pain or symptom aggravation influences when an exercise is stopped, reduced, or progressed. In time-contingent care, activity is progressed according to a planned schedule despite fluctuations in pain, with the intention of reducing excessive symptom-dependent behavior and gradually restoring function. Geraets et al. (2005) evaluated a behavioral, time-contingent graded exercise program in chronic shoulder complaints and reported a small advantage for restoration of daily activities compared with usual care. An integrated shoulder-pain framework by Ristori et al. (2018) also distinguished symptom-contingent and time-contingent approaches according to clinical presentation and pain mechanisms, indicating that neither approach should automatically be assumed to be appropriate for every patient.

Psychological and behavioral features may further modify responses to rehabilitation. Fear of movement, catastrophizing, anxiety, and confidence can influence pain and activity in persistent shoulder conditions. Farzad et al. (2021) found that behavioral and cognitive components have been incorporated into shoulder-pain interventions, although treatment targets and intervention rationales are often poorly specified. This is relevant because a time-contingent progression strategy may be intended to reduce pain-driven

avoidance, whereas a symptom-contingent strategy may prioritize tolerance and irritability. Without adequate characterization of participants' pain mechanisms and psychosocial factors, it is difficult to determine in advance which strategy should be preferable.

Reliable measurement of pain and disability is essential when comparing rehabilitation strategies. The NPRS is a simple 0-10 measure widely used to quantify pain intensity and has demonstrated strong correspondence with visual analogue pain scales (Bijur et al., 2003). The SPADI was developed specifically for shoulder conditions and includes pain and disability subscales (Roach et al., 1991). The total SPADI score is conventionally expressed on a 0-100 scale, with higher values indicating greater pain and disability. These instruments permit assessment of both symptom intensity and the functional consequences of shoulder pain.

An additional issue is treatment individualization. Contemporary shoulder rehabilitation increasingly emphasizes matching exercise and load to the person rather than to a diagnostic label alone. Desmeules et al. (2025) recommend attention to symptoms, functional limitations, psychosocial and contextual factors, and patient goals when planning rehabilitation. This does not prescribe a single progression rule, but it does support the broader principle that progression should be clinically reasoned and reproducible. A symptom-contingent strategy operationalizes individualization through explicit symptom thresholds, whereas a time-contingent strategy operationalizes progression through planned exposure to activity. Comparing these approaches is therefore clinically meaningful because the distinction concerns how clinicians respond to pain during rehabilitation, not simply which exercise is selected.

The evidence also indicates that pain reduction and functional recovery are related but not identical outcomes. A patient may report lower pain while still avoiding activity, or may regain function despite persistent discomfort. For that reason, the present study used both NPRS and SPADI rather than relying on a pain score alone. The NPRS provides a direct measure of perceived pain intensity, whereas SPADI

captures the extent to which shoulder symptoms interfere with common activities. Examining both outcomes is particularly important when comparing symptom- and time-contingent strategies because the two approaches could theoretically influence pain behavior and functional engagement differently. At the same time, outcome interpretation should focus on between-group effects and their uncertainty, rather than on whether each group separately reaches statistical significance. Randomized trials are designed primarily to estimate the difference between interventions.

Taken together, the literature supports active rehabilitation for shoulder pain but leaves uncertainty regarding the optimal progression strategy. The present trial addresses this narrower question by comparing symptom-contingent and time-contingent progression while both groups receive corresponding manual therapy and exercise components. The clinical value of such a comparison lies in determining whether the rule used to progress treatment is associated with different short-term outcomes, rather than assuming that all forms of 'progressive rehabilitation' are equivalent.

METHODOLOGY

Study Design and Setting

This study used a parallel-group randomized controlled trial design and was conducted exclusively in the Department of Physiotherapy, Farooq Hospital, Lahore, Pakistan. Study activities, including screening, treatment, and follow-up, were conducted from May to August 2026. Patients attending the physiotherapy outpatient department were screened consecutively, enrolled after written informed consent, and randomized after baseline assessment. Treatment was delivered three times per week for 12 weeks, and the same blinded outcome assessor repeated the NPRS and SPADI assessments at the end of week 12. Both groups received conventional physiotherapy plus manual therapy and exercise rehabilitation; the intended contrast was the rule governing treatment progression.

Participants and Eligibility

Participants were men and women aged 25-60 years with mechanical shoulder pain of more than 4 weeks' duration who were willing to provide written informed consent. Mechanical shoulder pain and eligibility were confirmed by Faizan Ali, a Doctor of Physical Therapy (DPT), through clinical examination based on shoulder pain, restricted movement, and associated functional limitation consistent with mechanical shoulder problems. Recruitment used non-probability consecutive sampling among patients attending the physiotherapy outpatient department. Exclusion criteria were a history of shoulder surgery or fracture, neurological disease affecting the upper limb, systemic inflammatory conditions such as rheumatoid arthritis, and severe pain requiring medical attention.

Sample Size

The sample size was determined for comparison of two independent means using 80% statistical power and a 5% significance level ($\alpha = .05$). The expected between-group difference and variance assumptions were based on the previous randomized shoulder-pain study cited in the protocol (Naranjo-Cinto et al., 2022). The resulting minimum sample was 56 participants, with 28 participants in each treatment group.

Randomization, Allocation Concealment, and Blinding

A computer-generated randomization sequence was prepared before recruitment by an independent researcher who was not involved in recruitment, treatment, or outcome assessment. Allocation was concealed using sequentially numbered, opaque, sealed envelopes (SNOSE). After written consent and baseline assessment, the treating physiotherapist opened the next consecutively numbered envelope and assigned the participant in a 1:1 ratio to SMBT or TMBT. Participants and the treating physiotherapist could not be blinded because of the nature of the interventions. Outcome assessment was performed at baseline and week 12 by the same qualified physiotherapist, who remained blinded to group allocation and was not involved in recruitment, allocation, or

treatment delivery. Participants were instructed not to disclose their group during follow-up assessment, and data were analyzed using coded participant identifiers.

Interventions

Both groups received the same standardized conventional physiotherapy component: patient education about mechanical shoulder pain, posture and ergonomic instruction, activity modification, superficial heat or cold for 5-10 minutes according to clinical presentation, and gentle pain-free range-of-motion exercise including Codman pendulum and active-assisted movement. This conventional component lasted approximately 15-20 minutes per session and was delivered three times weekly for 12 weeks.

In addition, both groups received manual therapy and exercise rehabilitation for approximately 30-45 minutes per session, three times weekly for 12 weeks. The intervention categories included glenohumeral and scapulothoracic mobilization, soft-tissue mobilization, stretching, rotator-cuff and scapular strengthening, and functional rehabilitation. Treatment was organized into three phases: weeks 1-4 (pain control and early mobility), weeks 5-8 (mobility and strengthening), and weeks 9-12 (advanced strengthening and functional rehabilitation). All treatment sessions were delivered by Faizan Ali (DPT), who had approximately two years of clinical practice experience.

In the SMBT group, progression depended on the participant's symptom response and was advanced only when pain was $\leq 3/10$ on the NPRS and exercise did not increase symptoms. If symptoms exceeded the threshold, progression was postponed until they settled. In the TMBT group, the corresponding manual-therapy and exercise content was progressed according to the predefined phase schedule rather than daily symptom response, except where contraindications or adverse effects made progression inappropriate.

No home exercise program was prescribed. All therapeutic exercises were performed during supervised treatment sessions. During the 12-week study period, participants were not permitted to receive additional shoulder

physiotherapy or rehabilitation, injections, other concurrent shoulder treatment, or analgesic medication for shoulder pain.

During weeks 1-4, the protocol used grade I-II posterior/inferior glenohumeral mobilization (2-3 sets $\times$ 30 s), scapulothoracic mobilization (2-3 sets $\times$ 30 s), upper-trapezius and pectoralis-minor soft-tissue release (2-3 min), pendulum and passive/assisted range-of-motion exercise, and rotator-cuff isometrics (10 repetitions with 5-s holds). In SMBT, advancement depended on pain and movement response; in TMBT, these components followed the fixed early-phase schedule.

During weeks 5-8, treatment progressed to grade III posterior/inferior glenohumeral mobilization (3-4 sets $\times$ 30-60 s), mobilization with movement (3 $\times$ 10 repetitions), active range-of-motion exercise (3 $\times$ 10-12 repetitions), resistance-band external rotation, internal rotation, and scapular retraction (2-3 $\times$ 10-12 repetitions), and stretching/stabilization exercises. SMBT progression continued to depend on tolerable symptoms, improved range, and movement quality, whereas TMBT advanced according to the fixed phase schedule.

During weeks 9-12, the protocol included grade III-IV mobilization (3-4 sets $\times$ 30 s), progressive resistance training (3 $\times$ 12-15 repetitions), closed-chain wall push-ups (2-3 $\times$ 10-12 repetitions), serratus-anterior/lower-trapezius strengthening (3 $\times$ 10-12 repetitions), overhead/functional training, and task-specific activity. SMBT used symptom response, strength gains, movement control, and return-to-activity goals to guide advancement; TMBT increased load and complexity on the predefined time schedule.

Outcome Measures

The primary outcome was pain intensity measured using the 11-point Numeric Pain Rating Scale (NPRS), ranging from 0 (no pain) to 10 (worst imaginable pain) (Bijur et al., 2003). The secondary outcome was shoulder-related pain and disability measured using the Shoulder Pain and Disability Index (SPADI), reported on a 0-100 total scale with higher scores indicating greater impairment (Roach et al., 1991). The English SPADI was used.

Participants completed the questionnaire themselves, with clarification or explanation provided when necessary to ensure understanding without altering the meaning of the items. In the available results tables, pain and disability subscales were presented as raw subscale totals, while total SPADI was expressed on the 0-100 scale.

Ethical Considerations

The study protocol was approved by the Research Ethical Committee, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan (Ref. IRB/FAHS/REHAB/04/26/MS/RS-4064).

The committee approved the protocol on 24 April 2026; the formal approval letter was issued on 24 August 2026. Farooq Hospital granted permission for the study. Written informed consent was obtained from all participants before enrollment. Participation was voluntary, confidentiality and anonymity were maintained, and participants were informed that they could withdraw at any time without penalty or effect on their treatment. The study was conducted in accordance with the Declaration of Helsinki.

Trial registration: The trial was not registered.

Statistical Analysis

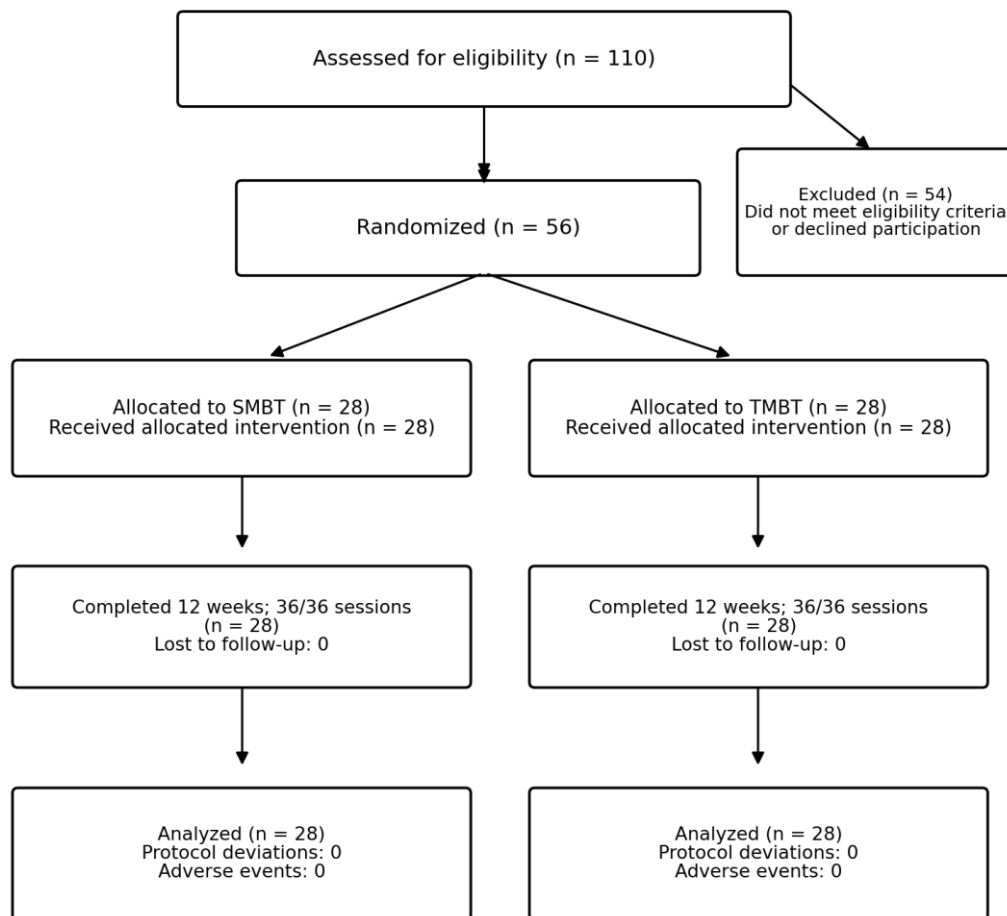
Data were analyzed using IBM SPSS Statistics, version 26.0. Normality was assessed using the Shapiro-Wilk test. Pre-intervention NPRS scores and NPRS change scores were non-normally distributed in both groups ($p < .05$), whereas SPADI pre-, post-, and change scores

were approximately normally distributed ($p > .05$). Consequently, within-group NPRS changes were analyzed using the Wilcoxon signed-rank test and between-group NPRS change using the Mann-Whitney U test. Within-group total SPADI changes were analyzed using paired-samples t tests, and the between-group change in total SPADI using an independent-samples t test. For the Mann-Whitney comparison, effect size was calculated as $r = |Z|/\sqrt{N}$. The between-group mean difference in SPADI change is reported with a 95% confidence interval. All tests were two-sided and statistical significance was set at $p < .05$. Statistical analysis was conducted by Faizan Ali and independently rechecked by the research supervisor for accuracy. All randomized participants completed follow-up and were included in the analysis; no missing outcome data required imputation.

ANALYSIS & DISCUSSION

Results

A total of 110 patients were screened for eligibility. Fifty-four were excluded because they did not meet the eligibility criteria or declined participation. The remaining 56 participants were randomized equally to SMBT ($n = 28$) and TMBT ($n = 28$). All randomized participants received their allocated intervention, completed the 12-week program and all scheduled treatment sessions (36 sessions per participant), and were included in the analysis. There were no losses to follow-up, protocol deviations, or treatment-related adverse events. Participant flow is summarized in Figure 1.



SMBT = symptom-contingent manual therapy; TMBT = time-contingent manual therapy.

Figure 1. Participant flow through the randomized controlled trial.

At baseline, the SMBT group included 16 men (57.1%) and 12 women (42.9%), whereas the TMBT group included 12 men (42.9%) and 16 women (57.1%). Mean age was 41.04 ± 6.30 years in SMBT and 41.68 ± 5.00 years in

TMBT. Baseline mean NPRS was 7.14 in both groups, and total SPADI values were descriptively similar (69.57 in SMBT and 68.46 in TMBT).

Table 1. Baseline demographic and clinical characteristics

Variable	SMBT (n = 28)	TMBT (n = 28)
Age, mean $\pm$ SD (years)	41.04 ± 6.30	41.68 ± 5.00
Male, n (%)	16 (57.1%)	12 (42.9%)
Female, n (%)	12 (42.9%)	16 (57.1%)

Variable	SMBT (n = 28)	TMBT (n = 28)
NPRS pre-intervention, mean $\pm$ SD	7.14 $\pm$ 0.97	7.14 $\pm$ 0.85
Total SPADI pre-intervention, mean $\pm$ SD	69.57 $\pm$ 3.70	68.46 $\pm$ 3.57

Pain intensity improved in both groups over the intervention period. NPRS decreased from 7.14 $\pm$ 0.97 to 2.82 $\pm$ 1.33 in the SMBT group and from 7.14 $\pm$ 0.85 to 3.96 $\pm$ 1.37 in the TMBT group. Within-group reductions were

statistically significant in both SMBT ($Z = -4.680$, $p < .001$) and TMBT ($Z = -4.663$, $p < .001$). The decrease based on the group means was 4.32 NPRS points for SMBT and 3.18 points for TMBT.

Table 2. NPRS and SPADI outcomes before and after intervention

Outcome	Group	Pre, mean $\pm$ SD	Post, mean $\pm$ SD
NPRS (0-10)	SMBT	7.14 $\pm$ 0.97	2.82 $\pm$ 1.33
NPRS (0-10)	TMBT	7.14 $\pm$ 0.85	3.96 $\pm$ 1.37
SPADI pain raw subscale (0-50)	SMBT	34.71 $\pm$ 2.40	14.86 $\pm$ 3.31
SPADI pain raw subscale (0-50)	TMBT	34.39 $\pm$ 3.02	20.00 $\pm$ 3.47
SPADI disability raw subscale (0-80)	SMBT	55.71 $\pm$ 4.18	23.79 $\pm$ 4.79
SPADI disability raw subscale (0-80)	TMBT	54.61 $\pm$ 3.93	30.57 $\pm$ 4.93
Total SPADI (0-100)	SMBT	69.57 $\pm$ 3.70	29.73 $\pm$ 4.99
Total SPADI (0-100)	TMBT	68.46 $\pm$ 3.57	38.90 $\pm$ 3.86

Note. SPADI pain and disability subscales are presented as raw totals, whereas total SPADI is presented on the 0-100 scale. Inferential tests were reported only for total SPADI.

The between-group comparison of NPRS change favored SMBT. Median improvement was 4.0 points (IQR 4.0-5.0) in SMBT and 3.0 points (IQR 2.0-4.0) in TMBT. The mean rank was 36.25 in SMBT and 20.75 in TMBT ($U = 175.00$, $Z = -3.674$, $p < .001$). The corresponding rank-based effect size was $r = .49$. Total SPADI also improved in both groups. The SMBT group decreased from 69.57 $\pm$ 3.70 to 29.73 $\pm$ 4.99, whereas the TMBT group decreased from 68.46 $\pm$ 3.57 to 38.90 $\pm$ 3.86. Within-group change was statistically significant in SMBT ($t = 74.144$, $df = 27$, $p < .001$) and TMBT ($t = 65.011$, $df = 27$, $p < .001$).

For the between-group comparison, mean total SPADI reduction was 39.84 $\pm$ 2.84 points in SMBT and 29.56 $\pm$ 2.41 points in TMBT. The between-group mean difference in improvement was 10.28 points (95% CI 8.87-11.69), and the independent-samples test was statistically significant ($t(54) = 14.613$, $p < .001$), indicating greater improvement in shoulder-related pain and disability in SMBT. Inferential tests for the separate SPADI pain and disability subscales were not available; therefore, subscale values are presented descriptively only.

Table 3. Between-group comparison of change outcomes

Outcome	SMBT	TMBT	Between-group result
NPRS change	Median 4.0 (IQR 4.0-5.0); mean rank 36.25	Median 3.0 (IQR 2.0-4.0); mean rank 20.75	$U = 175.00$; $Z = -3.674$; $p < .001$; $r = .49$

Outcome	SMBT	TMBT	Between-group result
Total SPADI change	39.84 ± 2.84	29.56 ± 2.41	Mean difference 10.28 (95% CI 8.87-11.69); t(54) = 14.613; p < .001

Discussion

The principal finding of this randomized trial was that both rehabilitation strategies were associated with marked improvement in pain and shoulder-related disability, but symptom-contingent progression produced greater improvement than time-contingent progression over the 12-week intervention. The randomized between-group analyses favored SMBT for NPRS change ($U = 175.00$, $p < .001$; $r = .49$) and for total SPADI change, where the mean between-group difference in improvement was 10.28 points (95% CI 8.87-11.69; $t(54) = 14.613$, $p < .001$).

The findings should be interpreted within the broader evidence on shoulder rehabilitation. Current clinical guidance emphasizes active exercise as a core treatment for common rotator cuff-related and non-traumatic shoulder presentations (Desmeules et al., 2025). Systematic evidence also indicates that shoulder-specific exercise is effective for reducing pain, while the additional value of manual therapy varies according to comparison, follow-up period, and study quality (Aguilar García et al., 2024; Silveira et al., 2024). Therefore, the present results should not be interpreted as evidence that manual therapy itself is superior. Both groups received corresponding manual therapy and exercise content; the trial was designed primarily to compare how that treatment was progressed.

A plausible clinical interpretation is that symptom-contingent progression allowed the treating physiotherapist to match treatment advancement to pain irritability and short-term tolerance. By requiring pain to be 3/10 or lower and symptoms not to increase before progression, the SMBT approach may have reduced excessive symptom provocation while still permitting gradual loading. Such an approach is conceptually consistent with frameworks that recommend symptom-guided loading for selected shoulder-pain presentations

(Ristori et al., 2018). However, the present trial did not measure tissue irritability, pain mechanism, fear, catastrophizing, or other psychological mediators; therefore, the mechanism responsible for the observed between-group difference cannot be established from these data.

The superiority of SMBT in this trial does not mean that time-contingent progression is generally ineffective. Time-contingent graded activity has a distinct behavioral rationale: patients progress according to planned activity targets rather than allowing pain to govern all activity. In an earlier randomized study of chronic shoulder complaints, a time-contingent graded exercise program produced modest improvements in daily activity compared with usual care (Geraets et al., 2005). Time-contingent approaches may be particularly relevant when pain-related avoidance or central pain processes contribute to disability. The integrated framework described by Ristori et al. (2018) likewise suggests that symptom-contingent and time-contingent strategies may be appropriate for different clinical presentations. The current sample was defined broadly as mechanical shoulder pain and was not stratified by pain mechanism or psychosocial profile, which limits conclusions about which patients are most likely to benefit from each progression strategy.

The magnitude of improvement was substantial in both groups. NPRS decreased by 4.32 points based on the SMBT group means and by 3.18 points in TMBT; the corresponding median improvements were 4.0 (IQR 4.0-5.0) and 3.0 (IQR 2.0-4.0). Total SPADI change was 39.84 ± 2.84 points in SMBT and 29.56 ± 2.41 points in TMBT, yielding a between-group mean difference of 10.28 points (95% CI 8.87-11.69). These estimates quantify the comparative effect more clearly than p values alone. However, the trial did not prespecify a minimal clinically important difference analysis or responder

threshold, so statistical significance should not automatically be equated with clinical importance.

The results are broadly compatible with evidence that combined rehabilitation can improve shoulder outcomes. Steuri et al. (2017) found evidence supporting exercise and possible short-term benefit from manual therapy in shoulder impingement populations, while Mintken et al. (2016) demonstrated improvement with exercise-based treatment with or without cervicothoracic manual therapy. At the same time, more recent reviews advise caution in attributing outcomes specifically to manual therapy because many trials have methodological limitations or show only small incremental effects (Aguilar García et al., 2024; Flowers et al., 2024). The present trial adds a different perspective by suggesting that the progression rule may itself be an important treatment variable.

Several design features strengthen the study. Randomization was computer generated, allocation concealment used sequentially numbered opaque sealed envelopes, and the same qualified outcome assessor remained blinded at baseline and week 12. Both groups were treated at the same clinical site over the same 12-week period, the interventions followed phase-based protocols, and all 56 randomized participants completed every scheduled treatment session. No protocol deviations or adverse events were reported. The NPRS and SPADI are established patient-reported measures for pain and shoulder-related disability (Bijur et al., 2003; Roach et al., 1991).

Important limitations remain. First, the sample was small and recruited from a single hospital, limiting external validity. Second, "mechanical shoulder pain" is a broad clinical category; eligibility was based on clinical examination, and diagnostic subgroup frequencies and specific orthopedic test findings were not reported. Third, participants and the treating physiotherapist could not be blinded, creating potential performance and expectation bias. Fourth, the same clinician performed clinical eligibility screening and delivered treatment, although randomization was generated independently and allocation was concealed

until after baseline assessment. Fifth, the English SPADI was used with explanation when necessary rather than a formally documented local-language version, which may have introduced variation in item interpretation. Sixth, outcomes were assessed only immediately after the 12-week intervention, with no longer-term follow-up. Finally, the trial was not prospectively registered, and the analysis relied on change-score comparisons rather than a prespecified baseline-adjusted model.

From a statistical perspective, interpretation should give priority to the randomized between-group comparisons. The within-group tests establish that scores changed over time, but the stronger evidence for comparative effectiveness comes from the between-group NPRS and SPADI change analyses. The present report therefore includes a rank-based effect size for NPRS and a 95% confidence interval for the SPADI mean difference. A future replication should prespecify a baseline-adjusted treatment-effect model and clinically meaningful responder analysis.

The study also highlights the need to separate treatment content from treatment progression. Both groups received the same standardized conventional physiotherapy and corresponding categories of manual therapy, strengthening, stretching, and functional rehabilitation. The intended contrast was that SMBT advanced according to pain and symptom response, whereas TMBT advanced according to the predefined time schedule. Because all sessions were supervised by the same treating physiotherapist and all participants completed the planned sessions, differences in attendance did not explain the between-group findings. Nevertheless, the observed effect should be interpreted as a comparison of the two complete rehabilitation strategies rather than as proof that the progression rule alone caused the entire difference.

These limitations mean that the results should be interpreted as evidence of a 12-week between-group difference within this single-center sample, not as definitive proof that symptom-contingent progression is universally superior. Larger multicenter trials with prospectively registered protocols, standardized

diagnostic characterization, validated local-language outcome administration where appropriate, predefined effect estimates, and longer follow-up are needed to confirm the finding.

CONCLUSION

In this randomized controlled trial, both symptom-contingent and time-contingent manual therapy and exercise progression improved pain and shoulder-related disability over 12 weeks in adults with mechanical shoulder pain. Between-group analyses favored symptom-contingent progression for both NPRS and total SPADI change. The findings suggest that tailoring progression to symptom response may be beneficial in selected patients, but the small single-center sample, broad clinical diagnosis, lack of participant and therapist blinding, absence of long-term follow-up, and lack of prospective trial registration limit generalization. Further adequately powered, registered multicenter trials are warranted.

LIMITATIONS

- Relatively small sample size and recruitment from a single hospital limit generalizability.
- Mechanical shoulder pain was defined clinically, without reported diagnostic subgroup frequencies or detailed special-test findings.
- Participants and the treating physiotherapist could not be blinded because of the nature of the interventions.
- Outcomes were assessed only at baseline and immediately after 12 weeks; longer-term sustainability was not evaluated.
- The English SPADI required clarification for some participants; use of a formally validated local-language version was not documented.
- The analysis used within-group tests and change-score comparisons rather than a prespecified baseline-adjusted model.
- The randomized trial was not prospectively registered.

RECOMMENDATIONS

- Future studies should use multicenter recruitment, larger samples, standardized diagnostic characterization, and prospective trial registration.

- Future trials should prespecify primary and secondary outcomes, use validated local-language outcome measures where appropriate, and document treatment fidelity.

- Future trials should prespecify and report baseline-adjusted treatment effects, clinically meaningful responder outcomes, and longer-term follow-up.

DECLARATIONS

Ethics approval and consent to participate: Approved by the Research Ethical Committee, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan (Ref. IRB/FAHS/REHAB/04/26/MS/RS-4064; protocol approved 24 April 2026; formal letter issued 24 August 2026). Written informed consent was obtained from all participants before enrollment.

Trial registration: Not registered.

Funding: This research received no external funding.

Conflict of interest: The authors declare no conflicts of interest.

Data availability: The anonymized data supporting the findings of this study are available from the corresponding author upon reasonable request.

Author contributions: Faizan Ali contributed to the study conception and design, participant recruitment, clinical screening, intervention delivery, data collection, statistical analysis, and preparation of the initial manuscript draft. Asima Irshad supervised the study, independently rechecked the statistical analysis, critically reviewed the manuscript, and contributed to its revision. Both authors approved the final manuscript.

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