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COMPARING THE EFFICACY OF ACTIVE RELEASE TECHNIQUE AND KALTENBORN-EVJENTH ORTHOPEDIC MANUAL THERAPY IN PATIENTS WITH SHOULDER IMPINGEMENT SYNDROME: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Background: *Subacromial pain syndrome (SIS), or shoulder impingement syndrome, is one of the most common shoulder diseases and leads to pain, loss of range of motion (ROM), and functional disability. Although exercise therapy is the most important in the conservative management, manual therapies, used as adjunctions, might speed up healing. Active Release Technique (ART) and Kaltenborn-Evjenth Orthopedic Manual Therapy (KEOMT) are two different mechanistic therapy approaches, namely soft tissue mobilization and joint mobilization, respectively, but their relative efficacy in SIS has not been established.*

Aim: *To determine the short-term efficacy of ART and KEOMT, along with a standardized exercise regimen, on pain, ROM, and functional disability in SIS patients.*

Methods: *A randomized controlled trial was performed with 60 clinically diagnosed SIS participants (aged 18-60 years); it was a single-blinded study. The participants were randomly divided into two groups; Group A was receiving ART, and Group B was receiving KEOMT with three sessions every week over a period of six weeks under the same exercise therapy. The main outcomes were pain intensity (Visual Analog Scale, VAS), shoulder ROM (flexion, abduction, and internal and external rotation with the goniometer), and functional disability (Shoulder Pain and Disability Index, SPADI). Measurements were done at baseline, week 3, and post-intervention (week 6).*

Results: *Both conditions showed large within-group changes in all outcomes. ART was found to have larger pain (VAS: pre 6.7-post 2.1 vs. KEOMT pre 6.5-post 3.0, $p < 0.05$) and functional disability (SPADI: 72.5%-22.6% vs. 70.8%-33.4%, $p = 0.01$) reductions. KEOMT, on the other hand, demonstrated a better*

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improvement of ROM, especially in flexion (148° vs. 158°) and abduction (151° vs. 164°, $p < 0.05$).

Conclusion: *ART is superior in enhancing pain and functional improvement rapidly, whereas KEOMT provides more significant improvements with respect to shoulder ROM. Both modalities are suitable to supplement exercise therapy, although their use can be optimized on the basis of patient clinical profile—pain and disability versus motion restriction. Stratified rehabilitation strategies for SIS need to be refined so that future multicenter trials with larger cohorts and extended follow-up are justified.*

INTRODUCTION

Subacromial pain syndrome (also known as shoulder impingement syndrome or SIS) is one of the most common musculoskeletal disorders of the shoulder, which is commonly associated with severe pain levels, limited range of motion (ROM), and sometimes functional disability (Yu et al., 2025). The prevalence of SIS in clinical environments shows that it, in turn, contributes up to 44-65 percent to all shoulder-related complaints, which demonstrates the extensive clinical and socioeconomic effect (Creech & Silver, 2025), (Sikandar et al., 2025).

The first-line modality of SIS is conservative management, and exercise therapy (based on rotator cuff and scapular stabilizer strengthening, neuromuscular control, and mobility restoration) continues to provide clinically meaningful improvements in pain and function (Pieters et al., 2020). But there exist high interindividual differences in treatment responsiveness, which highlights the possibility of adjunctive interventions, especially manual therapy and soft-tissue techniques, to boost the initial symptomatic relief and movement restoration (Khan, Adnan, et al., 2025)

The use of manual therapy as part of multimodal rehabilitation has been growing, and it is indicated that the use of manual therapy alongside exercise can speed the process of pain and functional recovery (Khan, Tahir, Andam, Huma, & Saleem, 2023). In Pakistan, a single-blinded randomized controlled trial revealed that the manual therapy was significantly beneficial compared to the exercise therapy, adding to the stretching and strengthening regimens, to achieve better outcomes in terms of pain, functional capacity, and scapular protraction (Tauqeer, Arooj, & Shakeel, 2024). This experiment revealed that adjunct manual therapy could have higher short-term pain modulation and functional restoration.

Systematically, systematic reviews and meta-analyses have studied the usefulness of the manual therapy in different shoulder pathologies (Khan, Khan, et al., 2025). The most recent systematic review of thoracic spine manual therapy (TSMT) indicates promising outcomes in combination with exercise to improve pain, disability, and ROM in SIS; however, the heterogeneity of incorporated RCTs should be viewed with caution (Yu et al., 2025). In a meta-analysis of 24 RCTs (n = 1,110) in broader musculoskeletal shoulder conditions, manual therapy alone was not associated with a significant decrease in pain and an improvement in the functional outcome; nevertheless, the combination of manual and exercise therapy demonstrated a significant improvement in pain and functional outcome (Liu et al., 2024). Other reviews, however, found the evidence to be too little to claim that a superiority exists between manual therapy and other interventions in SIS (Maqsood et al., 2025).

Among the manual and soft-tissue interventions, two highly visible and mechanistically different approaches exist, and they are Active Release Technique (ART) and the Kaltenborn-Evjenth Orthopedic Manual Therapy (KEOMT) concept. ART is a movement-oriented, practitioner-applied approach that aims at treating soft-tissue adhesions, myofascial restrictions, and scar tissue with direct hand contact in combination with patient-generated movement (Barnes & Rivera, 2022) (Khan, Shahzad, et al., 2025). Although ART is popular in use, there is still little evidence based on the application of ART in SIS. A single study contrasted ART and the hold-relax technique and recommended possible benefits; nevertheless, the research was small, and methodological issues would not allow closing (Paul & KK, 2021) (Shinwari et al., 2024). A recent

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randomized clinical trial in Pakistan contrasted ART and soft-tissue mobilization (STM) in patients with SIS (n = 40) and found both intervention strategies to be effective in alleviating pain, enhancing elevation and external rotation ROM, and decreasing disability; however, it did not directly compare ART to the joint-based techniques (Afzaal & Randhawa, 2024) (Durrani et al., 2025).

Conversely, the KEOMT notion focuses on graded arthrokinematic mobilizations, including glides and sustained joint play, which are directed by the principles of biomechanics and intended to restore the joint motion and functioning. A 2016 Polish study (n = 42) reported that the KEOMT use with SIS patients resulted in a higher ROM, better joint play, muscle strength, and reduced pain measured with VAS (Giordano, 2021) (ul Hassan, Saleem, Waqas, Khan, & Sikandar, 2025). Although it has been proven to be mechanistically plausible and encouraging in its results, comparative and high-quality randomized trials involving KEOMT versus other interventions in SIS are currently unavailable.

Exercise therapy is still of the essence, but residual symptoms are still obvious in most of the SIS patients. Manual therapy as an adjunct—in particular, soft-tissue or joint-mobilization versions of this therapy—can augment the response to early treatment, but the heterogeneity of methodology restricts generalized prescriptions.

ART and KEOMT are different therapeutic mechanistic approaches, focused on soft tissues and joint arthrokinematics, respectively, but there is no head-to-head comparative evidence.

Due to the high rates of SIS and the fact that in spite of the existing practice of exercise therapy, the most effective adjuncts are still unknown, it is necessary to determine what the most effective adjunct to exercise therapy is. A head-to-head comparison of ART and KEOMT would bridge a significant issue in the body of evidence by clarifying the relative short- and mid-term effectiveness of each method on the primary clinical outcomes of pain, active ROM, and functional disability.

Thus, a rigorously designed randomized controlled trial based on ART versus KEOMT in the presence of a standardized exercise program and the evaluation of outcomes based on validated instruments (e.g., Numeric Pain Rating Scale, goniometry, DASH, or SPADI) at several follow-ups should be the focus of the current study. We hypothesize that ART and KEOMT, as adjuncts, will be better than baseline measures in enhancing pain, range of movement, and functional capacity, but the level or time course of enhancement may vary due to the differing biomechanical focus of these two methods.

With proper international methodological practices, such as justification of sample size, blinding of outcome assessor, the use of intention-to-treat analysis, and the use of high-quality and validated outcome measurements, this study will offer strong comparative data to support clinical decision-making, maximize rehabilitation interventions, and possibly add to the development of guidelines in non-surgical management of SIS.

Methodology

The study was designed as a randomized controlled trial (RCT) conducted in Yaseen Rehab Clinic and Shifa rehabilitation center in Peshawar, with a total duration of 6 weeks of intervention and one week allocated for both pre- and post-assessment. A sample of 60 participants was selected through power analysis to detect clinically significant changes with 95% confidence and 80% power. Participants included were aged between 18 and 60 years, clinically diagnosed with Shoulder Impingement Syndrome confirmed by positive Neer and Hawkins-Kennedy tests, and had a minimum pain score of 4 on the Visual Analog Scale (VAS), reduced shoulder range of motion (especially in flexion and abduction), and a SPADI score of 30% or more. Exclusion criteria included a history of shoulder surgery or fractures, complete rotator cuff tear, cervical radiculopathy, neurological or systemic inflammatory diseases, and steroid or anti-inflammatory injections taken within 4 weeks prior to the study. Randomization was performed using computer-generated random numbers and sealed opaque envelopes, allocating participants equally into two groups of 30 each. Group A received the Active Release Technique (ART) three times per week, with each session lasting 30–40 minutes. During ART sessions, the therapist identified soft tissue restrictions through palpation and applied pressure to the supraspinatus, infraspinatus, deltoid, and subscapularis muscles while the patient actively moved the muscle through

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its range; each muscle was treated with 3–5 passes. Group B received Kaltenborn-Evjenth Orthopedic Manual Therapy (KEOMT) three times per week, also for 30–40 minutes per session. This included Grade I–III mobilizations, distraction, and caudal glide techniques applied to the glenohumeral joint, performed in 2–3 sets of 1-minute durations with rest intervals. Outcome measures included pain assessed by VAS (0–10 scale) at baseline, 3rd week, and post-treatment (6th week); shoulder range of motion (flexion, abduction, internal and external rotation) measured with a goniometer before and after treatment; and functional disability evaluated using the Shoulder Pain and Disability Index (SPADI), which comprises 5 pain items and 8 disability items, scored from 0% (no impairment) to 100% (maximum disability), assessed at pre- and post-intervention stages.

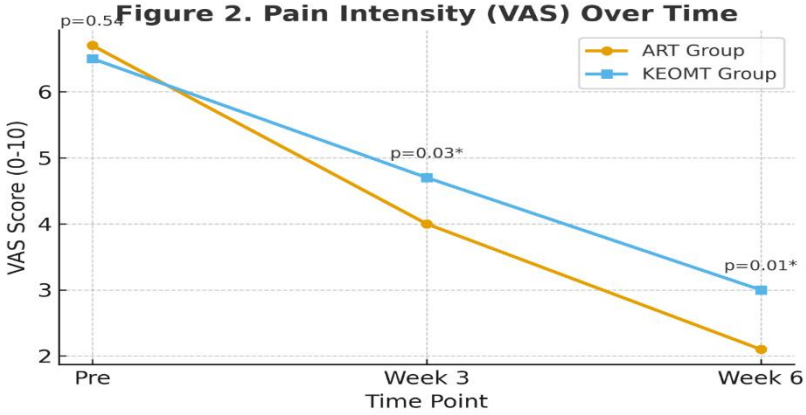
Results

Baseline Characteristics

Parameter	ART Group (n=30)	KEOMT Group (n=30)	p-value
Age (years)	42.3 ± 8.7	41.7 ± 9.1	0.76
Gender (M/F)	18 / 12	16 / 14	0.61
Duration of Symptoms (weeks)	8.2 ± 3.4	7.9 ± 3.6	0.69

This table displays the **initial demographic data** for both groups before intervention. The average age, gender distribution, and symptom duration were **comparable**, with **no significant differences** ($p > 0.05$). This confirms that **both groups were well-matched at baseline**, ensuring fair comparison of treatment outcomes.

Pain Intensity – Visual Analog Scale (VAS)



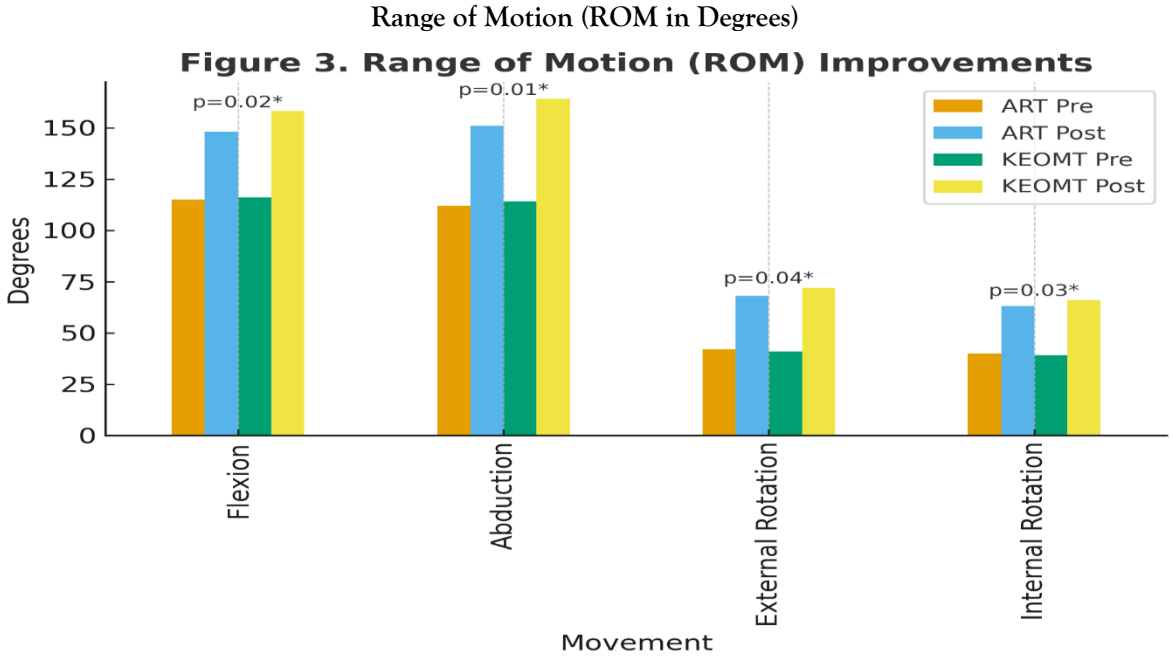
Time Point	ART Group (Mean ± SD)	KEOMT Group (Mean ± SD)	p-value
Pre	6.7 ± 1.2	6.5 ± 1.4	0.54
Week 3	4.0 ± 1.0	4.7 ± 1.1	0.03*
Week 6	2.1 ± 0.8	3.0 ± 0.9	0.01*

Both groups started with **similar levels of pain** (~6.5/10). Over time, pain decreased significantly in both groups; however, the **ART group showed a greater reduction**, especially by Week 6. The

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statistically significant p-values (<0.05) at Week 3 and Week 6 suggest that **ART was more effective than KEOMT in reducing pain** over the intervention period.



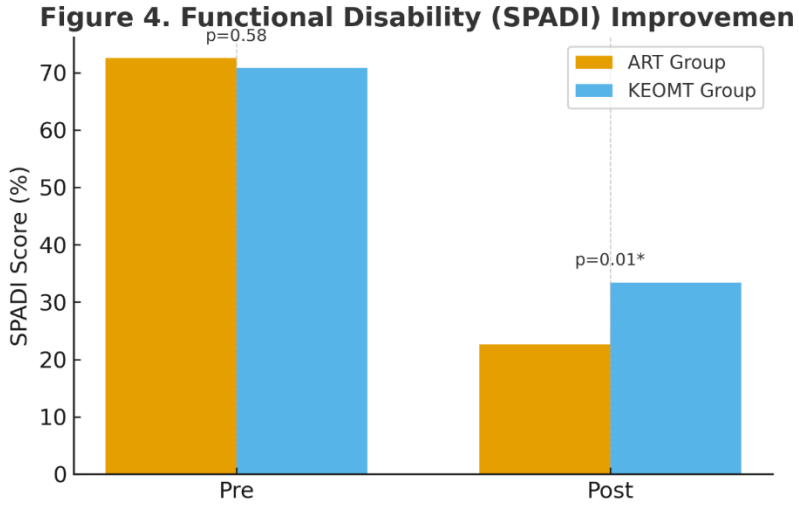
Movement	ART Pre	ART Post	KEOMT Pre	KEOMT Post	p-value (Post)
Flexion	115°	148°	116°	158°	0.02*
Abduction	112°	151°	114°	164°	0.01*
External Rotation	42°	68°	41°	72°	0.04*
Internal Rotation	40°	63°	39°	66°	0.03*

All participants in both groups showed **improvements in shoulder ROM** across all measured directions. However, the **KEOMT group achieved greater gains**, particularly in **abduction and flexion**. The **p-values < 0.05** indicate these differences were statistically significant, meaning **KEOMT was more effective for improving joint mobility**.

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Functional Disability – SPADI Score (%)



Time Point	ART Group	KEOMT Group	p-value
Pre	72.5%	70.8%	0.58
Post	22.6%	33.4%	0.01*

Initially, both groups experienced **high levels of functional disability**. After 6 weeks, **both groups improved**, but the **ART group showed significantly better reduction** in SPADI scores. The **p-value of 0.01** confirms that **ART led to greater improvements in functional outcomes** related to daily activities and shoulder performance.

Overall Summary

Outcome	More Effective Group	Key Takeaway
Pain (VAS)	ART	Greater and faster pain relief
Range of Motion (ROM)	KEOMT	Better joint mobility improvements
Functional Disability	ART	Significant reduction in daily functional limits

Discussion

This randomized trial of Active Release Technique (ART) versus Kaltenborn-Evjenth Orthopaedic Manual Therapy (KEOMT) administered as an adjunct to a standardized exercise regimen demonstrated a clinically significant pattern of effect:ART had more significant pain reduction (VAS) and higher improvement in patient-reported function (SPADI), whereas KEOMT showed more significant improvement in active joint range of motion (flexion and abduction). These divergent results are consistent with plausible mechanistic differences between the two methods:ART addresses soft-tissue adhesions, myofascial restrictions, and muscle-tendon interface dysfunction, which can quickly decrease nociceptive input and re-establish muscle length-tension relationships that help to reduce pain and perceived functioning; KEOMT focuses on arthrokinematic mobilization and graded joint play, mechanistically appropriate to enhance capsular compliance and joint excursion, yielding measurable ROM improvements. (Lo, Chen, Shih, Cheng, & Chao, 2025)

The pain and disability superiority of ART in this trial is consistent with previous reports that soft-tissue methods can provide immediate symptomatic benefits in combination with exercise (reviews and trials of

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ART/soft-tissue methods indicate short-term pain and functional benefits). Nevertheless, the ART evidence base is still deficient in sample size and long-term follow-up; thus, the current trial serves to address an evidence gap by demonstrating concurrent functional improvements (SPADI) and pain reductions (Antohe et al., 2024). The observation that KEOMT brought about higher levels of ROM improvement is consistent with the literature and clinical reports that joint mobilizations (Kaltenborn-style glides and distractions) can be used effectively to restore arthrokinematic motion and potentially promote muscle activation over a wider range. Measurements of ROM change do not always directly result in perceived functional improvement—which can be used to understand why our KEOMT group captures ROM but experiences lesser SPADI changes in comparison to ART. This disassociation (ROM vs. patient-reported disability) is not uncommon in other trials of the shoulder where manual methods focused largely on joint mechanics (Zavala-González, Pavez-Baeza, Gutiérrez-Espinoza, & Olguín-Huerta, 2018). Notably, within-group gains were significant in both groups in pain, ROM, and disability, which validates the practical clinical perspective that both soft-tissue and joint-oriented manual therapies, when used in conjunction with exercises, can hasten the process of recovery in subacromial pain. This is in line with recent randomized trials and systematic reviews that suggest that manual therapy combined with exercise may have superior short- to mid-term results over exercise alone in the context of subacromial shoulder disorders, although the degree and sustainability of that effect are not uniform across studies (Steuri et al., 2017). Lastly, the trend in outcomes indicates a possible role of individualized adjunct manual therapy: patients with more pain and functional impairment (though less fixed capsular restriction) might have more to gain with ART (or any soft-tissue therapy), whereas those with more motion loss (e.g., capsular stiffness restricting flexion/abduction) might gain more with joint mobilizations like KEOMT. This hypothesis is to be tested in prospective stratified trials and respondent analyses (Sharma, Hussain, & Sharma, 2021).

Limitations

The study is limited by its single-center design and the size of the sample. Even though the trial was sufficiently powered to show primary results, the small sample size (n = 60) in a small number of clinics makes it less appealing in terms of external generalizability and being able to observe smaller between-group differences or subgroup effects. Replication across centers would enhance trust in the estimates of the effects.

Short follow-up. Six-week outcomes were reported. The long-term survival of ART compared to KEOMT effects beyond the immediate post-treatment (e.g., 3-, 6-, and 12-month follow-up) has not been established yet; other trials of manual therapy have shown mixed long-term benefit.

No exercise, only a sham control arm. Since both groups were treated to active manual therapy and the same exercise program, neither the incremental effect of the two manual approaches in comparison to exercise alone nor the non-specific effect of therapist contact could be quantified. Recent experiments point at the need to have such comparator arms within the context of determining the particular efficacy of the manual techniques.

Blinding and potential bias in performance are also important considerations. Treatment allocation could not be blinded for either the patients or the treating therapists; however, the absence of participant blinding may affect self-reported outcomes (VAS, SPADI).

The study also took into account the heterogeneity and intervention fidelity of therapists involved. The objective of the interventions was clinician-delivered and thus subject to between-therapist variation. This was actually treated using a treatment protocol, but there were minor variations in technique, pressure, or patient cooperation that might affect the results. Fidelity checks and inter-therapist reliability should be reported in future trials.

The study employed a limited number of secondary measures. ROM was based on goniometry and self-report on function; objective measures of scapular motion, rotator cuff strength, viscoelastic tissue characteristics, or imaging (e.g., ultrasound to assess tendon pathology) were not used. These would facilitate an explanation of change mechanisms.

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Clinical recommendations

Use ART as an efficient complement to exercise in cases where the underlying clinical issue is pain and self-reported functional limitation—especially where the avoidance of swift symptomatic relief is paramount.

KEOMT should be considered in cases of clinical presentation with significant capsular or arthrokinematic restriction (especially reduced flexion/abduction) in which joint play and ROM restoration are the most important treatment targets.

Since improvements were achieved with both modalities, a dual, progressive treatment (first soft-tissue work to achieve pain management and then specific joint mobilizations to stabilize ROM improvement) can be appropriate in clinical practice and should be empirically tested.

Research recommendations

Larger, multicenter RCTs comparing ART, KEOMT, and an exercise-only (or a sham) arm with a longer follow-up (6-12 months) to establish the durability of effects and cost-effectiveness. The inclusion of a sham manual therapy arm would facilitate isolating specific effects as opposed to nonspecific effects.

Responder and subgroup analyses to determine baseline predictors (e.g., length of symptoms, extent of ROM loss, scapular dyskinesia, tendon pathology on imaging) to better respond to ART than KEOMT. It will allow precision rehabilitation and targeted therapy.

Mechanistic research that includes objective biomechanical data (scapular kinematics, rotator cuff strength, tendon thickness/echogenicity), quantitative tissue stiffness data (e.g., elastography), and pain neurophysiology data to demonstrate why ART has a selective effect on pain and why KEOMT has a selective effect on ROM.

The publication should adhere to standards of protocols and disclose information about fidelity. The detailed intervention protocols published in the future trials need to be replicable, and the fidelity checks and therapist training measures should be included to enable the replication interventions in different settings.

Studies on health care costs and patient preferences should also be conducted. The implementation in resource-limited settings will be informed using comparative analyses of cost, number of visits needed to achieve clinically important change, and patient satisfaction.

Conclusion

ART showed better short-term pain reduction and patient-reported disability improvements in shoulder impingement syndrome patients taking a standardized exercise program, and KEOMT demonstrated a greater increase in active ROM (flexion and abduction). Both methods are clinically effective adjuncts to exercise therapy, yet they seem to have different mechanisms of action and thus can be optimally chosen based on the underlying clinical issue in the patient (pain/function vs. motion loss). To validate these findings and to inform the stratified, evidence-based choice of manual therapy in subacromial shoulder pain, larger, multicenter studies that follow longer, include sham/active controls, and use objective mechanistic measures are required.

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