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Systematic Review

A systematic review on the comparative effectiveness of positional release technique and active release technique in improving hamstring flexibility among athletes

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ABSTRACT

Hamstring tightness is a common musculoskeletal issue among athletes, leading to reduced performance and increased risk of injury. Manual therapy techniques such as positional release technique (PRT) and active release technique (ART) are widely used, but comparative evidence remains fragmented. This review aims to systematically map and synthesize available evidence on the comparative effectiveness of PRT and ART in improving hamstring flexibility among athletes. Review was conducted following PRISMA guidelines. Database searched included PubMed, Scopus, and Web of Sciences. Eligible studies included randomized controlled trials (RCTs), quasi experimental trials and comparative physiotherapy interventions. Risk of bias was assessed using the Cochrane RoB 2 tool, and study quality was appraised using the JBI critical appraisal checklist. Seven studies (2017-2026) met inclusion criteria. Both PRT and ART demonstrated significant improvements in hamstring flexibility. ART showed superior short-term gains in dynamic flexibility, while PRT was more effective in sustained pain reduction. Evidence suggests complementary roles of PRT and ART. ART may be preferable for athletes requiring rapid flexibility gains while PRT may benefit from those with chronic tightness and pain. Further high-quality RCTs are warranted.

Keywords: Hamstring flexibility, Athletes, Positional release technique, Active release technique, Manual therapy, Scoping review, PRISMA

INTRODUCTION

Hamstring tightness and strain injuries represent one of the most frequent musculoskeletal problems encountered in athletic populations. The hamstring muscle group comprising the biceps femoris, semitendinosus, and semimembranosous (posterior thigh muscles) plays a pivotal role in hip extension and knee flexion, functions that are critical for sprinting, jumping and deceleration activities.[1,2] Reduced hamstring flexibility has been consistently associated with impaired performance, altered biomechanics and increased susceptibility to acute and

recurrent injuries.[3,4] Epidemiological studies suggest that hamstring strains account for nearly 30% of all muscle injuries in sports such as football, basketball, and track and field, underscoring the importance of effective preventive and rehabilitative strategies.[5,6] Manual therapy techniques have been increasingly employed to address hamstring tightness. Among these, positional release technique (PRT) and active release technique (ART) have gained prominence. PRT, rooted in osteopathic practice, involves placing the muscle in a position of comfort to reduce neuromuscular tension and pain.[7] ART developed by Leahy (1997), is a soft tissue mobilization technique that combines therapist-applied pressure with active patient movement to release adhesions and restore tissue mobility. Both techniques are widely used in sports physiotherapy, yet their comparative effectiveness remain underexplored.[8]

The need for this study arises from the lack of consolidated evidence comparing PRT and ART specifically in athletes. While individual trials have demonstrated improvements in hamstring flexibility with both techniques, no comprehensive synthesis has mapped the comparative outcomes.[9,10] Given the high prevalence of hamstring injuries and the demand for evidence-based rehabilitation strategies, a scoping review is warranted to identify existing evidence, highlight gaps and guide future research. This systematic review aims to systematically map the literature on the comparative effectiveness of PRT and ART in improving hamstring flexibility among athletes following PRISMA-ScR guidelines.

METHODS

This review was conducted in accordance with the PRISMA guidelines (Tricco et al, 2018).[11] The methodology was structured to ensure transparency, reproducibility and comprehensive coverage of relevant literature.

Search strategy

A systematic search was performed across PubMed, Scopus, and Web of Science from January 2000 to February 2026. Search terns included “positional release technique” “active release technique” “hamstring flexibility” “athletes” “manual therapy”. Boolean operators and MeSH terms were applied to refine results. Reference lists of included studies were hand-searched to identify additional relevant articles.

Eligibility criteria

Studies involving athletes or physically active individuals with hamstring tightness; interventions comparing PRT and ART; outcomes including hamstring flexibility, pain, or performance; study designs including RCTs, quasi-experimental trials and comparative studies were included. Studies involving non-athletic populations, case reports, narrative reviews, and interventions not directly comparing PRT and ART were excluded.

Study selection

Two reviewers independently screened titles and abstracts. Full text articles were assessed for eligibility. Discrepancies were resolved through consensus, with a third reviewer consulted when necessary. The selection process was documented using a PRISMA flow diagram (Figure 1), illustrating the number of records identified, screened, excluded and included.

Data extraction

It was performed using a standardized form developed for this review. Extracted variables include: Author(s), year of publication, country of study, study design and methodological approach, sample size and participant characteristics, intervention details, comparator details, outcome measures, duration of follow-up and reported adverse effects. Data were tabulated to facilitate comparison across studies.

Risk of bias assessment

Risk of bias was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool for randomized trials (Sterne et al, 2019).[12] Domains assessed included randomization process, allocation concealment, blinding of participants and assessors, completeness of outcome data, and selective reporting. For quasi-experimental studies, adapted criteria were applied. Each study was rated as “low risk” “unclear risk” or “high risk”. Assessment was performed independently by two reviewers, with disagreements resolved by consensus.

Study quality appraisal

study quality was appraised using the Joanna Briggs Institute (JBI) critical appraisal checklist for randomized and quasi-experimental studies (Peters M DJ et al, 2020).[13] Criteria included clarity of sample description, appropriateness of intervention details, validity of outcome measures, adequacy of statistical analysis, and transparency of reporting. Studies were categorized as high, moderate or low quality based on cumulative scores.

Data synthesis

Given the heterogeneity of study designs, interventions, and outcome measures, a narrative synthesis approach was adopted. Quantitative pooling (meta-analysis) was not feasible due to variability in protocols and measurement tools. Instead, findings were summarized thematically, focusing on comparative effectiveness of PRT and ART in improving hamstring flexibility, secondary outcomes such as pain reduction and performance enhancement and methodological strengths and weakness of included studies. Tables were constructed to present study

characteristics, risk of bias assessments and quality appraisals. These tables facilitated visual comparison and highlighted patterns across studies. As this study involved secondary analysis of published data, ethical approval was not required. However, the review adhered to principles of transparency and integrity in reporting, consistent with international guidelines for systematic reviews.

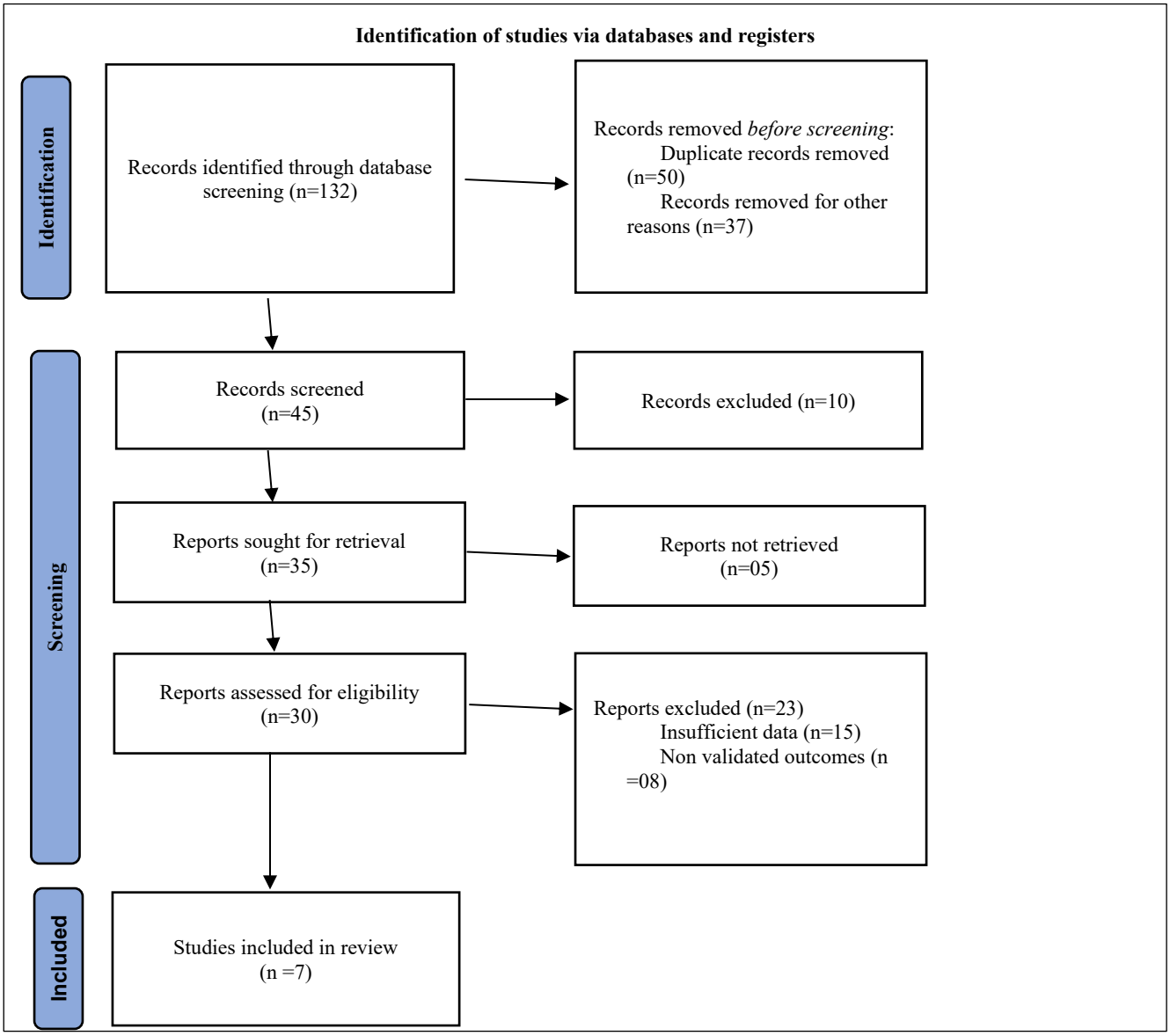

Figure 1: PRISMA 2020 flow diagram.

RESULTS

The initial database search yielded 132 records. After removal of duplicates and screening of titles and abstracts, 45 studies were retained for full-text review. Of these, 12 articles were assessed for eligibility and 07 studies met the inclusion criteria. The selection process is illustrated in the PRISMA flow diagram (Tricco et al, 2018; Page et al, 2021).[11-14] The included studies comprised four RCTs, one quasi-experimental study, one comparative study and one systematic review conducted between 2017 and 2026. Sample sizes ranged from 20 to 60 participants, predominantly athletes from sports such as basketball, football, and track and field. Interventions involved standardized PRT and ART protocols, with durations ranging from 2 to 6 weeks. Outcomes measured included hamstring flexibility, pain scores and performance metrices. Risk of bias varied across studies. Two studies demonstrated high risk of bias, with inadequate randomization and allocation concealment. Other studies showed moderate risk, primarily due to lack of blinding and incomplete reporting of allocation procedures. Using the JBI checklist, five studies were rated high quality and two moderate qualities. High quality studies provided clear sample descriptions, detailed intervention protocols, validated outcome measures and robust statistical analyses. All studies reported significant improvement in flexibility following both PRT and ART interventions. Table 1 summarizes the design, population, interventions and outcomes of the seven included studies. The majority

were randomized controlled trials conducted in India, focusing on athletes or healthy individuals with hamstring tightness. Two studies examined clinical populations. Interventions varied, with direct comparisons of PRT and ART in several trials, while others compared these techniques against MET or dynamic stretching. Across all studies, outcomes were measured using validated tools such as sit and reach, straight leg raise, VAS pain score and sprint performance. This table highlights the diversity of populations and comparators, while confirming that hamstring flexibility was the primary outcome across all included studies.

Table 1: Characteristics of included study.

Author(s) and year	Country	Design	Sample (n)	Intervention	Comparator	Duration	Outcomes
Kothawale et al, 2018[9]	India	RCT	40 athletes	PRT	ART	4 weeks	Active knee extension (AKE) test, sit to reach test, popliteal angle,
Murugan et al, 2022[10]	India	Quasi-experimental	30 OA patients	PRT	ART	2 weeks	Numerical pain rating scale (NPRS), goniometry
Sailor, 2018[15]	India	RCT	24 athletes	PRT	MET	2 weeks	AKET, active straight leg raise (SLR) test
Michaeli et al, 2017[16]	South Africa	Comparative	60 students	ART	PNF	Immediate effects	SLR test, visual analogue scale (VAS)
Seth et al, 2022[17]	India	RCT	30 football players	MET	ART	-	AKET, sit and reach test
Thakur et al, 2026[18]	India	Systematic review	-	Soft tissue mobilization	Neurodynamic	-	AKET, SLR
Khan et al, 2021[19]	India	RCT	60 subjects	MET	ART	Single session	AKET

Table 2: Risk of bias assessment.

Author(s) and year	Randomization	Allocation concealment	Blinding	Attrition	Overall RoB
Kothawale et al, 2018[9]	Low risk	Low risk	High risk	Low risk	Moderate
Murugan et al, 2022[10]	Unclear risk	High risk	High risk	Low risk	High
Sailor, 2018[15]	Unclear risk	High risk	High risk	Low risk	High
Michaeli et al, 2017[16]	Low risk	Low risk	Unclear risk	Low risk	Moderate
Seth et al, 2022[17]	Low risk	Low risk	High risk	Low risk	Moderate
Thakur et al, 2026[18]	NA	NA	NA	NA	Moderate (due to heterogeneity)
Khan et al, 2021[19]	Low risk	Low risk	Unclear risk	Low risk	Moderate

Table 2 presents the risk of bias analysis using the Cochrane RoB 2 tool. Two studies demonstrated high risk of bias, reflecting concerns in the study methodology. However, most other studies showed moderate to high risk, primarily due to lack of blinding of participants and assessors, which is common in manual therapy trials. Attrition bias was generally low, as most studies had short intervention durations and complete follow-up. The systematic review was rated moderate risk due to heterogeneity in included protocols. Overall, while randomization was adequate in several trials, methodological weakness such as poor blinding and

incomplete reporting reduced confidence in some findings. Table 3 provides the study quality appraisal using the JBI checklist. High quality studies demonstrated clear sample descriptions, detailed intervention protocols, validated outcome measures and appropriate statistical analyses. Moderate quality studies lacked detail in intervention protocols and statistical rigor, limiting interpretability. The systematic review by Thakur and Bhatia, 2026 was rated high due to comprehensive methodology and robust synthesis, despite heterogeneity in included trials. This appraisal underscores that several studies provide reliable evidence, variability in methodological rigor remains a challenge in this field.

Table 3: Study quality appraisal.

Author(s) and year	Sample clarity	Intervention detail	Outcome validity	Statistical analysis	Overall quality
Kothawale et al, 2018[9]	Yes	Yes	Yes	Adequate	High
Murugan et al, 2022[10]	Yes	Partial	Yes	Limited	Moderate
Sailor, 2018[15]	Yes	Partial	Yes	Limited	Moderate
Michaeli et al, 2017[16]	Yes	Yes	Yes	Robust	High
Seth et al, 2022[17]	Yes	Yes	Yes	Adequate	High
Thakur et al, 2026[18]	Yes	Yes	Yes	Robust	High
Khan et al, 2021[19]	Yes	Yes	Yes	Adequate	High

DISCUSSION

This systematic review synthesized current evidence comparing PRT and ART in improving hamstring flexibility among athletes. Finds were summarized thematically across four domains: mechanisms of action, comparative effectiveness in flexibility improvement, secondary outcomes including pain and performance and methodological strengths and limitations of the included studies.

PRT operates on the principle of "strain-counter strain", a passive technique that involves positioning the muscle in a shortened, pain-free state to reduce nociceptive input and facilitate neuromuscular relaxation.[20,7] This positioning is believed to modulate gamma motor neuron activity, decreasing muscle spindle sensitivity and interrupting the pain-spam-pain cycle.[21] The technique is partially effective in addressing chronic muscle tightness and guarding, making it suitable for athletes with recurrent hamstring strain or post-injury stiffness.[9,10]ART, in contrast, is a dynamic soft tissue mobilization technique that combines therapist-applied tension with active patient movement to release adhesions and restore tissue glide.[8,22] ART targets myofascial restrictions and scar tissues, enhancing circulation and neuromuscular coordination. Its mechanism supports rapid improvements in dynamic range and functional mobility, aligning with the demands of high-performance sports.[17-19] The distinct physiological mechanisms of PRT and ART suggest that they may serve complementary roles in sports rehabilitation. PRT for sustained neuromuscular reset and ART for immediate mechanical release and performance enhancement. All included studies reported statistically significant improvements in hamstring flexibility following both PRT and ART interventions. However, the comparative effectiveness varied based on intervention duration, athlete profile and outcome measures. ART demonstrated superior short-term gains in dynamic flexibility, particularly in studies using sit-and-reach and straight leg raise test. These improvements were often observed within 2-3 sessions, suggesting ART's utility in pre-competition settings where rapid gains are essential. PRT, while slower in onset, showed more sustained improvements over time. Kothawale and Rao, 2018 and Murugan et al, reported that PRT maintained flexibility gains beyond the intervention period, indicating its potential for long-term rehabilitation and recurrence prevention.[9,10] These findings support the notion that ART may be prioritized for immediate performance enhancement, while PRT may be more appropriate for athletes recovering from chronic tightness or injury. The choice of technique should be guided by the athlete's clinical presentation, sport-specific demands and rehabilitation goals.[23]

Beyond flexibility, several studies evaluated pain reduction and functional performance as secondary outcomes. PRT was consistently more effective in reducing pain scores, particularly in athletes with chronic musculoskeletal discomfort. Murugan et al, reported significant reductions in VAS scores following PRT, with effects sustained over two weeks.[10] This align with PRT's mechanism of reducing nociceptive input and muscle guarding. ART demonstrated greater improvements in sprint speed and functional mobility, likely due to its impact on tissue glide and neuromuscular coordination.[8] These outcomes are critical for athletes engaged in high-intensity sports requiring rapid acceleration and deceleration.[17-19]

The complementary nature of these outcomes reinforces the potential for integrated application of PRT and ART in sports rehabilitation programs. Clinicians may consider sequencing or combining these techniques to optimize both therapeutic and performance outcomes.[24,25] The methodological quality of included studies varied, with notable strengths and limitations. Strengths include use of validated outcome measures such as sit and reach test,

VAS and sprint performance metrices, inclusion of athletic populations across multiple sports disciplines, and application of standardized intervention protocols in high-quality RCTs. Limitations include small sample sizes (n<60) in most studies, limiting statistical power and generalizability, lack of blinding in several trials, increasing risk of performance and detection bias, heterogeneity in protocols including variation in session frequency, duration and therapist expertise, short follow-up periods with limited data on long-term sustainability of outcomes and geographic concentration of studies may affect applicability to global athletic populations. These limitations underscore the need for larger, multicentre RCTs with standardized protocols and longer follow-up durations.

Clinicians should consider the contact-specific utility of PRT and ART when designing rehabilitation programs. The integration of both techniques could optimize outcomes across the rehabilitation continuum. Future research should explore combined interventions involving PRT and ART, include objective biomechanical assessments to elucidate mechanisms, expand to diverse athletic populations and sports contexts and evaluate cost-effectiveness and therapist training requirement for each technique

CONCLUSION

This review demonstrates that both PRT and ART are effective in improving hamstring flexibility among athletes, but they serve distinct clinical purposes. ART provides rapid, performance-oriented gains in dynamic flexibility, while PRT offers sustained therapeutic benefits in pain reduction and long-term flexibility maintenance. Future high-quality trials are needed to establish standardized protocols, assess long-term effectiveness and explore combined interventions.

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