RESEARCH PAPER

Effectiveness of Physiotherapy Based Interventions for Hamstring Tightness of Knee Osteoarthritis: A Systematic Review

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ABSTRACT

Background: Knee osteoarthritis (KOA) is a common musculoskeletal condition associated with pain, stiffness, reduced range of motion, muscle weakness, and functional limitations. Hamstring tightness is an important associated impairment that may contribute to restricted knee extension, altered lower-limb biomechanics, and reduced functional performance. Various physiotherapy-based interventions have been used to address hamstring tightness in individuals with KOA; however, the comparative evidence regarding their effectiveness remains diverse.
Objective: To systematically review the available evidence regarding the effectiveness of physiotherapy-based interventions for reducing hamstring tightness and improving associated clinical outcomes in individuals with knee osteoarthritis.
Methods: A comprehensive literature search was conducted in PubMed, Google Scholar, Cochrane Library, Web of Science, ScienceDirect, and EMBASE. Studies published between 2014 and 2026 were considered. The search included terms related to knee osteoarthritis, hamstring tightness/flexibility, physiotherapy, stretching, proprioceptive neuromuscular facilitation (PNF), muscle energy technique (MET), post-isometric relaxation (PIR), soft-tissue mobilization, instrument-assisted soft-tissue mobilization (IASTM), Mulligan techniques, myofascial release, dry cupping, and therapeutic exercise. Studies involving adults aged 40 years or older with KOA and hamstring tightness or restricted knee extension were eligible. The primary outcomes were hamstring flexibility and knee extension, while secondary outcomes included pain, knee range of motion, and physical function. The review followed PRISMA guidelines.
Results: The search identified 154 records, of which 20 studies met the eligibility criteria and were included in the systematic review. The included studies investigated PNF and static stretching, MET/PIR, IASTM, dynamic soft-tissue mobilization, myofascial release, Mulligan techniques, dry cupping, and hamstring and quadriceps strengthening combined with stretching. Overall, PNF and static stretching improved hamstring flexibility and clinical outcomes. MET/PIR demonstrated favorable effects on hamstring flexibility and knee extension. IASTM was associated with improvements in hamstring flexibility, pain, and knee function, while dynamic soft-tissue mobilization and myofascial release improved flexibility, pain, and functional mobility. Mulligan techniques demonstrated beneficial effects on pain, knee extension, and functional performance. Dry cupping also produced immediate improvements in pain, functional mobility, and passive knee extension. Combined hamstring and quadriceps strengthening with stretching improved pain, range of motion, muscle strength, function, disability, and quality of life.
Conclusion: The available evidence suggests that physiotherapy-based interventions can effectively reduce hamstring tightness and improve pain, knee extension, flexibility, and functional performance in individuals with knee osteoarthritis.

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MET/PIR, IASTM, PNF stretching, dynamic soft-tissue mobilization, Mulligan techniques, myofascial release, dry cupping, and combined strengthening and stretching may be incorporated into individualized rehabilitation programs. However, heterogeneity in intervention protocols, outcome measures, sample sizes, and follow-up periods limits direct comparison between interventions. Further high-quality randomized controlled trials with standardized protocols, larger samples, and long-term follow-up are required to establish comparative and sustained effectiveness.
Keywords: Knee osteoarthritis; Hamstring tightness; Hamstring flexibility; Physiotherapy; Muscle energy technique; PNF stretching; Soft-tissue mobilization; Manual therapy; Rehabilitation.

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INTRODUCTION

Knee osteoarthritis is one of the most frequent musculoskeletal conditions encountered in clinical practice and is associated with substantial functional impairment (1). The condition is especially important because its symptoms often progress gradually, leading to reduced independence and decreased participation in daily activities (2). Among the impairments seen in patients with knee osteoarthritis, hamstring tightness is increasingly recognized as a relevant factor that may worsen movement limitation and alter lower-limb mechanics (3).

Pathophysiology

Knee osteoarthritis develops due to progressive degeneration of articular cartilage, changes in subchondral bone, synovial inflammation, and abnormal loading across the joint (1). These structural and biochemical changes lead to pain, muscle inhibition, weakness, and reduced joint motion, which further disturb normal biomechanics (2). Hamstring tightness may occur as a compensatory or associated musculoskeletal problem, contributing to limited knee extension, altered gait, and greater functional restriction (4).

Clinical Features

The clinical features of knee osteoarthritis commonly include knee pain, morning stiffness, crepitus, tenderness, reduced range of motion, muscle weakness, and difficulty with weight-bearing activities (1). Patients often report increased pain during activity and improvement with rest, although symptoms may later become persistent (5). Hamstring tightness can present as restricted straight-leg raising or limited knee extension and may contribute to poorer function and reduced mobility (3).

Diagnostic Investigations

Diagnosis of knee osteoarthritis is usually based on patient history and clinical examination, with imaging used to support the diagnosis when necessary (5). Plain radiographs may reveal joint-space narrowing, osteophyte formation, subchondral sclerosis, and other degenerative changes (5). In rehabilitation assessment, physiotherapists also evaluate hamstring flexibility, pain severity, range of motion, muscle strength, and functional performance to guide management planning (2).

Physical Therapy Management

Physical therapy is a key component of conservative management for knee osteoarthritis and includes exercise therapy, stretching, strengthening, manual therapy, soft tissue mobilization, taping, and education (1). Exercise therapy has been shown to improve pain and function, while manual therapy and stretching approaches may help address soft tissue tightness and mobility restrictions (6). For hamstring tightness specifically, interventions such as static stretching, proprioceptive neuromuscular facilitation, muscle energy techniques, and instrument-assisted soft tissue mobilization have shown potential to improve flexibility and pain outcomes (3).

REVIEW

A comprehensive search strategy was conducted across electronic databases to identify English-language studies evaluating different physiotherapeutic interventions in individuals with hamstring tightness associated with knee osteoarthritis (KOA). The databases searched included Google Scholar, PubMed, Cochrane Library, Web of Science, ScienceDirect and EMBASE. We searched for the following combination of keywords: "Osteoarthritis", "Knee Osteoarthritis", "Knee OA", "Hamstring Tightness", "Hamstring Shortness", "Hamstring Flexibility", "Hamstring Muscle Length", "Physiotherapy", "Physical Therapy", "Exercise Therapy", "Stretching", "PNF Stretching", "Proprioceptive Neuromuscular Facilitation", "Dynamic Soft Tissue Mobilization", "Instrument-Assisted Soft Tissue Mobilization", "Myofascial Release", "Muscle Energy Technique", and "Manual Therapy", “Electrotherapy” . Numerous physiotherapy studies on Hamstring Tightness in KOA were included in the searches, but Randomized Control Trials (RCTs), taking the year of publication into account, received more attention. The literature search yielded 154 records. Following the screening and eligibility assessment, 20 studies met the inclusion criteria and were included in the final systematic review from the timeframe year 2014 to 2026.

Eligibility Criteria

Studies were considered eligible for inclusion if they involved adults aged 40 years or older with clinically and/or radiologically diagnosed knee osteoarthritis and associated hamstring tightness, reduced hamstring flexibility, or restricted knee extension. Studies evaluating physiotherapy-based interventions aimed at improving hamstring flexibility or reducing hamstring tightness, including static stretching, proprioceptive neuromuscular facilitation (PNF), muscle energy technique/post-isometric relaxation (MET/PIR), Mulligan techniques, instrument-assisted soft tissue mobilization (IASTM), dynamic soft-tissue mobilization, dry cupping, manual therapy, and therapeutic exercise combined with hamstring stretching were included. Studies were required to report at least one relevant outcome measure, such as hamstring flexibility, Active Knee Extension Test (AKET), Chair Sit and Reach Test (CSRT), Passive Knee Extension Test (PKET), knee range of motion, pain, physical function. Randomized controlled trials, randomized clinical trials, controlled clinical trials, and comparative interventional studies published in English were considered. Studies involving healthy participants or individuals with conditions other than knee osteoarthritis, patients undergoing knee replacement or other surgical procedures, and studies evaluating only pharmacological, surgical, or injection-based interventions were excluded. Case reports, case series, review articles, systematic reviews, scoping reviews, narrative reviews, conference abstracts, editorials, protocols, duplicate publications, studies without relevant hamstring-related outcomes, and articles for which the full text was unavailable were also excluded.

Data extraction and outcome measures

Data were extracted using a standardized form, including author and year, study design, sample size, participant characteristics, knee osteoarthritis severity, intervention, comparator, treatment duration and frequency, outcome measures, and main findings. The primary outcome was hamstring tightness/flexibility, assessed using measures such as the Active Knee Extension Test (AKET), Passive Knee Extension Test (PKET), and knee extension range of motion. Secondary outcomes included pain (VAS/NPRS), knee range of motion, physical function (WOMAC/KOOS). Where available, statistical significance and between-group differences were also extracted.

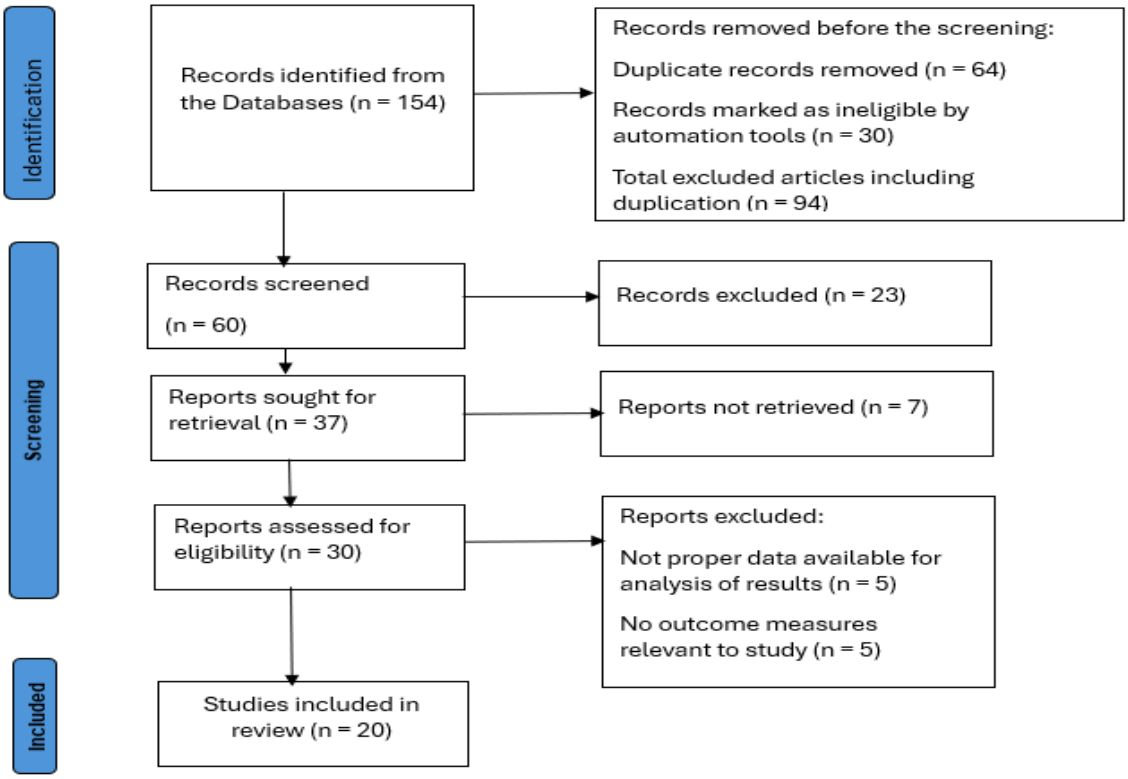

Figure 1 – PRISMA Chart

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Table 1 - DATA EXTRACTION TABLE:

Year	Authors	Methodology	Results Findings	Conclusion
2026(7)	Kara Öz İ, Gelecek N, Uraloğlu G	Randomized controlled trial; n=36, allocated to static hamstring stretching (n=18) or PNF hamstring stretching (n=18). Both received a standard physiotherapy program including hot pack, ultrasound and TENS. Intervention lasted 12 weeks. Outcomes included hamstring flexibility, pain, functional status and dynamic balance.	Both groups demonstrated improvement in the measured clinical outcomes. The study directly compared static and PNF hamstring stretching in symptomatic KOA.	Both static and PNF hamstring stretching can be incorporated into physiotherapy programs for KOA, with the study providing direct comparative evidence regarding flexibility, pain, function and balance.
2025 (8)	Gawande RP, Methe A	Comparative interventional study investigating the immediate effects of dry cupping versus proprioceptive neuromuscular facilitation (PNF) stretching on hamstring tightness in geriatric patients with knee osteoarthritis. Participants were assessed before and immediately after their respective interventions. Outcomes included pain (VAS), functional mobility (Chair Stand Reach Test/CSRT), and passive knee extension range of motion (PKET).	Both dry cupping and PNF stretching produced significant immediate improvements in pain, functional mobility and passive knee extension ROM following treatment. The groups showed comparable reductions in pain, with both interventions demonstrating beneficial immediate effects.	Both dry cupping and PNF stretching were effective in producing immediate improvements in pain, functional mobility and passive knee extension ROM in geriatric patients with knee OA. The findings suggest that dry cupping may be considered as an alternative/manual therapy approach for addressing hamstring tightness in this population.
2024(9)	Umapathy D, Kotteeswaran K	Randomized controlled trial; n=30. IASTM + quadriceps strengthening + TENS was compared with static hamstring stretching + quadriceps strengthening + TENS. Treatment lasted 6 weeks. Outcomes: NPRS, AKE test and WOMAC.	Significant between-group differences were found in NPRS, AKE and WOMAC ($p<0.0001$). The IASTM group demonstrated better improvement in pain, hamstring flexibility and knee function.	IASTM combined with strengthening and TENS was more effective than static stretching combined with strengthening and TENS for improving hamstring flexibility and clinical outcomes.
2024(10)	Mamipour H, Negahban H, Zeinalzadeh A, Ebrahimzadeh MH, Nazary-Moghadam S	Randomized clinical trial; n=40 with primary KOA and varus deformity. Compared general hamstring stretching/strengthening with selective lateral hamstring strengthening + medial hamstring stretching. Treatment 3 times/week for 4 weeks. Outcomes: KOOS, OAKHQOL and Tegner activity scale.	Both groups demonstrated significant improvement in pain, disability and most quality-of-life/physical activity outcomes.	Both general and selective hamstring exercise programs can improve pain, disability and quality of life in primary KOA with varus deformity.
2023(11)	Khadija Nafees, Aftab Ahmed Mirza Baig, et al.	The advantages of Dynamic Soft Tissue Mobilization (DSTM) and Proprioceptive Neuromuscular Facilitation (PNF) stretching were assessed in a single-blind, two-arm, parallel-design, randomized control study involving 48 patients with osteoarthritis (KOA) of the knee.	Both dynamic soft tissue mobilization and PNF stretching have significantly improved hamstring flexibility, reduced pain, and enhanced functional mobility. The post-treatment outcomes for the	Both PNF and DSTM stretching are equally helpful for KOA in terms of functional mobility, pain relief, and hamstring flexibility.

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		AKET, VAS, and KOOS were used to measure physical function, hamstring flexibility, and pain level. PNF and DSTM stretching greatly increased hamstring flexibility, decreased discomfort, and increased functional mobility. Following therapy, there was no discernible difference in the two groups' results. In terms of hamstring flexibility, pain alleviation, and functional mobility, DSTM and PNF stretching were equally beneficial for KOA.	two groups did not differ significantly.	
2023(4)	Narmeen Anjum, Raheela Kanwal Sheikh, et al.	60 people with KOA participated in a randomized controlled trial that compared IASTM and PNF stretching. measured health status (WOMAC), pain (VAS), and hamstring flexibility (AKET).	Both IASTM and PNF stretching produced gains, although IASTM's effects on hamstring flexibility, pain reduction, and overall health were more pronounced than PNF's.	In patients with KOA, IASTM is more beneficial than PNF stretching for increasing hamstring flexibility, lowering pain, and improving overall health.
2023(12)	Milton JA, Subbiah S	Comparative interventional study involving 40 patients with knee OA, divided into experimental and control groups. The experimental group received post-isometric relaxation (PIR/MET) of the hamstring, while the control group received static hamstring stretching. Treatment was provided 3 sessions/week for 2 weeks (6 sessions). Hamstring flexibility was assessed using the Active Knee Extension (AKE) test.	Both interventions improved hamstring flexibility, but the MET/PIR group demonstrated significantly greater improvement. The reported post-intervention AKE improvement was 18.4 ± 1.3° in the experimental group versus 10.6 ± 0.48° in the control group ($p < 0.001$).	Post-isometric relaxation/MET was significantly more effective than static stretching for improving hamstring flexibility in patients with knee OA. The study supports MET/PIR as a physiotherapy intervention for hamstring tightness associated with knee OA.
2022(13)	Sajidur Rahman Bin Habibur Rahman, Deepthi G, et al.	30 individuals with knee OA participated in a randomized controlled experiment that compared myofascial release (MFR) and conventional therapy (CT) versus CT alone. Hamstring tightness (AKET), function (KOOS), and discomfort (VAS) were measured.	MFR with CT group showed reduction in pain, improved AKET range of motion and improved function compared to CT alone.	For pain relief, increased hamstring flexibility, and decreased functional impairment from knee OA, MFR in conjunction with conventional therapy works better than conventional therapy alone.
2022(14)	Vijayalaxmi Kanabur, et al.	45 patients with subacute to chronic KOA participated in a randomized controlled trial and were split into three groups: vibrating foam roller, dynamic cupping, and traditional. Knee ROM, function, pain (NPRS), and quality of life (OPQOL) were measured.	All three groups showed significant pre-post improvements in pain reduction, knee flexion, and WOMAC, as well as quality of life. There were no appreciable variations in the three groups' post-treatment results.	Both vibrating foam rollers and dynamic cupping are equally useful as supplements to traditional therapy for controlling KOA symptoms and enhancing quality of life.
2022(15)	Jean-Philippe Berteau	review of the literature on knee OA treatments such as electrical	Brace interventions consistently reached the threshold for clinical	Brace interventions are the most efficient non-pharmacological

		stimulation, ultrasound, diathermy, exercise therapy, and knee braces.	efficiency (20% reduction in WOMAC pain score). Exercise and diathermy interventions reached the threshold in more than half of the studies.	intervention for reducing knee pain, followed by exercise and diathermy.
2022(16)	Taher AF, Bagheri H, Ashnagar Z, Jalaei S	Randomized comparative clinical trial; n=30, KOA participants. Compared Mulligan Mobilization With Movement (MWM) with Muscle Energy Technique (MET). Treatment was provided approximately 3 times/week for 4 weeks.	Both groups demonstrated improvement in pain and functional outcomes. No statistically significant superiority of one technique over the other was demonstrated.	Both Mulligan MWM and MET can be used to improve pain and function in knee OA, with neither technique clearly superior.
2022(17)	Witwit RT, Shadmehr A, Mir SM, Fereydounni a S, et al.	Randomized clinical trial comparing non-thrust manipulation with MET. Both groups also received supervised exercises and TENS. Approximately 4 weeks/10–12 sessions. Outcomes included pain, function and knee ROM. Randomized clinical trial comparing non-thrust manipulation with MET. Both groups also received supervised exercises and TENS. Approximately 4 weeks/10–12 sessions. Outcomes included pain, function and knee ROM.	Both treatment approaches improved pain, function and ROM. No significant difference was demonstrated between the two approaches for most outcomes; MET showed favorable improvement in knee ROM.	Non-thrust manipulation and MET are both useful adjuncts in KOA rehabilitation, with MET providing favorable effects on knee ROM.
2022(18)	Sherazi F, Waqar S, Khalid M, Saleem K, Kiani SK, Shahzad M	Randomized clinical trial; n=44, KOA grade II–III. Compared PIR with a combination of Kaltenborn mobilization/traction and kinesiotaping. Treatment approximately 3 times/week for 4 weeks. Hamstring length was assessed.	Both groups demonstrated improvement in hamstring muscle length and clinical outcomes. PIR showed favorable improvement in flexibility.	PIR and knee joint mobilization-based interventions may improve hamstring length in KOA, supporting the role of manual therapy in reducing muscular tightness.
2021(19)	Dr. Muskan Shashikant Mahant, et al.	17 patients with knee OA were studied using the goniometer to measure knee active range of motion and the Sit and Reach test to measure hamstring tightness. The association between hamstring tightness and disease duration was evaluated using Spearman's correlation.	There is a notable negative relationship between the length of knee OA and hamstring tightness: the longer knee OA lasts, the less flexible the hamstrings become. little relationship between knee active range of motion and illness duration.	Hamstring tightness and the duration of knee osteoarthritis are correlated, with flexibility decreasing as the disease duration increases.
2020(20)	Sejal Sailor, Amisha Limbani, et al.	35 individuals with knee OA were studied, and the active knee extension test (AKET) was used to measure hamstring flexibility. The WOMAC was used to measure pain and function.	Mean hamstring flexibility was 158.72 degrees. Mean WOMAC scores: pain 10.63, physical function 21.60, stiffness 4.66. Majority of participants were overweight.	This study provides demographic and self-reported outcome measures in patients with KOA.
2020(21)	Jin Hyuck Lee, PT, Ki-Mo Jang, Eunseon Kim, et al.	Examined the effects of static and dynamic hamstring stretches and strengthening activities on patients with inflexible hamstrings and patellofemoral pain (PFP). measured clinical results, muscle activation	The two groups' knee muscular strength and hamstring flexibility did not differ significantly. When compared to the static stretching group, the	Compared to static stretching, dynamic stretching enhances muscle activation time and clinical results in PFP patients;

		time, knee muscle strength, and hamstring flexibility. Twenty-one patients received dynamic stretching, and twenty-five received static stretching.	dynamic stretching group had noticeably better clinical results and muscle activation time.	nevertheless, neither technique appreciably increases knee muscle strength or hamstring flexibility.
2020(22)	Tariq K, Shoukat F, Ahmed U	Randomized clinical trial; 114 participants recruited, with approximately 101 included in final group analysis. Participants received either Mulligan BLR or PIR-MET. 12 sessions over 4 weeks. Outcomes: VAS, Active Knee Extension Test and Knee Oxford Score.	Both groups showed significant within-group improvement in pain, knee extension/hamstring flexibility and functional status. Between-group analysis showed a significant difference in pain, while differences in flexibility and function were not significant at later assessments.	Both Mulligan BLR and MET are effective, with BLR showing greater improvement particularly in pain reduction and functional knee movement.
2016(23)	Choksi P, Tank K	Randomized comparative study; approximately 90–120 patients with knee OA. MET/PIR was compared with conventional exercise. Hamstring flexibility was assessed using the Active Knee Extension Test and quadriceps strength was assessed. Intervention was conducted over approximately 3 weeks.	MET produced significantly greater improvement in hamstring flexibility and quadriceps muscle strength compared with conventional exercise.	Muscle Energy Technique is effective for improving hamstring flexibility and muscle strength in patients with knee OA.
2014(24)	Ahmed H Al-Johani, Shaji John Kachanathu, et al.	Two groups of forty people with knee OA were created and compared. Hot packs, hamstring stretches, and quadriceps and hamstring strengthening exercises were administered to Group 1. Group 2 received quadriceps-only strengthening, hamstring stretches, and heat packs. assessed muscular function (FWS), pain (VAS), and strength (dynamometry).	In comparison to Group 2 (quadriceps strengthening only), Group 1 (hamstring and quadriceps strengthening) demonstrated more notable improvements in discomfort, function, and muscular strength.	Patients with osteoarthritis in their knees experience better pain, range of motion, and functional performance when their hamstrings and quadriceps are strengthened.
2014(25)	Khuman PR, Surbala L, Patel P, Chavda D.	Study design: Randomized controlled study. Sample: 90 participants with knee OA, divided into 3 groups (n=30/group). Population: Participants >40 years with radiographic knee OA, primarily KL Grade I–II. Group A: Post-Isometric Relaxation Muscle Energy Technique (PIR-MET) + moist heat. Group B: Mulligan's Bent Leg Raise (BLR) + moist heat. Group C: Moist heat alone/control. Intervention: Single treatment session. Outcome measures: Pain assessed using Visual Analog Scale (VAS); hamstring flexibility assessed using Active Knee Extension (AKE) test. Outcomes were assessed before and immediately after treatment.	Both PIR-MET and Mulligan BLR produced significant immediate improvements in pain and hamstring flexibility compared with baseline. The improvement in the BLR group was greater than that observed with PIR-MET and moist heat alone. Moist heat alone produced comparatively limited improvement. The findings indicate that both manual therapy techniques can immediately reduce pain and improve hamstring flexibility in individuals with knee OA.	A single session of PIR-MET and Mulligan's BLR technique can immediately improve pain and hamstring flexibility in patients with knee OA. Mulligan's BLR appeared to provide greater immediate benefit than PIR-MET and moist heat alone. These techniques may therefore be useful physiotherapy interventions for addressing hamstring tightness associated with knee OA.

RESULT

The literature search identified 154 records from the selected electronic databases. Following screening and application of the predefined eligibility criteria, 20 studies published between 2014 and 2026 were included in the systematic review. The included studies evaluated different physiotherapy-based interventions for hamstring tightness and associated clinical impairments in patients with knee osteoarthritis. The review follows the Prisma Guidelines. Figure 1 depicts the PRISMA flow diagram. Table 1 includes reference to data extraction. This systematic review provided compelling evidence for a range of physiotherapy-based intervention approaches for managing hamstring tightness associated with knee osteoarthritis, including PNF stretching and static hamstring stretching to improve flexibility, dynamic soft tissue mobilization to reduce pain and improve functional mobility, muscle energy technique/post-isometric relaxation to increase hamstring flexibility and knee extension, instrument-assisted soft tissue mobilization to improve flexibility, pain, and knee function, myofascial release to reduce pain and improve functional performance, Mulligan techniques to improve pain and functional knee movement, and dry cupping to improve pain, functional mobility, and passive knee extension range of motion. In addition, hamstring and quadriceps strengthening combined with stretching demonstrated beneficial effects on pain, range of motion, muscle strength, functional performance, disability, and quality of life. Overall, these physiotherapy interventions can be incorporated into rehabilitation programs to effectively address hamstring tightness and associated impairments and may help enhance the quality of physiotherapy care provided to patients with knee osteoarthritis.

DISCUSSION

The present systematic review demonstrates that physiotherapy-based interventions can play an important role in managing hamstring tightness and associated impairments in individuals with knee osteoarthritis. Twenty studies published between 2014 and 2026 were included, with interventions ranging from stretching and muscle energy techniques to soft-tissue mobilization, Mulligan techniques, dry cupping, and strengthening exercises. The primary outcomes assessed across the included studies were hamstring flexibility, knee extension range of motion, pain, and physical function.

The findings indicate that stretching-based interventions, particularly PNF and static hamstring stretching, can improve hamstring flexibility and clinical outcomes in patients with knee osteoarthritis. Kara Öz et al. reported improvements following both static and PNF stretching, supporting the inclusion of hamstring stretching within conventional physiotherapy programs. (7) Similarly, Nafees et al. found that both PNF stretching and dynamic soft tissue mobilization significantly improved hamstring flexibility, reduced pain, and enhanced functional mobility, with no significant difference between the two interventions. These findings suggest that both stretching and soft-tissue approaches may be useful options for addressing hamstring tightness in knee osteoarthritis.

The review further highlights the potential role of instrument-assisted soft tissue mobilization (IASTM). Umapathy and Kotteeswaran reported significantly greater improvements in pain, hamstring flexibility, and WOMAC scores following IASTM combined with quadriceps strengthening and TENS compared with static stretching combined with the same adjunctive interventions. (9) Anjum et al. similarly reported greater improvements with IASTM than PNF stretching in hamstring flexibility, pain reduction, and overall health status. These findings suggest that IASTM may provide an effective adjunct to conventional rehabilitation when the primary treatment goal is to improve soft-tissue flexibility and functional outcomes. (4)

Muscle energy technique and post-isometric relaxation also demonstrated consistent benefits. Milton and Subbiah reported that both MET/PIR and static stretching improved hamstring flexibility, but the MET/PIR group demonstrated significantly greater improvement in the Active Knee Extension test. (12) Choksi and Tank also reported greater improvements in hamstring flexibility and quadriceps muscle strength following MET compared with conventional exercise. These findings support the use of MET/PIR as a physiotherapy technique for patients in whom hamstring tightness contributes to restricted knee extension. (23)

The findings also demonstrate that Mulligan-based manual therapy techniques may be beneficial for pain and functional limitations. Mulligan Bent Leg Raise and MET were both associated with improvements in pain, knee extension, hamstring flexibility, and functional status. In one study, Bent Leg Raise demonstrated greater improvement, particularly in pain reduction and functional knee movement, whereas other evidence suggested no clear superiority between Mulligan Mobilization with Movement and MET. Therefore, the available evidence supports both approaches but does not establish one manual therapy technique as universally superior. (16,22,25)

Soft-tissue and myofascial interventions were also associated with favorable outcomes. Myofascial release combined with conventional therapy produced improvements in pain, Active Knee Extension range, and functional outcomes compared with conventional therapy alone. Likewise, dry cupping and PNF stretching produced significant immediate improvements in pain, functional mobility, and passive knee extension range of motion. However, the findings for these interventions are primarily based on short-term or immediate outcomes, and therefore their long-term effectiveness for maintaining improvements in hamstring flexibility remains uncertain.

The review also supports the importance of therapeutic exercise and strengthening as part of a comprehensive rehabilitation program. Selective and general hamstring stretching and strengthening programs improved pain, disability, and quality-of-life-related outcomes in patients with primary knee osteoarthritis and varus deformity.

Furthermore, combined hamstring and quadriceps strengthening produced better improvements in pain, function, and muscular strength than quadriceps strengthening alone. These findings suggest that treatment of hamstring tightness should not be limited to flexibility training but should be integrated with strengthening and functional rehabilitation.

Overall, the evidence suggests that no single physiotherapy intervention should be considered universally superior for hamstring tightness associated with knee osteoarthritis. Instead, interventions such as PNF stretching, MET/PIR, IASTM, DSTM, myofascial release, Mulligan techniques, dry cupping, and strengthening can be selected according to the patient's clinical presentation, treatment goals, and functional limitations. The most consistently reported benefits were improvements in hamstring flexibility, knee extension range of motion, pain, and physical function.

These findings are consistent with broader evidence supporting exercise and physiotherapy as important components of conservative knee osteoarthritis management. The references included in the present review also identify exercise therapy and physiotherapy as important approaches for improving pain and function in knee osteoarthritis.

However, several limitations should be considered when interpreting the findings. The included studies differed considerably in intervention type, treatment duration, outcome measures, and comparison groups, making direct comparison between interventions difficult. Some studies assessed only immediate post-treatment effects, whereas others used several weeks of intervention. In addition, the review included different study designs and sample sizes, and some interventions were administered alongside conventional physiotherapy or electrotherapy. Therefore, the observed improvements cannot always be attributed exclusively to the specific intervention under investigation.

CONCLUSION

The present systematic review indicates that physiotherapy-based interventions are effective approaches for reducing hamstring tightness and improving pain, knee extension, flexibility, and functional performance in individuals with knee osteoarthritis. MET/PIR, IASTM, PNF stretching, DSTM, Mulligan techniques, myofascial release, dry cupping, and combined strengthening and stretching programs may be incorporated into individualized rehabilitation programs. Further high-quality randomized controlled trials with standardized intervention protocols, larger samples, and long-term follow-up are required to determine the comparative effectiveness and sustained benefits of these interventions.

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