

From Pain to Performance: Physiotherapy Approaches in Patellofemoral Pain Syndrome: A Narrative Review

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ABSTRACT

Background: Patellofemoral pain syndrome (PFPS) is a common musculoskeletal condition characterized by pain around or behind the patella, particularly during activities such as squatting, stair climbing, running, and prolonged sitting. Physiotherapy is widely used in its management, although different treatment approaches target different impairments associated with PFPS.

Objective: To review the available evidence regarding the effectiveness of physiotherapy interventions used in the management of patellofemoral pain syndrome.

Methods: A narrative review was conducted using literature identified through PubMed and Google Scholar. Boolean operators such as AND and OR were used with relevant keywords including “patellofemoral pain syndrome,” “physiotherapy,” and “rehabilitation.” Randomized controlled trials involving males and females of any age were considered. Studies involving patients with cardiovascular disease were excluded. Eight randomized controlled trials were included for narrative synthesis.

Results: The reviewed studies demonstrated beneficial effects of physiotherapy interventions on pain, muscle strength, functional performance, movement control, and quality of life in individuals with PFPS. Targeted hip and knee strengthening, balance and perturbation training, and structured exercise programs showed consistent improvements in pain and functional outcomes. Adjunctive interventions, including femoral nerve neurodynamic techniques, lumbar spinal manipulation, instrument-assisted soft tissue mobilization, blood-flow-restriction training, and digital rehabilitation, also demonstrated improvements in selected outcomes. However, the addition of manual therapy to exercise did not provide significant additional benefits compared with exercise alone.

Conclusion: Physiotherapy appears to be an effective component of PFPS management, with exercise-based rehabilitation demonstrating consistent benefits across several outcomes. An individualized

treatment program incorporating strengthening, neuromuscular control, and functional training, with adjunctive techniques selected according to patient-specific impairments, may be beneficial. Further high-quality studies with standardized protocols and longer follow-up are required to establish the long-term effectiveness of different physiotherapy interventions.

Keywords

Patellofemoral pain syndrome, physiotherapy, management , rcts , narrative

1. INTRODUCTION

Patellofemoral pain (PFP), commonly referred to as patellofemoral pain syndrome (PFPS), is one of the most frequently encountered musculoskeletal conditions affecting the knee.¹ Patellofemoral pain (PFP), commonly referred to as patellofemoral pain syndrome (PFPS), is one of the most frequently encountered musculoskeletal conditions affecting the knee.¹ Common activities that aggravate symptoms include squatting, stair climbing, running, jumping and prolonged sitting.¹ PFPS is frequently observed in adolescents and young adults and is particularly relevant among physically active and sporting populations.² The development of patellofemoral pain is considered multifactorial, with several local, proximal, distal and behavioral factors potentially contributing to symptom.³ Alterations in hip and knee muscle function have been investigated extensively because they may influence lower-limb movement and patellofemoral joint loading.³ Reduced strength of the quadriceps has been identified as one of the factors associated with the development of patellofemoral pain in some populations.⁴

Hip muscle weakness and impaired control of hip and knee movement have also been reported in individuals with patellofemoral pain.⁵ Excessive hip adduction and internal rotation during functional activities have been proposed as possible contributors to altered patellofemoral loading in some patients.⁶ However, current evidence indicates that PFPS cannot be explained by a single biomechanical abnormality, and individual variation needs to be considered during assessment.⁷ Changes in physical activity and training load may also influence the onset and persistence of patellofemoral pain, particularly in physically active individuals.⁸

The clinical assessment of PFPS is primarily based on the patient's history and physical examination, with pain provocation during functional activities being an important component.⁹ Imaging is not routinely required for the diagnosis of uncomplicated patellofemoral pain when the clinical presentation is typical.⁹ Physiotherapy management commonly focuses on reducing aggravating loads, improving physical capacity and addressing relevant impairments identified during assessment.¹⁰ Exercise therapy has strong evidence as an important intervention for individuals with patellofemoral pain.¹⁰

Programs combining hip-targeted and knee-targeted strengthening exercises have demonstrated beneficial effects on pain and functional outcomes.¹¹ Quadriceps strengthening is commonly incorporated because the quadriceps contributes substantially to knee function and load management during functional activities.⁹ Hip strengthening may be particularly useful when assessment identifies reduced hip muscle capacity or poor proximal movement control.¹⁰ Patellar taping may be used as an adjunct to exercise when it produces a meaningful reduction in symptoms during functional activities.

2. METHODOLOGY

A narrative literature review was conducted to explore the role of physiotherapy in the management of Patellofemoral Pain Syndrome (PFPS). Relevant literature was searched using the electronic databases **PubMed and Google Scholar**. The search was performed using keywords related to patellofemoral pain and physiotherapy management.

The following keywords and Boolean operators were used: **“Patellofemoral Pain Syndrome” OR “Patellofemoral Pain” AND “Physiotherapy” OR “AND “Management”**

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles published in 2026	Articles published before or after 2026
Randomized Controlled Trials (RCTs) only	Non-RCT study designs such as observational studies, case reports, case series, cohort studies, reviews, and meta-analyses
Participants of any age	Studies not involving participants with patellofemoral pain/PFPS
Both male and female participants	Studies involving only populations unrelated to PFPS
Studies investigating physiotherapy/rehabilitation management of PFPS	Studies not investigating physiotherapy or rehabilitation management
Physiotherapy interventions such as therapeutic exercise, strengthening, neuromuscular training, or rehabilitation	Studies primarily focusing on surgical or pharmacological treatment
Studies reporting outcomes such as pain, physical function, muscle strength, or functional performance	Studies with outcomes unrelated to physiotherapy management of PFPS
Participants without cardiovascular disease	Participants with cardiovascular disease

3. PRISMA FLOW CHART

IDENTIFICATION

Records identified through database searching
PubMed and Google Scholar
n = 1030



Duplicate records removed
n = 327



Records remaining after removal of duplicates
n = 703



SCREENING

Records screened
n = 703



Records excluded as non-RCTs
n = 434



ELIGIBILITY

Full-text RCT articles assessed for eligibility
n = 269



Full-text articles excluded
n = 261



INCLUDED

Articles included in the narrative review

n = 8

Article 1

Topic Name	Methodology	Outcome Measures	Result
Comparing the Impact of Intermittent Blood Flow Restriction Training and High-Load Resistance Training in Individuals With Patellofemoral Pain: A Randomized Controlled Trial	Double-blind randomized controlled trial involving 42 individuals with PFP. Participants were randomly assigned to an intermittent blood flow restriction (iBFR) group or high-load resistance training group. The iBFR group performed low-load resistance exercise at 30% 1-RM with 80% limb occlusion pressure, while the control group performed high-load exercise at 70% 1-RM with sham BFR. Training was performed 3 times/week for 8 weeks, with follow-ups at 8 and 24 weeks.	Pain, self-reported function, quadriceps muscle strength, quadriceps muscle thickness, adherence, and adverse events.	Both groups showed significant improvements in pain, function, muscle strength, and muscle thickness. No significant between-group difference was found in the primary outcomes ($p = 0.163$). The iBFR group demonstrated better adherence and fewer adverse events.

Article 2

Topic Name	Methodology	Outcome Measures	Result
Impact of a Targeted 8-Week Exercise Program on Pain Measures and Isokinetic Muscle Strength in Females With Patellofemoral Pain Syndrome: A Randomized Controlled Trial	Randomized controlled trial involving 30 females with PFPS. Participants were allocated to an experimental group (n=15) receiving an 8-week supervised Weight-Bearing Exercise for Better Balance (WEBB) program or a control	Isokinetic peak torque of hip and knee muscles using a Biodex dynamometer, Visual Analogue Scale (VAS), pressure pain threshold (PPT), and disability using the Oswestry Disability Index (ODI).	The WEBB group showed significant within-group improvements in all measured outcomes ($p < 0.05$). Significant between-group improvements were observed in hip flexor, hip adductor, knee flexor, and knee extensor strength, along with reduced pain intensity and disability. Some hip

Topic Name	Methodology	Outcome Measures	Result
	group (n=15) receiving no intervention.		muscle strength variables did not show significant between-group differences.

Article 3

Topic Name	Methodology	Outcome Measures	Result
Efficacy of a Mobile Multidisciplinary Digital Therapeutics App for Patellofemoral Pain: Randomized Controlled Trial	Parallel-group RCT involving 35 patients with PFP. Participants were assigned to a digital therapeutics (DTx) group (n=18) or control group (n=17). The DTx group used the MORA Cure (PFP) app for 8 weeks, incorporating home-based exercises and weekly cognitive behavioral therapy modules. The control group received conventional education and exercise instruction.	Numeric Pain Rating Scale (usual and worst pain), Anterior Knee Pain Scale (AKPS), knee extension strength using an isokinetic dynamometer, EQ-5D, and Patient Health Questionnaire-9 (PHQ-9).	The DTx group demonstrated significant reductions in usual pain at 4, 8, and 12 weeks. Knee extension strength significantly improved at 8 and 12 weeks and was greater than the control group at 8 weeks. Both groups showed significant functional improvement at 12 weeks. EQ-5D also improved in the DTx group.

Article 4

Topic Name	Methodology	Outcome Measures	Result
The Immediate Effects of Instrument-Assisted Soft Tissue Mobilization on Pain and Function in Female Runners With Patellofemoral Pain	Randomized controlled trial involving 28 female runners with PFP. Participants were assigned to a Hip and Knee (HK) group (n=14) or Knee-only (K) group (n=14). The HK group received IASTM to the quadriceps, patella, ITB, and gluteus medius, while the K group received treatment to the quadriceps and patella. Assessments were performed at baseline, immediately after	Visual Analogue Scale (VAS), hip adduction ROM, hip abduction and external rotation strength, step-down test, and patellofemoral function.	Running-related pain significantly decreased in both groups ($p < 0.001$), with no significant difference between groups. Hip adduction ROM, hip abduction strength, step-down performance, and patellofemoral function improved significantly. Hip external rotation strength did not significantly change.

Topic Name	Methodology	Outcome Measures	Result
	treatment, and at 1-week follow-up.		

Article 5

Topic Name	Methodology	Outcome Measures	Result
The Effects of Combined Balance and Perturbation Training on Gluteal Muscle Activity and Hip Kinematics in Women With Patellofemoral Pain Syndrome: A Randomized Controlled Trial	Randomized controlled trial involving 29 women with PFPS. Participants were allocated to an exercise group (n=14) or control group (n=15). The exercise group completed 18 sessions of combined balance and perturbation training over 6 weeks, while the control group received no intervention.	Surface EMG of gluteus maximus and gluteus medius, 3D hip kinematics, Visual Analogue Scale (VAS), and Anterior Knee Pain Scale (AKPS).	The exercise group showed significantly improved gluteal muscle activation patterns, including reduced gluteus maximus activity and increased gluteus medius activity. Significant improvements were found in gluteal activation timing, increased peak hip flexion, and decreased hip adduction. Pain and function also improved significantly compared with the control group ($p < 0.001$).

Article 6

Topic Name	Methodology	Outcome Measures	Result
Effects of Lumbar Spinal Manipulation on Pain and Quadriceps Strength in Patellofemoral Pain Syndrome: A Randomized Controlled Trial	Randomized controlled trial involving 30 participants with clinically diagnosed PFPS. Participants were allocated to a lumbar spinal manipulation group (n=15) or placebo group (n=15). Treatment was provided twice weekly for 4 weeks.	Pressure pain threshold, knee joint position sense/proprioception, Y-Balance Test, and quadriceps muscle strength.	Significant within-group improvements were observed in most outcomes. Compared with placebo, lumbar spinal manipulation produced significantly greater improvements in pain reduction and quadriceps strength ($p < 0.05$). No significant between-group differences were found for

Topic Name	Methodology	Outcome Measures	Result
			proprioception or dynamic balance.

Article 7

Topic Name	Methodology	Outcome Measures	Result
Efficacy of Adding Manual Therapy to Hip and Knee Exercises in Patients With Patellofemoral Pain Syndrome: A Double-Blinded Randomized Controlled Clinical Trial	Double-blinded RCT involving 59 adults with PFPS. Participants were randomized to an exercise control group (n=30) or manual therapy group (n=29). Both groups performed stretching and open- and closed-kinetic-chain exercises. The manual therapy group additionally received patellar mobilization, ITB release, and deep friction massage. Treatment consisted of 12 sessions over 4 weeks.	Knee pain during ascending, descending, squatting, and sitting; Kujala Patellofemoral Score; hip and knee muscle strength; calf and hamstring flexibility; and step-down test.	Both groups demonstrated significant reductions in pain and improvements in knee function, muscle strength, and flexibility ($p < 0.05$). However, no significant between-group differences were observed for any outcome ($p > 0.05$). Manual therapy produced improvements but did not demonstrate superiority over exercises alone.

Article 8

Topic Name	Methodology	Outcome Measures	Result
Effect of Femoral Nerve Neurodynamic Techniques on Pain in Patellofemoral Pain Syndrome: A Randomised Controlled Trial	Randomized controlled trial involving 71 patients with unilateral PFPS aged 18–45 years. Participants were assigned to a treatment group receiving femoral nerve neurodynamic techniques plus standard physiotherapy or a control group receiving standard physiotherapy alone. Treatment was provided for 10 sessions.	Visual Analogue Scale for pain at rest and during activity, Kujala Patellofemoral Score for function, and hip extension ROM.	The combined intervention produced significantly greater reductions in pain during squatting, stair climbing, kneeling, and sitting compared with standard physiotherapy alone. Significant improvements were also found in knee function and hip extension ROM. The findings support femoral nerve neurodynamic techniques as a potential adjunct to standard

Topic Name	Methodology	Outcome Measures	Result
			physiotherapy for short-term improvement in PFPS.

4. RESULT

The reviewed studies demonstrated that physiotherapy interventions can improve pain, functional ability, muscle strength, and movement-related impairments in individuals with patellofemoral pain syndrome (PFPS). Exercise-based interventions consistently produced positive outcomes. Targeted strengthening programs improved pain intensity and hip and knee muscle strength, while combined balance and perturbation training improved gluteal muscle activation, hip kinematics, pain, and functional performance.

Adjunctive interventions also showed beneficial effects. Femoral nerve neurodynamic techniques added to standard physiotherapy resulted in greater reductions in activity-related pain and improvements in functional ability and hip extension range of motion. Lumbar spinal manipulation was associated with improvements in pain and quadriceps strength, although its effects on proprioception and dynamic balance were limited. Instrument-assisted soft tissue mobilization produced short-term improvements in pain, hip mobility, muscle strength, and functional performance in female runners with PFPS.

The use of newer rehabilitation approaches was also supported. Mobile multidisciplinary digital therapeutics incorporating exercise and cognitive behavioral strategies improved pain, knee extension strength, and health-related quality of life. Intermittent blood-flow-restriction training and high-load resistance training both produced improvements in symptoms and muscle-related outcomes, with no clear superiority of one approach over the other. In contrast, adding manual therapy to hip and knee exercises did not provide significant additional benefits compared with exercise therapy alone.

Overall, the findings indicate that physiotherapy management based primarily on targeted exercise and strengthening, with selected adjunctive interventions, may provide improvements in pain, muscle performance, movement patterns, and functional ability in patients with PFPS.

5. DISCUSSION

The findings of this narrative review indicate that physiotherapy management can positively influence pain, muscle performance, movement control, and functional ability in individuals with patellofemoral pain syndrome (PFPS). Across the reviewed randomized controlled trials, exercise-based interventions were associated with clinically relevant improvements in several patient-related outcomes. These findings support the multifactorial nature of PFPS, in which alterations in muscle strength, neuromuscular control, lower-limb biomechanics, and pain sensitivity may contribute to functional limitations.

Targeted strengthening appears to be an important component of rehabilitation. The reviewed studies demonstrated improvements in hip and knee muscle strength following structured exercise programs. Strengthening the muscles around the hip and knee may improve the control of lower-limb movement during activities such as squatting, stair negotiation, and walking. Improvements in these areas may subsequently reduce mechanical stress and improve tolerance to functional activities. The findings also suggest that rehabilitation should not be restricted to the quadriceps alone, as hip musculature and proximal neuromuscular control may also influence patellofemoral function.

The study involving combined balance and perturbation training further supports the importance of neuromuscular rehabilitation. Improvements in gluteal muscle activation and hip movement were accompanied by reductions in pain and improvements in functional performance. Better activation and timing of the gluteal muscles may contribute to improved control of hip motion during weight-bearing activities. Therefore, incorporating exercises that challenge balance, postural control, and dynamic movement may be useful when conventional strengthening alone does not adequately address functional deficits.

Several adjunctive physiotherapy interventions also demonstrated favorable outcomes. Femoral nerve neurodynamic techniques combined with standard physiotherapy produced improvements in pain, function, and hip extension range of motion. This suggests that neural mechanosensitivity may have a role in some individuals with PFPS and that treatment directed toward neural mobility may be useful when appropriately indicated. Similarly, lumbar spinal manipulation was associated with improvements in pain and quadriceps strength. However, the limited changes in proprioception and dynamic balance indicate that spinal manipulation should be considered as an adjunct rather than a replacement for active rehabilitation.

Instrument-assisted soft tissue mobilization produced short-term improvements in pain and selected functional measures among female runners. However, the absence of a clear difference between the two treatment approaches indicates that the broader addition of soft-tissue treatment may not necessarily produce substantially greater benefits. This finding emphasizes the importance of considering the specific impairment being addressed rather than applying passive treatment techniques routinely.

The comparison between intermittent blood-flow-restriction training and high-load resistance training showed improvements in both groups without a clear difference in the primary outcomes. This suggests that different resistance-training strategies may be capable of producing beneficial changes in individuals with PFPS. Blood-flow-restriction training may therefore represent an alternative when conventional high-load exercise is difficult to tolerate, although treatment selection should consider individual symptoms, exercise tolerance, and clinical suitability.

The digital therapeutic intervention provides evidence for the potential role of technology-supported rehabilitation. Improvements in pain, knee extension strength, and quality of life indicate that structured home-based programs delivered through digital platforms may assist patients in maintaining rehabilitation outside the clinical setting. Such approaches may be particularly useful for improving access and encouraging regular exercise participation, although they should not be viewed as universally equivalent to individualized clinical assessment.

An important finding was observed in the trial comparing exercise therapy alone with exercise combined with manual therapy. Both groups improved, but the addition of manual therapy did not produce a significant additional benefit. This suggests that the therapeutic effects observed in PFPS rehabilitation may be largely related to active exercise and progressive physical conditioning. Manual techniques can still be considered when clinically indicated, but they may be most useful as complementary interventions rather than the central component of treatment.

Overall, the reviewed evidence supports an individualized and active physiotherapy approach for PFPS. Exercise prescription should consider the patient's strength deficits, movement pattern, pain response, activity requirements, and functional limitations. Combining strengthening with neuromuscular, balance, flexibility, or selected adjunctive techniques may allow treatment to be adapted to individual presentations. Nevertheless, differences in intervention protocols, sample sizes, outcome measures, treatment duration, and follow-up periods make direct comparison between studies difficult. Larger randomized trials with standardized rehabilitation protocols and longer follow-up are required to establish the sustained effects of different physiotherapy strategies and to determine which patient characteristics are associated with better treatment responses.

6. CONCLUSION

The available evidence suggests that physiotherapy plays an important role in the management of patellofemoral pain syndrome. Exercise-based rehabilitation, particularly targeted hip and knee strengthening and interventions addressing neuromuscular control, consistently demonstrated improvements in pain, muscle strength, movement quality, and functional performance. Adjunctive approaches such as neurodynamic techniques, spinal manipulation, soft tissue mobilization, blood-flow-restriction training, and digital rehabilitation may provide additional benefits in selected patients. However, manual therapy added to an exercise program did not demonstrate clear superiority over exercise alone. Overall, an individualized, exercise-focused physiotherapy program addressing strength, neuromuscular control, flexibility, and functional limitations appears to be an appropriate approach for PFPS management. Further high-quality randomized controlled trials with standardized protocols and longer follow-up are needed to determine the long-term effectiveness of different physiotherapy interventions.

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