Galore International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Vol. 10; Issue: 1; January-March 2025
Website: www.gijhsr.com
Review Article *P-ISSN: 2456-9321*

Effectiveness of Hip Muscle Strengthening in Patellofemoral Pain Syndrome: A Literature Review

Abhilash PV[1], Vishnu K Nair[2], Prathik[3], Kerina Varghese[4]

[1]Associate Professor, [2]Assistant Professor, [3]Post Graduate Student, [4]BPT Intern;
Laxmi Memorial College of Physiotherapy, Balmatta, Mangalore, 575002
Rajiv Gandhi University of Health Sciences, Karnataka

Corresponding author: Prathik

DOI: https://doi.org/10.52403/gijhsr.20250111

ABSTRACT

Background: Patellofemoral syndrome (PFS), also known as runner's knee, is a frequent source of anterior knee pain, commonly resulting from overuse, muscle imbalances, and improper alignment. It mainly affects young adults, particularly women. Key symptoms include generalized knee pain that worsens with activities such as squatting or running. Diagnosis is typically made through clinical evaluation, as imaging like radiographs are often not helpful. Treatment is conservative and focuses on managing pain, improving patellar movement, and strengthening muscles, particularly the hip abductors and rotators. Strengthening these muscles helps to minimize excessive hip movement, which in turn reduces stress on the patellofemoral joint. Patellar taping and targeted exercises are frequently used, while surgery is only considered after 24 months of unsuccessful non-surgical treatment.

Objectives: The objective is to find the effectiveness of hip muscle strengthening on pain and functional improvement for the patients with patellofemoral pain syndrome.

Design: review of literature

Data synthesis: recent researches, meta-analysis, randomized control trials, observation studies

Methodology: various articles from following databases like Science Direct, PubMed and Cochrane were retrieved through a search by using keywords- Patellofemoral pain syndrome, Anterior knee pain, Hip muscle strengthening exercises. Total 14 articles were included in the study and based on their findings a review was made.

Conclusion: This review highlights that hip muscle strengthening is effective in reducing pain and improving function in PFPS patients, though its impact on muscle strength is less clear. The findings support incorporating this intervention in treatment plans and can help clinicians communicate goals to patients, improving adherence.

Key words: Patellofemoral pain syndrome, Anterior knee pain, Hip muscle strengthening exercises.

INTRODUCTION

The patellofemoral joint (PFJ) is a complex connection between the patella and the femoral trochlear groove. The patella, the largest sesamoid bone in the body, has the thickest cartilage and features seven articulating surfaces that vary in length and curvature. The patellar ridge divides the medial and lateral facets of the articulating surface and can be positioned centrally or shifted towards the medial or lateral direction. The patella links the quadriceps muscles (vastus medialis, vastus intermedius, vastus lateralis, and rectus

femoris) to the tibia, aiding in knee extension by transmitting the force from the quadriceps to the tibia through the patellar tendon. When the knee is fully extended, the patella sits above the trochlear groove, with some contact in the distal lateral facets. As the knee bends, the patellar tendon pulls the patella into the trochlear groove, initially making contact with the lateral facets, which causes slight medial translation. At approximately 30° of knee flexion, the medial facets engage with the trochlear groove.[1] Patella flexion increases as the knee flexes, with patella flexion lagging behind the knee flexion angle by approximately 20%. Both the patella and knee achieve their maximum flexion simultaneously.[2] As knee flexion increases, the patella experiences greater lateral translation and lateral tilt following an initial movement toward the medial direction.[3] Beyond 45° of knee flexion, the patella gradually rotates medially. In deep flexion (greater than 90°), contact is made on the upper half of both the medial and lateral facets, and in most individuals, the odd facet is engaged at maximum knee flexion.[4] In passive flexion, contact is made primarily on the lateral facets, while active flexion results in a larger, more consistent contact area throughout the motion. Both passive structures like ligaments and bone shape, along with active muscles, influence patella kinematics, which in turn affects the contact area and mechanics. It has been proposed that the primary role of the patella is to enhance the mechanical advantage of the quadriceps by lengthening their moment arms. A longer moment arm decreases the muscle forces needed to generate torque at the knee, suggesting that the PFJ helps reduce the load on the controlling muscles.[5]

Patellofemoral syndrome (PFS), also referred to as patellofemoral pain syndrome (PFPS) or runner's knee, is a common cause of anterior knee pain seen by clinicians. Patients usually report generalized pain in the front of the knee, which worsens with activities that involve loading a flexed knee, such as running, stair climbing, and squatting. PFS is diagnosed by excluding other intraarticular or peripatellar conditions. Most individuals with PFS experience symptom relief with conservative treatments, although in rare cases, the condition may be resistant to therapy and persist for years. The exact cause of patellofemoral syndrome remains unclear, but it is believed to be multifactorial, often related to training practices. It is thought to involve six anatomical regions: subchondral bone, synovium, retinaculum, skin, nerves, and muscles.[6] Research identifies four primary contributing factors to patellofemoral syndrome: malalignment of the lower extremity and/or patella, muscular imbalances in the lower extremity, overuse or excessive load, and trauma.[7] Among the four contributing factors, overuse is considered the most significant. Additionally, early sport specialization has been found to increase the risk of developing PFS by 1.5 times compared to athletes who participate in multiple sports.[8] Patellofemoral syndrome is a prevalent knee condition encountered by clinicians. In physically active individuals, it is believed to represent 25% to 40% of all knee issues seen in sports medicine clinics, although the exact incidence remains unclear. 9 Studies indicate that patellofemoral syndrome affects women more than men, with a ratio of approximately 2:1.[10] Patellofemoral syndrome commonly occurs in adolescents and young adults, typically during the second and third decades of life. [11] The prevalence of patellofemoral syndrome in adolescents has been found to exceed 20%.[12]

Diagnosing patellofemoral syndrome primarily depends on a thorough history and physical examination. Symptoms may be present on one or both sides and can develop gradually or suddenly. Patients often report increased discomfort during activities such as squatting, running, sitting for extended periods, or climbing stairs.[13] The pain is often diffuse and difficult to pinpoint, typically felt behind or around the patella. It is usually described as an aching sensation, although it may also be sharp. The diagnosis of patellofemoral pain syndrome is generally

made through clinical evaluation. Additional imaging, such as plain radiographs, is typically not considered unless symptoms persist despite one to two months of conservative treatment. Radiographs often do not align well with the patient's symptoms, and distinguishing between the affected and unaffected sides is usually challenging.[14]

Treatment for patellofemoral syndrome typically focuses on pain relief, improving patellar tracking, and helping patients return to their previous activity levels. The treatment process is divided into two main phases: the acute phase and the recovery phase. During the acute phase, treatment includes modifying activities, using NSAIDs, and employing other conservative measures like ice. Naproxen, in particular, has been found to reduce pain more effectively than aspirin and placebo. However, NSAIDs are generally not recommended for long-term use.[15] Other treatments, such as therapeutic ultrasound and electrical stimulation, have not been proven to significantly alleviate symptoms.[16]

After the acute phase, the patient enters the recovery phase, which focuses on addressing the underlying factors that likely contributed to the development of the condition.[17] The most effective treatment involves a combination of knee and hip exercises aimed at improving lower extremity strength, mobility, and overall function.[18] If the patient experiences pain during exercises, adjunct therapies such as patellar taping can be utilized. Patellar taping has been found to reduce pain when combined with physical therapy, compared to physical therapy alone.[19] However, patellar taping tends to be less effective in patients with a higher BMI.[20]

Therapy should be individualized to address the specific dysfunctions of the patient. Referral to orthopaedic surgery is typically not recommended and is considered a last resort treatment option[21] non-operative therapy should be continued for up to 24 months before considering surgical interventions.[22]

Hip muscles, particularly the abductors and lateral rotators, play a crucial role in stabilizing the knee and pelvis during walking.[23] The hip abductors and lateral rotators work together to eccentrically control movements of hip adduction and internal rotation.[24] Weakness in the hip abductors and lateral rotator muscles can lead to impaired neuromuscular control during activities that place stress on the patellofemoral joint.[25] Weak hip abductors can lead to excessive femoral adduction, which increases lateral forces (knee valgum) acting on the patella.[26] On the other hand, weak hip lateral rotators can lead to excessive internal rotation of the femur, increasing contact pressure between the lateral facet of the patella and the lateral femoral condyle.[27] Therefore, weakness in muscles, particularly the abductors and lateral rotators, plays a significant role in the development of patellofemoral pain (PFP).[28]

Physiotherapy is advised to alleviate pain and reduce functional limitations associated with patellofemoral pain syndrome (PFPS). Conventional treatments focus on enhancing patellar alignment and strengthening the muscles around the knee.[29] However, numerous studies emphasize the role of other joints, such as the hip, in the development of patellofemoral pain syndrome (PFPS). Strengthening the hip muscles has been suggested as an effective treatment for PFPS. This approach is based on the theory that excessive motion in the hip, particularly in the frontal and transverse planes, increases stress on the patellofemoral joint.[30] Excessive hip motion may be linked to weakness in the muscles surrounding the hip joint.[31] Patients with patellofemoral pain syndrome (PFPS) may benefit from strengthening the hip muscles, as this can help reduce excessive hip motion and, in turn, decrease stress on the patellofemoral joint. Consequently, hip muscle strengthening has been suggested as an effective treatment to alleviate pain and enhance function in individuals with PFPS.[32]

Objectives

The objective is to find the effectiveness of hip muscle strengthening on pain and functional improvement for the patients with patellofemoral pain syndrome.

METHODOLOGY

Search strategy: Specific keywords were searched on the database to include articles based on the inclusion and exclusion criteria to include full articles in this literature review.

Database: PubMed, Google Scholar

Key words: Patellofemoral pain syndrome, Anterior knee pain, Hip muscle strengthening exercises

Inclusion criteria

- Insidious onset of symptoms unrelated to trauma
- Gender both male and female
- Pain in anterior knee
- Articles published between 2014-2024

Exclusion criteria

- Other orthopaedic condition of knee joint
- Hip or lumbar referred pain
- History of recurrent patellar subluxation or dislocation
- History of knee joint surgery
- Congenital acquired lower limb deformities
- Pregnancy
- Articles published before 2014

RESULTS

Total 14 articles were taken and studied. The review study is tabulated in table. As describing below about author, nature, Title and findings of studies.

DISCUSSION

This systematic review found that most of the studies reviewed suggest that strengthening the hip muscles is effective in reducing pain and improving function in individuals with patellofemoral pain syndrome (PFPS). However, there was disagreement among the studies about the impact of this treatment on muscle strength. The literature review revealed that only a limited number of randomized controlled trials (RCTs) compared hip muscle strengthening with other treatments. The selected studies used different intervention protocols and outcome measures, which made it challenging to compare results across studies and prevented the possibility of conducting a meta-analysis. All the studies included in this review assessed pain intensity, although different scales were used, and some studies asked participants to report pain levels in various situations. For instance, participants were asked to report the worst pain experienced in the past week, pain during stair climbing, and pain while squatting or sitting for long periods. Despite variations in the evaluation methods, most studies found a greater reduction in pain for the hip-strengthening group compared to the control group. Notably, three studies reported pain reduction during stair climbing in the experimental group, suggesting that this intervention positively impacts daily activities. Additionally, one study found that participants who strengthened both the hip and knee muscles experienced less pain during stair climbing a year after treatment ended, compared to those who only strengthened the knee muscles. This suggests potential long-term benefits of combining both muscle groups in treatment. However, this long-term benefit was only examined in one study, and further research is needed to explore the lasting effects of muscle strengthening in patients with PFPS.

REVIEW OF LITERATURE

Title & Authors & Year of publication	Type of study	Outcome measures	Result	Conclusion
Effectiveness of hip muscle strengthening in patellofemoral pain syndrome Patients. Thiago RT Santos et. al. 2015	A systematic Review of Randomized controlled trials	Numerical pain rating scale (NPRS) Visual analogue scale (VAS)	Seven studies were selected. These studies demonstrated that the hip muscle strengthening was effective in reducing pain. However, the studies disagreed regarding the treatments ability to improve muscle strength. Improvement in functional capabilities after hip muscle strengthening was found in five studies.	Hip muscle strengthening is effective in reducing the intensity of pain and improving functional capabilities in patients with PFPS, despite the lack of evidence for its ability to increase muscle strength.
Systematic review of the addition of hip strengthening exercises or adults with patella femoral pain syndrome Cara Elliot et. al. 2018	Randomized controlled trials	Visual analogue scale (VAS) Lower Extremity Functional Scale (LEFS)	Five randomised controlled trials of varying methodological quality met the inclusion criteria. The participants in these studies were aged between 18 and 40 years of age. The duration of the intervention ranged from four to six weeks consisting of 12 to 30 supervised exercise sessions. Studies used varying outcome measures for each of the three outcomes. Overall, the studies demonstrated that the addition of hip strengthening exercises to standard physiotherapy care consistently improved pain and function, but the impact on strength was variable.	Only a small number of studies have looked at the addition of hip exercises to standard physiotherapy care for the treatment of Patellofemoral Pain Syndrome. While there is a growing body of evidence for the efficacy of hip strengthening exercises for Patellofemoral Pain Syndrome, the studies tend to be constrained by bias towards female participants, lack of true controls, and low methodological quality of studies overall. Hip exercises added to standard physiotherapy care shows potential as a treatment approach for improving outcomes of pain and function in adults with patellofemoral pain syndrome.
Effects of Hip Exercises on the pain Severity in Patients with Patellofemoral Pain Syndrome. Seyed Esmaeil Shafieil et. al. 2019	Randomized controlled trials	Numerical Rating Pain Scale (NRPS) Anterior Knee Pain Scale (AKPS	In total, 58 patients (29 in each group) were evaluated. The distribution of patients in each treatment group is shown in the consort diagram. Of the 58 patients, 34.5% were male and 65.5% were female. The mean age of the patients in the adductor and abductor groups were 33.4±6.1 and 30.4±7.3 years, respectively, indicating that the age difference between the two groups was not statistically significant (p=0.1). The statistical analysis of the posttreatment evaluation of patients	The results of the present study indicate that 6 weeks of abductor and adductor muscle exercises, especially abductor muscle exercises, help reduce pain and improve joint function in patients with patellofemoral pain syndrome. In addition to better pain management and performance in both groups, the results showed significantly improved performance of the abductor group patients in the stepdown test compared with that of the adductor group

			showed significant improvement in the adductor group.	patients, indicating that strengthening of the abductor muscles is more important for and effective in improving performance.
Effects of strengthening of hip abductors and lateral rotators for improving pain and functional limitation in patients with patellofemoral dysfunction. Faiza Sharif et. al. 2020	randomized controlled trial	Visual Analogue Scale Kujala scale	The improvement in the score of visual analog scale in Group-A was 4.67±0.97 and in GroupB was 3.00±1.25 (p=0.002). The improvement in the score of Kujala scale was 41.00±12.86 in Group-A and 30.06±13.62 in Group-B (p=0.03).	Both interventions were found to be effective in reducing pain and functional limitations but hip strengthening along with conventional therapy was more effective as compared to conventional physiotherapy alone. Physiotherapists should apply hip strengthening exercises in patients with patella femoral pain to get optimal results.
Effect of hip abductors and lateral rotators' muscle strengthening on pain and functional outcome in adult patients with patellofemoral pain: Abdulaziz Alammari et. al. 2023	A systematic review and meta-analysis of Randomized controlled trials	Lower Extremity Functional Scale (LEFS) Tegner Activity Scale (TAS) Lysholm Knee Scoring Scale (LKSC) Daily Living Scale (KOSADL) Functional Index Questionnaire (FIQ)	All RCTs, except one, demonstrated that hip muscle strengthening is superior to quadriceps strengthening. Of the five RCTs assessing the additional effect of hip-quad versus quadriceps strengthening, four suggested that hip-quad strengthening is superior to standard quadriceps strengthening alone to improve PFP and knee function.	This systematic review and meta-analysis indicate that isolated strengthening of hip abductors and lateral rotators have therapeutic benefits compared to quadriceps strengthening alone for the treatment of PFP. It is also clear that the hip-quadriceps strategy gives a beneficial therapeutic outcome than isolated quadriceps or hip muscle strengthening. Therefore, we recommend developing a hip-quadriceps exercise strategy for the treatment of PFP to encourage improved compliance, even in unsupervised patients.
High Eccentric Hip Abduction Strength Reduces the Risk of Developing Patellofemoral Pain Among Novice Runners Initiating a Self Structured Running Program: A 1-Year Observational Study Danial Ramskov et. al. 2015	Observational prospective cohort study	Online questionnaire, which contained questions regarding health, previous injuries, and participation in sports	Results from the unadjusted generalized linear regression model for cumulative risk at 25 and 50 km indicated differences in cumulative risk of PFP between high strength, normal strength, and low strength (P<.05), with higher strength associated with reduced risk.	Findings from this study indicate that among novice runners, a level of peak eccentric hip abduction strength higher than normal reduces the risk of PFP. Considering this, exercise interventions designed to treat and prevent PFP should include strategies to increase eccentric hip abduction strength. An overall increase in peak eccentric hip abduction strength may be associated with reduced risk of PFP development among novice runners during the first 50 km of

				their self structured running regime. Further research is needed to understand the relationship between eccentric hip abduction strength and other PFP risk factors, and to identify the most effective exercise protocols to improve strength.
Short - Term Effects of Eccentric Hip Abductors and Lateral Rotators Strengthening in Sedentary People with Patellofemoral Pain Syndrome on Pain and Function Kavitha Shetty et. al. 2016	Randomized controlled trials	Numerical Rating Pain Scale (NRPS) Anterior Knee Pain Scale (AKPS) Lower Extremity Functional Scale (LEFS)	Hip strengthening exercises both led to improved function and reduced pain in sedentary population with PFPS. For most outcome measures, greater improvement was noted in the group combining knee and hip exercises, the importance of hip abductor and lateral rotator muscle strengthening in the treatment of PFPS has received increased attention in recent years. This approach is based on several studies that have demonstrated weakness of the hip abductors and lateral rotators in patients with PFPS.	Short term Knee strengthening exercises supplemented by eccentric hip abductor and lateral rotator musculature– strengthening exercises were more effective than knee exercises alone in improving function and reducing pain in sedentary people with PFPS.
Is hip strengthening the best treatment option for females with patellofemoral pain? A randomized controlled trial of three different types of exercises Marcelo Camargo Saad et. al. 2018	Randomized controlled trials	Visual Analog Scale (VAS) Anterior Knee Pain Scale (AKPS)	All treatment groups showed significant improvements on pain and Anterior Knee Pain Scale after intervention with no statistically significant differences between groups except when compared to the control group. Only hip and quadriceps groups demonstrated improvements in muscle strength and knee valgus angle during the step activities	Hip strengthening exercises were not more effective for pain relief and function compared to quadriceps or stretching exercises in females with patellofemoral pain. Only hip and quadriceps groups were able to decrease the incidence of dynamic valgus during step-down activity
Combined Hip Abductor and External Rotator Strengthening and Hip Internal Rotator Stretching Improves Pain and Function in Patients with Patellofemoral Pain Syndrome Anis Jellad et. al. 2021	Randomize d controlled trials	Visual Analog Scale (VAS) Anterior Knee Pain Scale (AKPS) Functional Index Questionnaire (FIQ)	Until the final follow-up, VAS, FIQ, and Kujala scores were significantly improved in both the A-B and B-A arms ($P < .05$ for all). Compared with protocol A, protocol B provided significant improvement in terms of pain and function in both the BA (VAS and Kujala; $P < .001$) and AB (VAS and Kujala; $P < .001$) groups.	Hip strengthening exercises were not more effective for pain relief and function compared to quadriceps or stretching exercises in females with patellofemoral pain. Only hip and quadriceps groups were able to decrease the incidence of dynamic valgus during step-down activity.

Effect of Pain and Hip Muscle Strength and Flexibility on Functional Status of Females with Patellofemoral Pain Syndrome Hira Jabeen et. al. 2016	Cross sectional study	Visual Analog Scale (VAS) Anterior Knee Pain Scale (AKPS)	females with PFPS. The Strengths of gluteus Medius, minimus and hip lateral rotators both were poor predictors of functional status of females with PFPS (p= .271 and .362 respectively). The strength of gluteus maximus explained 12.6% variation in functional status and was a better predictor of functional status in females with PFPS (p=0.025)	The study concludes that pain in unilateral squat and strength of hip extensors were better predictors of functional status in females with patellofemoral pain syndrome. Hip muscle flexibility was not a good predictor of functional status.
Addition of hip exercises to treatment of patellofemoral pain syndrome Kimberly Morelli et. al 2015	Meta analysis study	Visual Analog Scale (VAS) Anterior Knee Pain Scale (AKPS) Numerical Rating Pain Scale (NRPS) Lower Extremity Functional Scale (LEFS)	Two hundred eighty-three studies were screened for inclusion in our meta-analysis. Nine studies were deemed suitable for data extraction and analysis. A total of 426 subjects were used in the nine studies. Overall, there was a significant positive effect of hip-strengthening exercises on measures of pain and function in subjects with PFPS (ES = 0.94, P = 0.00004). None of the individual studies had a negative ES, with study ES ranging from 0.35 to 2.59. Because of the high degree of between-study variance (I 2 = 76%; Q = 34.0, P < 0.001), subgroup meta-analyses and meta-regressions were performed. None of the potential moderator variables that were investigated (e.g., outcome type, hip region targeted, duration of treatment) could explain a significant amount of the between-study variance in ES (P ≥ 0.23).	Overall, the addition of hip strengthening exercises to traditional physical therapy produced greater improvements in measures of pain and function
Effect of Hip Muscle Strengthening as an adjunct to conservative management in patients with patellofemoral pain syndrome Chandha Nathani et. al. 2015	Chit Method	Visual Analog Scale (VAS) Anterior Knee Pain Scale (AKPS) Lower Extremity Functional	Results shows improvement in pain and lower extremity functions in both the groups but group B was better as compared to group A.	Four weeks of either conservative treatment or conservative treatment supplemented by hip strengthening exercises were effective in improving function and reducing pain in PFPS.

		Scale (LEFS)		
Functional, Kinematic, and Isokinetic Strength outcomes of a hip strengthening program among adolescent females with idiopathic patellofemoral pain. Aaron J Provance et. al. 2014	Pilot Study	Visual Analog Scale (VAS) Anterior Knee Pain Scale (AKPS)	Post intervention, the subjects demonstrated a significant decrease in hip internal rotation during running [p=0.00341], downhill walking[p=0.0491] and single limb hop tasks[p=0.0214]. there was a significant increase in hip extensor, abductor, and external rotator strength after the intervention [p<0.05].	This study supports the utilization of a physical therapy program focused on hip musculature strength to alter lower extremity kinematics, improve hip muscle strength and reduce symptom severity in adolescent females with PFP.
The effect of strengthening exercises of the hip extensor and external rotator muscles on patellofemoral pain syndrome Sirous Azizi et. al. 2019	Randomized controlled trials	Visual Analog Scale (VAS)	A total of 54 individuals were enrolled, of which 14 were excluded due to insufficient patient data. The remaining 40 patients with the mean age 26 ± 2 years were divided into two groups of 20 patients. The mean pain score was 8.6 ± 0.8 and 8.2 ± 0.5 respectively. the mean of pain score decreased significantly to 6.0 ± 0.7 in the study group (P<0.01). We had significant pain improvement on running, stairs climbing, and during exercise following the strengthening exercise (P<0.01).	Considering the strengthening trainings that have been applied to reduce the pain of PFPS in other studies, the movements used in this method along with other therapeutic methods could increase the effectiveness, therapists can recommend this strength training method for the treatment.

Functional capabilities were assessed using questionnaires and functional tests in five of the seven studies included in the review. Two studies, which employed the Lower Extremity Functional Scale (LEFS), the Anterior Knee Pain Scale (AKPS), and the unilateral jump test, found that participants in the experimental group showed greater improvements in function compared to the control group. Additionally, one of these studies demonstrated that the functional improvements in the experimental group were sustained at three, six-, and twelve-months post-intervention, indicating long-term benefits. Another study using the AKPS also found that the experimental group showed more significant improvements in reported functional capabilities than the control group. This review summarized the existing literature and assessed the methodological quality of the randomized controlled trials (RCTs) published on the effects of hip muscle strengthening in patients with patellofemoral pain syndrome (PFPS).

The findings indicate that hip muscle strengthening plays a crucial role in treating patients with patellofemoral pain syndrome (PFPS), as it is effective in reducing pain and improving function. However, the results regarding the impact of this treatment on muscle strength were mixed. The data synthesized in this review may assist researchers in designing future studies. Additionally, the results can guide clinical decision-making by supporting the inclusion of hip muscle strengthening in PFPS treatment plans. Clinicians can also use these findings to explain the treatment's objectives to patients, potentially improving their adherence to the treatment.

Several studies have suggested that weakness in certain thigh muscle groups can disrupt knee alignment, contributing to the development of patellofemoral pain syndrome. When the abductor and external rotator muscles are weak, the control of adduction and internal rotation is compromised, leading to misalignment of the patellofemoral joint. In a clinical study by Cichanowski et al., the hip muscle strength of the affected and unaffected sides of 13 athletes with patellofemoral pain syndrome was compared. The study found that the muscles on the affected side were significantly weaker than those on the unaffected side. This finding underscores the importance of strengthening hip muscles to reduce pain and improve function in such patients, which aligns with the conclusions of the present study. However, unlike Cichanowski's study, which also examined the strength of adductor muscles, no significant difference was observed in their strength between the groups. In contrast, the present study did not measure muscle strength before and after the 6-week treatment, focusing instead on assessing pain levels and patient performance.

Tyler et al. suggested that improving the flexibility of the hip flexors and iliotibial band can help reduce tension in the lateral retinaculum, allowing for proper patellar glide. Patients with patellofemoral pain syndrome (PFPS) often show quadriceps weakness, which is believed to contribute to abnormal patellar tracking and irritation of the patellofemoral joint. Strengthening and restoring the function of the quadriceps has been shown to be a key factor in recovering from patellofemoral symptoms.

CONCLUSION

This review provides a summary of the existing literature and assesses the methodological quality of published randomized controlled trials (RCTs) regarding the effects of hip muscle strengthening in patients with patellofemoral pain syndrome (PFPS). The results indicate that hip muscle strengthening plays a significant role in treating PFPS, as it is effective in reducing pain and improving function. However, the evidence on its ability to enhance muscle strength was mixed. The data presented in this review may help guide researchers in designing future studies. Additionally, the findings support the inclusion of hip muscle strengthening in PFPS treatment plans, which can assist

clinicians in making informed decisions. These results can also be used to explain treatment objectives to patients, potentially improving their adherence to the treatment.

Declaration by Authors

Ethical Approval: Not Applicable
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCE

1. Yamada Y, Toritsuka Y, Horibe S, Sugamoto K, Yoshikawa H, Shino K. In vivo movement analysis of the patella using a three-dimensional computer model. 2007;89-B(6):752–760.
2. Van Kampen A, Huiskes R. The three-dimensional tracking pattern of the human patella. 1990;8(3):372–382.
3. Nagamine R, Otani T, White SE, McCarthy DS, Whiteside LA. Patellar tracking measurement in the normal knee. 1995;13(1):115–122.
4. Nakagawa S, Kadoya Y, Kobayashi A, Tatsumi I, Nishida N, Yamano Y. Kinematics of the patella in deep flexion: analysis with magnetic resonance imaging. *JBJS.* 2003;85(7):1238.
5. Cleather DJ. The patella: a mechanical determinant of coordination during vertical jumping. 2018; 446:205–211.
6. Fulkerson JP. Diagnosis and treatment of patients with patellofemoral pain. Am J Sports Med. 2002 May-Jun;30(3):447-56.
7. Thomeé R, Augustsson J, Karlsson J. Patellofemoral pain syndrome: a review of current issues. Sports Med. 1999 Oct;28(4):245-62.
8. Hall R, Barber Foss K, Hewett TE, Myer GD. Sport specialization's association with an increased risk of developing anterior knee pain in adolescent female athletes. J Sport Rehabil. 2015 Feb;24(1):31-5.
9. Witvrouw E, Callaghan MJ, Stefanik JJ, Noehren B, Bazett-Jones DM, Willson JD, Earl-Boehm JE, Davis IS, Powers CM, McConnell J, Crossley KM. Patellofemoral pain: consensus statement from the 3rd International Patellofemoral Pain Research Retreat held in Vancouver, September 2013. Br J Sports Med. 2014 Mar;48(6):411-4.
10. DeHaven KE, Lintner DM. Athletic injuries: comparison by age, sport, and gender. Am J Sports Med. 1986 May-Jun;14(3):218-24.
11. Taunton JE, Ryan MB, Clement DB, McKenzie DC, Lloyd-Smith DR, Zumbo BD. A retrospective case-control analysis of 2002 running injuries. Br J Sports Med. 2002 Apr;36(2):95-101.
12. Tállay A, Kynsburg A, Tóth S, Szendi P, Pavlik A, Balogh E, Halasi T, Berkes I. [Prevalence of patellofemoral pain syndrome. Evaluation of the role of biomechanical malalignments and the role of sport activity]. Orv Hetil. 2004 Oct 10;145(41):2093-101.
13. Post WR. Clinical evaluation of patients with patellofemoral disorders. Arthroscopy. 1999 Nov- Dec;15(8):841-51.
14. Haim A, Yaniv M, Dekel S, Amir H. Patellofemoral pain syndrome: validity of clinical and radiological features. Clin Orthop Relat Res. 2006 Oct; 451:223-8.
15. Hinted Heintjes E, Berger MY, Bierma-Zeinstra SM, Bernsen RM, Verhaar JA, Koes BW. Pharmacotherapy for patellofemoral pain syndrome. Cochrane Database Syst Rev. 2004;2004(3):CD003470.
16. Martimbianco ALC, Torloni MR, Andriolo BN, Porfírio GJ, Riera R. Neuromuscular electrical stimulation (NMES) for patellofemoral pain syndrome. Cochrane Database Syst Rev. 2017 Dec 12;12(12):CD011289.
17. Shanks P, Curran M, Fletcher P, Thompson R. The effectiveness of therapeutic ultrasound for musculoskeletal conditions of the lower limb: A literature review. Foot (Edinb). 2010 Dec;20(4):133-9.
18. Van der Heijden RA, Lankhorst NE, van Linschoten R, Bierma-Zeinstra SM, van Middelkoop M. Exercise for treating patellofemoral pain syndrome. Cochrane Database Syst Rev. 2015 Jan 20;1:CD010387.
19. Logan CA, Bhashyam AR, Tisosky AJ, Haber DB, Jorgensen A, Roy A, Provencher MT. Systematic Review of the Effect of Taping Techniques on Patellofemoral Pain Syndrome. Sports Health. 2017 Sep/Oct;9(5):456-461.
20. Lan TY, Lin WP, Jiang CC, Chiang H. Immediate effect and predictors of effectiveness of taping for patellofemoral pain syndrome: a prospective cohort study. Am J Sports Med. 2010 Aug;38(8):1626-30.

21. Collins NJ, Barton CJ, van Middelkoop M, Callaghan MJ, Rathleff MS, Vicenzino BT, Davis IS, Powers CM, Macri EM, Hart HF, de Oliveira Silva D, Crossley KM. 2018 Consensus statement on exercise therapy and physical interventions (orthoses, taping and manual therapy) to treat patellofemoral pain: recommendations from the 5th International Patellofemoral Pain Research Retreat, Gold Coast, Australia, 2017. Br J Sports Med. 2018 Sep;52(18):1170-1178.
22. Dixit S, DiFiori JP, Burton M, Mines B. Management of patellofemoral pain syndrome. Am Fam Physician. 2007 Jan 15;75(2):194-202.
23. Lankhorst NE, Bierma-Zeinstra SMA, van Middelkoop M. Risk factors for patellofemoral pain syndrome: A systematic review. J Orthop Sports Phys Ther. (2012) ; 42: : 81-94.
24. Robinson RL, Nee RJ. Analysis of hip strength in females seeking physical therapy treatment for unilateral patellofemoral pain syndrome. J Orthop Sports Phys Ther. (2007) ; 37: : 232-8
25. Bell DR, Oates DC, Clark MA, Padua DA. Two- and 3-dimensional knee valgus are reduced after an exercise intervention in young adults with demonstrable valgus during squatting. J Athl Train. (2013) ; 48: : 442-9.
26. Flack NAMS, Nicholson HD, Woodley SJ. The anatomy of the hip abductor muscles. Clin Anat. (2014) ; 27: : 241-53.
27. Prins MR, van der Wurff P. Females with patellofemoral pain syndrome have weak hip muscles: A systematic review. Aust J Physiother. (2009); 55: 9-15.
28. Souza RB, Powers CM. Differences in hip kinematics, muscle strength, and muscle activation between subjects with and without patellofemoral pain. J Orthop Sports Phys Ther. (2009); 39: 12-9.
29. Garcia FR, Azevedo FM, Alves N, Carvalho AC, Padovani CR, Negrao RF., Filho Effects of electrical stimulation of vastus medialis obliquus muscle in patients with patellofemoral pain syndrome: an electromyographic analysis. 2010; 14(6): 477– 482.
30. Powers CM. The influence of altered lower-extremity kinematics on patellofemoral joint dysfunction: a theoretical perspective. 2003;33(11):639–646.
31. Robinson RL, Nee RJ. Analysis of hip strength in females seeking physical therapy treatment for unilateral patellofemoral pain syndrome. 2007;37(5):232–238
32. Bolgla LA, Malone TR, Umberger BR, Uhl TL. Hip strength and hip and knee kinematics during stair descent in females with and without patellofemoral pain syndrome. 2008;38(1):12–18.

How to cite this article: Abhilash PV, Vishnu K Nair, Prathik, Kerina Varghese. Effectiveness of hip muscle strengthening in patellofemoral pain syndrome: a literature review. *Gal Int J Health Sci Res*. 2025; 10(1): 94-105. *DOI: https://doi.org/10.52403/gijhsr.20250111*

******