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MANUAL THERAPY FOR PATELLOFEMORAL PAIN SYNDROME REVIEW OF LITERATURE

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ABSTRACT

Background: *patellofemoral pain syndrome, a prevalent knee issue with multiple contributing factors, benefits from a multifaceted approach to treatment, including physiotherapy manual techniques. Despite these methods, Some individuals might have functional issues even after undergoing other medical treatments. focusing on the possibility of manual techniques being more effective in managing patellofemoral pain syndrome.*

Purpose: *This review manual physiotherapy approach in addressing patellofemoral pain, particularly in reducing pain levels and improving overall functionality for affected individuals.*

Methods: *A thorough, computer-based search was conducted to collect pertinent studies, ensuring a comprehensive scope for this review on the topic. Various databases were explored, including Some of the key databases for medical and healthcare research including Midline, Embase, CINAHL, Sports Discus, and the Cochrane Library. The search focused on publications from 2012 to 2023, aiming to include the most recent literature in the analysis.*

Results: *Among the all studies, 15 articles' outcomes show that physiotherapy manual techniques are more effective in treating patients with PFPS.*

Conclusion*: Research has demonstrated that manual physiotherapy methods can effectively alleviate pain and improve functionality for individuals suffering from patellofemoral pain, both in the immediate and long-term phases. In light of these findings, medical professionals, including physical therapists, are advised to incorporate these hands-on techniques into their dealing with this specific issue.*

KEYWORDS: *Exercise, manual techniques, and patellofemoral pain syndrome.*

INTRODUCTION

Patellofemoral pain syndrome is a prevalent knee issue, affecting a wide range of individuals. Estimates suggest that its occurrence falls between 8% and 40%, with females experiencing it more frequently than males.1,2 PFPS routinely affects adolescents, young adults, and the athletic population.2–5 Suffering generally presents to sports physicians and physical therapists with peri- patellar pain aggravated by activities stressing the patellofemoral joint, such as squatting, prolonged sitting, stair climbing, and running. Although the precise cause of PFPS remains unclear, it is generally attributed to a combination of factors involving biomechanics, muscle imbalances, and overuse. factors contributing to PFPS are thought to include: proximal and distal muscle imbalance and weakness, overuse, soft tissue tightness, and poor lower limb alignment, such as increased Q angle and poor foot biomechanics. Sometimes dynamic valgus is also noticed in patellofemoral pain syndrome and it is due to weak hip abductor muscles abnormal rear foot version with pes pronates valgus, vastus medialis and vastus lateralis disbalance, Hamstring tightness, and iliotibial band tightness. (1.5)

Patellofemoral Syndrome (PFS), commonly known as "runner's knee," is a prevalent knee issue characterized by discomfort around or beneath the patella. It is one of the leading causes of knee pain, often presenting as generalized anterior knee discomfort during activities that strain the patellofemoral joint. Despite extensive research, there is no consensus on the exact cause of PFS. Several factors are believed to contribute, including trauma, overuse, patellar malalignment, muscular imbalance, and, to a lesser extent, psychological factors such as mental health, fear, anxiety, and depression. This painful condition

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predominantly affects young, physically active individuals and has a higher prevalence in women compared to men.

Patellofemoral pain, or PFPS, is believed to stem from the patella's irregular movement within the trochlear groove. Various contributing factors, such as lower limb misalignment, muscular imbalances or weakness, reduced flexibility, excessive patellar mobility, incorrect running techniques, and overuse, can lead to this discomfort. PFPS is a prevalent overuse injury in physically active adults, with studies indicating that it affects 19-30% of female runners and 13- 25% of male runners.[2.3.4]

a frequent reason for anterior knee pain in outpatient settings, affecting adolescents and adults below 60 years old in the United States, with an incidence of 3% to 6%. Characterized by knee discomfort around the anterior region, it aggravates during weight-bearing activities involving knee flexion. Pain from PFPS tends to worsen in prolonged sitting or while descending stairs. A patient's squatting-induced pain is the most sensitive diagnostic indicator. Examining gait, posture, and footwear can help identify contributing factors. While X-rays of the knee are not essential for diagnosing PFPS, they can rule out other conditions, such as osteoarthritis, patellar fractures, and osteochondritis.

Need of study

Nowadays more peoples suffer from knee pain (patellofemoral pain syndrome) and some are compressing their lives with pain and someone trying to overcome the pain. But no one is happy with the pain, l to overcome that sadness or to get rid of the PFPS manual physiotherapy plays a major and key role.

METHODOLOGY

Inclusive criteria

- Articles explaining patellofemoral pain rehabilitation were included.
- Articles published in recent years.
- Full-text articles.
- Articles published in English

Exclusive criteria

These studies, each focusing on different approaches to managing Patellofemoral Pain Syndrome (PFS):

1. Combined Interventions: Researchers examine combining multiple treatments, such as exercise and manual therapy, in managing PFS.
2. Other Adjunctive Interventions: In this category, researchers explore additional treatments like therapies for managing PFS.
3. Individual Therapy Techniques: Studies in this area focus on the effectiveness of single treatment methods, such as specific exercises, massage, or other targeted therapies, in alleviating PFS symptoms.

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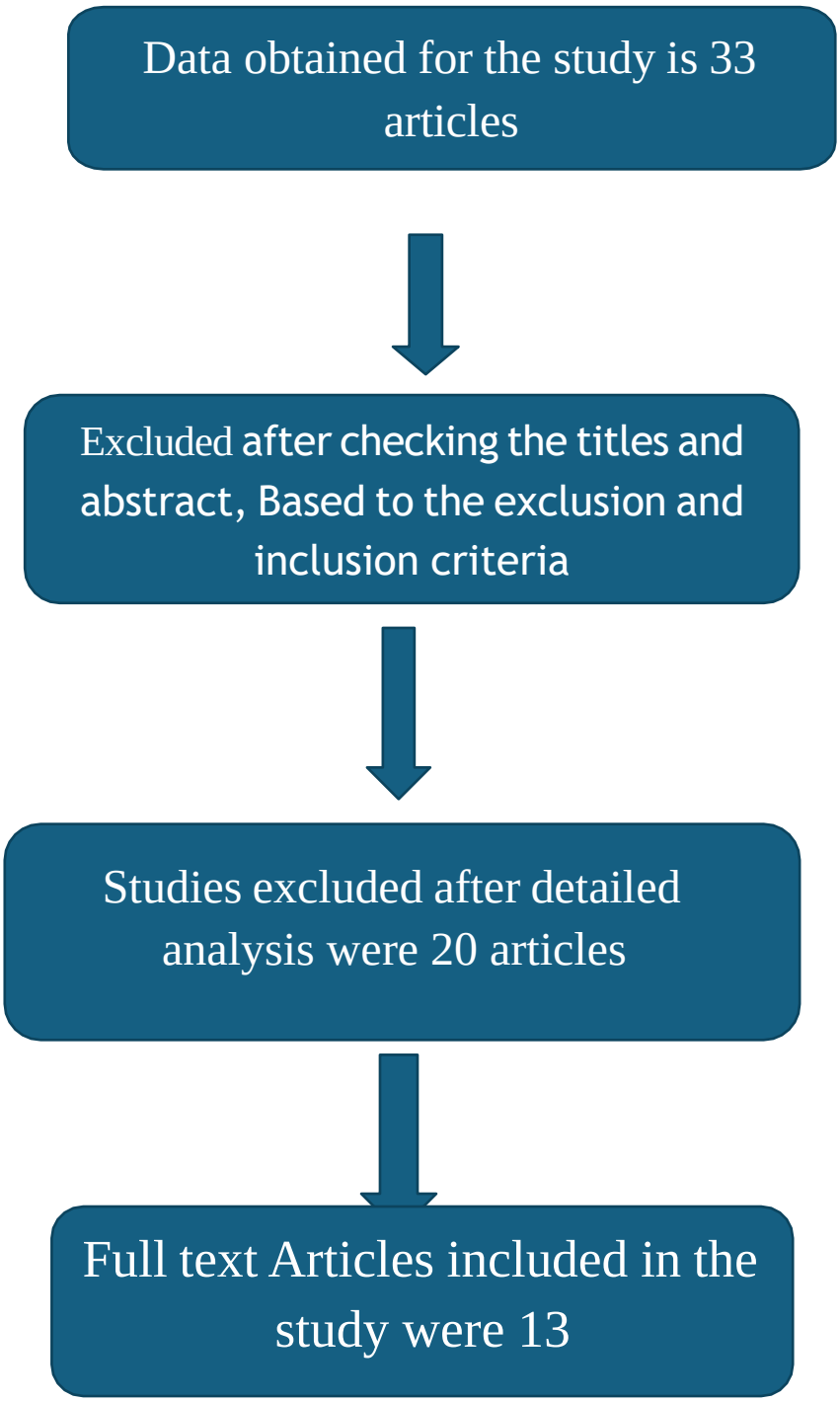
Flow Chart



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REVIEW OF LITERATURE

S.no	Title of the study	Name of the author and year	Types of the study	Mode of the study	Results
1	Physiotherapeutic interventions on quadriceps muscle architecture in patellofemoral pain syndrome	Vinaya Kumar, et al. 2023	Experimental and Questioners	Electrical neuromuscular stimulation and Quadriceps strengthening	Quadriceps strengthening plays a key role management of PFPS individuals.
2	Talonavicular joint mobilization and foot core strengthening in patellofemoral pain syndrome: a single- blind, three-armed randomized controlled trial.	Hyun- Joong Kim et al.2022	Noval approach	Foot Core Muscle Strengthening and Talonavicular Mobilization: These two techniques aim to improve foot and lower limb function by focusing on specific muscle groups and joints. Foot core muscle strengthening exercises help enhance the stability and strength of the intrinsic muscles in the foot, while talonavicular mobilization is a technique used to increase the mobility and flexibility of the Talonavicular joint, which plays a crucial role in maintaining proper foot alignment and overall biomechanics. Both methods can be incorporated into a comprehensive treatment plan to address various foot-related issues, including pain and discomfort.	In (PFPS), a combined approach utilizing Talonavicular Joint Mobilization (TNJM) and Foot Core Muscle Strengthening (FCMS) has demonstrated greater efficacy in alleviating pain and enhancing overall functional abilities. This integrated treatment strategy addresses both lower limb biomechanics and the specific muscles and joints involved in PFPS, ultimately leading to improved patient outcomes and better quality of life.
3	Comparison of mobilization with movement and Mulligan knee taping on patellofemoral pain syndrome	Mubarra Rehman et al 2021.	RTC	MWM with Mulligan taping	The study involved 34 participants, with 17 individuals (50%) in each of the two groups. The demographics included 6 males (17.6%) and 28 females (82.4%), with an average age of 31.17

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					years and a standard deviation of 7.22 years. In Group A, significant improvements in pain management were observed ($p < 0.0001$). Meanwhile, Group B experienced notable enhancements in hamstring flexibility ($p < 0.0001$). Both groups demonstrated substantial changes ($p < 0.0001$) in all outcome variables after the intervention.
4	Effectiveness of local exercise therapy versus spinal manual therapy in patients' patellofemoral pain syndrome medium- term follow-up results of a randomized controlled trial	Aldo Scafoglieri et al.2021	RTC	Spinal manual therapy for PFPS individuals	In a 6-week intervention study comparing Spinal Manipulative Therapy (SMT) and Local Patients who underwent exercise therapy (LET) reported noticeably better pain reduction. and functional improvements in both groups. The difference in maximum pain reduction between the two groups was 23.4 mm (95% CI: 9.3, 37.6; effect size (ES): 1.04). For the Australian Knee Pain Scale (AKPS), the difference was -12.4 (95% CI: -20.2, -4.7; ES: 1.00). At the 6- week follow- up, patients still showed notable improvements, with a difference in maximum pain of 18.7 mm (95% CI: 1.4, 36.0; ES: 0.68) for SMT and a difference of -11.5 (95% CI: -19.9, -3.3; ES: -0.87) for LET in AKPS scores. Both treatment approaches provided meaningful

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					benefits, highlighting the importance of tailoring interventions to individual patients' needs.
5	Effects of whole-body vibration with exercise therapy versus exercise therapy alone on flexibility, vertical jump height, agility and pain in athletes with patellofemoral pain:a randomized clinical trial	Ebrahim Rasti et al. 2020	RTC	Whole-Body Vibration Exercise Therapy: Enhancing Vertical Jump Performance	After the interventions, both groups saw notable advancements in variables related to vertical jump height, flexibility, agility, and pain intensity ($p < 0.05$). Notably, the Whole-Body Vibration (WBV) combined with exercise group showed a significantly more substantial improvement in flexibility ($p < 0.001$). However, when comparing vertical jump height, agility, and pain intensity, the WBV + methods effectively improved overall. WBV and exercise might be more effective in enhancing flexibility.
6	Functional joint mobilizations for patellofemoral pain syndrome: a clinical suggestion	Dhinu J. Jayaseelan, DPT, OCS, et.al.2020	Clinical suggestion	Joint mobilizations	In combination with other interventions, joint mobilization has demonstrated notable success in alleviating pain and enhancing Studies have demonstrated that an integrated approach involving Manual Therapy (MT) and conventional Physical therapy can make a big difference. functional outcomes for patients experiencing Patellofemoral Pain Syndrome (PFPS). It has been discovered that this technique produces moderate to large effect sizes, indicating its effectiveness in addressing the condition. indicating its effectiveness in

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					addressing the symptoms and improving the overall quality of life for those affected by PFPS.
7	Evidence-based treatment options for common knee injuries in runners	Simeon Mellinger et al. 2019	experimental	Manual techniques (joint mobilizations soft tissue mobilization, manual stretching,	Pain reduction with manual techniques.
8	2018 Consensus statement on exercise therapy and physical interventions (orthosis taping and manual therapy) to treat patellofemoral pain: recommendation form 5th international patellofemoral pain.	Collins NJ, et al. 2018	consensus	Exercise refers to a range of practices aimed at improving physical health, mobility, and overall well- being. These interventions often involve targeted exercises, manual techniques, and other methods designed to address specific issues, such as pain, muscle imbalances, or functional limitations. By incorporating it into a comprehensive treatment plan, individuals can experience enhanced strength, flexibility, and reduced discomfort, ultimately leading to improved quality of life.	Exercise therapy stands out as the preferred intervention when addressing Patellofemoral Pain Syndrome (PFPS). This non-invasive approach focuses on strengthening the muscles surrounding the knee joint, improving flexibility, and promoting proper biomechanics. By targeting the underlying causes of PFPS, exercise therapy helps alleviate pain and discomfort while restoring normal joint function and enhancing overall mobility. This makes it a popular choice among healthcare professionals and patients seeking effective, long- term solutions for managing PFPS.
9	Effectiveness of manual therapy combined with physical therapy in treatment of patellofemoral pain syndrome: a systematic review	Gemma Victoria Espí-López et al.2017	Systematic review	Manual therapy with physical therapy	Five high- quality Randomized Controlled Trials (RCTs), with a Jadad score of 3 or higher, were chosen for analysis. Manual Therapy (MT) with conventional Physical Therapy can effectively reduce pain and improve functional abilities in individuals suffering from Patellofemoral Syndrome (PFPS). This integrated approach addresses various aspects of the condition,

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					leading to better overall outcomes for patients. The results particularly emphasize the importance of addressing the full kinetic chain during treatment and focusing on strengthening muscle regions for optimal outcomes.
10	a systematic review of the effect of taping techniques on patellofemoral pain syndrome	Logan CA et.al.2017	Systematic review	Tapping techniques	This systematic review supports knee taping only as an adjunct to traditional exercise for PFPS; however, it do not support taping in isolation.
11	TIBIOFEMORAL JOINT MOBILIZATION IN THE SUCCESSFUL MANAGEMENT OF PATELLOFEMORAL PAIN SYNDROME: A CASE REPORT	Justin M Lantz et al.2016	Case report	Tibiofemoral joint mobilizations along with some manual techniques.	Therapeutic exercise,11-16 bracing,17,18 taping,19,20
12	Effectiveness of therapeutic physical exercises in the treatment of patellofemoral syndrome: a systematic review	Pablo Alba-Martín, et al.2015	experimental	Proprioceptive Neuromuscular Facilitation (PNF) involves Exercises that focus on stretching and strengthening the muscles responsible for external rotation and abduction of the hip. These exercises aim to improve muscle function, flexibility, and overall stability for better overall physical performance and injury prevention.	The findings of ten clinical trials of moderate to high quality were evaluated physical exercise as conservative management patellofemoral pain syndrome.
13	Exercise, education manual therapy and taping compared to education for patellofemoral osteoarthritis: a blinded randomized clinical trial osteoarthritis cartilage.	K M Crossley et al. 2015	RTC	Exercise education, manual therapy, and tapping	In this study, 81 participants (representing 88% of the sample) completed the 3-month follow-up, and the using an intention-to- treat approach. at the study's onset. A

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					comprehensive program involving exercise, education, manual therapy, and taping resulted in more participants (20/44) from the experimental group reporting significant improvement (5/48). This translates to a number needed to treat of 3 (95% confidence interval 2 to 5). The experimental group also experienced a notable reduction in pain levels (-15.2 mm, 95% CI -27.0 to -3.4). However, no significant effects were observed on daily activities (5.8; 95% CI -0.6 to 12.1). At the 9-month mark, no substantial differences were found in self-reported improvement, pain reduction (-10.5 mm, 95% CI -22.7 to 1.8), or daily activities (3.0, 95% CI -3.7 to 9.7).
14	Early intervention for adolescents with patellofemoral pain syndrome –a pragmatic cluster randomized controlled trial	Rathleff MS et.al.2012	questionnaire	The multimodal physiotherapy consists of patellofemoral soft tissue mobilization, stretching hip and knee, patellar taping, neuromuscular training foot, knee, and hip, and quadriceps strength training for the knee and hip exercises.	Physiotherapy helps in reduce pain and also make disable to functionally independent.
15	Effectiveness of different and stretching physiotherapy on pain and movement in patellofemoral pain	Moyano FR, et.al.2012	Experimental	The study involved three treatment groups: Proprioceptive Neuromuscular Facilitation (PNF)	The study involved 74 participants who were assigned to one of three groups: Proprioceptive

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	syndrome: a randomized controlled trial.			combined with aerobic exercise, a traditional stretching group, and a control treatment. four months, all participants received interventions under the guidance and supervision of a qualified physiotherapist.	Neuromuscular Facilitation (PNF) combined with stretching, traditional stretching, and a control group. After a four-month intervention, both the PNF and classic stretching groups exhibited significant improvements in all assessed variables ($p < 0.001$). Comparing the mean Kujala knee score changes among the groups at the four-month mark, the difference was -24.05 (95% confidence interval: -30.19, -17.90) for the classic stretching group, -39.03 (95% Confidence interval: -42.5, -35.5) for the PNF group, and -0.238 (95% confidence interval: -1.2, 0.726) for the control group, with the PNF group showing the most significant improvement ($p \leq 0.001$), while the control group showed no significant changes ($p = 0.621$).

DISCUSSION

In this comprehensive review, various studies evaluated diverse manual techniques in managing Patellofemoral Pain Syndrome (PFPS). The manual techniques employed in the selected studies encompassed a range of approaches, such as manipulation, mobilization, strengthening and stretching exercises for the muscles surrounding the knee joint, Proprioceptive Neuromuscular Facilitation (PNF) techniques, and tapping techniques, among others.

Patellofemoral Pain Syndrome (PFPS) often results from imbalances in the forces governing, particularly when the joint experiences excessive stress. [(11)] Manual techniques, as mentioned earlier, contribute to a more effective recovery from PFPS by addressing these imbalances and alleviating the associated discomfort. The comprehensive findings of this review indicate that manual therapy (MT) or physical therapy interventions can help reduce pain and increase range of motion and increase strength.

PFJ joint congruency increases with knee flexion, and mobility subsequently decreases, mobilizing the individual's PFJ in the angle or position of symptom provocation or joint restriction may allow for enhanced PFJ load dispersion and decreased pain. identification and improvement in an individual's primary symptomatic movement (ie their comparable sign) are associated with an improved outcome at discharge. This means patellofemoral joint mobilizations are more effective in PFPS Individuals.

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Some of the authors explained that along with the local manual techniques, spinal manipulations, and foot intervention (talonavicular joint mobilizations) play a major role reduction of pain and functional improvement. because sometimes PFPS is common due to sacroiliac dysfunction and flat foot. Sometimes weakness of the quadriceps leads to PFPS, so the strength and flexibility of those muscles do not hit the knee joint. The above review suggests that strengthening and stretching exercises to the quadriceps also help in the reduction of pain in PFPS. [8,11,13]

The manual technique known as tapping serves as a supportive complement to other interventions in addressing and managing Patellofemoral Pain Syndrome (PFPS) cases. One author also concluded in his review study that Mulligan mobilization with movement also helps This method of tapping aids in alleviating pain and improving overall knee function in patients experiencing Patellofemoral Pain Syndrome (PFPS). [14]

In this review literature, one limitation is that no single manual techniques give better results in individuals with PFPS, a combination of manual techniques plays or gives the best result.

CONCLUSION

Manual physiotherapy techniques have been found to provide pain relief and enhance function, both in the short and long term, for patients experiencing patellofemoral pain. Consequently, healthcare professionals, such as physical therapists, are encouraged to integrate these manual techniques into this condition.

REFERENCE

1. *Saltychev M, Dutton RA, Laimi K, Beaupré GS, Virolainen P, Fredericson M. Effectiveness of conservative treatment for patellofemoral pain syndrome: A systematic review and meta-analysis. J Rehabil Med. 2018 May 8;50(5):393-401. doi: 10.2340/16501977-2295. PMID: 29392329.*
2. *Moyano FR, Valenza MC, Martin LM, Caballero YC, Gonzalez-Jimenez E, Demet GV. Effectiveness of different exercises and stretching physiotherapy on pain and movement in patellofemoral pain syndrome: a randomized controlled trial. Clin Rehabil. 2013 May;27(5):409-*
3. *17. doi: 10.1177/0269215512459277. Epub 2012 Oct 4. PMID: 23036842.*
4. *Jayaseelan DJ, Holshouser C, McMurray MW. FUNCTIONAL JOINT MOBILIZATIONS FOR PATELLOFEMORAL PAIN SYNDROME: A CLINICAL SUGGESTION. Int J Sports Phys Ther. 2020 Aug;15(4):643-649. PMID: 33354396; PMCID: PMC7735690..*
5. *Lantz JM, Emerson-Kavchak AJ, Mischke JJ, Courtney CA. TIBIOFEMORAL JOINT MOBILIZATION IN THE SUCCESSFUL MANAGEMENT OF PATELLOFEMORAL PAIN SYNDROME: A CASE REPORT. Int J Sports Phys Ther. 2016 Jun;11(3):450-61. PMID: 27274430; PMCID: PMC488681.*
6. *Rasti E, Rojhani-Shirazi Z, Ebrahimi N, Sobhan MR. Effects of whole body vibration with exercise therapy versus exercise therapy alone on flexibility, vertical jump height, agility and pain in athletes with patellofemoral pain: a randomized clinical trial. BMC Musculoskelet Disord. 2020 Oct 26;21(1):705. doi: 10.1186/s12891-020-03732-1. PMID: 33106162; PMCID: PMC7590484.*
7. *Crossley KM, Vicenzino B, Lentzos J, Schache AG, Pandy MG, Ozturk H, Hinman RS. Exercise, education, manual-therapy and taping compared to education for patellofemoral osteoarthritis: a blinded, randomised clinical trial. Osteoarthritis Cartilage. 2015 Sep;23(9):1457-64. doi: 10.1016/j.joca.2015.04.024. Epub 2015 May 7. PMID: 25960116.*
8. *Mellinger S, Neurohr GA. Evidence based treatment options for common knee injuries in runners. Ann Transl Med. 2019 Oct;7(Suppl 7):S249. doi: 10.21037/atm.2019.04.08. PMID: 31728373; PMCID: PMC6829001.*
9. *Kim HJ, Cho J, Lee S. Talonavicular joint mobilization and foot core strengthening in patellofemoral pain syndrome: a single-blind, three-armed randomized controlled trial. BMC Musculoskelet Disord. 2022 Feb 15;23(1):150. doi: 10.1186/s12891-022-05099-x. PMID: 35168620; PMCID: PMC8845242*
10. *Rehman M, Riaz H. Comparison of mobilization with movement and Mulligan knee taping on Patellofemoral pain syndrome. J Pak Med Assoc. 2021 Sep;71(9):2119-2123. doi: 10.47391/JPMA.04-658. PMID: 34580498*
11. *Espí-López GV, Arnal-Gómez A, Balasch-Bernat M, Inglés M. Effectiveness of Manual Therapy Combined With Physical Therapy in Treatment of Patellofemoral Pain Syndrome: Systematic Review. J Chiropr Med. 2017 Jun;16(2):139-146. doi: 10.1016/j.jcm.2016.10.003. Epub 2016 Nov 22. PMID: 28559754; PMCID: PMC5440631..*
12. *Scafoglieri A, Van den Broeck J, Willems S, Tamminga R, van der Hoeven H, Engelsma Y, Haverkamp S. Effectiveness of local exercise therapy versus spinal manual therapy in patients with patellofemoral pain syndrome: medium term follow-up results of a randomized controlled trial. BMC Musculoskelet Disord. 2021 May 15;22(1):446. doi: 10.1186/s12891-021-04310-9. PMID: 33992100; PMCID: PMC8126114.*
13. *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. doi: 10.1136/bjsports-2018-099397. Epub 2018 Jun 20. PMID: 29925502.*
14. *Mv VK, Subramanian NB, S S, Kotamraju S, Krishnan M. Physiotherapeutic interventions on quadriceps muscle architecture in patello-femoral pain syndrome. Bioinformation. 2023 Apr 30;19(4):454-459. doi: 10.6026/97320630019454. PMID: 37822824; PMCID: PMC10563562.*
15. *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. doi: 10.1177/1941738117710938. Epub 2017 Jun 15. PMID: 28617653; PMCID: PMC5582697.*
16. *Rathleff MS, Roos EM, Olesen JL, Rasmussen S. Early intervention for adolescents with patellofemoral pain syndrome--*

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
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a pragmatic cluster randomised controlled trial. BMC Musculoskelet Disord. 2012 Jan 27;13:9. doi: 10.1186/1471-2474-13-9. PMID: 22280484; PMCID: PMC3328242.

17. *Petersen W, Ellermann A, Gösele-Koppenburg A, Best R, Rembitzki IV, Brüggemann G-P, et al. Patellofemoral pain syndrome. Knee Surg Sports Traumatol Arthrosc. 2014;22(10):2264–2274. Doi: 10.1007/s00167-013-2759-6. [PMC free article] [PubMed] [CrossRef] [Google Scholar]*
18. *Ferber R, Bolgla L, Earl-Boehm JE, Emery C, Hamstra-Wright K. Strengthening of the hip and core versus knee muscles for the treatment of patellofemoral pain: a multicenter randomized controlled trial. J Athl Train. 2015;50(4):366–377. Doi: 10.4085/1062-6050-49.3.70. [PMC free article] [PubMed] [CrossRef] [Google Scholar]*
19. *Freedman SR, Brody LT, Rosenthal M, Wise JC. Short-term effects of patellar kinesio taping on pain and hop function in patients with patellofemoral pain syndrome. Sports Health. 2014;6(4):294–300. Doi: 10.1177/1941738114537793. [PMC free article] [PubMed] [CrossRef][Google Scholar].*
20. *Scholtes SA, Salsich GB. A dynamic VALGUS index that combines hip and knee angles: assessment of utility in females with patellofemoral pain. Int J Sports Phys Ther. 2017;12(3):333–340. [PMC free article] [PubMed] [Google Scholar]*
21. *Salsich GB, Graci V, Maxam DE. The effects of movement pattern modification on lower extremity kinematics and pain in women with patellofemoral pain. J Orthop Sports Phys Ther. 2012;42(12):1017–1024. Doi: 10.2519/jospt.2012.4231. [PMC free article] [PubMed] [CrossRef] [Google Scholar*
22. *Miao P, Xu Y, Pan C, Liu H, Wang C. Vastus medialis oblique and vastus lateralis activity during a double-leg semisquat with or without hip adduction in patients with patellofemoral pain syndrome. BMC Musculoskelet Disord. 2015;16:289. Doi: 10.1186/s12891-015-0736-6. [PMC free article] [PubMed] [CrossRef] [Google Scholar*
23. *Van Cant J, Pineux C, Pitance L, Feipel V. Hip muscle strength and edurance in females with patellofemoral pain: a systematic review with meta-analysis. Int J Sports Phys Ther. 2014;9(5):564–582. [PMC free article] [PubMed] [Google Scholar]*
24. *Barton CJ, Levinger P, Crossley KM, Webster KE, Menz HB. Relationships between the foot posture index and foot kinematics during gait in individuals with and without patellofemoral painsyndrome. J Foot Ankle Res. 2011;4:10. Doi: 10.1186/1757-1146-4-10. [PMC free article] [PubMed] [CrossRef] [Google Scholar*
25. *Campolo M, Babu J, Dmochowska K, Scariah S, Varughese J. A comparison of two taping techniques (Kinesio and McConnell) and their effect on anterior knee pain during functional activities. Int J Sports Phys Ther. 2013;8:105-110. [PMC free article] [PubMed] [Google Scholar]*
26. *Jessee AD, Gourley MM, Valovich McLeod TC. Bracing and taping techniques and patellofemoral pain syndrome. J Athl Train. 2012;47:358-359. [PMC free article] [PubMed] [Google Scholar]*
27. *Wright RW, Brand RA, Dunn W, Spindler KP. How to write a systematic review. Clin Orthop Relat Res. 2007;455:23-29. [PubMed] [Google Scholar*
28. *Magnusson SP, Narici MV, Maganaris CN, et al. Human tendon behaviour and adaptation, in vivo. J Physiol 2008;586:71-81. 10.1113/jphysiol.2007.139105 [PMC free article] [PubMed] [CrossRef] [Google Scholar*
29. *Heiderscheit BC, Chumanov ES, Michalski MP, et al. Effects of step rate manipulation on joint mechanics during running. Med Sci Sports Exerc 2011;43:296-302. 10.1249/MSS.0b013e3181ebedf4 [PMC free article] [PubMed] [CrossRef] [Google Scholar]*
30. *Willy RW, Scholz JP, Davis IS. Mirror gait retraining for the treatment of patellofemoral pain in female runners. Clin Biomech (Bristol, Avon) 2012;27:1045-51.*
31. *10.1016/j.clinbiomech.2012.07.011 [PMC free article] [PubMed] [CrossRef] [Google Scholar*
32. *Willy RW, Davis IS. The Effect of a Hip Strengthening Program on Mechanics during Running and during a Single Leg Squatting. J Orthop Phys Ther. 2011;41:625–32. [PubMed] [Google Scholar]*
33. *Avraham F Aviv S Ya'akobi P, et al. The efficacy of treatment of different intervention programs for patellofemoral pain syndrome–a single blinded randomized clinical trial. Pilot study. ScientificWorldJournal. 2007;7:1256-1262. [PMC free article] [PubMed] [Google Scholar]*
34. *Simpson BG Simon CB. Lower extremity thrust and non-thrust joint mobilization for patellofemoral pain syndrome: A case report. J Man Manip Ther. 2014;22(2):100-107. [PMC free article] [PubMed] [Google Scholar]*