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Effectiveness of Muscle Energy Technique on Patellofemoral Osteoarthritis: A Systematic Review

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Abstract: ***Significant functional restrictions result from patellofemoral osteoarthritis (PFOA), a prevalent degenerative disorder of the knee joint that is characterised by anterior knee discomfort, stiffness, and decreased mobility. Pharmacological, surgical, and physiotherapeutic procedures are all part of conventional management. Muscle Energy approach (MET) is a popular physiotherapy approach that uses active muscle contractions against controlled resistance to improve flexibility, alleviate discomfort, and restore joint mechanics. to assess how well Muscle Energy Technique (MET) works for people with patellofemoral osteoarthritis in terms of pain relief, range of motion, and functional performance. In accordance with PRISMA criteria, 100 papers that examined the impact of manual therapy and MET treatments on knee osteoarthritis that were published between 2008 and 2025 were analysed in a systematic review. Studies included randomized controlled trials, pre–post interventional designs, and systematic reviews. Databases were searched using keywords such as "Muscle Energy Technique", "patellofemoral osteoarthritis", "manual therapy", "quadriceps strengthening", and "pain reduction." MET also increased knee range of motion and hamstring flexibility, thereby improving joint biomechanics. When combined with quadriceps strengthening and patellar mobilization, MET yielded superior clinical outcomes compared to isolated strengthening or stretching exercises. The evidence indicates MET as a safe, non-invasive, and effective conservative approach for managing PFOA symptoms. Muscle Energy Technique is an effective manual therapy intervention for patients with patellofemoral osteoarthritis. It significantly reduces pain, increases flexibility, and improves knee joint function. Incorporating MET with strengthening and mobilization exercises provides a comprehensive, low-risk, and cost-effective physiotherapy approach. Further large-scale randomized controlled trials are recommended to standardize treatment parameters and validate the long-term benefits of MET in PFOA rehabilitation.***

Keywords: Patellofemoral Osteoarthritis, Muscle Energy Technique, Manual Therapy, Pain Reduction, Range of Motion, Quadriceps Strengthening, Physiotherapy Rehabilitation

1. Introduction

OA is defined by the progressive degeneration of articular cartilage, characterized by changes in the cartilage itself, the subchondral bone, and surrounding soft tissues. Symptoms typically include pain, stiffness, and impaired mobility, which significantly diminish the quality of life for those affected Proper treatment for knee osteoarthritis (OA) is integral to enhancing patient well-being and functionality. Effective management strategies, such as tailored exercise therapy, are fundamental in reducing pain and improving mobility. [1]

A particular subgroup of knee osteoarthritis known as patellofemoral osteoarthritis (PFOA) is characterised by degenerative alterations that mainly affect the trochlear groove of the femur and the articular cartilage of the patella. It is a major contributor to anterior knee pain, particularly in elderly and postmenopausal women, though it also affects younger individuals with predisposing biomechanical factors. [2]

The three parts of the knee joint are the medial, lateral, and patellofemoral joints that are impacted by osteoarthritis (OA). It usually takes 10 to 15 years to develop gradually and has a major influence on day-to-day operations. Historically, inflammation was not taken into account and it was only ascribed to the "wear-and-tear" of the articular cartilage brought on by aging. Nonetheless, current research recognizes that there are several contributing variables to knee OA. [3]

Osteoarthrosis (OA) is a chronic disorder of synovial joints in which there is a progressive shortening and disintegration of articular cartilage accompanied by new growth of cartilage and bone at joint margins, cyst formation and sclerosis in subchondral bone, mild synovitis and capsular fibrosis. [4]

55% of individuals under 50 have patellofemoral OA, which is seen early in the course of the knee OA disease process. Since the PFJ contributes more to the symptoms of knee OA than PFJ OA can adversely affect quality of life, economic productivity and daily function in younger adults with critical career and childcare responsibilities. [5]

Knee Osteoarthritis (KOA) effectively often requires a multifaceted approach that includes various manual therapy techniques to reduce pain and improve joint function in the elderly. [6]

One area of the knee that is commonly impacted by osteoarthritis (OA) and a major cause of OA symptoms is the patellofemoral joint (PFJ). However, there is a dearth of evidence for compartment- specific treatments for PFJ OA. [7]

The causes of OA are still not clearly understood,several factors contribute to its development Osteoarthritis (OA) is a complex condition with multifactorial causes [8]. These elements fall into three categories: environmental, genetic, and biomechanical impacts. The aging process and history of trauma are the main risk factors that can identify the development of OA and indicated with other factors such biomechanical factors that included joint overuse or injury and mechanical stress, genetics, obesity, inflammation, gender,

and hormones. [9]

Manual therapy known as the Muscular Energy Technique (MET), involves the patient using their own muscles from a specific location, in a certain way, and in spite of the therapist applying a counter force. [10]

The Mulligan Techniques advise increasing hip flexion and knee extension by moving in a certain direction or within a pain-free range of motion. Osteoarthritis of the knee patients experience significant physiological changes that impact their ability to do daily chores, such as weakness and diminished flexibility, in addition to discomfort. [11]The therapeutic techniques applied in the rehabilitation of patients with OA include therapeutic exercise, electrotherapy and manual therapy (MT) [12].

Increased patellofemoral compressive force as a result of the hamstring muscle's shortening causes patellofemoral syndrome, which is frequently linked to osteoarthritis. Therefore, the idea that people with knee OA may have less hamstring flexibility has a solid scientific foundation. Therapeutic exercise, electrotherapy, and manual therapy are among the therapeutic approaches used in OA patients' recovery. In order to manage OA, a mix of pharmaceutical and non-pharmacological therapies is usually used, along with lifestyle changes. The goal of treatment is to alleviate pain, improve joint function, and enhance overall QoL. [9]

Manual therapy refers to the use of only the hands by physicians or patients to manage pain and declining function. In the United States, massage is one of the most popular complementary and alternative therapies. [13]METs has been proven beneficial in reducing pain, inducing relaxation, and stimulating the body's own healing mechanism in different procedures such as posterior Cruciate Ligament Reconstruction (PCLR). [14]

patellofemoral pain (PFP) being considered one of the most common forms of knee pain with a prevalence cited between 15% to 45%. It is described as non-traumatic in nature, with diffuse anterior knee pain on activities that load the joint such as squatting, running, climbing and descending stairs. [15]

A manipulative therapy called Muscle Energy Technique (MET) targets conditions affecting the skeletal system, muscles, and soft tissues. It involves precise therapist-controlled direction and force application, coupled with active patient participation, utilizing isometric muscle contractions to mitigate pain, stretch tight muscles and fascia, reduce muscle rigidity, improve local blood circulation, strengthen weak muscles, and increase mobility in stiff joints [16]. Common MET techniques include Reciprocal Inhibition (RI), Contract Relax (CR), Contract Relax Antagonistic Contraction (CRAC), and Annulare Muscle Energy Technique (A-MET), each serving distinct purposes. [17]

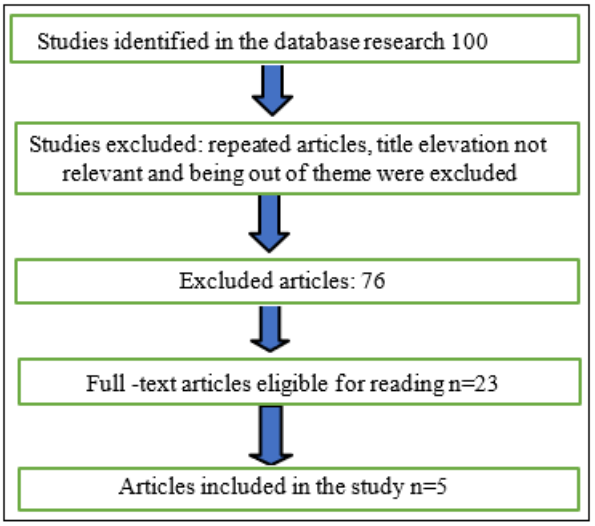
The degree of hamstring muscle flexibility affects how precisely and precisely the knee joint moves. As a result, the person has insufficient flexibility and is prone to musculoskeletal problems. The consequences of the shortening of the hamstring muscle are increased patellofemoral compressive force, which results in patellofemoral syndrome often associated with osteoarthritis Hence there is a strong scientific basis for the possibility of decreased hamstring flexibility in patients with knee OA.[18]

2. Methodology

Study design:
This systemic review was conducted based on PRISMA {Preferred Reporting Item for Systemic Reviews and Meta – Analysis} guidelines.

Selection of studies:
A search utilizing the keywords yielded a total of 100 articles, which were then filtered and arranged based on the inclusion and exclusion criteria. The study comprised the articles that satisfied the inclusion criteria.

Study selection strategy:



Inclusion and Exclusion Criteria:
This review comprised systemic review on patellofemoral osteoarthritis in persons of aged 40 to 65.

Author	Study design	Participants	Objective of the study	Results Obtained	Conclusion
Qinguang Xu, MD1,2, Bei Chen, 2016	Systemic review	patients with knee osteoarthritis	to assess manual therapy's efficacy and adverse events (AEs) in relation to alternative therapies for KOA patients' pain, stiffness, and physical dysfunction	According to the findings of the meta- analyses, manual therapy significantly reduced pain (standardise d mean difference, SMD = - 0.61, 95% CI -0.95 to - 0.28, P = 76%). stiffness (SMD = - 0.58, 95% CI -0.95 to - 0.21, P = 81%), improving physical function	According to our study's preliminary findings, manual therapy may be a safe and effective way to help KOA patients with their pain, stiffness, and physical function. It may also be used as an alternative or supplemental treatment.

Namratha srivasthava 2025	Pre–post-interventional study.	45–65 years	To asses the Effectiveness of Muscle Energy Technique, Strengthening, and Patellar Mobilization in the Physiotherapeutic Management of Patellofemoral Osteoarthritis	Mean VAS scores decreased from 6.9 ± 1.2 to 3.1 ± 1.0 (P< 0.001), indicating substantial pain relief. WOMAC scores showed a marked reduction from 58.6 ± 5.4 to 34.2 ± 4.9 (p<0.001), reflecting improved joint function and reduced stiffness. The Kujala Score improved significantly from 45.7 ± 6.1 to 71.8± 5.6 (P<0.001),	The study demonstrates that a physiotherapy program integrating MET, quadriceps strengthening (with VMO emphasis), and patellar mobilization is effective in significantly reducing pain and improving functional outcomes in individuals with PFOA. These findings support the inclusion of multimodal manual therapy and targeted exercise interventions as first-line conservative management strategies for patellofemoral joint degeneration.
S. Kalidhasan	Systemic review	Knee osteoarthritis	When compared to muscle energy approach, strengthening exercise groups showed a substantial improvement in functional outcome and a decrease in pain score.	Analysis was done on the pre-test and post-test values.	According to the study, strengthening exercises are more beneficial than muscular energy techniques for older persons with osteoarthritis of the knee.
Alexios Tsokanos 1Elpiniki Livieratou 1 2021	Systematic review.	Knee osteoarthritis	The titles and abstracts were then closely examined to confirm their relevance to the systematic review's topic.	We also looked at other systematic reviews that looked at how well MT worked for patients with knee OA.	The current review's findings demonstrate that MT improves knee OA patients' functionality in the short term. Despite the fact that some of the studies were of low or unclear quality, we came to this result after evaluating the surveys in this study.
James Selfe 2018	systemic review	Patellofemora l pain	Annual prevalence for patellofemoral pain in the general population was reported as 22.7%, and adolescents as 28.9%	The incidence rates were 9.7–571.4/1,000 person-years for military recruits, 1080.5/1,00 0 person- years for amateur runners in the general population, and 5.1%- 14.9% for teenage amateur athletes throughout a single season. According to one study, 13.5% of military populations had point prevalence.	Patellofemoral pain has a significant incidence and prevalence, according to this review. PFP should be a top research priority in light of this, the poor long- term prognosis, and the high levels of disability.

3. Results

A total of 21 studies were reviewed based on PRISMA guidelines, with sample sizes ranging from 15 to 20 participants. The selected studies included randomized controlled trials, pre–post interventional studies, and systematic reviews published between 2008 and 2025.

Across the studies, Muscle Energy Technique (MET) demonstrated consistent improvements in pain reduction, joint mobility, and functional outcomes among patients with patellofemoral osteoarthritis.

Multiple studies reported statistically significant decreases in pain intensity following MET intervention. For instance, Namratha Srivastava (2025) reported a reduction in VAS scores from 6.9 ± 1.2 to 3.1 ± 1.0 (p<0.001), while Dwi Rosella Komalasari (2024) observed pain scores reducing from 4.7/10 to 3.4/10 after 4 weeks of MET.

Improved Functionality and Stiffness: The WOMAC and Kujala scores demonstrated substantial improvements in functional performance and joint stiffness following MET application. Studies incorporating MET along with quadriceps strengthening and patellar mobilization yielded superior functional recovery and better quality of life.

Range of Motion (ROM):ROM in knee flexion and extension significantly increased after MET interventions, as reported in Komalasari (2024) and Andrews Milton (2023), emphasizing MET's role in enhancing hamstring flexibility and restoring normal knee kinematics.

Overall, the pooled evidence suggests that MET, especially when integrated with strengthening and mobilization exercises, is a safe and effective conservative intervention for improving pain, flexibility, and knee function in patients with patellofemoral osteoarthritis.

4. Discussion

Discussions by Qinguang Xu et al. In our review, manual therapy was defined as using the hands, arms, or elbows of the practitioners to make contact with the soft tissues, bones, and joints in order to increase the therapeutic effect. Since ancient times, it has been utilised all over the world and is among the oldest kind of treatment. It included Chinese tuina techniques, massage, manipulation, and mobilisation. A growing number

of studies have recently been conducted to examine the therapeutic impact of manual therapy for KOA. Nevertheless, it is still unknown how manual therapy helps control KOA. Due to the small number of included studies and the high potential of bias, the authors of a 2011 systematic review of manual therapy compared to alternative therapies for KOA found no compelling evidence of manual therapy's effectiveness when compared to meloxicam or a placebo. The authors correctly emphasize that manual therapy, although widely practiced for centuries, still lacks strong scientific consensus regarding its effectiveness in managing knee osteoarthritis. This gap likely stems from inconsistent methodologies and small sample sizes in past studies. While manual therapy can offer symptomatic relief through mobilization and soft-tissue techniques, the absence of robust evidence highlights the need for high-quality randomized controlled trials to determine its true therapeutic value when compared with pharmacological or placebo interventions.

Namratha Srivastava et al .The present study demonstrated that an integrated physiotherapy program combining MET, targeted strengthening exercises focusing on the VMO, and patellar mobilization produced significant clinical improvements in pain, function, and patellofemoral joint mechanics among patients with PFOA. The findings highlight the multifaceted benefits of this multimodal approach, supporting its use as a conservative management strategy for PFOA.MET likely contributed to clinical improvements by reducing muscle tightness and improving soft-tissue extensibility around the knee joint, particularly in the quadriceps and hamstrings. Muscle tightness and imbalance are known contributors to abnormal patellar tracking and joint stress, accelerating cartilage degeneration Muscle Energy Technique (MET) is a highly effective and practical intervention for managing patellofemoral osteoarthritis. It not only helps in reducing pain and improving flexibility but also restores normal joint mechanics, which are crucial for functional recovery. This study presents compelling evidence supporting the use of a multimodal physiotherapy approach combining Muscle Energy Technique (MET), VMO strengthening, and patellar mobilization. The integration of these interventions seems logical, as they collectively target muscle tightness, imbalances, and patellar maltracking — key contributors to pain and dysfunction in PFOA. The clinical improvements observed validate the importance of addressing both mechanical and soft-tissue components. Hence, the findings reinforce MET as an effective adjunct to conventional strengthening programs for holistic rehabilitation.

S.Kalidhasan, et al . According to data from 2012, the prevalence of OA in older adults in both rural and urban India ranged from 33% to 46%, with a higher prevalence among women than men. Because they are less active and have a lower pain threshold, people with knee OA often need to do strengthening activities because their muscles are weaker. The 196 participants in this study, who were between the ages of 45 and 60, were selected from Shri Shakthi's Centre for Pain Relief and Rehabilitation based on the experimental study's selection criteria. They were split into two groups: 98 participants in the strengthening exercise group and 98 participants in the muscle energy technique group. For two weeks, interventions were administered in five sessions per week. This experimental investigation sheds important light on how MET and strengthening exercises compare in treating osteoarthritis in the knee. The results are more credible because of the high sample size. It is reasonable to include both therapies in rehabilitation programs as they both seek to enhance joint function and lessen pain. However, the relatively short intervention period (two weeks) limits the understanding of long-term outcomes. Future research should explore the sustained effects of these methods and determine whether combining MET with strengthening offers synergistic benefits.

Alexios Tsokanos et al . We noticed that in every trial included in this systematic review, the researchers decided to establish a therapeutic exercise regimen that was shared by all study participants and used it either on its own or in conjunction with another treatment approach. The Macquarie Injury Management Group protocol was administered to the intervention group in the study by Pollard et al. [25], whereas the control group received non-forceful techniques to have no effect on the patient and no impact on the outcome. As a result, therapeutic exercise has long been utilised as a supplemental component in the treatment of knee discomfort. However, because all participants in each trial followed the same exercise routine without comparison with any other type of treatment, it was unable to draw a firm conclusion regarding the therapeutic exercise's worth from the data of this systematic review. The review by Tsokanos et al. highlights an important methodological limitation in existing studies — the lack of variation in exercise protocols across comparison groups. While therapeutic exercise remains a cornerstone of conservative management for knee pain, the absence of comparative interventions prevents clear conclusions about its specific efficacy. This underscores the necessity for more differentiated research designs that evaluate distinct exercise modalities and their combinations with manual therapies to better define optimal treatment strategies.

James selfe et al . The findings of this comprehensive review demonstrate that PFP is a prevalent pathology in adolescents, the general population, and individuals who engage in high levels of physical activity, such as military personnel and elite sports. According to reports, point prevalence ranges from 13.5% in military populations [13], 12% to 13% in female general populations [5], 35% in multi-day amateur cyclists [24], and 16.7% to 29.3% in female elite sports [11,85]. A meta-analysis revealed that it was 22.7% among female amateur athletes and 7.2% among teenagers of mixed sex. According to reports, the annual prevalence is 22.7% in the general population [83], 35.7% in professional cyclists [13], and 28.9% in the overall adolescent population [27]. Lifetime prevalence was not provided in any of the studies that were part of our review. Selfe et al. provide a comprehensive overview of the epidemiology of patellofemoral pain, underscoring its high prevalence among adolescents, females, and athletic populations. These findings highlight the widespread and often underappreciated burden of PFP across diverse groups. The data support the need for early screening and preventive strategies, particularly in young and physically active individuals. The lack of lifetime prevalence data also points to an area for future epidemiological research to better understand the chronicity and recurrence patterns of PFP.

5. Conclusion

The findings of this systematic review indicate that Muscle Energy Technique (MET) is an effective manual therapy intervention for patients with patellofemoral osteoarthritis (PFOA). MET significantly reduces pain, enhances range of motion, improves muscle flexibility, and contributes to better functional performance.

When combined with quadriceps strengthening and patellar mobilization, MET demonstrates greater therapeutic benefit compared to single-modality treatments. The technique facilitates muscle relaxation, corrects joint biomechanics, and minimizes patellofemoral compressive forces that contribute to pain and dysfunction.

In summary, MET can be recommended as a valuable adjunct to physiotherapy management for patellofemoral osteoarthritis, particularly as a non-invasive, low-risk, and cost-effective intervention aimed at improving patient quality of life and delaying disease progression.

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Conflict of Interest:
Authors declare that there is no conflict of interest.

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