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REVIEW ARTICLE

Effectiveness of Muscle Energy Techniques in Knee Osteoarthritis Rehabilitation: A Systematic Review

Sulfandi Sulfandi[1*], Noor Azliyana Azizan[1], Zarina Zahari[1], Wahyuni Dwi Cahya[2]

[1]*Center for Physiotherapy Studies, Faculty of Health Sciences, Universiti Teknologi MARA Selangor, Puncak Alam Campus, 42300 Puncak Alam Selangor, Malaysia.*
[2]*Faculty of Medicine, Mulawarman University, Samarinda, East Kalimantan, Indonesia*
Correspondence: *sulfandi8877@gmail.com*
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ABSTRACT

Knee osteoarthritis (OA) poses significant challenges to mobility, pain management, and overall quality of life, particularly in an ageing population. This study aimed to evaluate how successfully MET treats knee OA by examining the corpus of evidence on its effects on joint mobility, pain management, and functional enhancement. The following PICO criteria were used to select the studies. Clinical trials that focus on patients over the age of 18, incorporate moderate exercise training, and report outcomes like knee pain, joint function, or quality of life are among the inclusion requirements. These trials must be published between 2020 and 2024. Studies with non-specific results, narrative reviews, and meta-analyses are excluded from the analysis. A literature search was conducted using the five databases. The research keywords were determined based on the expertise of the participating authors. After a comprehensive search of multiple databases, 12,105 items were identified, and 12 articles were included in the final review. The results of this systematic review indicate that MET is efficacious in improving function, muscle strength, and flexibility in patients with knee osteoarthritis, thereby enhancing their overall quality of life. Optimizing outcomes for patients with knee osteoarthritis requires the integration of kinesio taping, Proprioceptive Neuromuscular Facilitation (PNF) methods, and structured rehabilitation programs. The use of specific rehabilitation techniques that address both the physical and psychological components of recovery will be crucial for the effective management of knee osteoarthritis as its prevalence increases, particularly among the elderly population.

KEYWORDS: Joint Mobility, Knee Osteoarthritis, Muscle Energy Technique, Pain Reduction, Rehabilitation

INTRODUCTION

Knee osteoarthritis (OA) is a prevalent degenerative joint disease affecting approximately 25% of adults, with its incidence increasing significantly among older populations. It is a major contributor to pain and functional disability in individuals aged over 45 years, with estimates suggesting that between 19.2% to 27.8% of adults in this age group report knee pain attributed to OA, and around 37% of individuals aged 60 years and older experience knee complaints [1,2]. 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 [3,4].

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. Research indicates that exercise can have pain-relieving effects comparable to those of analgesics, albeit with fewer side effects [5]. Furthermore, conservative treatments, including weight management and physical therapy, are strongly recommended within clinical guidelines to delay disease progression and mitigate associated complications [6].

To prevent further deterioration, traditional treatments for knee OA focus on symptom management and functional improvement. Knee osteoarthritis (OA) management remains a clinical priority. Pharmacological treatments such as NSAIDs and non-pharmacological treatments such as physical therapy, weight control, and lifestyle changes are both included in conservative treatment plans. Although these treatments may provide short-term relief, they often fail to address the complex nature of knee OA, where joint biomechanics, muscle function, and physical degeneration and pain perception are all linked [7]. The limits of traditional procedures have led to the emergence of manual treatment techniques, particularly the Muscle Energy Technique (MET), as supplementary strategies for maximizing joint health [8].

The patient actively participates in a specialized manual therapy approach called the Muscle Energy Technique (MET) [9]. By applying regulated resistance to the patient's muscular contractions, MET helps enhance joint range of motion, develop muscle flexibility, and realign joint structures. In contrast to passive methods, MET actively engages the patient, encouraging improved neuromuscular control and muscle balance, which are crucial for achieving long-term functional gains and maintaining joint stability. According to these principles, MET may be beneficial for individuals with knee OA, providing a therapeutic strategy that improves knee joint stability and muscular support in addition to addressing pain [10].

The MET is a specialized manual therapy in which the patient actively participates through resisted muscular contractions aimed at enhancing overall joint function and promoting neuromuscular control[11]. Recent studies suggest that MET can lead to substantial improvements in pain levels, range of motion, and functional outcomes for individuals with knee OA [4,12]. For instance, participants undergoing MET have demonstrated enhanced muscle flexibility, improvements in stability, notable reductions in localized swelling, and increased ranges of motion, underscoring its potential as an effective adjunct to conventional rehabilitation methods [4].

Systematic reviews also emphasize the need for protocol standardization regarding MET applications to establish its efficacy across diverse patient populations [12,13]. While some studies have shown favorable outcomes with MET, further research is essential to validate its long-term benefits and to develop comprehensive treatment guidelines. Given the complex multifactorial nature of knee OA, clinicians must consider incorporating MET into holistic treatment strategies, complementing traditional therapies with tailored physical training regimens focused on muscle strengthening and functional improvement [3,4]. This integrative

approach aims to alleviate immediate symptoms while addressing the broader implications of knee OA on joint health and overall mobility.

By analyzing its effects on important clinical outcomes, such as pain management, joint mobility, and functional ability, this systematic review aimed to compile the body of research on MET's role of MET in knee OA rehabilitation. This review aimed to provide a better understanding of MET's therapeutic potential of MET by combining data from recent trials. This will help doctors create evidence-based, customized treatment programs for patients with knee OA and guide future research. This systematic review presents a novel synthesis of the varied research on Muscle Energy Techniques (MET) in the context of knee osteoarthritis (OA) rehabilitation, which is a relatively underexplored modality compared to more traditional treatments. By rigorously analyzing the effects of MET on key clinical outcomes, specifically pain management, joint mobility, and functional ability, this review aims to elucidate the therapeutic potential of MET and establish a comprehensive understanding of its efficacy. The integration of recent clinical trials allows for a robust evidence base that supports the customization of treatment strategies for knee OA patients.

METHODOLOGY

Eligibility Criteria

The review considered clinical trials that addressed the use of the muscular energy technique (MET) to treat non-specific neck pain (NNP), published between 2020 and 2024, and available in English. The studies were selected using the following PICO criteria. **(Table I)**

Table I: PICOS Framework

Inclusion Criteria	Exclusion Criteria
Clinical trials	Meta-analysis, narrative review, and systematic review
English language	Other languages
Published between 2020 to 2024	Published before 2020
Patients with Knee Osteoarthritis, Pain, and Functional Activity	Populations with other diseases
Full text available	Full text not available
Aged >18 years old	A rehabilitation program that excludes MET
Male and female	Aged < 45 years and above
Program for rehabilitation that includes MET	All studies not including the mentioned outcomes
At least one of the following outcomes is present in every study: knee pain, joint function, and quality of life.	

Sources and Searches for Information

A literature search was conducted using the following five databases: Web of Science, PubMed, Google Scholar, ScienceDirect, and Scopus. The research keywords were determined based on the expertise of the participating authors. Keywords such as "Muscle energy technique AND/OR knee pain AND/OR knee osteoarthritis, MET AND/OR knee OA AND/OR knee osteoarthritis" were used.

Study Selection

All records discovered during the search were imported into Microsoft Excel. Two reviewers employed the same methodology to search the databases, ensuring sufficient cross-checking of the results. The authors evaluated the papers discovered through searches using preset inclusion and exclusion criteria.

Data Collection

The study design, intervention intensity, authors, study date, intervention type, essential components, diagnostic population, and original authors' evaluations of the effectiveness of various research outcomes were among the data collected from the included studies. When multiple studies were available, the reviewers highlighted instances where the most recent data outperformed earlier findings.

Quality Assessment

The danger of bias was assessed separately by the two writers. The domain-based evaluation methodology developed by the Cochrane Collaboration was used to evaluate the risk of bias in the controlled studies. Selection bias (hidden allocation and randomized sequence generation), performance bias (blinding of employee and participant), detection bias (blinding outcome assessment), attrition bias (incomplete outcome data, for instance, due to dropouts), reporting bias (selective reporting), and other sources of bias were the main domains

evaluated in that order. The total risk score for systematic bias and the scores for each bias domain were classified as low, high, or unknown. Methodological quality was further assessed using the Physiotherapy Evidence Database (PEDro) scale.

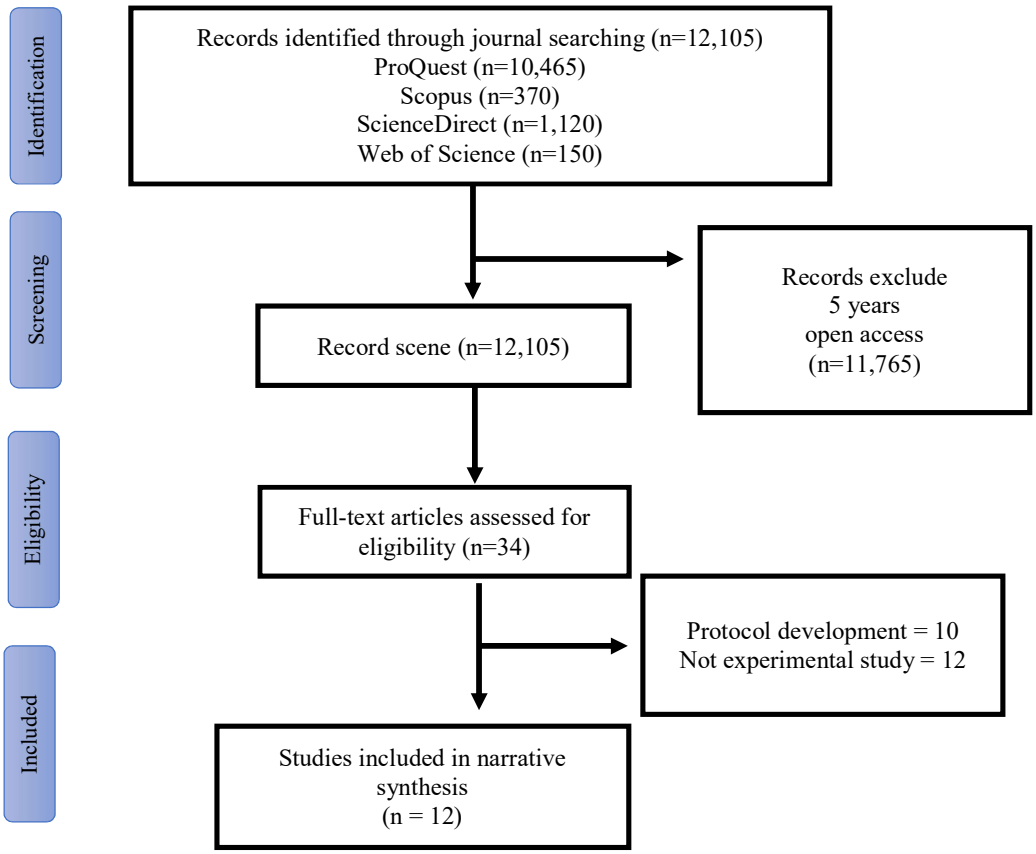

Figure I: PRISMA 2020 flow diagram for the process of study selection

RESULTS

As shown in **Table II**, the use of MET for knee OA is centered on results such as decreased pain, increased joint mobility, and improved quality of life, all of which add to the body of research proving that MET is an effective knee OA rehabilitation technique.

Table II: The Summary of Results

Ref	Type of Intervention	Sample	Intervention	Control	Conclusion
14	Methods of Proprioceptive Neuromuscular Facilitation (PNF)	50 patients with knee osteoarthritis	For eight weeks, 25 patients received PNF treatments twice a week, each lasting 30 to 45 minutes.	Twenty-five patients who merely received standard treatment without any extra help	When compared to the control group, patients with osteoarthritis in their knees showed a substantial improvement in muscle strength through the use of proprioceptive neuromuscular facilitation techniques. It is advised that medical practitioners include PNF approaches in treatment plans for this patient population if these results are supported by more research.
15	The study examined the efficacy of two therapy approaches in individuals with osteoarthritis of the knee: Muscle Energy Technique (MET) and Proprioceptive Neuromuscular Facilitation (PNF) stretching.	A random sample technique was used to choose the 36 participants in the study who had osteoarthritis of the knee.	PNF stretching is being administered to patients in addition to a baseline routine.	Individuals undergoing MET in addition to a baseline regimen	According to the study's main finding, patients in Group A (who received PNF stretching) showed noticeably higher improvements in their hamstring flexibility (Active Knee Extension Test scores: Group A: 10.63 ± 4.89 vs. Group B: 4.37 ± 2.01), functional mobility (WOMAC scores: Group A: 27.21 ± 12.31 vs. Group B: 14.11 ± 7.88), and pain levels (NPRS scores: Group A: 7.66 ± 1.02 vs. Group B: 3.44 ± 0.92). Therefore, it was discovered that PNF stretching was superior than MET in enhancing patients' functional mobility, flexibility, and pain levels in cases with osteoarthritis of the knee.
16	Kinesio taping in conjunction with traditional therapy (Group A) and the muscle energy technique in conjunction with traditional therapy (Group B) were the two therapeutic strategies for knee osteoarthritis that were examined in this study.	For the study, 30 participants with a diagnosis of osteoarthritis in their knees were enlisted. They were split into two groups at random, each with fifteen subjects.	Participated in three sessions a week for three weeks, receiving Kinesio taping in addition to traditional therapy.	Receive five sessions a week for three weeks, combining the muscle energy technique with traditional therapy.	According to the study's findings, Group A (Kinesio taping combined with traditional therapy) outperformed Group B in terms of hamstring flexibility ($t = 5.983$, $p < 0.05$), extension range of motion ($t = 5.983$, $p < 0.05$), and knee pain ($t = 3.862$, $p < 0.05$). Nevertheless, there was no discernible difference between the two groups' total improvements. In individuals with knee osteoarthritis, the intervention in Group A was therefore found to be more successful in lowering pain and improving hamstring flexibility and knee extension range of motion.
17	Rehabilitation through regular exercise was the strategy used in this study.	There were 166 patients with knee osteoarthritis in the study's entire sample..	Patients doing physical exercise therapy made up the intervention group.	The control group was treated conventionally with COX-2 inhibitors and non-steroidal anti-inflammatory medications (NSAIDs), which included: - Naproxen (n = 28) Diclofenac, with a total of 27 Celecoxib (sixteen)	The study's findings demonstrated that, over a 12-week follow-up period, physical exercise rehabilitation considerably outperformed NSAID and COX-2 inhibitor treatment in terms of symptom relief and quality of life for patients with osteoarthritis in the knee.
18	An aquatic training program was contrasted with an individualized comprehensive rehabilitation (ICR) program as the intervention type assessed in this	Forty women with a diagnosis of persistent osteoarthritis in their knees participated in the trial.	The individualized comprehensive rehabilitation (ICR) program was administered to the intervention group participants.	Participants who were enrolled in an aquatic training program made up the control group.	When compared to the aquatic training program at the 3-month follow-up, the study's results showed that the 8-week customized complete rehabilitation program significantly improved functioning, physical performance, and perceived health status. Significant differences favouring the ICR group were observed in physical performance (Timed Up and Go, P = 0.031 and Stair Climbing Test, P = 0.046) and functionality

Ref	Type of Intervention	Sample	Intervention	Control	Conclusion
	study.				(stiffness P = 0.049, function P = 0.005, and overall subscores P = 0.048)..
19	The study used non-invasive cardiac output monitoring and the 6-minute walk test (6MWT) to design a home rehabilitation exercise program for patients with osteoarthritis in their knees after total knee arthroplasty (TKA).	The study comprised 66 participants who had been diagnosed with osteoarthritis in their knees and were scheduled for total knee arthroplasty.	A multidisciplinary team comprising a cardiologist, orthopaedic physician, and clinical rehabilitation physician oversaw the extensive rehabilitation instruction given to patients in the intervention group. Throughout their recovery, they sought advice and assistance via the WeChat app.	Patients in the control group were given rehabilitation training manuals upon discharge and were expected to finish their therapy on their own, unsupervised..	The results showed that post-TKA patients' lower limb function and exercise ability were considerably improved by the interdisciplinary post-operative rehabilitation exercise training program. Furthermore, it has a positive impact on non-invasive haemodynamic markers of heart function, indicating the intervention's efficacy in comparison to conventional rehabilitation techniques.
20	Patients with symptomatic knee osteoarthritis participated in a 6-week rehabilitation program that included eccentric or concentric muscle strengthening exercises.	Thirty patients each were assigned to the eccentric and concentric intervention groups, for a total of 60 patients in the trial.	Exercises that emphasize eccentric muscle activities—which highlight the extension of the muscle under tension—are performed by the eccentric group.	The concentric group engaged in workouts that emphasized the shortening of the muscle during contraction and concentrated on concentric muscle activity.	According to the study's findings, patients with symptomatic knee osteoarthritis benefit greatly from both eccentric and concentric physical activities in terms of enhanced function and decreased discomfort. The eccentric group did, however, have certain advantages over the concentric group, such as notable improvements in muscular performance (quadriceps power PMAX and contraction strength MMAX) and vastus medialis hypertrophy. There were no discernible differences between the two groups in terms of improvements in WOMAC scores or total pain reduction.
21	A comparison between conventional physical therapy (CPT) and proprioceptive neuromuscular facilitation (PNF).	This summary does not yet specify the total number of participants; they will be assigned at random (1:1) to either the PNF group or the CPT group.	Twelve weeks of PNF training sessions will be provided to the PNF group.	For twelve weeks, the CPT group will get standard physiotherapy treatments.	The creation of a physiotherapy regimen based on the PNF idea seeks to offer a therapeutic strategy grounded in learning and motor control principles, which should lessen pain and enhance physical function and quality of life for people with osteoarthritis (KOA) in the knee.
22	Combining laser therapy and stretching exercises, as well as comparing the results with a control group that received placebo therapy and stretching exercises, only laser therapy, simply stretching exercises, and a control group that did not receive any intervention, were the interventions used in this study.	430 knees with osteoarthritis were treated out of the 215 participants with the condition that were enrolled. There were forty-three patients in each intervention group..	1. Laser + Stretch (n = 43): Active laser therapy and stretching exercises were administered to patients. 2. Placebo + Stretch (n = 43): Patients underwent stretching exercises and placebo laser therapy. 3. Stretch (n = 43): Only stretches were given to patients. 4. Laser (n = 43): Active laser therapy was the only treatment given to patients. 5. Control (n = 43): No intervention was given to the patients.	In this study, the control group consisted of two groups: one that received placebo therapy (Placebo + Stretch) and the other that did not get any intervention (Control).	In patients with knee osteoarthritis, laser therapy in conjunction with stretching exercises significantly improved range of motion, stiffness, muscle shortening, and discomfort during everyday activities and during rest. This study demonstrates how well this intervention works to enhance function and lessen osteoarthritis symptoms in the knee.
23	Comparison of gap balancing (GB) and	96 patients with	The group that accepts gap	The measured resection	In terms of lowering the osteoarthritis index, improving knee and squat function, extending

Ref	Type of Intervention	Sample	Intervention	Control	Conclusion
	measured resection (MR) methods in patients with osteoarthritis in the knee following primary total knee arthroplasty (TKA).	osteoarthritis in their knees were split into two groups: 48 were in the GB group and 48 were in the MR group..	balancing approaches is called GB.	approach was administered to the MR (measured resection) group.	knee range of motion, decreasing operative time, and lowering pain, the GB technique outperformed the MR technique by a substantial margin. Furthermore, compared to the MR group (18.75%), the GB approach had a decreased postoperative complication rate (4.17%), indicating that it merits widespread use and practical application.
[24]	Total hip/knee arthroplasty (THA/TKA) is an elective procedure for individuals with advanced osteoarthritis (OA).	70 participants (26 males and 44 females).	MuIS+ patients (n=24) who are susceptible to muscular inflammation.	Patients lacking a sensitivity to muscle inflammation are known as MuIS- (n=46).	In addition to higher proinflammatory and catabolic gene expression in the operative limb's skeletal muscle, patients with MuIS+ status also have poorer skeletal muscle integrity, as seen by increased fibrosis. This implies that MuIS+ status may have a substantial impact on postoperative results, underscoring the significance of perioperative MuIS assessment in order to properly customize postoperative therapy.
[25]	Three rehabilitation techniques after total knee arthroplasty (TKA) and total hip arthroplasty (THA) were examined in the trial: 1. Telerehabilitation at home 2. Rehabilitation at home 3. The control group did not undergo physical rehabilitation.	A total of 168 patients who have had THA or TKA will be included in the trial.	Group 1: Telerehabilitation at home. Group 2: Rehabilitation at home	Patients who would not get any therapeutic rehabilitation exercises after being discharged made up the control group.	The purpose of the study is to assess the efficacy of home-based rehabilitation and home-based tele-rehabilitation against no physical rehabilitation. The main outcome measure will be the knee injury and osteoarthritis outcome score (KOOS) for knee patients and the hip disability and osteoarthritis outcome score (HOOS) for hip patients. At the initial follow-up following the 6-week intervention, the primary focus will be on the function of daily living. The findings will offer important information about how post-discharge rehabilitation plans for patients following THA and TKA should be structured.

DISCUSSION

Proprioceptive neuromuscular facilitation (PNF) approaches have become a crucial therapeutic intervention for patients with knee osteoarthritis (OA). Joint pain, stiffness, and diminished muscle strength are the hallmark symptoms of this illness, and together, they cause functional limitations in affected patients. PNF approaches should be incorporated into routine therapy regimens because recent studies have shown that they can significantly enhance muscular strength, flexibility, and overall functional performance in patients with knee OA[14]. PNF techniques are applied through targeted strengthening and stretching activities that activate the proprioceptors of the muscles and joints.' This stimulation improves neuromuscular control and coordination, which is especially helpful for patients with knee OA because the degenerative nature of the disease frequently results in proprioceptive impairments. For example, Sari's study shows that PNF stretching exercises provide a variety of benefits for individuals with knee OA, since they not only reduce pain but also enhance postural balance and dynamic stability [26].

The validity of the findings was reinforced by the study's methodology, which included a randomized selection of 36 participants. Because they reduce bias and enable a more precise evaluation of therapy efficacy, randomized controlled trials are regarded as the gold standard in clinical research [15]. Additionally, using validated assessment instruments, such as the NPRS and WOMAC, guarantees that the outcomes being measured are accurate and pertinent to the patient population being studied. These results are consistent with previous research that highlights the significance of customized treatment approaches for knee osteoarthritis. For example, a systematic review found that a variety of physiotherapy methods, such as strengthening and stretching exercises, are essential for OA patients to manage their symptoms and improve their function [27].

An essential contribution to our understanding of non-pharmacological interventions for knee osteoarthritis (KOA) is a comparison of the effectiveness of Kinesio taping in conjunction with conventional therapy versus the Muscle Energy Technique (MET) in conjunction with conventional therapy. The results of the study showed that, in comparison to Group B, which received MET in addition to conventional therapy, Group A, which received Kinesio taping in addition to conventional therapy, demonstrated statistically significant improvements in knee pain, extension range of motion, and hamstring flexibility. In particular, the findings indicated that Group A saw a substantial decrease in pain ($t=3.862$, $p<0.05$) and improvements in hamstring flexibility ($t=5.983$, $p<0.05$) and extension range of motion ($t=5.983$, $p<0.05$), highlighting the possibility of Kinesio taping as a successful supplemental treatment for KOA[16].

Numerous studies have been conducted on the treatment of knee osteoarthritis (KOA), with a special emphasis on the effectiveness of rehabilitation through regular exercise compared to traditional pharmaceutical therapies. When compared to treatment with non-steroidal anti-inflammatory drugs (NSAIDs) and COX-2 inhibitors, a structured physical exercise rehabilitation program dramatically improved symptoms and quality of life over a 12-week follow-up period, according to a recent study involving 166 patients with KOA[17]. It is crucial to remember, though, that in some situations, oral NSAIDs may offer greater rapid advantages than exercise [28]. This result is consistent with the growing body of research supporting exercise as the primary treatment for KOA, emphasizing how it can improve physical function and alleviate pain more effectively than pharmaceutical alternatives [29].

The literature has extensively shown the significance of customized rehabilitation regimens for knee osteoarthritis. For example, a randomized controlled trial by **López et al.** [18] examined the efficacy of a customized, comprehensive rehabilitation program for women with knee osteoarthritis. Although a Cochrane review found no significant differences in pain,

symptoms, functionality, or quality of life between self-management programs and other exercise-based physiotherapy interventions in patients with knee osteoarthritis, its findings imply that such programs can result in notable improvements in health-related quality of life and functional capabilities. Furthermore, it is impossible to overestimate the importance of exercise in the treatment. According to research, people with osteoarthritis in their knees often become sedentary due to the discomfort, which makes their condition worse[19]. his problem is directly addressed by the ICR program's emphasis on improving physical performance and functionality, which encourages active participation in rehabilitation exercises. The results of **Kangeswari et al.** [30], found that strengthening exercises significantly reduce pain and enhance functional performance in individuals with knee osteoarthritis.

Evidence indicating that eccentric contractions can successfully lower joint loading and preserve articular cartilage supports the role of eccentric strengthening in the setting of knee OA [20]. This is particularly relevant, given that biomechanical factors significantly influence the onset and progression of knee OA. By reinforcing lower extremity muscle strength, especially the quadriceps, eccentric exercises can mitigate the mechanical stress on the knee joint, potentially delaying the progression of the disease[31]. In addition to the direct benefits of muscle strengthening, there is a broader context of rehabilitation that includes flexibility and balance training. For example, yoga has been shown to improve flexibility and reduce pain in knee OA patients, which complements the strength training aspect of rehabilitation[32]. **Trojani et al.'s (2022)**[33] results are consistent with earlier studies that highlight the value of customized exercise regimens for patients with knee osteoarthritis. For example, a study demonstrated that a therapeutic exercise program combining elements of muscle strengthening and flexibility significantly improved physical function and reduced pain in patients with knee osteoarthritis. This supports the idea that patients may benefit considerably from a multimodal rehabilitation program that incorporates both eccentric and concentric strengthening exercises.

Recent orthopaedic research has focused considerable attention on the comparison of gap balancing (GB) and measured resection (MR) procedures in total knee arthroplasty (TKA) for patients with osteoarthritis in their knees. The clinical results of these two surgical approaches were the primary focus of this investigation, specifically regarding operative time, postoperative discomfort, range of motion, functional performance, and complication rates. According to the results, the GB approach may produce better results than the MR technique, which would support its broader use in clinical practice [24]. The goal of the GB approach is to achieve optimal soft tissue balance during total knee arthroplasty (TKA), which is crucial for achieving positive postoperative results. GB aims to improve the overall stability and functionality of the knee joint following surgery by establishing symmetrical and equal gaps in both flexion and extension. Compared to the MR technique, which frequently requires more extensive soft tissue release following bone cuts, this technique has been associated with shorter operating durations because it enables more effective knee joint alignment and balancing. According to research, patients who undergo GB TKA spend less time in the operating room. This is because the treatment involves balancing the knee in a more efficient manner[34,35].

Given the rising incidence of total hip arthroplasty (THA) and total knee arthroplasty (TKA) in the elderly population, research on the efficacy of various rehabilitation techniques following these surgeries is crucial. The experiment compared three different rehabilitation modalities: home-based tele-rehabilitation, home-based rehabilitation, and a control group that did not receive any recommended therapeutic rehabilitation activities after discharge. With a specific focus on the hip disability and osteoarthritis outcome score (HOOS) for patients with hip disease and the knee injury and osteoarthritis outcome score (KOOS) for patients with

knee disease, this study attempts to clarify the effect of these rehabilitation techniques on patient outcomes. At the initial follow-up after a six-week intervention period, the primary outcome measure will evaluate the function of daily life [25].
Given the results of a pragmatic, randomized controlled study by **Mark-Christensen et al.** [25] that compared physical rehabilitation with no rehabilitation following THA and TKA, the trial design, which included a control group that received no physical rehabilitation, is particularly pertinent. According to their findings, systematic rehabilitation programs may improve postoperative results. The present study efficiently evaluated the relative effectiveness of home-based therapy and home-based tele-rehabilitation in comparison to a baseline of no rehabilitation by incorporating a control group.

CONCLUSION

Incorporating PNF approaches into rehabilitation regimens for knee osteoarthritis offers a viable way to improve patient outcomes. The importance of non-pharmacological therapies in the management of knee OA is shown by the evidence supporting the effectiveness of PNF, as well as findings from studies on Kinesio taping, structured exercise programs, and customized rehabilitation strategies. Additionally, the investigation of various surgical methods and rehabilitation strategies following TKA and THA underscores the importance of continuous efforts to improve patient recovery outcomes. Kinesio taping, Proprioceptive Neuromuscular Facilitation (PNF) techniques, and organized rehabilitation programs must be combined to achieve optimal results for patients with knee osteoarthritis. This information demonstrates the effectiveness of these therapies in enhancing muscle strength, flexibility, and overall functional performance, all of which contribute to the improved quality of life for individuals affected by these conditions. As the prevalence of knee osteoarthritis continues to rise, particularly among older populations, it is crucial to employ specialized rehabilitation strategies that address the psychological and physical aspects of recovery. To provide patients with knee osteoarthritis the best care possible, doctors must stay up-to-date on the most recent evidence-based techniques as the body of research continues to expand.

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Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Sulfandi S: Gathering, evaluating and interpreting the data for the project, creating and editing the draft, and obtaining final approval
Azizan NA: Analyzing the data for the project, creating the work, and manuscript editing
Zahari Z: Analyzing the data for the project, creating the work, and manuscript editing
Cahya WD: Creating the work and manuscript editing

REFERENCES

1. Hidayah Fn, Naufal Af, Pradana A. Physiotherapy Management In Bilateral Knee Osteoarthritis By Providing Manual Therapy And Exercise Therapy: Case Report. Fisio Mu: Physiotherapy Evidences. 2023 Jun 7;4(3):220–6.
2. Yu C. Research Progress In The Treatment Of Knee Osteoarthritis. Bio Web Conf. 2023 May 8;59(5):1–12.
3. Kurniawan A. Exercise Therapy For Knee Osteoarthritis To Reduce The Pain: A Systematic Review. Int J Multidiscipl Res Analysis. 2024 Aug 15;07(08):1–12.
4. Ashraf F, Anwar K, Arshad H. The Effects of Muscle Energy Technique Along Conventional Physical Therapy After Mesenchymal Stem Cell Transplantation In Knee Osteoarthritis Patients. Pak J Med Sci. 2024 Nov 20;40(11):2558–64.
5. Xiao C, Zhuang Y, Kang Y. Effects Of Wu Qin Xi Qigong Exercise On Physical Functioning In Elderly People With Knee Osteoarthritis: A Randomized Controlled Trial. Geriatr Gerontol Int. 2020 Oct 4;20(10):899–903.
6. Cai W, Xu D, Xiao A, Tian Z, Wang T. Comparing The Efficacy Of Non-Invasive Physical Therapy In Improving Pain And Joint Function Of Knee Osteoarthritis. Medicine. 2021 May 7;100(18):1–12.
7. Ferreira Rm, Martins Pn, Gonçalves Rs. Non-Pharmacological and Non-Surgical Interventions To Manage Patients With Knee Osteoarthritis: An Umbrella Review 5-Year Update. Osteoarthr Cartil Open. 2024;6(3):100497–507.
8. Santos Gk, Gonçalves De Oliveira R, Campos De Oliveira L, Ferreira C. De Oliveira C, Andraus Ra, Ngomo S, Et Al. Effectiveness Of Muscle Energy Technique In Patients With Non-specific Low Back Pain: A Systematic Review With Meta-Analysis. Eur J Phys Rehabil Med. 2023;58(6):827–37.
9. Mazidavi A, Karimi N, Khorasani B, Baraghoosh P, Biglarian A. Effects Of Muscle Energy Technique On Pain And Range Of Motion In Chronic Low Back Pain Subjects With Lateral Flexion Restriction. Physical Treatments - Specific Physical Therapy. 2023;13(4):245–52.
10. Tsokanos A, Livieratou E, Billis E, Tsekoura M, Tatsios P, Tsepis E et al. The Efficacy Of Manual Therapy In Patients With Knee Osteoarthritis: A Systematic Review. Medicina (B Aires). 2021;57(7):696–708.
11. Marks R. Muscle Atrophy And Knee Osteoarthritis Joint Status: Highlights And Their Implications [2017-2023]. Acta Scientific Orthopaedics. 2023 May 1;6(5):14–24.
12. Kim Mj, Kang Bh, Park Sh, Kim B, Lee Gy, Seo Ym, et al. Association Of The Western Ontario And Mcmaster Universities Osteoarthritis Index (Womac) With Muscle Strength In Community-Dwelling Elderly With Knee Osteoarthritis. Int J Environ Res Public Health. 2020 Mar 27;17(7):2260–70.
13. Prijatno Ac, Kasimbara Rp, Fariz A. Effect Of Ultrasound Therapy And Muscle Energy Technique On Changing The Rom In The Case Genu Osteoarthritis At Immanuel Hospital Bandung. Jurnal Kesehatan Mesencephalon. 2024 Apr 30;10(1):1–12.
14. Salehi N, Mohammadi HR, Poursamad A, Afrasiabifar A, Najafi Doulatabad S. The Effect Of Proprioceptive Neuromuscular Facilitation Techniques On Muscular Strength In Patients With Knee Osteoarthritis: A Quasi-Experimental Study. Jundishapur Journal Of Chronic Disease Care. 2023;13(1):1–7.
15. Minal Bharat Masekar, Amrutkuvar Rayjade, Trupti Yadav, Khushboo Chotai. Effectiveness Of Muscle Energy Technique And Proprioceptive Neuromuscular Facilitation In Knee Osteoarthritis. Int J Life Sci Pharma Res. 2022;1(1):16–22.

16. Anam T, Kalita A, Kalita A, Dutta A. Comparative Study Between Kinesiotaping Versus Muscle Energy Technique In Patients With Knee Osteoarthritis. Int J Life Sci Pharma Res. 2023;13(4):61–75.
17. Chao J, Jing Z, Xuehua B, Peilei Y, Qi G. Effect Of Systematic Exercise Rehabilitation On Patients With Knee Osteoarthritis: A Randomized Controlled Trial. Cartilage. 2021;13(1_Suppl):1734s-1740s.
18. López L, Benítez PO, López JC, Martos IC, Torres Jr, Santiago MG et al. Effectiveness Of An Individualized Comprehensive Rehabilitation Program In Women With Chronic Knee Osteoarthritis: A Randomized Controlled Trial. Menopause. 2022;29(6):687–92.
19. Lin Y, Hu X, Cao Y, Wang X, Tong Y, Yao F et al. The Role Of 6-Minute Walk Test Guided By Impedance Cardiography In The Rehabilitation Following Knee Arthroplasty: A Randomized Controlled Trial. Front Cardiovasc Med. 2021;8(11):1–9.
20. Trojani Mc, Chorin F, Gerus P, Breuil V, Michel C, Guis S et al. Concentric Or Eccentric Physical Activity For Patients With Symptomatic Osteoarthritis Of The Knee: A Randomized Prospective Study. Ther Adv Musculoskelet Dis. 2022;14(1):1–13.
21. Maia Tfld, Tenório A Da S, Martins Jvp, Barros Pt De, Oliveira Fb De, Barboza Pjm, Et Al. Proprioceptive Neuromuscular Facilitation Compared To Usual Resistance Exercise Therapy In Individuals With Knee Osteoarthritis: A Randomized Clinical Trial Protocol. Research, Society And Development. 2022;11(10):1–20.
22. Robbins Sr, Alfredo Pp, Junior Ws, Marques Ap. Low-Level Laser Therapy And Static Stretching Exercises For Patients With Knee Osteoarthritis: A Randomised Controlled Trial. Clin Rehabil. 2022;36(2):204–13.
23. Xiao Q, Liu B, Zhao B. Gap Balancing Improve Squat Function And Knee Function: A Randomized Controlled Trial Comparing Gap Balancing And Measured Resection. J Orthop Surg Res. 2021 Dec 8;16(1):1–8.
24. Drummer Dj, Mcadam Js, Seay R, Aban I, Lavin Km, Wiggins D et al. Perioperative Assessment Of Muscle Inflammation Susceptibility In Patients With End-Stage Osteoarthritis. J Appl Physiol. 2022;132(4):984–94.
25. Mark-Christensen T, Thorborg K, Kallemose T, Bandholm T. Physical Rehabilitation Versus No Physical Rehabilitation After Total Hip And Knee Arthroplasties: Protocol For A Pragmatic, Randomized, Controlled, Superiority Trial (The Draw1 Trial). F1000res. 2021;10(2):1–22.
26. Dwi Rosella Komala Sari, Raden Andrea Zalfa Zaki Gazella. The Effect Of Proprioceptive Neuromuscular Facilitation Stretching Exercises On Pain And Postural Balance In Patients With Knee Osteoarthritis. Physical Therapy Journal Of Indonesia. 2023;4(2):138–43.
27. Adams Kr, Famuyide Ao, Young Jl, Maddox Cd, Rhon Di. Pragmatism In Manual Therapy Trials For Knee Osteoarthritis: A Systematic Review. Arch Physiother. 2024;14(1):1–10.
28. Weng Q, Goh Sl, Wu J, Persson Msm, Wei J, Sarmanova A, Et Al. Comparative Efficacy Of Exercise Therapy And Oral Non-Steroidal Anti-Inflammatory Drugs And Paracetamol For Knee Or Hip Osteoarthritis: A Network Meta-Analysis Of Randomised Controlled Trials. Br J Sports Med. 2023;57(15):990–6.
29. Yu C. Research Progress In The Treatment Of Knee Osteoarthritis. Bio Web Conf. 2023;59(5):1–6.
30. Kangeswari P, Murali K, Arulappan J. Effectiveness Of Isometric Exercise And Counseling On Level Of Pain Among Patients With Knee Osteoarthritis. Sage Open Nurs. 2021;7(1):1–11.

31. Thomas Dt, R S, Prabhakar Aj, Dineshbhai Pv, Eapen C. Hip Abductor Strengthening In Patients Diagnosed With Knee Osteoarthritis – A Systematic Review And Meta-Analysis. Bmc Musculoskelet Disord. 2022;23(1):1–14.
32. Shetty M, Tambe A, Darekar A, Agrawal R, Bhalala H. Influence Of Yoga On Pain, Lower Extremity Kinetics, Kinematics And Function In Patients With Knee Osteoarthritis. Int J Community Med Public Health. 2024;11(6):2324–30.
33. Goyal H. To Study The Efficacy Of Low Level Laser Therapy As Compared To Patellofemoral Mobilization Along With Knee Strengthening Exercises (Conventional Treatment) In Patients With Bilateral Patellofemoral Knee Osteoarthritis- A Randomised Split- Body Design. International Journal Of Medical Science And Diagnosis Research. 2021;5(10):1–11.
34. Sun C, Zhao Z, Lee Wg, Ma Q, Zhang X, Zhu J, Et Al. Sensor-Guided Gap Balance Versus Manual Gap Balance In Primary Total Knee Arthroplasty: A Meta-Analysis. J Orthop Surg Res. 2022;17(1):1–10.
35. Van De Kelft As, De Mulder K, De Schepper J, Victor J, Vundelinckx B. Balancing The Flexion Gap First In Total Knee Arthroplasty Leads To Better Preservation Of Posterior Condylar Offset Resulting In Better Knee Flexion. Knee Surgery, Sports Traumatology, Arthroscopy. 2023;31(9):3792–8.