A Comparative Study of the Efficacy of Two Different Muscle Energy Techniques in Improving Pain and Knee Extension in Patients with Knee Osteoarthritis: A Randomized Clinical Trial

Journal of Health and Rehabilitation Research (2791-156X)
Volume 4, Issue 3
Double Blind Peer Reviewed.
https://jhrlmc.com/
DOI: https://doi.org/10.61919/jhrr.v4i3.1579
www.lmi.education/
LINK MEDICAL INTERFACE

Iqra Tahir[1], Samiya Munir[2], Aleema Ali[3], Sana Yaseen[4], Imran Ullah Khan[5], Mehar Un Nisa[6], Aqsa Shahid[7], Muhammad Fareed Nasir[8], Hifza Tahir[1], Umar Tariq[1]

Correspondence
Iqra Tahir
iqratahir742@gmail.com

Affiliations
1 Professors Hospital, Faisalabad, Pakistan
2 Government Comprehensive Model Higher Secondary School, Samanabad, Faisalabad, Pakistan
3 BPP University, London, United Kingdom
4 King Edward Medical University, Lahore, Pakistan
5 PhD Scholar, Al-Hamad Islamic University, Department of Physical Education and Sports Science, Government College University Faisalabad (GCUF), Faisalabad, Pakistan
6 Clinic 1, Lahore, Pakistan
7 Riphah International University, Islamabad, Pakistan
8 Sindh Institute of Physical Medicine and Rehabilitation, Karachi, Pakistan

Keywords
knee osteoarthritis, muscle energy techniques, post-isometric relaxation, reciprocal inhibition, pain reduction, knee extension, physical therapy

Disclaimers

Authors' Contributions	All authors contributed equally to the conception, data acquisition, and manuscript preparation.
Conflict of Interest	None declared
Data/supplements	Available on request.
Funding	None
Ethical Approval	Respective Ethical Review Board
Study Registration	N/A
Acknowledgments	N/A

ABSTRACT

Background: Knee osteoarthritis (OA) is a degenerative joint disease-causing pain and restricted movement. Muscle energy techniques (METs) are commonly used to manage OA symptoms, but their comparative effectiveness remains unclear.

Objective: To compare the effects of two METs—post-isometric relaxation (PIR) and reciprocal inhibition (RI) in reducing pain and improving knee extension in patients with knee OA.

Methods: This single-blinded, randomized clinical trial included 32 patients with knee OA, randomly assigned to two groups: PIR (n = 16) and RI (n = 16). Both groups received 12 treatment sessions over four weeks, including baseline moist heat. Pain was assessed using the Visual Analogue Scale (VAS), and knee extension was measured with a goniometer. Data were analyzed using SPSS 25 with the Friedman and Mann-Whitney U tests for within- and between-group comparisons.

Results: PIR reduced pain by 35.33 points ($p = 0.001$) and improved knee extension by 6.93° ($p = 0.004$). RI reduced pain by 21.73 points ($p = 0.003$) and improved knee extension by 5.46° ($p = 0.001$). PIR showed significantly better pain reduction compared to RI ($p = 0.001$).

Conclusion: Both PIR and RI effectively improved knee extension, but PIR was more effective in reducing pain in knee OA patients.

INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disease that primarily affects the knee, resulting in the gradual deterioration of articular cartilage due to mechanical stress over time. The knee joint is composed of two functional articulations: the tibiofemoral and patellofemoral joints, which rely on various factors for stability, including static ligaments, dynamic muscle forces, and joint load distribution. Osteoarthritis is a prevalent condition affecting approximately 600 million individuals worldwide, particularly in those aged 50 and older. This condition has a multifactorial etiology, with both systemic and local factors contributing to its development. Genetics, joint injuries, obesity, and participation in sports are common risk factors, making OA a condition that can affect people of all ages, though its prevalence increases with age (1, 2). The impact of OA extends beyond physical pain, often leading to limitations in daily activities such as walking, climbing stairs, and performing household chores, which can significantly affect the psychological well-being of affected individuals (3).

Management of knee OA typically involves a range of conservative and surgical approaches. Conservative treatments, particularly non-pharmacological methods such as physical therapy, are widely recommended as first-line interventions. Physical therapy techniques, including electrotherapy and manual therapy, have proven beneficial in reducing pain and improving function in patients with knee OA. Among the manual therapy techniques, muscle energy techniques (METs) such as post-isometric relaxation (PIR) and reciprocal inhibition (RI) have gained attention due to their efficacy in enhancing joint range of motion, alleviating pain, and improving overall function in patients with knee OA (4, 5). The use of METs, which involve the use of a patient's own muscle contractions to relax and lengthen muscles, has been demonstrated to be effective in managing musculoskeletal conditions like OA (6). Additionally, weight control and physical activity are critical components in managing OA symptoms, as excess body weight can exacerbate joint stress and contribute to the inflammatory processes associated with the disease (7).

Several studies have highlighted the benefits of METs in improving flexibility and reducing pain in knee OA patients. For instance, the combination of METs with heat therapy has been shown to yield significant improvements in pain relief and knee range of motion (8, 9). In contrast, other studies have demonstrated that METs may be more effective than conventional treatments in improving flexibility and

functional outcomes in patients with knee OA (10). These findings suggest that METs, particularly PIR and RI, can play a vital role in non-pharmacological management strategies for knee OA. However, there remains a need for further research to compare the relative efficacy of different METs techniques in addressing pain and joint mobility issues in knee OA patients. This study aims to compare the effects of PIR and RI on pain reduction and knee extension improvement in patients with knee OA, thus contributing to the body of knowledge on effective treatment modalities for this debilitating condition (11, 12).

MATERIAL AND METHODS

The study was conducted as a single-blinded, randomized clinical trial, with participants blinded to the group allocation. It was registered with the Iranian Registry of Clinical Trials, and ethical approval was obtained from the institutional review board of The University of Faisalabad. The study was carried out over six months, and participants were recruited from several hospitals in Faisalabad. A total of 32 participants with knee osteoarthritis (OA) were enrolled after a thorough screening process, which was based on the inclusion and exclusion criteria. The sample size was determined using the OpenEpi tool, ensuring appropriate statistical power.

Participants were selected using convenience sampling and were randomized into two groups using the lottery method. Informed consent was obtained from all participants prior to their enrolment, and they were informed about the study's objectives, procedures, and potential risks and benefits. Participants were assigned to either the post-isometric relaxation (PIR) or reciprocal inhibition (RI) group, with an equal number of participants in each group (16 each). Each participant picked a paper from two options to determine their group, ensuring unbiased allocation. The inclusion criteria for the study required participants to be between 45 and 60 years of age, experiencing chronic knee pain, and presenting with active knee extension limitations between 15° and 20°. Patients with a history of lumbar pathology, neurological disorders, recent hamstring muscle injuries, fractures, surgeries, or any implants or infections in the affected limb were excluded. These criteria ensured a homogeneous sample appropriate for the intervention.

The treatment protocol for both groups included 12 treatment sessions over four weeks. Group A received post-isometric relaxation (PIR) combined with baseline moist heat therapy, while Group B received reciprocal inhibition (RI) with baseline moist heat therapy. Pre-treatment, mid-treatment (after two weeks), and post-treatment (after four weeks) assessments were conducted to evaluate changes in pain and knee extension. Pain was assessed using the Visual Analogue Scale (VAS), and knee extension was measured with a goniometer. The VAS and goniometer were selected for their high intertester reliability and validity in measuring pain and joint mobility (13).

Post-isometric relaxation was applied by positioning the participant in a supine posture with the contralateral hip and knees semi-flexed. The therapist positioned the leg to be treated on their shoulder and applied a submaximal isometric contraction against resistance for 7-10 seconds. The process was repeated for four repetitions per session. Reciprocal inhibition followed a similar setup, but the participant extended the knee against the resistance provided by the therapist's hand. Both techniques were performed three times per week for four weeks.

The outcome measures included pain reduction, assessed by the VAS, and knee extension improvement, measured using a goniometer. The VAS, with an ICC of 0.98 and a standard error of measurement of 0.04, was considered a reliable tool for evaluating knee OA pain. The goniometer, with high intertester reliability ($r = 0.97$; ICC = 0.98), was used to quantify improvements in knee extension.

Data analysis was performed using SPSS version 25. Descriptive statistics were used to summarize demographic data, including age and gender distribution. The Friedman test was applied to assess within-group changes over time for both the VAS and knee extension measurements, while the Mann-Whitney U test was employed to compare between-group differences. Statistical significance was set at $p < 0.05$ for all analyses.

The study adhered to the ethical principles outlined in the Declaration of Helsinki. Participants' confidentiality and anonymity were maintained throughout the study. Personal data were handled securely, and all participants had the right to withdraw from the study at any point without any repercussions. The researchers ensured that no harm came to the participants during the study, and the dignity of all participants was respected. All study participants signed an informed consent form before any intervention commenced.

RESULTS

The study included a total of 32 participants with knee osteoarthritis, comprising 14 males (43.8%) and 18 females (56.3%), as shown in Table 1. The mean age of the participants was 51.41 ± 4.48 years. Table 1 and Table 2 provide the demographic distribution of the participants, including their age and gender.

Within-group analysis using the Friedman test revealed significant reductions in pain for both treatment groups. Post-isometric relaxation (Group A) showed a mean VAS reduction from 46.67 ± 10.47 at baseline to 11.33 ± 6.40 after four weeks of treatment, with a statistically significant p-value of 0.001.

Table 1: Age Distribution of Participants

Age Group	Frequency	Percent	Cumulative Percent
45-49 years	13	40.6%	40.6%
50-54 years	9	28.1%	68.8%
55-60 years	10	31.3%	100.0%
Total	32	100.0%	-

For the reciprocal inhibition group (Group B), the mean VAS score decreased from 46.00 ± 10.56 at baseline to 24.67 ± 11.25 after four weeks, with a significant p-value of 0.003.

Between-group analysis using the Mann-Whitney U test revealed no significant difference between Group A and Group B at baseline (p = 0.843).

Table 2: Gender Distribution of Participants

Gender	Frequency	Percent	Cumulative Percent
Male	14	43.8%	43.8%
Female	18	56.3%	100.0%
Total	32	100.0%	

Table 3: Visual Analogue Scale (VAS) Within-Group Analysis

Group	Timepoint	N	Mean	Std. Deviation	p-value
Post-Isometric Relaxation	Baseline	16	46.67	10.47	0.001
	After 2nd Week	16	27.33	7.99	
	After 4th Week	16	11.33	6.40	
Reciprocal Inhibition	Baseline	16	46.00	10.56	0.003
	After 2nd Week	16	34.67	9.90	
	After 4th Week	16	24.67	11.25	

However, after two weeks, the VAS scores showed a significant difference (p = 0.042), and this difference became even more pronounced at the end of the study (p = 0.001).

Table 4: Visual Analogue Scale (VAS) Between-Group Analysis

Timepoint	Mann-Whitney U	Z-score	p-value (Asymp. Sig.)
Baseline	123.000	-0.198	0.843
After 2nd Week	66.000	-2.032	0.042
After 4th Week	37.500	-3.285	0.001

Table 5: Active Knee Extension (AKE) Test Within-Group Analysis

Group	Timepoint	N	Mean (degrees)	Std. Deviation	p-value
Post-Isometric	Baseline	16	17.33	1.80	0.004
Relaxation	After 2nd Week	16	13.60	1.12	
	After 4th Week	16	10.40	1.50	
Reciprocal	Baseline	16	16.47	1.41	0.001
Inhibition	After 2nd Week	16	13.53	1.51	
	After 4th Week	16	11.00	1.60	

Within-group analysis of active knee extension showed that post-isometric relaxation improved knee extension by 6.93°, from a mean of 17.33° ± 1.80 at baseline to 10.40° ± 1.50 after four weeks, with a p-value of 0.004. Reciprocal inhibition resulted in a mean improvement of 5.46°, from 16.47° ± 1.41 at baseline to 11.00° ± 1.60 after four weeks, with a p-value of 0.001. Between-group analysis of the active knee extension test showed no statistically significant difference between Group A and Group B at baseline or after treatment, with p-values of 0.252, 0.625, and 0.447 at baseline, 2nd week, and 4th week, respectively.

Table 6: Active Knee Extension (AKE) Test Between-Group Analysis

Timepoint	Mann-Whitney U	Z-score	p-value (Asymp. Sig.)
Baseline	98.500	-1.146	0.252
After 2nd Week	101.500	-0.489	0.625
After 4th Week	95.000	-0.761	0.447

The results of this study indicate that both post-isometric relaxation and reciprocal inhibition techniques were effective in improving knee extension and reducing pain in patients with knee osteoarthritis. However, post-isometric relaxation showed a greater reduction in pain compared to reciprocal inhibition, with statistically significant differences observed in VAS scores between the two groups. Both techniques, however, were similarly effective in improving knee extension as measured by the AKE test.

DISCUSSION

The findings of this study demonstrated that both post-isometric relaxation (PIR) and reciprocal inhibition (RI) muscle energy techniques were effective in improving knee extension and reducing pain in patients with knee osteoarthritis (OA). However, PIR was found to be more effective in reducing pain than RI. These results are consistent with previous studies that have highlighted the

effectiveness of muscle energy techniques in managing musculoskeletal conditions, including knee OA. Choksi et al. (2016) reported that METs were more effective than conventional treatment in improving flexibility and reducing pain in knee OA patients, supporting the current study's findings that METs, particularly PIR, can provide significant pain relief in this patient population (14).

The observed greater reduction in pain with PIR compared to RI aligns with the work of Khuman et al. (2014), who demonstrated that post-isometric relaxation combined with moist heat was effective in reducing pain and enhancing hamstring flexibility in individuals with knee osteoarthritis. Similarly, Adkitte et al. (2016) showed that a 6-day MET program led to significant improvements in flexibility and pain reduction in athletes, further validating the efficacy of PIR in addressing musculoskeletal issues (15, 13). The greater pain reduction observed in the PIR group may be attributed to the deeper relaxation of the musculature that PIR provides, which could reduce joint stress and discomfort more effectively than RI.

In contrast, both techniques were equally effective in improving knee extension, as indicated by the lack of statistically significant differences between the two groups in post-treatment knee extension values. This finding is consistent with studies like that of Addala et al. (2013), who reported similar improvements in range of motion with both MET and other therapeutic modalities in OA patients. The present study's results support the notion that while METs are effective in improving joint mobility, the specific technique may not significantly influence the degree of improvement in knee extension (16).

Despite these promising results, this study has several limitations that should be acknowledged. The sample size was relatively small, which may limit the generalizability of the findings to the broader population of knee OA patients. Larger-scale studies are needed to confirm these results and explore whether similar outcomes would be observed across different demographics and clinical settings. Additionally, the study duration was limited to four weeks, and while both techniques showed improvements in this period, longer-term follow-up is necessary to determine the sustainability of these effects. Another limitation is the reliance on self-reported pain measurements, which, while validated by tools such as the VAS, can still introduce subjectivity into the data.

One strength of this study is its randomized design, which helped to reduce bias in treatment allocation. The use of well-established outcome measures, such as the VAS and goniometric assessments, added robustness to the results. However, future studies should consider including objective biomarkers or imaging techniques to complement these assessments and provide a more comprehensive understanding of the physiological changes associated with METs in knee OA patients.

Based on these findings, it is recommended that both PIR and RI be incorporated into the non-pharmacological management of knee OA, with PIR being particularly beneficial for patients with significant pain. Clinicians may choose between the two techniques depending on the patient's specific symptoms and treatment goals. Further research should explore the long-term effects of these interventions and investigate whether combining METs with other therapeutic modalities, such as exercise or pharmacological treatments, would yield even greater improvements in pain and function.

CONCLUSION

In conclusion, this study has contributed valuable insights into the comparative efficacy of PIR and RI in managing knee OA. Both techniques were found to be effective in improving knee extension, but PIR was more successful in reducing pain. These findings suggest that METs, particularly PIR, can be valuable components of conservative treatment strategies for knee OA.

REFERENCES

1. Heijink A, Gomoll AH, Madry H, Drobnič M, Filardo G, Espregueira-Mendes J, et al. Biomechanical Considerations In The Pathogenesis Of Osteoarthritis Of The Knee. Knee Surg Sports Traumatol Arthrosc. 2012;20(3):423-35.
2. Heidari B. Knee Osteoarthritis Prevalence, Risk Factors, Pathogenesis, And Features: Part I. Caspian J Intern Med. 2011;2(2):205.
3. Fransen M, Bridgett L, March L, Hoy D, Penserga E, Brooks P. The Epidemiology Of Osteoarthritis In Asia. Int J Rheum Dis. 2011;14(2):113-21.
4. Foo CN, Manohar A, Rampal L, Lye MS, Mohd-Sidik S, Osman ZJ. Knee Pain And Functional Disability Of Knee Osteoarthritis Patients Seen At Malaysian Government Hospitals. Malays J Med Health Sci. 2017;13(2):7-15.
5. Skou ST, Roos EM, Laursen MB, Rathleff MS, Arendt-Nielsen L, Rasmussen S, et al. Total Knee Replacement And Non-Surgical Treatment Of Knee Osteoarthritis: 2-Year Outcome From Two Parallel Randomized Controlled Trials. Osteoarthritis Cartilage. 2018;26(9):1170-80.
6. Sathe SS, Rajandekar T, Thodge K, Chavhan A. Comparison Between Immediate Effects Of Post Isometric Relaxation And Reciprocal Inhibition Techniques On Hamstring Flexibility In Patients With Hamstring Tightness: An Experimental Study. Indian J Forensic Med Toxicol. 2020;14(4):25.
7. Cibere J, Bellamy N, Thorne A, Esdaile JM, McGorm KJ, Chalmers A, et al. Reliability of The Knee Examination In Osteoarthritis: Effect Of Standardization. Arthritis Rheum. 2004;50(2):458-68.
8. Masekar MB, Rayjade DA, Yadav DT, Chotai DK. Effectiveness Of Muscle Energy Technique And Proprioceptive Neuromuscular Facilitation In Knee Osteoarthritis. Int J Life Sci. 2021;11(1):16-22.
9. Nguyen USD, Zhang Y, Zhu Y, Niu J, Zhang B, Felson DT. Increasing Prevalence Of Knee Pain And Symptomatic Knee Osteoarthritis: Survey And Cohort Data. Ann Intern Med. 2011;155(11):725-32.
10. Silverwood V, Blagojevic-Bucknall M, Jinks C, Jordan J, Protheroe J, Jordan K. Current Evidence On Risk Factors For Knee Osteoarthritis In Older Adults: A Systematic

Review And Meta-Analysis. Osteoarthritis Cartilage. 2015;23(4):507-15.
11. Agrawal SS. Comparison Between Post Isometric Relaxation And Reciprocal Inhibition Maneuvers On Hamstring Flexibility In Young Healthy Adults: Randomized Clinical Trial. Int J Med Res Health Sci. 2016;5(1):33-7.
12. Payla M, Gill M, Singal SK, Shah N. A Comparison Of The Immediate And Lasting Effects Between Passive Stretch And Muscle Energy Technique On Hamstring Muscle Extensibility. Indian J Physiother Occup Ther. 2018;12(1):99.
13. Adkitte R, Rane SG, Yeole U, Nandi B, Gawali P. Effect Of Muscle Energy Technique On Flexibility Of Hamstring Muscle In Indian National Football Players. Saudi J Sports Med. 2016;16(1):28.
14. Choksi P, Tank K. To Study The Efficacy Of Muscle Energy Technique On Muscle Strength And Flexibility In Patients. Indian J Physiother Occup Ther. 2016;10(3):41.
15. Khuman PR, Surbala L, Patel P, Chavda D. Immediate Effects Of Single Session Post Isometric Relaxation Muscle Energy Technique Versus Mulligan's Bent Leg Raise Technique On Pain And Hamstring Flexibility In Knee Osteoarthritis Participants: A Randomised Controlled Study. Physiotherapy. 2014;3(9):324-35.
16. Addala D, Kumar KS, Madhavi K. Effectiveness Of Muscle Energy Technique On Pain And Range Of Motion On Osteoarthrosis Of Knee. Indian J Physiother Occup Ther. 2013;7(4):29.