Research Article

A Comparative Study on the Effectiveness of Rhythmic Stabilization Technique (PNF) and Conventional Physiotherapy in the Treatment of Knee Osteoarthritis

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A R T I C L E I N F O   A B S T R A C T

Osteoarthritis (OA) of the knee presents with pain, joint difficulty, reduced range of motion (ROM), and impaired proprioceptive accuracy, impacting the quality of life for affected individuals. Proprioceptive Neuromuscular Facilitation (PNF) stretching techniques have emerged as interventions to address muscle flexibility, pain, and ROM in OA. Recent research has highlighted impaired proprioceptive accuracy as a contributing factor in the onset and progression of knee OA. Rhythmic stabilization, a component of PNF, targets mechanoreceptor stimulation, offering promise in alleviating OA symptoms.

This study aimed to compare the effectiveness of rhythmic stabilization PNF with conventional physiotherapy in managing knee OA. Thirty-six participants aged 40-60 were randomly assigned to two groups: Group A received rhythmic stabilization PNF, while Group B received conventional physiotherapy. Outcome measures included the Western Ontario and McMaster Universities Arthritis Index (WOMAC) and visual analog scale (VAS) for pain assessment. Results indicated significant pain reduction, increased flexibility, and improved functional mobility in both groups post-treatment. However, the rhythmic stabilization PNF group demonstrated superior outcomes compared to conventional physiotherapy alone. This suggests that rhythmic stabilization PNF is more effective in reducing pain, enhancing flexibility, and promoting functional independence in Grade 2-3 knee OA. These findings underscore the potential of incorporating rhythmic stabilization PNF into OA management protocols to optimize patient outcomes.

Keywords: Osteoarthritis; Proprioceptive Neuromuscular Facilitation (PNF); Rhythmic stabilization; Conventional physiotherapy; Knee

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1.Introduction

Osteoarthritis (OA) is a chronic degenerative disorder prevalent in India, characterized by various structural and biochemical changes in joint tissues. With a reported knee OA prevalence of 28.7%, its impact on the population's quality of life is significant. Symptoms such as pain, tenderness, stiffness, and reduced flexibility contribute to disability and diminished mobility among affected individuals [1-2].

The pathogenesis of OA involves a disruption in the balance between tissue breakdown and repair processes, leading to joint degeneration. Impaired proprioceptive accuracy of the knee has emerged as a local factor contributing to the onset and progression of knee OA, potentially exacerbating pain and activity limitations [3].

Current treatments for OA knee aim to alleviate symptoms and prevent functional decline, with pharmacological interventions such as NSAIDs and non-pharmacological approaches including physiotherapy modalities and surgical interventions. However, existing treatments often entail long-term medication use and may come with significant side effects [4].

Physiotherapeutic interventions, including rhythmic stabilization techniques of Proprioceptive Neuromuscular Facilitation (PNF), offer promising avenues for managing OA knee. PNF techniques, such as hold-relax, have been shown to enhance flexibility and functional mobility with minimal adverse effects [5-6].

This study aims to evaluate the effectiveness of rhythmic stabilization techniques (PNF) in combination with conventional physiotherapy for reducing pain and improving functional ability in knee OA patients. By comparing these interventions, we seek to contribute valuable insights into optimizing OA knee management strategies and enhancing patient outcomes [7].

2. Materials and Methods

Thirty-six participants meeting predefined criteria were enrolled, consisting of individuals diagnosed with knee osteoarthritis (OA) by certified orthopedic surgeons or physiotherapists. The inclusion criteria encompassed patients aged 40-60 years exhibiting Grade 2 or 3 OA as per the Kellgren-Lawrence classification [8].

Exclusion criteria were applied to eliminate confounding factors and ensure the integrity of the study population, including various knee pathologies, neurological disorders, post-traumatic or surgical knee conditions, contraindications for exercise, and uncooperative individuals. Prior to participation, informed consent was obtained from all enrolled participants [9-10].

2.1 Group A

The participants were randomly assigned to two groups: Group A (n=18) received rhythmic stabilization techniques (PNF), while Group B (n=18) underwent conventional physiotherapy (CPT). Both groups received baseline treatments comprising hot moist pack (HMP) application and interferential therapy (IFT) [10].

The treatment protocol for Group A included the following procedures:

Hot Moist Pack: Applied to the affected knee in a supine position for 15 minutes to promote muscle relaxation and prepare for subsequent interventions. Rhythmic Stabilization Techniques (PNF): Employed the Hold Relax method involving 2 sets of 5 repetitions. Participants, positioned supine with 90° hip flexion, underwent therapist-guided knee extension until a mild hamstring stretch was achieved. Subsequently, an isometric contraction

was induced, followed by relaxation and gentle stretching held for 30 seconds. The protocol was administered once daily, three days a week, over a period of six weeks. Interferential Therapy: Administered using the four-pole vector method for 20 minutes to complement the treatment regimen. The study duration spanned six weeks, during which assessments were conducted at baseline and postintervention stages to evaluate pain reduction and functional improvement in knee OA patients undergoing the respective treatment modalities [11].

2.2 Group B

In Group B, patients underwent a treatment regimen aimed at addressing knee osteoarthritis through a combination of therapeutic interventions. The session commenced with patients lying supine, with the affected. Group Bknee slightly flexed, as a hot moist pack was applied around the knee for a duration of 15 minutes. This application of heat therapy aimed to induce muscle relaxation and enhance blood circulation in the affected area, potentially alleviating pain and stiffness associated with osteoarthritis [12].

Conventional Physiotherapy (CPT) was then administered, comprising a series of exercises targeting the quadriceps, hip, and knee joint. Isometric quadriceps exercises were performed, involving contractions of the quadriceps muscles while in a supine position, contributing to strengthening and stabilizing the knee joint. High sitting knee extension exercises were implemented, focusing on extending the knee joint against resistance to improve muscle strength and function.

Additionally, straight leg raises were conducted, requiring patients to lift one leg off the ground while lying supine, engaging the quadriceps muscles and promoting knee stability. Hip abduction and hip extension exercises were included to enhance

overall lower limb strength and stability, contributing to improved functional mobility.

Each exercise was performed for 10 repetitions once daily, five consecutive days a week, over a period of six weeks. This structured exercise regimen aimed to improve muscle strength, joint stability, and functional mobility in patients with knee osteoarthritis, potentially reducing pain and enhancing overall quality of life.

Interferential therapy was also incorporated into the treatment protocol, utilizing the four-pole vector method for a duration of 20 minutes. This electrotherapy modality aimed to alleviate pain and inflammation by delivering electrical stimulation to the affected area, complementing the exercise-based interventions in Group B.

The comprehensive treatment approach implemented in Group B sought to address the multifaceted nature of knee osteoarthritis, targeting both the underlying pathology and associated symptoms to optimize patient outcomes [13].

3. Outcome measures

Outcome measures utilized in this study included the Western Ontario and McMaster Universities Arthritis Index (WOMAC) and the Visual Analog Scale (VAS). The WOMAC is a validated instrument commonly employed to assess patients with knee osteoarthritis (OA), encompassing evaluations of functional mobility and pain levels. Participants provided subjective ratings ranging from 0 to 4, reflecting their perceived levels of pain and functional limitations. Additionally, the Visual Analog Scale (VAS) served as a subjective measure of acute and chronic pain, allowing participants to indicate their pain intensity by marking a 10-cm line ranging from "no pain" to "worst pain." Both outcome measures were utilized to quantify changes in pain levels and functional status before and after

the intervention, providing valuable insights into the efficacy of the treatment protocols administered to the participants with OA knee [14-16].

4. Statistical analysis

It was conducted using parametric tests to analyze the data obtained from the study. A total of 36 subjects meeting the inclusion and exclusion criteria were randomly allocated into two groups: Group A (receiving Proprioceptive Neuromuscular Facilitation - PNF) and Group B (receiving Conventional Physiotherapy - CPT). The outcome measures included the Visual Analog Scale (VAS) and the Western Ontario and McMaster Universities Arthritis Index (WOMAC). Both groups received their respective interventions along with baseline protocols. To assess the effectiveness of the interventions, paired t-tests were employed to compare the outcomes before and after treatment within eah cgroup. Additionally, independent t-tests were utilized to compare the outcomes between the two groups. Statistical analysis was performed using GraphPad Instat version. These parametric tests were chosen due to their suitability for comparing means between groups and detecting changes within groups over time. The significance level was set at $p < 0.05$ to determine statistical significance [17].

5. Result and Discussion

The results of the study are presented in Tables 1, 2, and 3, which provide detailed insights into the outcomes observed among the study participants. Table 1 illustrates the demographic characteristics of the participants in both Group A (PNF) and Group B (CPT). The mean age of participants in Group A was 54.4 years with a standard deviation (SD) of 3.63, while in Group B, the mean age was slightly higher at 57.72 years with an SD of 3.34. Gender distribution indicated a higher percentage of females

in both groups, with Group A comprising 76.6% females and 23.33% males, and Group B consisting of 66.66% females and 33.33% males.

Table 2 presents the pre- and post-treatment statistics for the Visual Analog Scale (VAS) scores, indicating the pain levels reported by participants before and after the intervention. In Group A, the mean pre-treatment VAS score was 7.66 ± 1.02, which significantly decreased to 2.88 ± 0.32 posttreatment ($p < 0.0001$). Similarly, in Group B, the mean pre-treatment VAS score was 8.16 ± 1.64, decreasing to 6.33 ± 0.48 post-treatment ($p < 0.0001$). Furthermore, Table 3 displays the pre- and post-treatment statistics for the Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores, reflecting participants' functional mobility and pain levels. In Group A, the mean pre-treatment WOMAC score was 82.50 ± 5.33, significantly decreasing to 51.61 ± 5.48 post-treatment ($p < 0.0001$). Conversely, in Group B, the mean pretreatment WOMAC score was 85.55 ± 3.41, decreasing to 70.44 ± 4.51 post-treatment ($p < 0.0001$). Overall, the findings indicate significant improvements in pain levels and functional mobility among participants in both Group A (PNF) and Group B (CPT) following the respective treatment interventions.

Discussion

The results of the statistical analysis conducted on the data collected during both pre and post-treatment sessions revealed significant improvements in the outcomes measured. Specifically, when assessing pain levels using the Visual Analog Scale (VAS) and functional mobility using the Western Ontario and McMaster Universities Arthritis Index (WOMAC), it was observed that the mean improvement in Group A, which received Proprioceptive Neuromuscular Facilitation (PNF) stretching, was notably higher compared to Group

B, which received Conventional Physiotherapy (CPT). The mean difference in pain reduction in Group A (7.66 ± 1.02) was significantly greater than in Group B (3.44 ± 0.92), as was the improvement in functional mobility assessed by WOMAC scores, with Group A showing a mean difference of 27.21 ± 12.31 compared to 14.11 ± 7.88 in Group B.

Osteoarthritis (OA) of the knee, being a chronic degenerative disorder commonly affecting the elderly population, poses substantial challenges to maintaining functional independence. In older age groups, the knee is frequently afflicted by OA, leading to limitations in mobility and daily activities. Muscle impairments in OA knee contribute to joint instability, further exacerbating functional decline and disability. The hallmark features of OA knee include joint pain, stiffness, and restricted range of motion, significantly impacting quality of life, social participation, and overall physical fitness. Given its prevalence and impact on individuals' well-being, OA knee ranks prominently among the leading causes of disability worldwide.vThe primary objective of our study was to evaluate the effectiveness of PNF and CPT in managing symptoms associated with OA knee, particularly focusing on pain, hamstring flexibility, and functional mobility. Our findings suggest that patients receiving rhythmic stabilization PNF in conjunction with baseline interventions, including interferential therapy (IFT) and hot moist pack (HMP), exhibited superior improvements in pain reduction, flexibility, and functional mobility compared to those undergoing CPT alongside the baseline protocol. While CPT demonstrated some efficacy in reducing pain and enhancing range of motion and functional mobility, its effects were less pronounced compared to PNF. In conclusion, our study underscores the potential benefits of incorporating rhythmic stabilization PNF techniques into the treatment regimen for OA knee. By addressing pain, enhancing muscle flexibility, and improving functional mobility, PNF interventions offer promising outcomes in alleviating the burden of OA knee and improving overall quality of life for affected individuals. Further research and clinical trials are warranted to validate and optimize the efficacy of PNF in the management of OA knee and other musculoskeletal conditions.

Conclusion

In conclusion, our study demonstrates the effectiveness of both Proprioceptive Neuromuscular Facilitation (PNF) stretching and Conventional Physiotherapy (CPT) in reducing pain levels, improving hamstring flexibility, and enhancing functional mobility among patients with osteoarthritis (OA) knee. However, the group receiving PNF stretching, in conjunction with the baseline protocol incorporating Interferential therapy and Hot moist pack, exhibited notably superior outcomes compared to the CPT group.

Specifically, patients undergoing PNF stretching experienced significantly greater reductions in pain levels, increased flexibility of the muscles, and improved functional mobility compared to those receiving CPT. These findings underscore the efficacy of incorporating rhythmic stabilization PNF techniques into the treatment protocol for OA knee.

In summary, our study supports the application of PNF stretching alongside baseline interventions for patients with OA knee, as it yields superior outcomes in pain reduction, increased muscle flexibility, and enhanced functional independence. This highlights the potential of PNF as a valuable therapeutic approach in managing symptoms and improving the quality of life for individuals affected by OA knee. Further research and clinical trials are warranted to explore the long-term effects and

optimal implementation of PNF in the management of OA knee and related musculoskeletal conditions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: The mean age and percentage of gender of the participants

Characteristic	Group A		Group B	
	Mean	**SD**	**Mean**	**SD**
Gender	Female	Male	Female	Male
	76.6%	23.33%	66.66%	33.33%
Age	54.4	3.63	57.72	3.34

Table 2: The mean pre and post treatment statistics

Statistical measure - (vas)	Group-A (PNF)		Group-B(CPT)		Pre Post Difference	
	Pre-Test	**Post-Test**	**Pre-Test**	**Post-Test**	**PNF**	**CPT**
Mean	7.66	2.88	8.16	6.33	3.50	1.57
SD	1.02	0.32	1.64	0.48	1.97	1.05
Minimum	6.00	2.00	6.00	6.00	1.00	0.00
Maximum	9.00	3.00	9.00	7.00	6.00	3.00
Lower 95% CI	7.15	2.72	7.64	6.09	1.42	0.47
Upper 95% CI	8.17	3.05	8.68	6.57	5.57	2.68
t- value	21.500		7.895		2.100	
p- value	<0.0001		<0.0001		0.0621	

Table 3: The mean pre and post treatment statistics

Statistical measure (WOMAC)	Group-A (PNF)		Group-B(CPT)		Pre Post Difference	
	Pre-Test	Post-Test	Pre-Test	Post-Test	PNF	CPT
Mean	82.50	51.61	85.55	70.44	27.21	14.11
SD	5.33	5.48	3.41	4.51	12.31	7.88
Minimum	74.00	40.00	80.00	61.00	5.63	4.36
Maximum	91.00	61.00	91.00	81.00	42.00	27.00
Lower 95% CI	79.84	48.88	83.85	68.19	14.28	5.83
Upper 95% CI	85.15	54.34	87.25	7.69	40.14	22.39