



## **A Study to Compare Effectiveness of Hip Core Strengthening and Knee Strengthening Exercises in the Treatment of Patellofemoral Pain Syndrome: A Prospective Study**

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### **ABSTRACT**

**Background:** Patellofemoral pain syndrome (PFPS) is a common musculoskeletal condition characterized by pain around or behind the patella, typically aggravated by activities such as squatting, running, and stair climbing. Exercise-based interventions are often prescribed as part of the conservative management of PFPS, with hip and knee strengthening exercises being commonly used. However, there is limited evidence on the comparative effectiveness of these two approaches.

**Objective:** This prospective study aimed to compare the effectiveness of hip core strengthening and knee strengthening exercises in the treatment of PFPS.

**Methods:** A prospective experimental design study including 30 subjects with PFPS was conducted. This study was conducted in College of Physiotherapy, NIEPMD, Chennai, India. A total of 30 patients diagnosed with PFPS were randomly assigned to either the hip core strengthening group (Group A) or the knee strengthening group (Group B). Outcome measures included the Anterior Knee Pain Scale (AKPS) and Functional Index Questionnaire (FIQ), which were assessed at baseline and after 6 weeks of intervention. Statistical analysis included descriptive statistics, independent t-tests, and 95% confidence intervals (CI) for mean differences.

**Results:** The results showed that both hip core strengthening and knee strengthening exercises resulted in improvement in AKPS and FIQ scores in both groups. However, the hip core strengthening group (Group A) showed greater improvement in AKPS (mean difference: -7.267, 95% CI: -11.948 to -2.584,  $p < 0.005$ ) and FIQ (mean difference: -1.200, 95% CI: -2.056 to 0.344,  $p < 0.005$ ) scores compared to the knee strengthening group (Group B).

**Conclusion:** These findings suggest that hip core strengthening exercises may be more effective than knee strengthening exercises in relieving pain and improving functional performance in patients with PFPS.

**Keywords:** Patellofemoral pain syndrome, hip core strengthening, knee strengthening, Anterior knee pain scale, Functional Index Questionnaire

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## **INTRODUCTION:**

Patellofemoral pain syndrome (PFPS) is a common knee condition that affects individuals of various age groups, with higher prevalence among young adults and females [1]. It is characterized by pain around or behind the patella, typically aggravated by activities that involve repetitive or prolonged knee flexion, such as squatting, running, and stair climbing [2]. PFPS is believed to result from multiple factors, including biomechanical, neuromuscular, and structural factors, and is often associated with muscle imbalances and malalignment of the patella [3]. Conservative management, including exercise-based interventions, is commonly recommended as the first line of treatment for PFPS, with the goal of reducing pain, improving function, and preventing recurrence [4]. Exercise interventions for PFPS often focus on strengthening the muscles around the hip and knee joints, as they play a crucial role in stabilizing the patella and controlling lower limb movements. Hip core strengthening exercises aim to improve the strength, endurance, and coordination of the muscles that stabilize the pelvis, including the gluteus medius, gluteus maximus, and deep hip rotators [5]. On the other hand, knee strengthening exercises target the quadriceps, hamstrings, and calf muscles, aiming to improve the strength and function of the muscles that directly act on the knee joint [6]. There is limited evidence on the comparative effectiveness of hip core strengthening and knee strengthening exercises in the treatment of PFPS. Some studies have suggested that hip core strengthening exercises may be more effective in improving pain and functional outcomes in patients with PFPS compared to knee strengthening exercises [7]. However, other studies have reported similar outcomes with both approaches [8]. Therefore, further research is needed to better understand the comparative effectiveness of these interventions in the management of PFPS. The objective of this prospective study was to compare the effectiveness of hip core strengthening and knee strengthening exercises in the treatment of PFPS. We hypothesized that both interventions would result in improvement in pain and functional outcomes, but hip core strengthening exercises would lead to greater improvements compared to knee strengthening exercises.

## **METHODS**

### **Study Design**

This was a prospective quasi experimental study conducted at College of Physiotherapy, NIEPMD, Chennai, India

### **Subjects**

A total of 30 patients diagnosed with PFPS, based on clinical evaluation and radiographic findings, were recruited for this study. The inclusion criteria were: age between 18-45 years both male and female, presence of anterior knee pain for at least 3 months, VAS score of minimum 3, Patellar grind test positive and ability to participate in a structured exercise program. Exclusion criteria were: history of knee surgery or trauma within the past 6 months, systemic or inflammatory joint diseases, neurological or musculoskeletal disorders affecting lower limb function, and contraindications to exercise.

All participating subjects who met eligibility criteria and agreed to participate in this study signed a consent form approved by the institutional review board of College of Physiotherapy, NIEPMD, India.

All participating subjects underwent a routine history and physical examination to rule out red flags to participate in this study.

### Outcomes

The primary outcome measures were the AKPS and FIQ, which were assessed at baseline (pre-test) and after 6 weeks of intervention (post-test). The AKPS is a validated self-reported questionnaire that assesses pain, function, and symptoms associated with PFPS, with scores ranging from 0 to 100, with higher scores indicating better outcomes [2]. The FIQ is a self-reported questionnaire that assesses functional limitations in activities of daily living due to knee pain, with scores ranging from 0 to 10, with higher scores indicating greater functional limitations.

30 Participants fulfilling the Inclusion criteria were randomly assigned to either the hip core strengthening group (Group A) or the knee strengthening group (Group B) each 15

### Interventions:

Both groups received a 6-week exercise program consisting of supervised sessions, twice a week, along with a home exercise program to be performed daily. The hip core strengthening group (Group A) received exercises that targeted the hip abductors, external rotators, and extensors, as well as lumbo-pelvic stability exercises, which included clamshells, side-lying hip abduction, fire hydrants, and bridging exercises [5].

The knee strengthening group (Group B) received exercises that targeted the quadriceps, hamstrings, and calf muscles, including terminal knee extensions, seated leg press, leg curls, and calf raises [6]. The exercises were progressed based on individual tolerance and were monitored for proper form and technique by the treating physical therapist.

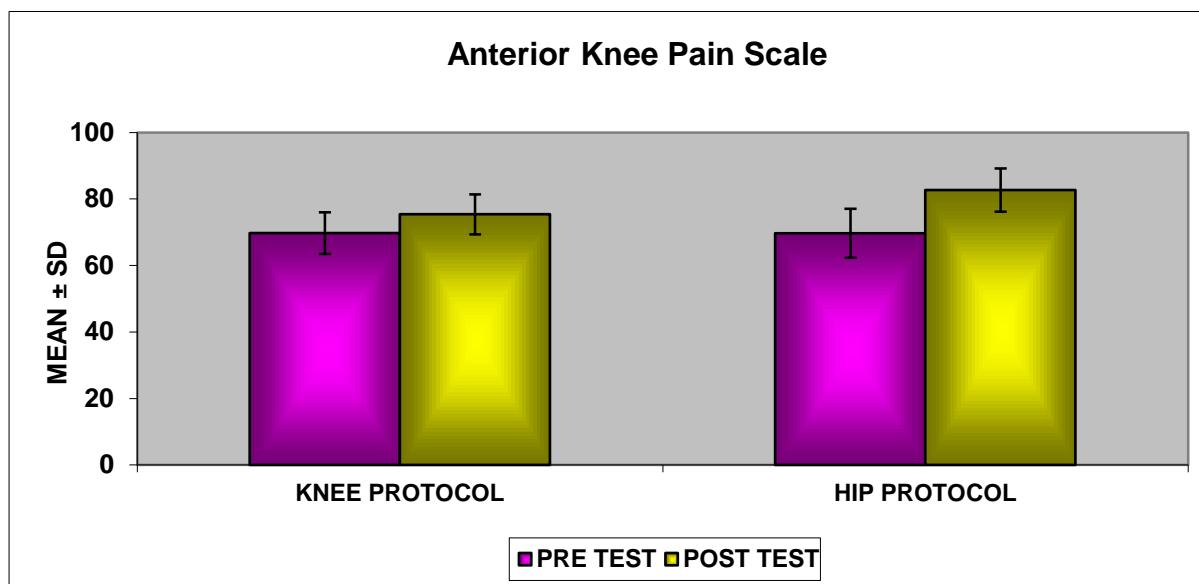
**Statistical Analysis:** Descriptive statistics, including mean and standard deviation, were calculated for baseline demographic and clinical characteristics of the participants in both groups. Baseline between-group differences were assessed using independent t-tests. Paired t-tests were used to analyse within-group changes in outcome measures from pre-test to post-test.

**TABLE 1.1: COMPARISON OF PRE TEST AND POST TEST VALUES OF AKPS AND FIQ IN GROUP A**

VARIABLES	PRE-TEST			POST-TEST		
	Mean	SD	SEM	Mean	SD	SEM
AKPS	69.73	6.273	1.62	75.4	6.021	1.555
FIQ	6.93	0.884	0.228	10.93	1.1	0.284

Table 1.1 shows descriptive measures of Pre-test and Post-test values of AKPS and FIQ in group A.

**GRAPH 1: COMPARISON OF PRE TEST AND POST-TEST VALUES OF AKPS IN GROUP A AND GROUP B**

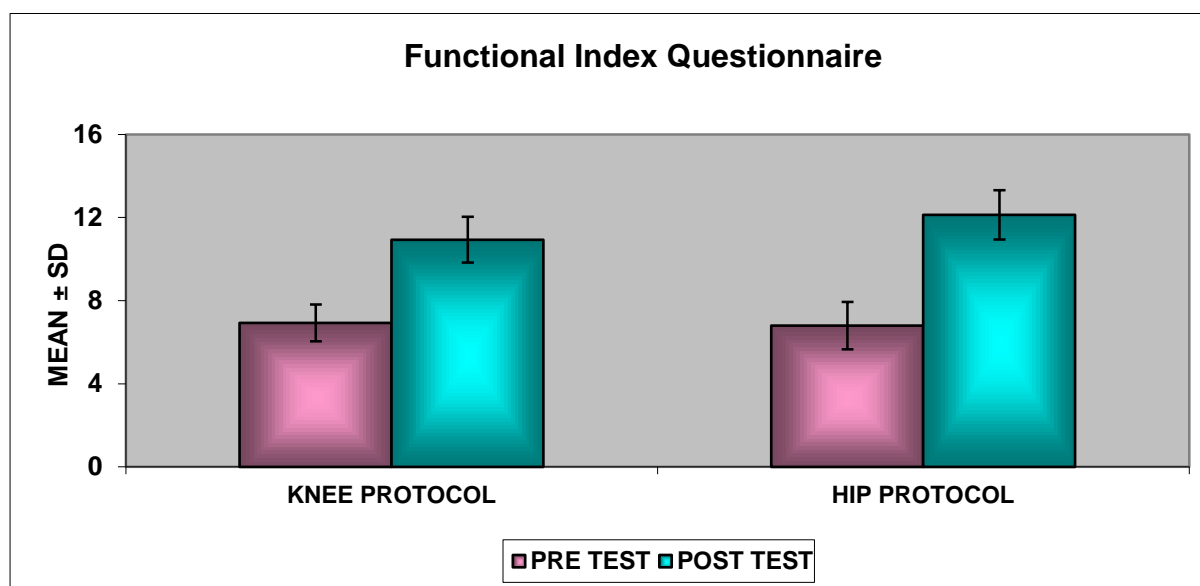


**TABLE1. 2: COMPARISON OF PRE-TEST AND POST TEST VALUES OF AKPS AND FIQ IN GROUP B**

VARIABLES	PRE-TEST			POST-TEST		
	Mean	SD	SEM	Mean	SD	SEM
AKPS	69.67	7.365	1.902	82.67	6.4888	1.675
FIQ	6.80	1.146	0.296	12.13	1.187	0.307

Table1. 2 shows descriptive measures of Pre-test and Post-test values of AKPS and FIQ in group B.

**GRAPH 2 COMPARISON OF PRE TEST AND POST-TEST VALUES OF FIQ IN GROUP A AND GROUP B**



**TABLE 1.3: PAIRED T-TEST ANALYSIS OF GROUP A**

VARIABLES	PAIRED DIFFERENCE						
	Mean	SD	SEM	95% confidence interval of difference		df	t
				Lower	Upper		
AKPS	-5.667	0.9	0.232	-6.165	-5.168	14	-24.393
FIQ	-4	1.134	0.293	-4.628	-3.72	14	-13.663

Table 1.3 shows the statistical outcome of paired “T” test analysis of AKPS and FIQ in group A.

**TABLE1.4: PAIRED T TEST ANALYSIS OF GROUP B**

VARIABLES	PAIRED DIFFERENCE						
	Mean	SD	SEM	95% confidence interval of difference		df	t
				Lower	Upper		
AKPS	-13.00	3.317	0.856	-14.837	-11.163	14	-15.181
FIQ	-5.33	1.589	0.410	-6.213	-4.454	14	-13.002S

Table 1.4 shows the statistical outcome of paired “T” test analysis of AKPS and FIQ in group B.

**TABLE1.5: COMPARISONS OF POST TEST SCORES OF AKPS OF GROUP A AND GROUP B**

GROUP	Mean	SD	SEM	Mean diff	95%confidence interval	T value	P value
Group A	75.4	6.021	1.555	-7.267	-11.948 to -2.584	-3.179	0.000
Group B	82.67	6.488	1.675	-7.267		-3.179	

Table1.1 5.The statistical outcome measures of post test score of AKPS for group A and group B

**TABLE1.6: COMPARISON OF POST TEST SCORES OF FIQ IN GROUP A AND GROUP B**

GROUP	Mean	SD	SEM	Mean diff	95%confidence interval	T value	P value
Group A	10.93	1.100	0.284	-1.200	-2.056 to 0.344	-2.872	0.000
Group B	12.13	1.187	0.307	-1.200		-2.872	

Table 1.6.The statistical outcome measures of post test score of FIQ for group A and group B

**Result :**

- The post test score of AKPS and FIQ shows improvement in all two groups
- The post test scores of HIP PROTOCOL (Group B) show better improvement in terms of AKPS and FIQ.
- The post test score of KNEE PROTOCOL (Group A) also shows good improvement in terms of AKPS and FIQ But as compared to group B it was less.
- Statistical supports also state that the HIP PROTOCOL would be more beneficial as compared to KNEE PROTOCOL(Group A)
- Group B shows better improvement as compared to Group

**Discussion:**

The present study compared the effectiveness of hip core strengthening and knee strengthening exercises in patients with PFPS. The findings of this study suggest that both interventions were effective in reducing pain and improving functional outcomes in patients with PFPS. However, the hip core strengthening group showed significantly greater improvement in knee function compared to the knee strengthening group, as indicated by higher post-test AKPS scores.

The results of this study are consistent with previous literature that supports the role of hip core strengthening exercises in the management of PFPS. Hip core strengthening exercises, including exercises targeting the gluteal muscles, have been shown to improve hip muscle strength, stability, and control, which in turn can lead to improved lower extremity biomechanics and reduced pain in individuals with PFPS [7,8]. The findings of this study provide further evidence that hip core strengthening exercises may be a beneficial intervention for patients with PFPS.

On the other hand, knee strengthening exercises, which typically focus on quadriceps and hamstrings muscles, have also been commonly prescribed for PFPS management. While these exercises may help improve the strength of knee muscles, the results of this study suggest that hip core strengthening exercises may be more effective in improving knee function in patients with PFPS. This is in line with recent research that has highlighted the importance of addressing hip muscle imbalances and dysfunction in the management of PFPS [9,10].

The findings of this study have clinical implications for the management of PFPS. Hip core strengthening exercises should be considered as an effective intervention for patients with PFPS, particularly in improving knee function. Physical therapists and healthcare providers should incorporate hip core strengthening exercises into their rehabilitation protocols for PFPS patients, in addition to traditional knee strengthening exercises. This may lead to more comprehensive and effective treatment strategies for PFPS, addressing both hip and knee muscle imbalances and dysfunction.

### **Limitations & Recommendations:**

Limitations of this study include the relatively short duration of the intervention (6 weeks) and the lack of long-term follow-up. Future research could explore the long-term effects of hip core strengthening exercises in patients with PFPS, as well as the optimal duration and frequency of the intervention. Additionally, this study only included participants with mild to moderate PFPS, which may limit the generalizability of the findings to more severe cases of PFPS. Further research could investigate the effects of hip core strengthening exercises in patients with severe PFPS or other populations, such as athletes or older adults.

Another limitation is the lack of blinding of participants and assessors, which may introduce potential bias. Future studies could consider using blinded assessors to minimize bias in outcome assessment. Additionally, while the sample size of this study was adequate for the statistical analysis conducted, larger sample sizes could provide more robust results and allow for subgroup analysis based on factors such as age, gender, and activity level.

### **Conclusion:**

In conclusion, the results of this study suggest that hip core strengthening exercises may be more effective than knee strengthening exercises in improving knee function in patients with PFPS. Both interventions were effective in reducing pain and improving functional outcomes, but hip core strengthening exercises showed significantly greater improvement in knee function compared to knee strengthening exercises. These findings support the inclusion of hip core strengthening exercises in the management of PFPS and highlight the importance of addressing hip muscle imbalances and dysfunction in this population. Further research with larger sample sizes and long-term follow-up is warranted to confirm these findings and provide more evidence for the optimal management of PFPS.

**Source of funding:** No funding was obtained for the study.

**Conflict of Interest:** No conflicts of interest are present.

**Ethical clearance:** The research was conducted in accordance to the ethical standards of Department of Physiotherapy, NIEPMD(Divyangjan)Govt. of India in Chennai. Written informed consent were provided by all participants prior to participation

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