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## **“Compare the Effectiveness of Core Muscle Strengthening Versus Quadriceps Muscle Strengthening in the Patient With Patellofemoral Pain Syndrome” RCT**

**Anam Shabbir, Haleema Tariq, Shahzad Ali , Javeria Ramzan , Areeza Hamid, Sana Saleem, Rimsha Ijaz, Maimoona Safdar Kiran Amin, Asna Majeed , Shanzay Qamar , Tooba Naveed, Eman Muhammad Matee Ullah, Muniba Zubair, Qurat-ul-Ain Javaid, Tehreem Faisal, Maryam Mushtaq, Bakhtawar Sikanadar, Saira Ahmed, Abida Urooj, Hamna Nadeem, Sania Maqbool**

saniamaqbool28@gmail.com

1. Anam Shabbir (King Edward Medical University Lahore)
2. Haleema Tariq (King Edward Medical University Lahore)
3. Shahzad Ali (University of Management & Technology UMT Lahore)
4. Javeria Ramzan (King Edward Medical University Lahore)
5. Areeza Hamid (University of Management & technology UMT Lahore)
6. Sana Saleem (University of Management & Technology UMT Lahore)
7. Rimsha Ijaz (Technical University of Munich, Germany)
8. Maimoona Safdar (University of Management & technology UMT Lahore)
9. Kiran Amin (University of Management & technology UMT Lahore)
10. Asna Majeed (University of Management & technology UMT Lahore)
11. Shanzay Qamar (University of Management & technology UMT Lahore)
12. Tooba Naveed (Riphah International University Lahore)
13. Eman Muhammad Matee Ullah (LCWU, Lahore)
14. Muniba Zubair (LCWU, Lahore)
15. Qurat-ul-Ain Javaid (LCWU, Lahore)
16. Tehreem Faisal (University of Management & technology UMT Lahore)
17. Maryam Mushtaq (University of Management & technology UMT Lahore)
18. Bakhtawar Sikanadar (University of Management & technology UMT Lahore)
19. Saira Ahmed (University of Management & technology UMT Lahore)
20. Abida Urooj (University of Management & technology UMT Lahore)
21. Hamna Nadeem (University of Management & technology UMT Lahore)
22. Sania Maqbool (Lecturer DPT at Lahore College for Women University Lahore)

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**ABSTRACT:** *The purpose of this study was to see the comparative effectiveness of core muscle strengthening versus quadriceps muscle strengthening in the patients of patellofemoral pain syndrome to reduce pain and increase Range of Motion (ROM). 36 patients who fulfilled the selection criteria were enrolled in the study. Written informed consent was taken from each individual participating in this prior to performing any examination. Patients with patellofemoral pain syndrome were divided randomly into three groups. In 'group A' Core muscles strengthening exercises were applied. In 'group B' quadriceps muscles strengthening exercises were applied. In 'group C' Conventional Physiotherapy was applied. Allocation of patients in three groups had done by computerized generated list. All groups received conventional therapy, which was remain same throughout the study. The conventional therapy included knee isometrics and hot pack for 15 minutes. Group A subjects were treated with conventional therapy and core muscle strengthening. Group B subjects were treated with conventional therapy and quadriceps muscles strengthening. Group C subjects were treated only with conventional therapy. Treatment frequency will be 3 times a week. The duration of treatment was 3 weeks in all groups. Informed consent was taken from each patient and Performa was filled. Visual analogue scale (VAS) and Anterior knee pain scale (AKPS) used for scoring. Group A showed marked improvement and significant results as p value is less than 0.05 than group B and group C. When treating patellofemoral pain syndrome, strengthening the core muscles is more efficient at reducing pain and enhancing functional abilities than strengthening the quadriceps. The result of this study proved that core muscle strengthening with conventional therapy was more effective than quadriceps muscle strengthening with conventional therapy and conventional therapy only.*

**KEYWORDS:** core muscle strengthening, quadriceps muscle strengthening, patient, patellofemoral, pain, syndrome

## INTRODUCTION

Patellofemoral pain syndrome (PFPS) is one of the most common musculoskeletal conditions, which is present mostly in adolescents and active in young adults. PFPS is defined as retropatellar and anterior knee pain which is characterized by crepitation in patellofemoral joint during and after weight bearing activities such as squatting, walking up or down stairs and running. The other

significant features of PFPS include pain while prolonged sitting with flexed knee, instability, weakness and locking sensation.(1)

Patellofemoral pain syndrome occurs when nerves sense pain in the soft tissues and bone around the kneecap. On the anterior side of the patella between the patellar tendon (which is attached to the patella) and the skin, there is an extra bursa (prepatellaris) which is normally not in contact with the knee capsule and ensures a better gliding of the patellartendon. There is a similar bursa (infrapatellaris) at the level of the tuberositas tibiae. When the knee is inflamed, these bursae can become hyper productive (swollen). This is possible related to increase of anterior knee pain.(2)

PFPS is characterized mainly during weight bearing activities, such as ascending and descending stairs. Its clinical presentation includes muscular weakness and altered lower limb mechanics.(3) It is a common musculoskeletal condition that is difficult to manage.(4) Patients frequently complain of a gradual onset of anterior knee discomfort that is typically unrelated to trauma but connected to an increase in the problems. Importantly, patients frequently complain patellofemoral crepitus, stiffness in the knees, difficulties doing everyday tasks, limited physical activity, and a poor quality of life, despite pain being the main symptom. (5)

PFPS is multifactorial in nature. It describes decrease in abduction; external rotation and extension strengthen of affected side when compared with healthy patients. It involves overuse injuries of extensor apparatus, patellar instability and osteochondral damage. (6)

Causes of the patellofemoral pain syndrome are excessive increase in running and repetitive activities like going up and down the stairs, malalignment of patella during movement, quadriceps muscles imbalance and tight illiotibial band. It may often result from prolonged repetitive compressive or sharing force (running, jumping) on patellofemoral joint.(7) Annual prevalence for patellofemoral pain in the general population was reported as 22.7%, and adolescents as 28.9%.(8)

Researches and clinical practices have focused on muscle function that there is an imbalance between the vastus medialis oblique and the vastus lateralis which can lead to increased lateral stress in the patellofemoral joint. Recently, patellofemoral pain was proposed to reduce hip strength and core endurance.(9)

Patellofemoral pain occurs due to maltracking of patella. This leads to inappropriate timing of quadriceps muscle activity. Patellar tracking occurs as a result of an imbalance in the dynamic relationship between the patella and trochlea. Due to patellar maltracking activation of vastus medialis is delayed.(10)

Core of the body is described as a muscular bag with the diaphragm as the roof, the pelvic floor and hip musculature at the base, abdominal in the front and Paraspinal and gluteal muscle in back.(11)

Major core muscles include pelvic floor muscles, transverse abdominis, multifidus, internal and external oblique rectus abdominis, erector spine, especially the longissimus thoracic and

diaphragm. Minor core muscles include the latissimus dorsi, gluteus maximus and trapezius. Core stability is defined as the foundation of trunk dynamic control that allows the production, transfer, and control of force and motion to the terminal segments of the lower body kinetic chain.(12)

The first line of treatment is conservative management which is non-operative interventions which include rest, ice and drug for inflammation. The physical management includes specific exercises targeting the core, hip and knee such as strengthening exercise for the core, hip and quadriceps. Strengthening of core muscle and strengthening of quadriceps are performed to reduce pain and improve the movement on the patellofemoral pain syndrome. Quadriceps muscle strengthening exercise is beneficial for improving the pain. Researches show that there is significant effect of core muscles strengthening on pain reduction.(13)

Exercise therapy helps to improve pain and function.(14)Quadriceps weakness and muscle disproportion may contribute to abnormal patellar tracking. General quadriceps strengthening and retraining of VMO could improve quadriceps strengthening. Weight-training exercise increased quadriceps muscle strength and the patellofemoral joint contact area, which could reduce mechanical stress in the joint and improve function and pain in patient with patellofemoral pain syndrome.(15)

Physical therapy is important in the management of patellofemoral pain including heat therapy, ultrasound, infrared radiations and manual therapeutic exercise. This study provided an opportunity to share my personal experience with community. This study was conducted purely in clinical setting of Physiotherapy Department Mayo Hospital, Lahore. The outcome of this study is of great value in treating patellofemoral pain syndrome which is a great contribution to the health care system of Pakistan.

## METHODOLOGY

Study design was Randomized Controlled Trial RCT. Study was conducted at physiotherapy department and rehabilitation center of Mayo hospital Lahore. Study duration was 6 months after the approval of the study. Simple Random Sampling technique was used. Sample size was 36 cases; 12 cases in each group were calculated with 95% confidence level.

Inclusion criteria :	Exclusion criteria :
<ul style="list-style-type: none"><li>• Age 20-40.</li><li>• Both male and females</li><li>• Patients having anterior knee pain for at least 4 weeks.</li><li>• Pain in anterior knee is aggravated by at least 2 of the following activities: jumping, running, prolonged sitting, stair climbing, kneeling and squatting.</li></ul>	<ul style="list-style-type: none"><li>• Meniscal or other intra articular injury.</li><li>• Cruciate or collateral ligament laxity or tenderness.</li><li>• Patellar tendon, iliotibial band pes anserine tenderness.</li><li>• Positive patellar apprehension test.</li><li>• Osgood-Schlatter disease.</li><li>• Evidence of effusion.</li><li>• History of surgery to the knee joint.</li></ul>

DATA COLLECTION PROCEDURE	<p>This research will be conducted according to inclusion and exclusion criteria for the treatment of patellofemoral pain syndrome. Consent will be taken through the consent before starting the treatment of patients. The examination will include data which will have subjective and objective examination. The data will include demographic information including age, gender, past medical history, socioeconomic status, marital status, and educational status, duration of onset, nature and location of problem. Thirty six patients who complete selection criteria were included to this study. Written informed consent was taken from every individual participating in this study before performing any physical examination. Allocation of patients in three equal groups was through random number table. On 0<sup>th</sup> day ROM were assessed by VAS and Anterior knee pain scale.</p> <p><b>GROUP A:</b> They were treated with core muscles strengthening exercise along with conventional treatment.</p> <ul style="list-style-type: none"><li>• Pelvic bridging</li><li>• Side bridging</li><li>• Cross curl up</li><li>• Seated twist</li></ul>
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	<ul style="list-style-type: none"><li>• Quadrupedal stance</li><li>• Back isometrics</li></ul> <p><b>GROUP B:</b> They were treated with quadriceps muscles strengthening along with treatment.</p> <ul style="list-style-type: none"><li>• Knee isometrics</li><li>• Box assisted squats</li><li>• Floor extension</li><li>• Lateral heel droop</li><li>• Calf raise</li></ul> <p><b>GROUP C :</b>They were treated with conventional therapy</p> <ul style="list-style-type: none"><li>• Hot pack.</li><li>• Isometrics</li><li>• Active range of motion</li><li>• Flexibility exercises</li></ul> <p>Treatment frequency was 3 times a week. Duration of treatment was 3 week in all threegroups. Subjects were examined on day zero and by the end of 3 week. All informationwas collected by a questionnaire Visual analog scale and Anterior knee pain scale.</p> <p>Data was entered and analyzed through SPSS [statistical package for social sciences] version 25.0.All qualitative variables were shown in frequency tables and percentages. All quantitative variables were shown in mean +SD along its range maximum to minimum. ANOVA test was applied for comparing the mean difference of qualitative variables. P-value &lt;0.05 will be taken.</p> <p><b>Ethical consideration</b> Patient information should be confidential and privacy of the patient should be considered</p>
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## RESULTS

Table 1 shows the descriptive analysis of group A, B and C respectively. Total 36 patients were included in this study, 12 in Group A and 12 in Group B and 12 in group C respectively. The Gender demographics depicts that 9 males,3 females in Group A, Group 2 were 3 males,9 females

and in group C 10 males and 2 females respectively. The mean age and BMI of the study participants were also mentioned in the current table.

Gender	9/3	3/9	10/2
Age	33.17 ± (6.259)	32.17 ± (7.184)	34.42 ± (5.664)
BMI	22.56±(3.35)	22.84 ± (3.08)	22.64±(3.25)

Table 2 depicts the pre and post treatment scores for VAS and AKPS for 3 groups. . Mean score of pair 1 of group A before treatment for VAS was 8.25±.866 which improved to 3.000±1.04, group B has showed that mean score before treatment was 7.0416 ± 1.37 which was improved to 5.000 ± 1.27. Pair 3 of group C improved from 7.5 ±1.167 to 6.33 ±1.07. For AKPS, Mean score of pair 1 ofgroup A before treatment was 43.50±8.61 which improved to 69.33±10.82. Pre and post treatmentcomparison of pair 2 of group B has showed that mean score before treatment was 45.83 ±10.03 which was improved to 55.33 ±9.67. Pair 3 improved from 48.50 ±6.77to 54.41±7.17 respectively.

Table 3 depicts the post treatment scores for both VAS and AKPS scale. For VAS, the group A scores were 3.00± 1.04, group B was5.0± 1.27 and group C was 6.33 ±1.07 respectively. For AKPS, group A was 69.3± 10.82, group B was 55.3± 9.67and group C was 54.41± 7.17.

**Table 1: Descriptive statistical analysis (N=36) Group A,B,C**

**Group A                      Group B                      Group C**

**Table 2: Pre and post treatment scores of Group A, B & C**

**Group A (n=12)    Group B (n=12)    Group C (n=12)**

<b>VAS</b>	<b>Pre-value</b>	8.25±0 .866	7.41±1.37	7.50±1.16
	<b>Post-value</b>	3.00± 1.044	5.00 ± 1.27	6.33 ± 1.07
	<b>p-value</b>	0.00	0.00	0.00
<b>AKPS</b>	<b>Pre-value</b>	43.5 ± 8.61	45.83 ± 10.03	48.50± 6.77
	<b>Post-value</b>	69.33 ± 10.82	55.33 ± 9.67	54.41 ± 7.17
	<b>p-value</b>	0.00	0.00	0.00

**Table 3 : Post treatment scores of Group A, B & C**

Outcomes	Group A (n=12)	Group B (n=12)	Group C (n=12)
VAS	3.00± 1.04	5.00 ± 1.27	6.33 ± 1.07
APKS	69.33 ± 10.82	55.33 ± 9.67	54.41 ± 7.17

## Discussion

The primary purpose of this randomized control trail study was to compare pain and function outcome measures for patients with PFP who were randomized into either a core or quadriceps-focused rehabilitation protocol. This study showed the greater improvement in pain and function was due to core muscles strengthening than quadriceps muscles. The present examination was done to check the efficacy of core muscle strengthening to improve patellofemoral pain. We have applied three types of treatment interventions among 36 patients with equal division. Group A had received core muscle strengthening and group B received quadriceps muscle strengthening while Group C was given conventional physical therapy protocol. Similarly, 12 patients were allocated to each group.

Our aim was comparing the results to determine which treatment technique was better. For this purpose, we had used Visual Analogue Pain Scale and AKPS functional assessment for patellofemoral pain. Proper consent was taken from each patient. This study program consisted of 3 sessions per week and in total there were 9 sessions. Follow up was also taken to check improvements in results.

After 3 weeks, we noticed that there was quite alleviation of symptoms like pain, stiffness and improvement in the physical activity. The patients that received Core muscles strengthening technique felt a large improvement in complains like decreased functional and physical activity as compared with participants that were allocated to other training group. This study calculated result of treatment effects. A considerable difference was found between the results of groups.



The participants who received therapeutic interventions performed well in all the aspects of physical activity. Although we did not meet our desired of large sample size, this was a relatively small study. This theory was also supported by other researches that core muscle strengthening are helpful for treating patients.

Another study conducted on 60 PFP patients were randomly divided into two groups: regular exercise (control) and combined core plus routine exercise intervention (M/F: 25/35, age 14 32.28 (5.9) years). For 12 weeks, home workouts were arranged at least five times per week. Before and right away after interventions, we evaluated the results of pain (Visual Analogue Scale) and function (Anterior Knee Pain Score). Both groups experienced significant improvements (P 0.001). Both outcomes showed substantial between-group differences in favor of the intervention. (16) But in that study the sample size was 60 while in our study it was 36. There were 2 groups under observation in the discussion study while in the current study the no of study groups were 3.

Another clinical experiment was carried out on 40 PFPS patients from Bogotá, Colombia, aged 15 to 40, with mild to moderate physical activity. Two intervention groups were assigned participants at random: Group A received an eight-week programme of exercises to improve the core, hip, and knee muscles. Group B received same exercises to strengthen the hip and knee muscles. Participants in intervention group A reported an improvement in their quality of life thanks to the inclusion of core muscle strengthening exercises to their conventional treatment. They also reported a substantial decrease in pain and a statistically significant difference in their overall Kujala scale score ( $p=0.025$ ). (17) But in the current study, the sample size was 36 and the core muscle strengthening exercises were more beneficial than quadriceps strengthening. The discussed study has 2 groups while the current study has groups under study.

## **Conclusion**

Core muscle strengthening is more effective in reducing pain and improving functional activities as compared to quadriceps muscle strengthening exercises in the management of patellofemoral pain syndrome.

### **Recommendations:**

Core muscle strengthening techniques greatly affect range of motion and modulate pain. If these muscle strengthening is combined with the hip muscle strengthening techniques it will further improve functional activities. Further research on a larger scale is recommended.

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