

**ORIGINAL ARTICLE****EVALUATION OF CORE MUSCLES STRENGTH IN FEMALE PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME AND HEALTHY FEMALES - A COMPARATIVE STUDY****Ankita Naik<sup>1</sup>, Dr. Deepak Anap<sup>2</sup>**<sup>1</sup>B.P.Th (Intern), <sup>2</sup>Professor and HOD in Dept. of PT in Musculoskeletal Sciences, Dr Vithalrao Vikhe Patil Foundation's College of Physiotherapy, Ahmednagar**ABSTRACT:**

**Background:** PFPS is a commonly encountered musculoskeletal condition in the young population. The core muscles serve as a muscular corset working as a unit to stabilize the body. It is the centre of the functional kinetic chain. Thus, this study aimed to compare the core muscle strength of patients with PFPS compared to healthy females. **Methods:** It was an observational study with four months duration. A total of 20 female participants were recruited with a purposive sampling method (N=10) were normal females and (N=10) were females diagnosed with PFPS. The outcome measure assessed core muscle strength using the Pressure Biofeedback Unit for both superficial and deep abdominal muscles. **Result:** The average muscle strength of the Rectus abdominis & Oblique muscle was ( $63.53 \pm 11.829$ ), which is higher than the PFPS group ( $35.46 \pm 9.54$ ). The p-value is  $<0.0001$ , which is extremely significant between both groups. For Transverse abdominis muscle, the p-value is  $<0.0001$  showing a significant difference in the muscle strength between both the groups. **Conclusion:** This study concludes that core muscle strength directly correlates with the patellofemoral joint resulting in PFPS. The study also concludes that a significant difference exists in both groups in terms of core muscle strength.

**Keywords:** PFPS. Anterior knee pain, females, core muscles, muscle strength, Pressure biofeedback unit

**INTRODUCTION:**

Patellofemoral pain syndrome (PFPS) is a very common musculoskeletal condition that accounts for 20–40% of all knee problems in adolescents and young adults and remains one of the most perplexing and clinically challenging orthopaedic conditions. It is a non-traumatic condition mostly affecting young women twice as compared to men and

causes anterior knee pain due to pathological structural changes in the knee joint.<sup>[1-2]</sup>

The most important manifestation of PFPS is the dull and diffusing type of Anterior or Retro patellar knee pain characterized by crepitation in the patellofemoral joint during and after weight-

bearing activities, such as squatting, walking up or downstairs and running. Other characteristic features include pain while sitting with the knees flexed, instability, occasional weakness and locking sensations.<sup>[2]</sup> PFPS can also be diagnosed with plain radiography, which is the standard evaluation. However, no significant differences are observed in X-ray in patients of PFPS and everyday individuals.<sup>[10]</sup> The first line of treatment for PFPS is conservative management consisting of rest, icing, anti-inflammatory drugs, and adjustment of activities and physiotherapy<sup>[11]</sup>. The core is described as a muscular box with the abdominals in the front, paraspinal and gluteal in the back, diaphragm serving as the roof, pelvic floor, and hip girdle serving as the base.

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The core is also termed as the Foundation, Engine or Powerhouse of all the limb movements. The core muscles function as a muscular corset that works as a unit to stabilize the body and spine, with or without movements. In short, the core is the centre of the functional kinetic chain. Deficiency in the neuromuscular control of the "core" may affect the dynamic stability of the lower extremity, which leads to injury in the tibiofemoral or patellofemoral joints.<sup>[21]</sup> The core muscles are responsible for strength and stabilize the spine by equally distributing the shear and compressive forces to the rest of the body and serving as the foundation to move the extremity.<sup>[22]</sup> Previous studies state that the knee is the frequently injured joint in core instability with the decreased hip strength<sup>[22]</sup>. Even though there are many studies on the management issues so far, there are no studies about the core muscle stability program for the improvement of pain and balance in PFPS patients. Thus, this study compares the core muscle strength of patients with PFPS compared to healthy females.

## METHODS

This is an Observational, Cross-sectional study with a study duration of 04 months. A total of Twenty participants were recruited using the Department of Physiotherapy and Orthopaedics purposive sampling method, Dr Vikhe Patil Memorial Hospital, Ahmednagar. The study materials included the Pressure biofeedback unit, latest medical records of patellofemoral pain syndrome patients if available. The inclusion criteria included female participants between the 20- 40 years age group with anterior knee pain, aggravated by jumping, running, stair-climbing, prolonged sitting, kneeling, and squatting. Clinically diagnosed patients with patellofemoral pain syndrome. Positive patellar grinding test. Age-matched healthy individuals without patellofemoral pain syndrome with no functional impairments related to bilateral knee

joints.<sup>[22]</sup>

While the exclusion criteria were patients with any cruciate, meniscal, collateral l ligament injuries or tenderness, any intra-articular damage, acute knee trauma, osteoarthritis, chondral defects, disc herniation, spinal referred pain, Metabolic diseases like rheumatoid arthritis and diabetes mellitus, Any previous surgery around the knee joint, patellar subluxation or dislocation, evidence of effusion and Pregnancy.<sup>[22]</sup>

## PROCEDURE

Institutional Ethical Committee approval was obtained before the commencement of the study. After explaining the importance of the research, when a patient agreed to participate in the study, a verbal and written informed consent form in Marathi/English was obtained from all the participants. The primary demographic information, clinical examination like chief complaints, pain assessment, knee joint Range of motion (ROM), special tests findings were evaluated and documented. Confirmation of the diagnosis PFPS was considered based on previous medical records and previous investigations like X-rays or MRI reports. A sample of 20 participants was recruited, among which [N=10 was PFPS group] and [N=10 were healthy female controls]. The outcome measure of this study was muscle strength for core muscles for upper rectus abdominis, lower rectus abdominis, transverse abdominis, internal and external obliques. The strength evaluation of selected core muscles was done by using a Pressure Biofeedback Unit (PBU). It is a very reliable tool for assessing muscle contraction. It is a simple and portable device that records the pressure in an air-filled pressure bag after the muscle is contracted<sup>[27]</sup>. It is especially used in spinal and abdominal muscles for recording/assessing strength and endurance. The PBU consists of a combined gauge/inflation bulb that is connected to a pressure cell.

The gauge contains  $16.7 \times 24$  cm of inelastic material, and the pressure cell measures from 0 to 200 mm Hg, with an accuracy of 2 mm. [26]

**To evaluate the strength of Transverse abdominis:** The patient was positioned in a prone lying position. The PBU was placed under the transverse abdominis muscle, i.e. on the Anterior Superior Iliac Spine (ASIS). The pressure was 70mm Hg by the therapist, and then participants were asked to contract the muscle as much as possible by drawing in the muscle movement and holding it for 10 seconds. The reflected range was noted. Like-wise total of 3 readings had been taken, and mean value was calculated [33]

To evaluate the strength of the Rectus abdominis, Internal and External obliques: The patient position was supine, lying with both the hips and knees maintained to 90 degrees and feet supported. The PBU was positioned under the Posterior Superior Iliac Spine (PSIS), and the gauge was inflated to 40 mm of Hg before the muscle contraction. The patients were asked to contract the muscle by pressing against the pressure insufficiently gently, i.e. abdominal draw-in exercise, and instructed to sustain it for 10 seconds, and the reflected range was noted. Total three readings had been taken, and the mean value was calculated, and then it was documented by the researcher.



**Fig 1:** Strength testing for rectus abdomin



**Fig 2:** Strength

**RESULT:**

The data were analyzed in an excel sheet. An instant version3 was used to calculate the mean, standard deviation and p values. The student's unpaired "t" test was used to compare between two groups.

**TABLE 1:** Baseline characteristics of patients

Group	Healthy females	Females with PFPS	Total
Number	10	10	20
Age	22 ± 10	30 ± 10	20-40

The above table shows the baseline characteristics property of the number and age. A total of 20 females participated in the study, out of which ten females were healthy and normal with no knee complaints. In contrast, the other ten females were patients with anterior knee pain complaints diagnosed as Patellofemoral pain syndrome.

**TABLE 2A:** Result for superficial abdominal muscle strength of Rectus abdominis, Internal Oblique and external Oblique in the supine lying position.

Group	Mean± SD	p value	t value	Result
Healthy females	63.53± 11.829	<0.0001	16.98	Extremely significant
PFPS females	35.46± 9.54		11.75	

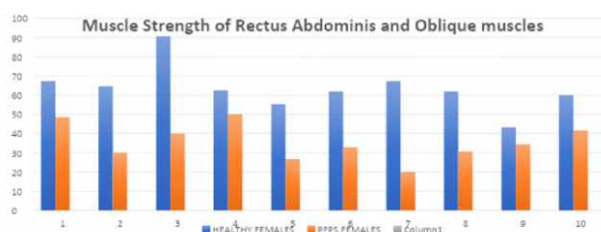
The above table depicts the mean values of superficial muscle strength among the females with and without PFPS. The mean strength of healthy females was found to be  $63.53 \pm 11.829$ . While the average strength of females with PFPS was  $35.46 \pm 9.54$ , suggesting poor muscle

strength compared to healthy normal individuals' strength. The p-value is <0.0001, which is extremely significant, which confirms that the muscle strength of PFPS females is extremely lower as compared to healthy females.

**TABLE 2B:** Result for deep abdominal muscle strength of Transverse abdominis muscle in the prone lying position.

Group	Mean± SD	p value	t value	Result
Healthy females	22.196± 6.971	<0.0001	3.746	Very significant
PFPS females	13.231± 2.945		14.207	

The table mentioned above displays the average mean muscle strength of deep abdominal muscle between both groups. It is found that the average muscle strength of healthy females is higher (mean± SD = 22.196 ± 6.971) in comparison with females with PFPS diagnosis

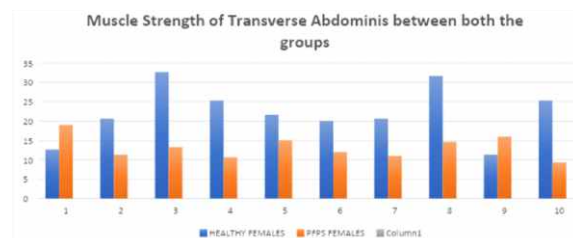


(mean± SD = 3.746± 14.207), suggesting weak muscle contraction and reduced muscle strength of TAB among the PFPS females.

Fig no.3: the above-given bar graph represents the data showing a comparison of average muscle strength for superficial abdominal muscles of Rectus abdominis, Internal Oblique and external Oblique in females with and without PFPS. The graph shows a significant difference among both groups.

**Fig no.4:** the above-given bar graph is a graphical representation of the values showing a comparison of average muscle strength Transverse abdominis muscle in prone lying position between healthy females and PFPS females. In the above graph, the ability of females with PFPS to contract deep abdominal muscle is found to be significantly lower as

compared to healthy females. Hence, the core muscle strength of PFPS patients in the female population is reduced compared to normal females.



## DISCUSSION:

Patellofemoral pain syndrome (PFPS) has become a commonly emerging musculoskeletal condition in the young female population. The term 'anterior knee pain' is suggested to encompass all pain-related problems of the anterior part of the knee. PFPS results from a malalignment of the lower extremity, which is considered a contributory factor in the development of symptoms. Other lower extremity alignment factors associated with patients with PFPS include femoral neck anteversion, genu-valgum, hyperextension of the knee, increased Q angle, tibia varum and excessive rearfoot pronation<sup>[3]</sup>. Muscle tightness of quadriceps or hamstrings has been proposed as an important factor associated with knee extensor mechanism disorders. Muscular imbalance with decreased strength because of hypertrophy or inhibition of the lower extremity muscles has been suggested as a potential cause of PFPS. Weakness of quadriceps muscle is the major finding in patients with PFPS. Studies suggest that an abnormal relationship between the VMO and VL muscle activation pattern can disturb the dynamics of the patellofemoral joint<sup>[3]</sup>. Core strengthening has recently gained the attention of researchers in various musculoskeletal conditions; despite its widespread use, research in core muscle impairments and its strengthening is a meagre concept. Numerous research publications are



found to be providing evidence of altered kinematics of hip and ankle joints among patients with PFPS. In contrast, very few to no studies directly correlate between core muscles' insufficient strength and anterior knee pain in PFPS patients. Hence, this study was conducted to assess abdominal muscle strength of core among female patients with PFPS and healthy females and compare the strength of core muscles between both the groups to check for any correlation between core and the knee joint in the body. This was an observational cross-sectional study performed on 20 female participants. After considering oral and verbal informed consent, the abdominal muscle strength for core muscles was evaluated by the Pressure biofeedback unit tool in supine and prone lying positions for three muscle contractions. In our study, we only included females looking at the highest prevalence mentioned in the literature. Gretchen B. Salsich<sup>[9]</sup> et al. conducted a study that suggests anterior knee aching pain is precisely seen twice in females as compared to male due to excessive hip adduction and internal rotation, increased Q-angle, wider pelvis, that results in knee joint adduction and hence reduces the dynamic stability of knee joint<sup>[9]</sup>. Hence this study was particularly focused on the female population diagnosed with PFPS. The core is a vital component of the body; it is described as passive structures of the thoracolumbar spine and pelvis and the active contributions of the trunk musculature in the abdominals' front, paraspinal, and gluteal back. It serves as the centre of the functional kinetic chain for the lower extremity<sup>[21]</sup>. Core stability is generally defined as a foundation of dynamic trunk control that allows production, transfer, and control of force and motion to distal segments of the kinetic chain. Bohdanna T. Zazulak et al. suggested that a deficit in core neuromuscular control may contribute to unstable behaviour and injury

throughout all kinetic chain segments. Consequently, impaired core proprioception and insufficient muscle strength of core muscles may lead to impaired core control and dynamic instability. This, in turn, affects control of the knee and may lead to a knee injury of the tibiofemoral joint resulting in PFPS<sup>[21]</sup>. Sommer et al. Reported that insufficient ability of the core muscles (abdominal, gluteus and hip) to generate torque result in excessive femoral adduction and internal rotation increases the dynamic instability of the knee joint. The core acts through the thoracolumbar fascia, also known as "nature's back belt." In other terms. the thoracolumbar fascia serves as part of a "hoop" around the trunk that connects the lower limb and the upper limb. With the contraction of the muscular contents, the thoracolumbar fascia also functions as a proprioceptor, providing feedback about trunk positioning. One of the limitations of this study was a smaller sample size, and it wasn't calculated statistically. Also, this study primarily focused on the female population due to its high incidence and prevalence in females. Thus, in future, studies can be undertaken on large sample size, including male patients into consideration. However, the result found after conducting this study reveals an extremely significant difference in core muscles of female patients in PFPS, which indicates that the core being the centre of functional kinetic chain and foundation of the body responsible for lower extremity movement, when is incapable and insufficient of its stabilizing effect on the spine, reduced dynamic postural control and neuromuscular control can lead to malalignment of the knee joint resulting into PFPS. Hence, this study provides evidence that female patients with PFPS have weak proximal muscle strength of abdominals compared to normal individuals.

## CONCLUSION:

The study concludes that there is a direct correlation between impaired core muscle strength to anterior knee pain among females with PFPS. The above study found a significant difference in core muscles strength in females with PFPS compared to normal healthy females.

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