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Effects of hip abductors and lateral rotators strengthening versus core muscles strengthening on pain and function in women with patellofemoral pain syndrome

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Abstract
The purpose of the study is to compare the effectiveness of hip abductor strengthening and lateral rotators strengthening along with conventional knee exercises versus core muscle strengthening along with knee conventional exercises on pain and function in women with patellofemoral pain syndrome by the end of 6 week. 40 participants were taken ranging from 20-40 years of age, they were selected on the basis of inclusion and exclusion criteria and were divided into 2 groups by simple random sampling method. The subjects were evaluated before and after 6 week Statistical analysis of the data was done using paired t test within group and unpaired t test between groups, there was statistical difference within pre and post analysis of hip abductors and lateral rotators strengthening on pain and function (p value < 0.0001) and pre and post analysis of core muscle strengthening on pain and function (p value < 0.0001), when comparison was done between the groups hip abductors and lateral rotators strengthening exercise was statistically more effective in reducing pain and improving function on NPRS and LEFS as compared to core muscle strengthening.

Keywords: hip abductor, lateral rotators, strengthening, patellofemoral pain syndrome

1. Introduction

- Patellofemoral Pain Syndrome is a frequent musculoskeletal disorder, which accounts for 20-40% of all knee problem. Patellofemoral Pain Syndrome is described as retro patellar or anterior knee aching pain without any other specific pathology and characterised by crepitation in patellofemoral joint during weight bearing activities, such as squatting, walking, up or down stairs and running. The other characteristics feature of Patellofemoral Pain Syndrome include pain during sitting with knees flexed, instability, occasionally weakness and locking sensation [1].
- The spine, abdominal region, pelvis, and proximal lower extremity are known as the core of the body. This is sometimes defined as the muscular box, with diaphragm as the roof, the pelvic muscles as the floor, abdominals in front, and paraspinal muscle and gluteal muscle in the back. These muscles strength allows the system to stabilize the spine mechanically and then distribute and deliver the translational, compressive and shear forces to and from the rest of the body. The core muscles serve as the foundation order to move the extremity, the effect of core muscles strengthening have been proven as an effective method of management in various cases. Previous studies states that knee is the frequently injured joint in core instability [1].
- Hip muscle weakness have also been proposed to contribute Patellofemoral Pain Syndrome. Proximal factors including hip muscle weakness have also been proposed to contribute to patellofemoral malalignment and the development of patellofemoral pain. Recent kinetic analysis of running reveals that, although the largest knee joint moments occur in the sagittal plane, the knee is also subject to significant frontal and transverse plane moments. Additional research has shown that women, as compared to their male counterparts, exhibit significantly greater external knee valgus moments and associated movement into knee valgus and hip internal rotation. The ability of women to control these motions may depend on the strength of proximal muscle groups that are antagonistic to these movement tendencies. In the absence of sufficient proximal strength, the femur may adduct or internally rotate, further increasing lateral patellar contact pressure. Repetitive activities with this malalignment may eventually lead to the retro patellar articular cartilage damage generally associated with this patella femoral pain syndrome [2]. All patients included in the trial were sedentary, defined as not having practiced physical activity (aerobic and strengthening exercises) any day of the week for at least 6 months previously [5]. Hence the current study is to compare the effect of the hip abductors and lateral rotators strengthening with core muscles strengthening.

2. Methodology

2.1 Purpose

The purpose of the study was to compare the effect of hip abductors and lateral rotators strengthening versus core muscles strengthening in females with patellofemoral pain syndrome

2.2 Selection of the subjects

40 subjects ranging from 20 to 40 years having patellofemoral pain syndrome with a positive clark's test and functional disability were included, the subjects were

selected by simple random sampling method from in and around Pune city.

2.3 Procedure

Subjects were divided into two groups, Group A received hip abductors and lateral rotators strengthening along with conventional knee exercises and Group B received core muscle strengthening along with conventional knee exercise. The duration varied from 20 to 30 minutes for both the training techniques.

Exercise protocol for both the groups are as following

Table

GROUP A	GROUP B
Warm up: active movement of low back, hip, knee. ▪ Dynamic stretching of trunk and lumbar muscles, static marching. ▪ Static exercises for hamstrings. ▪ Static exercises for quadriceps. ▪ Static exercises for abdominals.	***Warm up:*** active movement of low back, hip, knee. ▪ Dynamic stretching of trunk and lumbar muscles, static marching. ▪ Static exercises for hamstrings. ▪ Static exercises for quadriceps. ▪ Static exercises for abdominals.
Strengthening protocol: ▪ 3 days/week ▪ Repetition- 10/exercise ▪ Set- 3 sets/exercise ▪ Load- 70% of 1 RM ▪ Weight cuff will be used.	***Strengthening protocol:*** ▪ 3 days/week ▪ Repetition- 10/exercise ▪ Set- 3 sets/exercise ▪ Load- 70% of 1 RM
Conventional knee exercises: **Stretching-** Hamstring, Quadricep, Iliotibial band (hold- 30 seconds, 3set/day) **Exercises-** Seated knee extension, squatting, single leg raising, prone knee flexion (weight cuff- load of 70% of 1 RM)	***Conventional knee exercises:*** **Stretching-** Hamstring, Quadricep, Iliotibial band (hold- 30 seconds, 3set/day) **Exercises-** Seated knee extension, squatting, single leg raising, prone knee flexion (weight cuff- load of 70% of 1 RM)
Hip muscle strengthening: Hip abduction (side lying) Hip abduction(standing) Hip lateral rotation	***Core muscle strengthening:*** Curl up Diagonal curl up Bilateral straight leg raising Double knee to chest

Table 1: Intra group numerical pain rating scale (Group A)

NPRS	PRE	POST
MEAN	6.444	4.222
SD	1.333	1.309
P VALUE	<0.0001 (considered extremely significant)	

Table 2: Intragroup lower extremity functional score (Group A)

LEFS	PRE	POST
MEAN	44.444	67.111
SD	5.305	4.651
P VALUE	<0.0001 (considered extremely significant)	

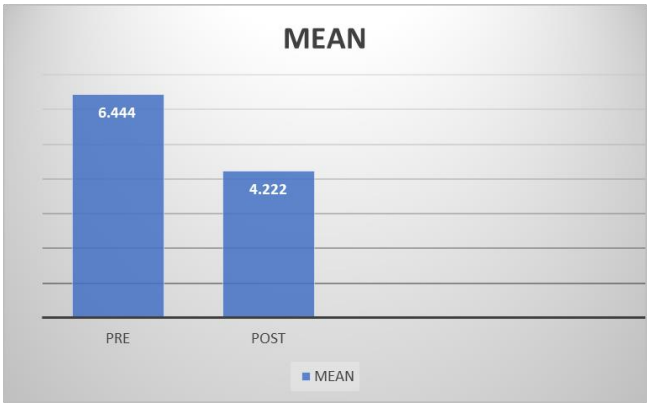

Fig 1

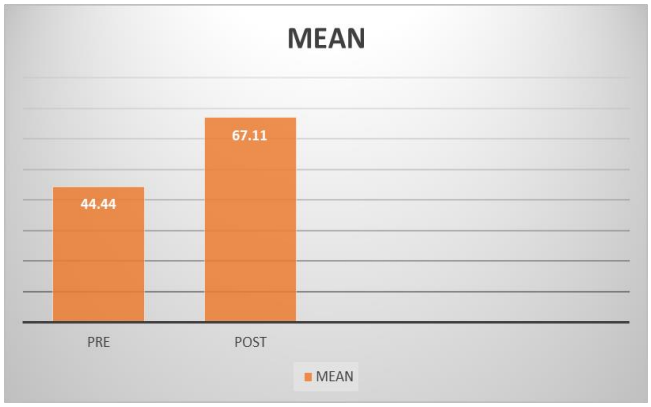

Fig 2

Table 3: Intragroup numerical pain rating scale (Group B)

NPRS	PRE	POST
MEAN	6.5	5.5
SD	1.098	0.985
P VALUE	<0.0001 (considered extremely significant)	

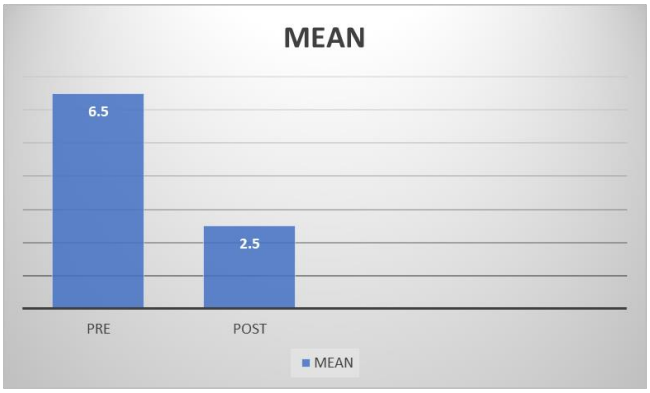

Fig 3

Table 4: Intragroup lower extremity functional score (Group B)

LEFS	PRE	POST
MEAN	45.667	60.667
SD	5.626	5.780
P VALUE	<0.0001 (considered extremely significant)	

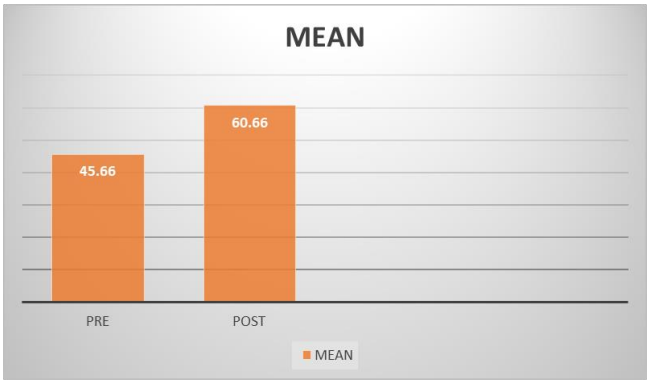

Fig 4

Table 5: Intergroup numerical pain rating scale (Group A vs Group B)

NPRS	POST (GROUP A)	POST (GROUP B)
MEAN	4.222	5.500
SD	1.309	0.985
P VALUE	0.0067 (considered very significant)	

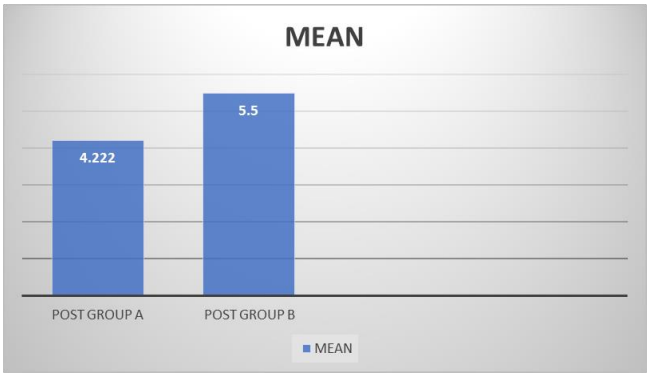

Fig 5

Table 6: Intergroup lower extremity functional score (Group A vs Group B)

LEFS	POST (GROUP A)	POST (GROUP B)
MEAN	67.111	60.667
SD	4.651	5.780
P VALUE	0.0019 (considered very significant)	

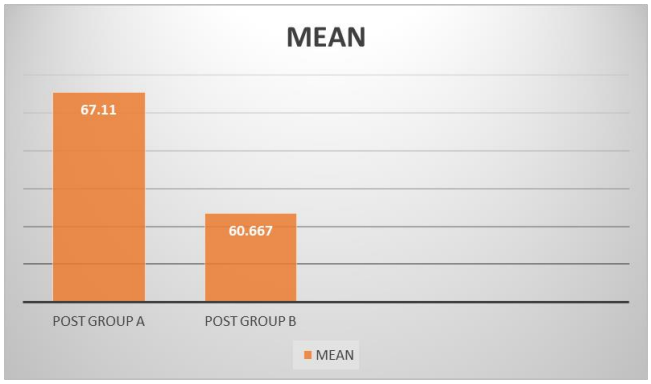

Fig 6

3. Result

NPRS Score

- Mean value for NPRS were 4.222±1.309 and 5.5±0.985 for Group A and Group B respectively
- Unpaired t test was used to compare effectiveness in both the groups.
- The p value was 0.0067 which is considered very significant.

LEFS Score

- Mean values for LEFS scale were 67.111±4.651 and 60.667±5.780 for Group and Group B respectively.
- Unpaired t test was used to compare effectiveness in both the groups.
- The p value was 0.0019 which is considered very significant.

4. Discussion

- Patellofemoral Pain Syndrome is described as retro patellar or anterior knee aching pain without any other specific pathology and characterized by crepitation in patellofemoral joint during weight bearing activities, such as squatting, walking, up or down stairs and running. The other characteristics feature of Patellofemoral Pain Syndrome include pain during sitting with knees flexed, instability, occasionally weakness and locking sensation. It is more prevalent in females than in males. The present study was done to evaluate and compare the effectiveness of hip abductor and lateral rotators strengthening versus core muscle strengthening on pain and function in sedentary women of patellofemoral pain syndrome. This study includes 40 subject (female) in the age group of 20-40 years. Both hip musculature and core musculature strengthening along with knee conventional exercises which included stretching of hamstring, quadricep, Iliotibial band, prone knee bending, squatting, single leg raising. The duration of the protocol was 6 weeks with treatment given for 3 days a week.
- When pre and post analysis was done within hip abductor and lateral rotator strengthening along with conventional knee exercises (Group A) it showed that

the treatment was effective in reduce pain and disability. The data analyzed by paired t test within the group showed significant statistical difference in all two outcome measures. *Sommer* visually observed a stereotypical motion pattern into knee valgus and femoral internal rotation during the acceleration phase before take-off during jumping in healthy, fatigued, male and female subjects. Similarly, more recent, sophisticated kinematic analysis of subjects during athletic movements has confirmed this movement pattern, particularly in women. Our results indicate that females with PFP may have insufficient strength to resist these external valgus and internal rotation moments. Consequently, the femur may excessively adduct and internally rotate during athletic movements, promoting lateral patellar tracking and increasing lateral retro patellar contact pressure. Repetitive movements with this alignment may cause injury to the retinaculum, retro patellar articular cartilage, or subchondral bone.12 These results in combination with previous empirical evidence suggest that proximal stabilization programs may be beneficial for the treatment of PFP.

- Within the group B (core muscle strengthening and conventional knee excises), pre and post analysis within the group done by paired t test also showed significantly difference post the intervention in reducing pain and improving function. The spine, abdominal region, pelvis, hips, and proximal lower extremities, are defined as the core of the body. This is sometimes defined as a muscular box, with the diaphragm as the roof, the pelvic floor and hip girdle musculature as the base, abdominals in the front, and the paraspinal and gluteal muscles in the back. These muscles' strength allows the system to stabilize the spine mechanically and then distribute and deliver translational, compressive, and shear forces to and from the rest of the body. The core or the compound of muscles consists of the static and dynamic anatomy at the zone that serves as the foundation in order to move the extremity. The effects of core muscle strengthening have been proven as an effective method of management in various cases. Previous studies states that the knee is the frequently injured joint in core instability with the decreased hip strength. Even though there are many studies on the management issues of PFPS, so far, there are no studies about the effectiveness of the core muscle stability program for the improvement of pain and balance in PFPS patients.
- The inter group analysis done using unpaired t test showed that while both the strengthening protocol are individually effective in reducing pain and improving function. The hip abductor and lateral rotator strengthening along with knee conventional exercises was more effective as compared to core musculature strengthening along with knee conventional exercises in reducing pain and improving function according to statistical analysis. Hip weakness is associated with excessive dynamic valgus of the knee, it is noteworthy that few clinical trials have investigated the effectiveness of programs to strengthen the hip musculature as part of the treatment strategy for PFPS.13,26,35 A recent study conducted by Fukuda *et al*15 compared the short-term effect of specifically strengthening the muscles around the knee with a group that also performed exercises to strengthen the hip abductors and lateral rotators. In addition, the study included a control group that neither received treatment nor performed exercises. The authors concluded that, in the short term, both treatment approaches were more effective than no treatment for improving function and reducing pain. However, improvements were greater in the group that performed a combination of hip- and knee-strengthening exercises. Based on the obtained results, it is thought that the muscles that directly influence the hip also affect the knee.2,30 Specifically, the posterolateral hip musculature can contribute to control ground reaction forces and the dynamic valgus alignment of the lower extremity during daily activities.

5. Conclusion

This study concluded that both hip musculatures strengthening along with knee conventional exercises and core musculature strengthening along with knee exercises are effective in reducing pain and improving function but hip musculature strengthening along knee conventional exercises are more effective than core musculature strengthening along with knee conventional exercises.

Limitation

- The sample size was less
- Absence of follow up after duration of study ended.

Future scope

- Larger sample size can be taken.

6. References

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