



# International Journal of Medical and Exercise Science

(Multidisciplinary, Peer Reviewed and Indexed Journal)

## ORIGINAL ARTICLE

**COMPARING THE EFFECTS OF SPECIFIC HIP STRENGTHENING EXERCISES AND CONVENTIONAL KNEE EXERCISES IN SPINTERS WITH PATELLO-FEMORAL PAIN SYNDROME**

Search engine:  
[www.ijmaes.org](http://www.ijmaes.org)

**M.S.Sundaram, MPT<sup>1</sup>, Merlin<sup>2</sup>**

**Corresponding Author:**

<sup>1</sup>Professor, School of Physiotherapy, Vels University, Chennai, India. Mail id: [sundaram.sp@velsuniv.ac.in](mailto:sundaram.sp@velsuniv.ac.in)

**Co author:**

<sup>2</sup>BPT Internee, School of Physiotherapy, Vels University, Chennai, India.

### *Abstract*

**Background and purpose:** Patello femoral pain Syndrome is an over use injury and one of the commonest problems seen in adolescents who are physically active. Till date no study has been done comparing the effect of adding specific hip strengthening exercises (gluteus medius, gluteus maximus & lateral rotators) over conventional exercises in subjects with Patello femoral Pain Syndrome. **Objective:** The objective of the study is to compare the effects of hip Strengthening exercises and Conventional Knee exercise among female sprinters with Patello femoral pain syndrome. **Methods:** 30 subjects with age group 17-22 were participated in this study. Subjects were divided in to two equal groups with 15 samples in each group. Group A performed specific weight bearing hip strengthening exercises and Group B performed Hip strengthening exercise with resistance along with conventional knee exercise. Both group performed the exercises for four(4) weeks. Outcome was messured before and after the treatment. **Result:** Pre-post-test within the group found significantly effective on both groups. Comparative study found that there is significant difference on effect between the groups with P-value 0.0001. Group B found more effective compared to Group-A with hip strengthening resistance exercise and conventional exercise over hip strengthening exercise alone. **Conclusion:** This study concluded that both exercise program are effective in reduction of pain, improvement of muscle strength and functional staus, but combined exercise program was more effective among female sprinters with Patello femoral pain syndrome.

**Keywords:** Patello-femoral Pain syndrome (PFPS), Numerical Pain Rating Scale (NPRS), Anterior Knee Pain Scale (AKPS), Manual Muscle Testing (MMT), Conventional exercise.

Received on 19<sup>th</sup> April 2017, Revised 18<sup>th</sup> May 2017, Accepted on 29<sup>th</sup> May 2017

## INTRODUCTION

**Patello femoral Pain Syndrome:** Patello femoral pain syndrome is a broad term used to describe pain in the front of the knee and around the patella, or kneecap. Patello femoral pain syndrome occurs when the patella (kneecap) rubs on the femur bone underneath. It is often thought that incorrect tracking or rubbing of the patella over the femur bone is a significant factor and results in damage or irritation of the articular cartilage underneath the patella. Damage to the cartilage itself cannot directly cause pain because there are no blood vessels or nerves involved. However it can lead onto other problems which in turn result in pain. These include synovitis (inflammation of the synovial membrane or joint lining), erosion of the cartilage and bone under the patella, soft tissues injury or irritation for example to the lateral retinaculum and the infra patella fat pad <sup>1, 2, 3</sup>.

Patello femoral pain syndrome is also called as "runner's knee" because it is common in people who participate in sports—particularly females and young adults—but patello femoral pain syndrome can occur in non-athletes, as well. The pain and stiffness it causes can make it difficult to climb stairs, kneel down, and perform other everyday activities.

The population at most risk from Patello femoral pain syndrome are runners, cyclists, basketball players and other sports participants. The initial cause of patello femoral pain syndrome is likely to be overuse. Onset can be gradual or the result of a single incident and this may be from external factors for example a sudden increase in training regime that includes dramatic increases in training time, distance or intensity or performing high intensity jumping and knee bending, worn or the wrong type of footwear or it can be from internal factors such as poor patella tracking, patellar mal-alignment, increase in Q-angle, quadriceps weakness, decreased flexibility of lower extremity and muscle imbalance which results in an increase in cartilage and subcondral bone stress. Identifying the cause is an important part of treatment it can be compounded symptoms include discomfort while sitting with bent knees or descending stairs and generalised knee pain <sup>4, 5</sup>.

Treatment involves resting and physical therapy that includes stretching and strengthening exercises for the legs. Excessive hip internal rotation and lateral patellar displacement has been seen in patients with Patello femoral pain syndrome. So to limit this excessive hip internal rotation, it appears appropriate to design

rehabilitation program using therapeutic exercise.

Patello femoral pain Syndrome is an over use injury and one of the commonest problems seen in adolescents who are physically active. Till date no study has been done comparing the effect of adding specific hip strengthening exercises (gluteus medius, gluteus maximus & lateral rotators) to conventional exercises in subjects with Patello femoral Pain Syndrome (PFPS) <sup>6,7</sup>.

#### **Need of the study:**

The purpose of the study is to implement the best treatment to relieve pain on patello femoral pain syndrome patients.

#### **Objective of the Study:**

Objective of the study was to Compare the effects of Hip Strengthening exercises and Conventional Knee exercise on relieve pain, Muscle strength and Improve functional status in Female sprinters with Patello femoral pain syndrome.

**Null hypothesis:** There is no significance difference in improving muscle strength and functional status and reducing pain through conventional knee exercise and hip strengthening exercise.

**Alternate hypothesis:** There is significance difference in improving muscle strength and functional status and reducing pain through conventional knee exercise and hip strengthening exercise.

#### **METHODOLOGY**

**Study Setting:** YMCA, Nandhanam, Chennai, was the study setting area for this study.

**Study Design :** Comparative experimental study design.

**Study Duration:** The study conducted for a duration of 4-Weeks.

**Sample Size:** Total 30 samples were selected for this study, then equally divided in to 15 subjects by lottery method for Group A and Group B.

#### **Inclusion criteria:**

Female athletes, Age group between 17-22 years, Positive patellar compression test, Subjects having anterior knee pain for least 4 weeks, Muscle power for quadriceps, hamstring, gluteus medius and gluteus maximus should be grade 3 and Pain aggravates during any of the following two activities like ascending & descending stairs, squatting, kneeling, jumping, running, jogging, Average pain level of 3-cm or more on a 10-cm Numerical pain rating scale.

**Exclusion criteria:**

Any neurological disorder, Injury to lumbosacral region, hip or ankle, Rheumatoid arthritis, Pregnancy, Patellar instability, history of knee injury, signs or symptoms of other pathology, a recent history (within 3 months) of knee surgery, a history of patellar dislocation/subluxation, or clinical evidence of meniscal lesion, ligamentous instability, traction apophysitis around the patello femoral complex, patellar tendon pathology, chondral damage, osteoarthritis, or referred pain from the spine.

Features that could affect the implementation of the trial: Previous experience with patellar taping, an inability to attend a physical therapy clinic for a 4week treatment program.

**Outcome Measures:** Pain evaluated with Numerical Pain Rate Scale(NPRS), Manual Muscle Testing (MMT) to evaluate muscle strength and functional status evaluated by AKPS (Anterior Knee Pain Scale) questionnaire.

**Procedure:** Subjects who fulfilled inclusion criteria are taken for the study. All the subjects were explained about the study and informed consent was obtained. Thirty number of female sprinters age between 17-22 years are selected. Before conducting the

actual method for subjects, Patello femoral pain syndrome evaluation is done.

First day before treatment, pain evaluation were done by using visual analogue scale consisting of 10cm horizontal line with anchor point of 0(no pain) and 10(maximum pain) and patient were asked to mark the point up to which they feel the pain. Muscle power was assessed by MMT (Manual Muscle Testing) and the function level are tested by given AKPS (Anterior Knee Pain Scale) questionnaire and asked to mark the results. Subjects were divided into 2 groups randomly. Each group consisting of 15 patients.

Group A were given conventional knee exercise and weight bearing hip strengthening exercise, Group B were given conventional knee exercise and hip strengthening exercise with resistance. Both groups are given with the above said methods for alternative days in a week for 4 weeks. Subjects were instructed to perform conventional knee exercise and hip strengthening exercise for 10 repetitions of each set, 3 times a day for 4 weeks. At the end of program subjects are reassessed by recording muscle strength, pain intensity and functional level. Finally pre and post recordings were compared and analyzed.

**Interventions:****Conventional knee exercise for both Group A and Group B:**

Conventional knee exercise includes the following exercises; Stretching, Squatting, seated knee extension, Prone knee flexion, single leg calf raise.

Stretching for quadriceps, hamstring, Iliotibial band [3 repetitions with 10 sec hold]. Squatting[0°– 45°/3 sets of 10 repetitions], Seated knee extension [90°- 45°/3 sets of 10 repetitions ], Prone knee flexion [ 0°- 90° / 3 sets of 10 repetition], Single leg calf raise[ 3 sets of 10 repetition ].

**GROUP A: Hip strengthening exercise against gravity**

Clam in side lying [ 3 sets of 10 repetition ],

unilateral bridging[ 3 sets of 10 repetition], hip extension in quadruped on elbows with knee extension[3 sets of 10 repetition], hip extension in quadruped on elbows with knee flexion[3 sets of 10 repetition].

**GROUP B : Hip strengthening exercise with resistance**

Clam in side lying with resistance [ 3 sets of 10 repetition ]. Unilateral bridging with resistance [3 sets of 10 repetitions]. Hip extension in quadruped on elbows with knee extension with resistance [ 3 sets of 10 repetitions]. Hip extension in quadruped on elbows with knee flexion with resistance [ 3 sets of 10 repetitions].

For initial 2 weeks, resistance is given with sand bag of 2 kg weight, for next 2 weeks the sand bag weight is increased to 4 kg.

**RESULT****Discriptive statistics:****GROUP-A: Conventional knee exercise with Hip Strengthening exercise against gravity**

Outcome	Mean		Standard Deviation		t - value	p - value
	Pre - Test	Post -Test	Pre -Test	Post -Test		
<b>NPRS</b>	6.2	4.2	1.06	0.77	9.3737	0.0001
<b>AKPS</b>	45.93	71.13	7.69	4.22	11.1190	0.0001

**Table1.** Pre-post test for NPRS and AKPS for Group A

**Group-A**

OUTCOME (MMT)	MEAN		STANDARD DEVIATION		t - value	p - value
	Pre -Test	Post-Test	Pre -Test	Post -Test		
QUADRICEPS	2.76	3.83	0.523	0.481	12.2202	0.0001
HAMSTRINGS	2.76	3.90	0.523	0.481	12.2202	0.0001
HIP ABDUCTORS	3.13	4.23	0.372	0.362	12.4746	0.0001
HIP EXTERNAL ROTATORS	3.16	4.23	0.372	0.417	6.0894	0.0001

**Table 2.** Pre-post test for hip muscles strength for Group A**GROUP-B: Conventional knee exercise with Hip Strengthening exercise with resistance.**

OUTCOME	MEAN		STANDARD DEVIATION		t - value	p - value
	Pre - Test	Post - Test	Pre -Test	Post -Test		
NPRS	5.86	2.73	1.30	1.03	9.7399	0.0001
AKPS	41.26	81.86	6.05	3.31	20.8065	0.0001

**Table 3.** Pre-post test for NPRS and AKPS for Group B**GROUP - B**

OUTCOME (MMT)	Mean		Standard Deviation		t - value	p - value
	Pre -Test	Post-Test	Pre -Test	Post -Test		
QUADRICEPS	2.76	3.83	0.372	0.556	11.1169	0.0001
HAMSTRINGS	2.76	3.90	0.372	0.604	10.9898	0.0001
HIP ABDUCTORS	3.13	4.23	0.297	0.320	15.1987	0.0001
HIP EXTERNAL ROTATORS	3.16	4.23	0.297	0.320	12.6021	0.0001

**Table 4.** Pre-post test for hip muscles strength for Group B

The pre-test and post-test mean value tables (Table-1,2,3,4) shows that both group has significant improvement. Although improvement was seen in both groups, Group-B (hip strengthening with resistance) improved better compared to Group-A(hip strengthening against gravity).

## DISCUSSION

Patello-femoral pain syndrome (PFPS) is one of the com-mon problems among physically active individuals be-tween the ages of 15 and 30<sup>1</sup>. It is an overuse injury char-acterized by aching pain in the prepatellar area.

The study compared the effectiveness of adding specific hip strengthening exercises to conventional knee exercises in patients with Patello femoral pain syndrome. The sub-jects in this study had similar baseline values of all depen-dent variables suggesting that all groups had homogenous distribution of patients. The results of this study revealed that although both treatment techniques were effective in reducing pain, improving muscle strength and improving functional status but statistically there was a significant difference between both the groups at the end of 4th week suggesting that Group B treatment protocol i.e. the specif-ic hip strengthening exercises (hip abductors and external rotators) to conventional treatment protocol in patients with patello-femoral pain syndrome is a better treatment option than conventional treatment alone in patients with PFPS<sup>8</sup>.

The results of our study are in accordance with the results of previous studies. According to McMullen et al (1990),

isometric quadriceps exercises such as straight leg raises can facilitate quadriceps activation without stressing the patello-femoral joint and minimizes patello-femoral joint reaction forces, because the patella has no contact with the femoral condyles in the full extension position<sup>9</sup>.

Kaya et al (2012) suggested that the prescription of the quadriceps strengthening exercise for the patients with PFPS must be well-designed because the contact area be-tween the patella and the femur changes throughout knee flexion and extension. In closed kinetic chain exercises, movement at one joint produces predictable movements at all other joints. Weight bearing closed kinetic chain activi-ties may increase joint compressive force and thus enhance joint stability<sup>10,11</sup>.

Nakagawa et al (2008) et al in his study suggested an as-sociation between hip muscle weakness or motor control impairment and the patello-femoral pain syndrome. Poor hip control may lead to abnormal patellar tracking, in-creasing patello-femoral joint stress and causing wear on the articular cartilage. Especially poor eccentric hip abduc-tors and lateral rotators muscles control can result in fem-oral adduction and medial rotation during weight-bearing activities, leading to a predisposition to lateral patellar tracking as the femur medially rotates underneath the pa-tella. A possible treatment for the patello-femoral pain syn-drome could include optimizing hip abductors and lateral rotators muscle function to control these femur motions and prevent or reduce greater lateral forces acting on the patella<sup>12</sup>.

Fukuda et al (2012) have shown an association between hip muscle weakness, especially of the abductors and lateral rotators and changes in kinematic patterns of the lower extremity. Some evidence suggests that these strength deficits may lead to excessive medial rotation and adduction of the femur, which in turn may lead to excessive dynamic valgus alignment of the knee in symptomatic patients with PFPS when compared to controls.

Mechanically, weakness of the hip musculature could lead to increased femoral adduction, flexion, and medial rotation during dynamic weight-bearing activities, which would increase the lateral patello-femoral joint vector, leading to patellar facet overload. It is noted that most major muscle groups at the hip control movements in 2 or 3 planes (sagittal, frontal, and transverse). The gluteus maximus, for example, can produce hip abduction, and lateral rotation. For this reason, they developed a protocol composed of strengthening exercises for hip abductor, lateral rotator muscles.

However, it is well documented that the recurrence rate of PFPS can be as high as 91%. These findings would suggest that, although a conventional knee-stretching and strengthening program may produce successful short-term outcomes, the inclusion of hip strengthening may be needed to prevent recurrence of future symptoms<sup>13, 14</sup>.

Selkowitz (2013) in his study investigated that which exercises would best activate the Gluteus Medius and Superior Gluteus Maximus while minimizing TFL activity. He stated that abnormal hip kinematics (i.e,

excessive hip adduction and internal rotation) has been linked to certain musculoskeletal disorders.

The TFL is a hip abductor, but it also internally rotates the hip. As such, it may be important to select exercises that activate the gluteal hip abductors while minimizing activation of the TFL. So if the goal of rehabilitation is to preferentially activate the gluteal muscles while minimizing TFL activation, then the Clam, Sidestep, Unilateral Bridging, Quadriceps with Knee Extension, and Quadriceps with Knee Flexion exercises appear to be most appropriate. This is based on the fact that all of these exercises produced significantly greater normalized EMG in both the Gluteus Medius and the Superior-Gluteus Maximus muscles relative to the TFL<sup>15, 16, 17</sup>.

The results of the study indicated that although both treatment groups resulted in significant improvements in pain, muscle strength and functional status, the Group B treatment protocol i.e. Addition of specific hip strengthening exercises with resistance of Gluteus maximus and Gluteus medius to conventional treatment protocol was statistically better compared to group where only hip strengthening was given without resistance.

#### **Limitation of the study:**

The sample size was minimal. There was no follow-up. Study was done only on subjects with female sprinters, sedentary life-style were not included in the study.



**Recommendations for further study:**

Future study can be done with large number of samples. Sports people like foot ball , volley ball , basket ball , kabadi players can also be included for future study. Research can be done with male athletes. Sedentary people can also be included in future study.

**CONCLUSION**

The study compared the effectiveness of adding specific weight bearing hip strengthening exercises for group A and hip strengthening exercise with resistance for group B along with conventional knee exercise for both groups in athletes with Patello-femoral pain syndrome and it is concluded that Pain decreased significantly in group B as compared to group A, Functional status improved significantly in group B as compared to group A and Muscle strength increased significantly in group B as compared to group A.

Group B treatment protocol i.e. "Hip specific strengthening with resistance (gluteus medius and gluteus maximus) in addition to conventional treatment in athletes with patello-femoral pain syndrome", was found to be effective in reducing pain, improving functional status and increasing muscle strength than Group A treatment protocol i.e. "Knee strengthening and stretching and weight bearing hip strengthening exercises". Hence it is concluded that Group B treatment protocol is effective therapeutic option in the treatment of athletes with Patello femoral pain syndrome.

**REFERENCE**

1. De Haven KE, Lintner DM. Athletic injuries: comparison by age, sport and gender. *Am J Sport Med.* 1986; 14(3):218-224.
2. Theresa Helissa Nakagawa, Thiago Batista Muniz, Rodrigo de Marche Baldon. The effect of additional strengthening of hip abductor and lateral rotator muscles in patellofemoral pain syndrome: a randomized controlled pilot study. *Clinical rehabilitation* 2008; 22(12):1051-1060.
3. Sameer Dixit, John P. Difiori, Monique Burton, Brandon Mines. Management of patellofemoral pain syndrome. *Am Fam Physician.* 2007; 75(2): 194-202.
4. Fredericson M, Yoon K. Physical examination and patellofemoral pain syndrome. *American Journal of Physical Medicine and Rehabilitation.* 2006; 85(3): 234-243.
5. Powers CM, Ward SR, Fredericson M, Guillet M, Shellock FG. Patellofemoral kinematics during weight-bearing and non-weight bearing knee extension in persons with lateral subluxation of the patella: a preliminary study. *J Orthop Sports PhysTher.* 2003;
6. Elias J J, Mattessich SM, Kumagai M, Mizuno Y, Cosgarea AJ, Chao EY. In-vitro characterization of the relationship between the Q-angle and the lateral component of the quadriceps force. *Proceedings of the Institution of Mechanical Engineers H.* 2004;218(1):63-67.
7. Mizuno Y, Kumagai M, Mattessich SM, Elias J J, Ramrattan N, Losgarea AJ, Chao EY. Q-angle influences tibiofemoral and

- patellofemoral kinematics. Journal of Orthopaedic and Research.2001; 19(5): 834-840.
8. Naslund J, Naslund UB, Odenbring S, Lundeberg T. Comparison of symptoms and clinical findings in subgroups of individuals with patellofemoral pain syndrome. Physiotherapy Theory and Practice.2006; 22(3): 105-118.
  9. Thomee R,. Patellofemoral pain syndrome in young women.II.Muscle function in patients and healthy controls. Scand J Med Sci Sports. 1995;5(4):245-51.
  10. Piva SR, Goodnite EA, Childs JD. Strength around the hip and flexibility of soft tissues in individuals with or without patellofemoral pain syndrome. J Orthop Sports PhysTher. 2005; 35(12):793-801.
  11. Thomee R, Augustsson J, Karlsson J. Patellofemoral pain syndrome: a review of current issues. Sports Medicine.1999; 28(4): 245-262.
  12. Wilson T. The measurement of patellar alignment in patellofemoral pain syndrome: are we confusing assumptions with evidence? Journal of Orthopaedics and Sports Physical Therapy.2007; 37(6): 330-341.
  13. Cibulka MT, Threlkeld-Watkins J. Patellofemoral pain and asymmetrical hip rotation. Physical Therapy.2005; 85:1201-1207.
  14. Fukuda T Y, Rossetto FM, Magalhaes E, Bryk FF, Martin RL, Marcos BZ. Hip posterolateral musculature strengthening in sedentary women with patellofemoral pain syndrome: a randomized controlled clinical trial with 1-year follow-up. J Orthop Sports Phys Ther.2012; 42(10):823-830.
  15. David M. Selkowitz, George J. Benek, Christopher M. Powers. Which exercises target the gluteal muscles while minimizing activation of the tensor fascia lata? Electromyographic assessment using finewire electrodes. J Orthop Sports PhysTher. 2013; 43(2): 54-60.
  16. McMullen W, Roncarati A, Koval P. Static and isokinetic treatments of the chondromalacia patella: a comparative investigation. J Orthop Sports PhysTher. 1990; 12(6):256-266.
  17. Defne Kaya, MahmutNedim Doral, Michael Callaghan. How can we strengthen the quadriceps femoris in patients with patellofemoral pain syndrome? Muscles, ligaments and Tendons Journal. 2012; 2 (1): 25-32.

**Citation:**

**M.S.Sundaram and Merlin.** Comparing the effects of specific hip strengthening exercises and conventional knee exercises in sprinters with patello-femoral pain syndrome, *IJMAES*, 2017; 3(2), 290-299.