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Effect of Hip Abductors and Lateral Rotators Strengthening in Patients with Patellofemoral Pain Syndrome

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Abstract: ***Background: Patellofemoral pain syndrome affects active and non-active persons. Incidence rate of 7% to 10% have been reported in young male and young female respectively. Objective: To study the effect of Hip Abductors and Lateral Rotators Strengthening along with conventional exercise, as compared to conventional exercise alone, on pain and functional activity in subjects with Patellofemoral pain syndrome. Materials and Method: 30 participants were taken in study. They were randomly divided into 2 groups.15 participants in each group were treated for period of 4 weeks, 6 days a week, once daily. Group A underwent Hip abductors and Lateral rotators strengthening along with conventional exercise. Group B underwent conventional exercise. Outcome measures were recorded in the form of VAS and KUJALA SCORE. Results: Results showed that there was significant improvement in VAS, KUJALA in Group A as compared to Group B. Conclusion: Hip abductors and Lateral rotators strengthening along with conventional exercise is more effective than only conventional exercise in patients with Patellofemoral Pain Syndrome.***

Keywords: Patellofemoral pain syndrome, Patella, hip muscle strengthening

1. Introduction

Patellofemoral pain syndrome is one of the commonest knee pain syndromes seen in the physical therapy outpatient clinic. (1,2,3) The term "PFPS" is often used interchangeably with "anterior knee pain" or "runner's knee." PFPS can be defined as anterior knee pain involving the patella and retinaculum that excludes other intraarticular and peri-patellar pathology. (4,5) Chondromalacia patellae, a condition in which there is softening of the patellar articular cartilage, occurs only in a subset of patients who present with anterior knee pain. (4-7)

The reported incidence of PFPS in clinical setting ranges for 21to40%. Patellofemoral-related problems occur twice as often in females as in males. (3,8).Kannus et al, noted that Nearly 10% of all sports medicine center visits by physically active individuals are attributed to patellofemoral pain syndrome. Taunton et al, constitutes 16-25% of all injuries in runners. (9)

The primary cause of PFPS is poorly understood and is likely multifactorial. The most commonly accepted hypothesis is that of patellar maltracking. Maltracking of the patella can cause increased load or stress to the underlying articular cartilage, resulting in wear and pain. (9)

Risk factors can be divided into anatomical and physiological.

Anatomical Risk Factors
- Femoral anteversion
- Trochlear notch sulcus angle
- Tibial torsion
- Patella alta or baja
- Foot and ankle alignment

Physiologic Risk Factors
- Muscle performance (strength, endurance, motor control)
- Range of motion or flexibility.

The potential muscular causes of patellofemoral pain can be divided into "weakness" and "inflexibility" categories. These include Weakness of the quadriceps, medial quadriceps specifically VMO dysplasia,hip abductors,hip lateral rotators, and tightness of quadriceps, iliotibial bands, hamstring, and calf muscles. (9,10)

Accordingly, many clinical interventions have focused directly on the patella, with the goal of trying to correct the patellar alignment and motion. These interventions with intended direct effect on patella alignment included quadriceps strengthening, especially the oblique fibers of the vastus medialis muscle, hamstring and iliotibial band stretching, patellar mobilization, and patellar taping among others. (11,12,13,14,15)

Recently, various authors have suggested an association between hip muscle weakness ormotor control impairment and the patellofemoral pain syndrome. (3,16,17) Poor hip control may lead to abnormal patellar tracking, increasing patellofemoral joint stress and causing wear on the articular cartilage. (3,18)

Especially poor eccentric hip abductors and lateral rotators muscles control can result in femoral adduction and medial rotation during weight-bearing activities, leading to a predisposition to lateral patellar tracking as the femur medially rotates underneath the patella. (19,20) Based on these reports, it has been suggested that strengthening of the hipmusculature could help improve lower extremity alignment and tracking of the patella, reducing excessive retropatellar joint pressure and ultimately leading to

decreased pain and improved function in individuals with PFPS. (14 ,16,21,22)

Despite numerous studies showing weakness of the hip musculature and poor control of hip motion in females with PFPS, there is currently very limited information on the effectiveness of hip strengthening exercises to decrease pain and improve function in these individuals. Thus, the purpose of this study was to determine whether strengthening the hip abductors and lateral rotators in addition to the knee musculature would be superior to strengthening the knee musculature alone or no treatment at all for outcomes of pain and function in patients with PFPS.

2. Literature Survey

Study design: Experimental study
Study setting: Samples were taken from OPD of following: Ahmedabad institute of medical sciences, Red Cross society, Apangmanavmandal
Sampling design: Simple random sampling
Study duration:4 weeks
Sample size:
Group A: 15 patients
Group B: 15 patients

Inclusion criteria:

- Patients had a history of anterior knee pain for at least the past 3 months and reported pain in 2 or more daily activities (ascending and descending stairs, squatting, kneeling, jumping, long sitting, isometric knee extension contraction at 60° of knee flexion, and pain on palpation of the medial and/or lateral facet of the patella).
- Patients diagnosed with Patellofemoral pain syndrome
- Chondromalasiapatelle
- Age group:20-40 years.
- Patients who are able to comprehend commands.
- Willingness to participate.

Exclusion criteria:

- Any neurological disorders,
- Hip or ankle injuries,
- Low back or sacroiliac joint pain,
- Rheumatoid arthritis,
- Used corticosteroids and/or anti-inflammatory drugs,
- A heart condition that precluded performing the exercises,
- Previous surgery involving the lower extremities.
- Other knee pathologies such as patellar instability, patellofemoral dysplasia, meniscal or ligament tears, osteoarthritis, tendinopathies, and epiphysitis.

Materials used in the study:

- Consent Form
- Assessment Form
- Vas Scale
- Kujala Scale
- Paper Pencil
- Sand Bag
- Weight Cuff
- Hot pack
- Last degree extension board
- Plinth
- Camera

3. Method

Thirty patients referred form orthopedic OPD were included in the study with patellofemoral pain syndrome and fitting in inclusion criteria. On the first visit, a complete orthopedic assessment was done. Subjects who have been found suitable to participate were explained the nature of the study and were requested to sign the consent form for general identification and demographic data was taken.

Pre-participation evaluation form consisting of VAS, KUJALA SCALE and musculoskeletal assessment which included chief complain, history, etc. was documented. Patients were treated for period of 4weeks, for 6days a week, once a day.

4. Procedure

Patients were divided randomly into two groups, with 15 subjects in each group.

Group A was given Hip Abductors and Lateral Rotators Strengthening and Conventional Exercises.
Group B was given Conventional Exercises alone.

Recording for pain on VAS, functional disability on KUJALA SCALE, was done on first day and after 4weeks.

5. Treatment Protocol

Patient of both group were assessed properly and were given conventional therapeutics management according to the below mentioned protocol for 4 weeks.
Conventional exercise - [23, 24]

- Hot packs to affected knee for 15-20 minutes, 6 days per week for 4 weeks.[24]
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- Stretching exercise,3 repetition with 30second hold, in a day
  - 1) Hamstring
  - 2) Gastrocnemius
  - 3) Quadriceps
  - 4) Illiotibial band.

- Open chain exercise:
  - Quadriceps setting exercise: static quadriceps
  - Straight Leg Raise(SLR) with femur laterally rotated
  - Short-arc terminal extension: last 20-degree extension

- Closed chain exercise:
  - Partial squats up to about 30 degrees
  - Partial lunges.

- Strengthening exercise:10 repetition

  - Quadriceps strengthening exercise

Group A was given additional Hip abductors and Lateral rotators strengthening which were as follows:
The patient was evaluated during 1st treatment session using 1-repition maximum (1RM).1 RM is defined as the

maximum load the person could use to complete 1 repetition of the exercise without pain. The 1RM wasreviewed weekly and adjustments were made according to newly obtained 1 RM. The load used for treatment was 70% of 1 RM.
Hip abductors and lateral rotators strengthening were given in non-weight bearing position, using weight cuff at ankle joint. Each patient had to complete 10 repetitions of the exercises, with the weight, adjusted according to 70% of their 1RM. (11)

Hip abductors strengthening [23]
Side lying: Have the patient flex the bottom leg for balance, and then lift the top leg into abduction, keeping the hip neutral to rotation and in slight extension. Do not allow the hip to flex or the trunk to roll backward. Resistance was given by free weight cuff tie around ankle joint.

Lateral rotators strengthening[23]
Sitting
With knees 90 degree flexed over the edge of the treatment table, tie free weight cuff around the ankle joint. Have the patient move the foot toward the opposite limb, causing external rotation of the hip.

6. Result

The present study was done to study the effectiveness of Hip abductors and Lateral rotators strengthening in relieving pain and improving functional activity in patients with patellofemoral pain syndrome. The study comprised of total 30 subjects with patellofemoral pain syndrome; 15 subjects in each group. Data was analyzed using statistical software SPSSv20. Before applying statistical tests, data was screened for normal distribution. All the outcome measures were analyzed at baseline and after 4 weeks of treatment using appropriate statistical test. Level of significance was kept at 5%. Changes in outcome measures were analyzed within group as well as between groups.

The outcome measurements were pain measured on visual analogue scale, and Functional activity measurement by KUJALA SCALE.

To analyze the difference in the VAS score after 4 weeks of intervention in both the groups, non-parametricwilcoxon matched pair test was used. For both the groups A and B, p values were <0.001 in both the groups, showing significant difference in VAS score as compared to baseline.

Table 1: Comparision Of Mean Vas Score Within Groups A & B

Outcome	*Pre-treatment*		*Post treatment*		*W Value*	*P Value*
	Mean	*SD*	*Mean*	*SD*		
Group-A	8.06	0.79	1.66	0.72	-3.46	<0.001
Group-B	8.00	0.75	3.20	0.67	-3.44	<0.001

To analyze the difference in the KUJALA score after 4 weeks of intervention in both the groups, wilcoxon matched Pair Test was used. For both the groups A and B, p values were <0.001 showing significant difference in KUJALA score as compared to baseline.

Table 2: Comparision of Mean Kujala Score within Groups A & B

Outcome	Pre-treatment		Post treatment		W Value	P Value
	Mean	SD	Mean	SD		
Group-A	63.73	4.26	88.26	2.31	-3.41	<0.001
Group-B	62.46	4.48	80.25	3.75	-3.42	<0.001

The difference between the improvements in VAS score between two groups was analyzed using Mann whitney U test. For U= -3.391, p=<0.001, showing significant difference in group A compared to group B.

Table 3: Mean difference in VAS score between Groups A & B

Difference in VAS score	Group-A	Group-B	U value	P value
Mean	6.40	4.80	-3.391	<0.001
SD	0.98	1.08	-3.391	<0.001

The difference between improvements in KUJALA score between two groups was analyzed using Mann whitney U test. For U= -3.648, p=<0.0001, showing significant difference in group A compared to group B.

Table 4: Difference in kujala score between Groups A & B

Difference in kujala score	Group-A	Group-B	U value	p value
Mean	24.53	17.80	-3.648	<0.0001
SD	5.152	4.783	-3.648	<0.0001

Hence, it is concluded that Hip abductors and Lateral rotators strengthening has additive effect over conventional therapy on pain and functional activity in patients with patellofemoral pain syndrome.

7. Discussion

Patellofemoral pain syndrome is one of the conditions, which can be treated by a wide variety of physiotherapy methods. It is still difficult to formulate all proof guidelines for the management of patellofemoral pain syndrome. Various methods of treatment exist with own claims of success without any attempts of comparing the maximal effective methods. The objective of this study was to fin out the effectiveness of Hip abductors and Lateral rotators strengthening along with conventional exercise in treatment of patellofemoral pain syndrome.

Group A was given Hip abductors and Lateral rotators strengthening along with conventional therapy and Group B was given conventional therapy alone. Conventional treatment included Hot pack, static quadriceps, SLR with femur laterally rotated, last 20-degree extension, stretching of hamstring, quadriceps, gastrocnemius, illiotibial, strengthening of quadriceps, partial lunges and partial squat up to 30º.

VAS and KUJALA scores were documented for both the groups at baseline and after 4 weeks of treatment. The results of present study showed significant improvement in pain and functional activity in Group A as well as Group B with significant more improvement in Group A compared to Group B.

In Group B patients were treated with conventional exercise alone. The present study showed significant decrease in VAS (W=-3.442 for p<0.001) and improving KUJALA score (W= -3.426 for p<0.001) in Group B.

Heat therapy creates higher tissue temperatures, which produces vasodilatation that increases the supply of oxygen, and nutrients and the elimination of carbon dioxide and metabolic waste. (25)

Physiological effects of heat include analgesia, increased flexibility of collagenous tissues, and reduction of muscle spasm through selective decrease in excitation of nociceptive nerve endings. Increased muscle temperature also decreases spindle sensitivity and reduces "muscle spasm." Heat increases blood flow to the warmed area, which also may accelerate healing. Because heat increases extensibility of collagen tissues, it may be helpful before stretching exercises of shortened muscles prior to strengthening. (26)Thus, hot packs help in relieving pain.

Quadriceps strengthening is most commonly recommended because the quadriceps muscles play a significant role in patellar movement. (37) TFL tightness is associated with anterior knee pain and lateral knee pain and also link with excessive lateral deviation of patella and it will cause abnormal tracking of patella so stretching of TFL is necessary. (28,23) Quadriceps, hamstring, gastrocnemius have been identified as specific muscle with decrease flexibility in individual with patellofemoral dysfunction. So stretching of these muscle is also necessary.(29)

A study done by G. Syme,D. Martin et al in (2008) who studied effects of rehabilitation with emphasis on retraining the vastus medialis (VMO) component of the quadriceps femoris muscle and rehabilitation with emphasis on general strengthening of the quadriceps femoris muscles on pain, function and Quality of Life in patients with patellofemoral pain syndrome and found that a large number of PFPS patients can experience significant improvements in pain, function and Quality of Life, at least in the short term, with quadriceps femoris rehabilitation, with or without emphasis on selective activation of the VMO component.(30)

A study done by CharuEapen,Chetan D. Nayak, et al in 2011 also confirmedthat,Quadriceps femoris muscle strengthening is useful forimproving functional ability, in patients with PFPS.Isotonic eccentric training of quadriceps muscles iseffective in reducing pain and improving the functionalstatus of patients with patellofemoral pain syndromeand can be suggested as part of treatment. (31)

Another study done by Susan A.Doucette(1992) showed that patellar tracking is improved with VMO strengthening, iliotibial band stretching and joint mobility exercise in majority of subjects with lateral patellar compression syndrome. (32)

In Group A patients were treated with Hip abductors and Lateral rotators strengthening along with conventional exercise. The present study shows significant decrease in VAS (W= -3.461 for p<0.001) and improving KUJALA score (W= -3.419 for p<0.001) in Group A.

But there was more significant decrease in VAS (W= -3.391 for p<0.001) and improving KUJALA score (W=-3.648 for p<0.0001) in Group A ascompared Group B, in which patients were treated with conventional alone.

Poor hip control may lead to abnormal patellar tracking, increasing patellofemoral joint stress and causing wear on the articular cartilage. Especially poor eccentric hip abductors and lateral rotators muscles control can result in femoral adduction and medial rotation during weight-bearing activities, leading to a predisposition to lateral patellar tracking as the femur medially rotates underneath the patella. (3)

Several authors have documented significant weakness of the hip lateral rotators and abductors in women with PFPS. Several researchers have also measured excessive internal rotation and adduction of the hip, leading to an excessive dynamic valgus alignment of the knee, in women with PFPS. Based on these reports, it has been suggested that strengthening of the hip musculature could help improve lower extremity alignment and tracking of the patella, reducing excessive retropatellar joint pressure and ultimately leading to decreased pain and improved function in individuals with PFPS. (11)

These finding go in accordance with the study done by THIAGO YUKIO FUKUDA, FLAVIO MARCONDES ROSSETTO et al(2010);who studied Short-Term Effects of Hip Abductors and Lateral Rotators Strengthening in Females With Patellofemoral Pain Syndrome: A Randomized Controlled Clinical Trial and found that Rehabilitation programs focusing on knee strengthening exercises and knee strengthening exercises supplemented by hip strengthening exercises were both effective in improving function and reducing pain in sedentary women with PFPS. Improvements of pain and function were greater for the group that performed the hip strengthening exercises, but the difference was significant only for pain rating while descending stairs. (11)

THERESA HELISSA NAKAGAWA, THIAGO BATISTA MUNIZ et al,(2008) who studiedThe effect of additional strengthening of hip abductor and lateral rotator muscles in patellofemoral pain syndrome found that Supplementation of strengthening of hip abductor and lateral rotator muscles in a strengthening quadriceps exercise program provided additional benefits with respect to the perceived pain symptoms during functional activities in patients with patellofemoral pain syndrome after six weeks of treatment. (3)

MAARTEN R PRINS et al (2009) found that female with patellofemoral pain syndrome demonstrate a decrease in abduction, external rotation and extension strength of the affected side compared with healthy controls. (33)

Thus, hip abductors and lateral rotators strengthening along with conventional exercise brought more significant pain relief as well as improvement in functional activity in patients of Group A as compared to Group B.

Hence above results showed that hip abductors and lateral rotators strengthening along with conventional exercise, reduce pain and improve functional activity in patient with patellofemoral pain syndrome more than conventional exercise alone.

8. Conclusion

The conclusion of the study is that, Hip abductors and Lateral rotators strengthening along with conventional exercise is more effective than conventional exercise alone in patients with patellofemoral pain syndrome.

So, clinically it can be implicated that Hip abductors and Lateral rotators strengthening along with conventional exercises has additional effect on pain and functional activity in patients with patellofemoral pain syndrome.

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