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Original Article

Short - Term Effects of Eccentric Hip Abductors and Lateral Rotators Strengthening In Sedentary People with Patellofemoral Pain Syndrome on Pain and Function : A Randomized Control Trail

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Abstract

Purpose: To investigate the influence of additional eccentric strengthening to the hip abductor and lateral rotator musculature on pain and function in sedentary people with Patellofemoral pain syndrome (PFPS).

Methods: 30 sedentary patients between 18 and 40 years of age, with a diagnosis of PFPS, all the subjects received treatment for a period of 4weeks and the subjects were randomly assigned to Control group (CG) and Experimental group (EG). The patients in the Control group (n = 15) performed a conventional knee-stretching and strengthening program, whereas, patients in the Experimental group (n = 15) performed the same exercises as those in the control group ,in addition received eccentric strengthening exercises for the hip abductors and lateral rotators. An 11-point numeric pain rating scale (NPRS), the Lower Extremity Functional Scale (LEFS) and the Anterior Knee Pain Scale (AKPS) were used as outcome measures during the baseline and at the end of 4weeks .

Results: Statistics were retrieved using SPSS.16, paired 't' test was conducted to compare AKPS and LEFS values ,whereas, Mann-Whitney U test was used for NPRS value between the groups. After 4 weeks of treatment, the control group, pre and post-test value for AKPS ($p<0.001$),LEFS ($P<0.001$),NPRS ($p<0.001$) shows a statistical significance and even in the experimental group, pre and post-test value for AKPS ($p<0.001$),LEFS ($P<0.001$),NPRS ($p<0.001$) shows a statistical significance in pain and function, but comparing both the group experimental group is significantly more better AKPS ($p=0.002$),LEFS ($P<0.001$),NPRS ($P<0.001$) then a control group.

Conclusion: short term Knee strengthening exercises supplemented by eccentric hip abductor and lateral rotator musculature–strengthening exercises were more effective than knee exercises alone in improving function and reducing pain in sedentary people with PFPS.

Keywords: Patellofemoral pain syndrome, eccentric strengthening, hip abductor and external rotator strengthening, Anterior knee pain scale, Lower Extremity Functional Scale

Introduction

Patellofemoral pain syndrome (PFPS) is one of the commonest and challenging knee pathologies seen in the physical therapy outpatient clinic. It is frequently seen in adolescents and younger adults. It is higher for women than for men (2:1).[1,2,3]The most typical symptom of PFPS is a diffuse peripatellar and retropatellar pain, typically provoked by ascending or descending stairs, squatting, cycling and sitting with flexed knees for prolonged periods of time. [4] The exact cause for PFPS is still unknown but has been proposed to be multifactorial. The most commonly accepted hypothesis of the cause of PFPS is that abnormal patellar tracking increases PFJ stress and causes subsequent wear on the articular cartilage.[4]

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Historically, PFPS has been linked with quadriceps muscle impairement.[5,6] But more recent research regarding PFPS has focused on strength deficits of the proximal hip musculature as a contributor to this disorder causing

femoral adduction and medial rotation during weight-bearing activities abnormal patellar tracking.[7,8,9]

The majority of published material on conservative treatment of PFPS has focused on Patellar bracing, Taping, Exercise, stretching and use of foot orthoses to attempt to alleviate pain and restore patients to full-functioning status.[10]The Quadriceps strengthening exercises have been repeatedly demonstrated to be an effective intervention for individuals with PFPS.[11, 12] But based on the recent studies, several articles have reported associations between hip strength and knee pain, including studies that suggest hip strengthening may improve knee pain. 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.[13,14] But the level of evidence to recommend eccentric hip strengthening for the treatment of PFP is currently lacking. So this created a scope to for further research in role of eccentric hip musculature strengthening especially in sedentary people with PFPS as majority study where concentrated on female athletes, therefore there is a need to evaluate the effect of hip musculature strengthening on on a sedentary population.

Materials and MethodsSubjects

Thirty Subjects with PFPS of both sexes, between 18 and 40 years of age were selected from the population group satisfying the inclusion and exclusion criteria. Informed consent was obtained from the subjects before recruitment into the study. PFPS patients are diagnosed and referred from the Department of Orthopaedics, K.S Hegde Charitable hospital, Mangalore. Inclusion criteria; Location of symptoms (peripatellar and/ or retropatellar) and the reproduction of pain with activities from at least 3 of the follow -ascending/descending stairs, squatting, kneeling, and prolonged sitting, insidious onset of these symptoms being unrelated to a traumatic incident, pain persistent for at least 1 month , presence of pain on palpation of the patellar facets; on stepping down from a 25-cm step/ double-legged squat, all patients in this study will be sedentary according to the criteria of ACSM. Exclusion criteria ; History of patellar fracture/dislocation/ knee surgery, pregnancy ,Signs of nerve root compression , previous surgery around knee joint, systemic disorder ,hip or lumbar referred pain, tenderness over the patellar tendon, iliotibial band, or pes anserinus tendons, a positive finding on any special tests aimed to identify knee ligament or meniscal injuries or other intra-articular pathologic

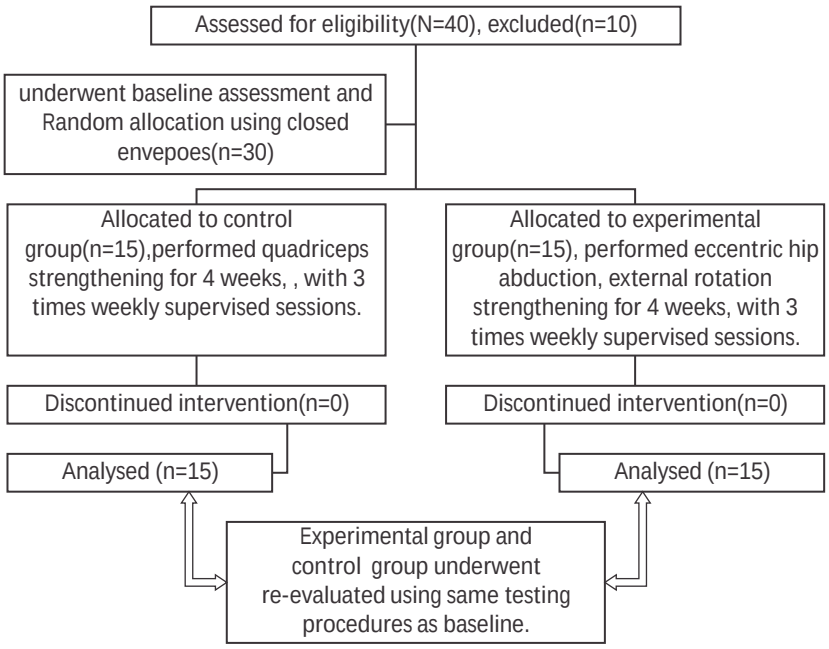


Fig. 1 : Participant flow diagram

conditions. The subjects included in this study were randomly assigned into two groups of equal number: control ; all patient in this group performed stretching and quadriceps strengthening exercise and Experimental ;patients performed all the exercise given to the control group ,in addition perform eccentric hip abduction and external rotation strengthening for a period of 4weeks.

For evaluation- Self-Administered Anterior Knee Pain Scale (AKPS), Lower extremity functional scale (LEFS) and 11 point numeral pain rating scale (NPRS) were used during pre-treatment and post treatment (after 4 weeks of treatment).

Self-Administered Anterior Knee Pain Scale (AKPS) it is a13-item questionnaire that contains questions related to various levels of knee function and Response scores are summed. Total score is 100 and higher scores indicate greater function and lower levels of pain. kujala.pdf

Lower extremity functional scale (LEFS) - The LEFS is a 20-item functional assessment tool that rates the level of difficulty of functional tasks from 0 (extreme difficulty) to 4 points (no difficulty), yielding a maximum score of 80 points, with lower scores indicating more disability. LEFS

11 point numeral pain rating scale (NPRS) - The NPRS is an 11-point scale that ranges from 0 (no pain) to 10 (worst imaginable pain) and subjects were instructed to circle pain level during ascending and descending functional activity. Table 1 and 2 explains the treatment protocol for control and experiment group

Table 1 : control group treatment protocol

Activity	Duration
Stretching (all exercise session) • Sitting hamstring stretch • Sitting patellar mobilization • Standing quadriceps stretching • Standing calf stretching • Standing iliotibial band stretch	3repetitions/30-seconds hold
Week 1 & 2 exercise • Isometric quadriceps contractions while sitting with 90^0 of knee flexion. • Straight-leg raise in supine position • Mini squats to 40^0 of knee flexion	2 sets of 10 repetitions/ 10-second hold 3 sets of 10 repetitions
Weeks 3 and 4 exercises • Wall slides (0–60^0 of knee flexion) • Steps-up and steps-down from a 20-cm step • Forward lunges (0–45^0 of knee flexion) • Balance exercises: unilateral stance on the floor and on an trampoline, with opened and closed eyes	3 sets of 10 repetitions 3 sets of 5 repetitions 3 sets of 10 repetitions 3 sets of 30-second hold each exercise

Table 2 : experimental group treatment protocol

Activity	Duration
Same as control group, below mentioned exercises are added from 1^{st} week to 4^{th} week and exercise weight is progressed based on DAPRAE method.	
• In side lying with the hips and knees slightly flexed with free weight, the patient will be passively taken to abduction - lateral rotation then patient has to eccentrically drop the hip towards adduction and medial rotation direction. • Side-lying patient will be passively taken to abduction controlled hip adduction with extended knee	2 sets of 15 repetitions 2 sets of 15 repetitions

Statistical analysis

The collected data of both groups were statistically analysed. Descriptive statistics were done in the form of mean and standard deviation (SD) of all measuring variables in addition to the age and gender. Paired t-test was run to compare the pre and post treatment mean values of all measuring variables within each group. Independent t-test was used to compare the pre and post treatment mean values of all measuring variables between both groups. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through SPSS (Statistical Package for Social Sciences) version 16.

Table 3 : Demographic variables

Group	Experimental group N=15	Control group N=15
Age [mean ± SD]	29.06±6.6	26.42±4.2
Gender [Male & female]	3 and 12 [20% and 80%]	5 and 10 [33% and 67%]

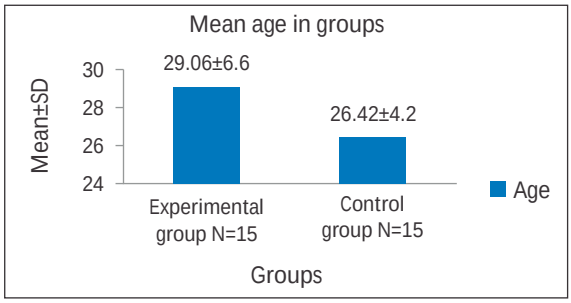


Table 4 : Description of variables

Group	Experimental group N=15	Control group N=15
AKPS first assessment [mean ± SD] [min./max. score]	66.33±9.92 49/87	72.85±11.71 52/90
AKPS second assessment [mean ± SD] [min./max. score]	84.93±6.11 39/94	82.28±11.51 42/90
LEFS first assessment [mean ± SD] [min./max. score]	40.26±13.15 23/72	48.50±15.29 29/73
LEFS second assessment [mean ± SD] [min./max. score]	66.20±7.49 32/73	56.92±17.19 28/65
NPRS first assessment [mean ± SD] [min./max. score]	5.86±1.24 3/8	4.07±2.01 2/8
NPRS second assessment [mean ± SD] [min./max. score]	2.33±1.40 1/6	2.50±1.40 3/7

Table 5 : Paired t test within Experimental group

Experimental group	Difference Mean ±SD	95% Confidence Interval	P-value
AKPS [pre-post]	1.86±7.53	14.4 to 22.7	<0.001
LEFS [pre-post]	2.59±9.46	20.69 to 31.17	<0.001
NPRS [pre-post]	3.53±0.99	2.98 to 4.08	<0.001

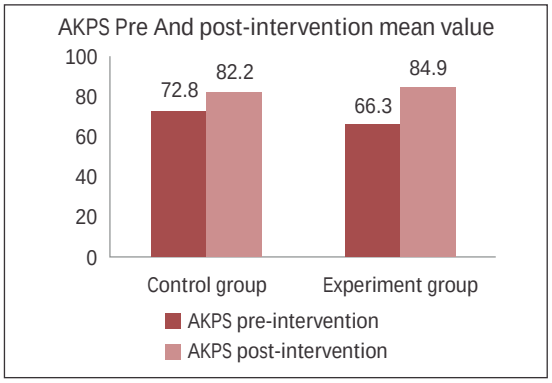
The above table illustrates the pre and post-test values in experimental group and it is clear based on the (p <0.001) that there is a significant difference within the group in the entire variable. Therefor experiment group showed improvement after the intervention in all the outcome scale.

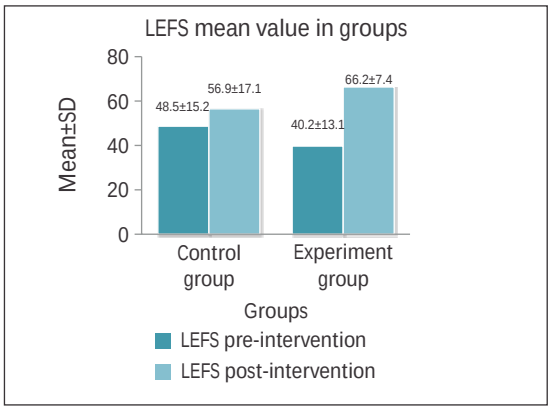
Table 6 : Paired t test within control group

Control group	Difference Mean ±SD	95% Confidence Interval	P-value
AKPS [pre-post]	9.42±7..02	5.37 to 13.48	<0.001
LEFS [pre-post]	8.42±5.10	5.47 to 11.37	<0.001
NPRS [pre-post]	1.57±0.93	1.03 to 2.11	<0.001

The above table illustrates the pre and post-test values in the control group and it is clear based on the (p <0.001) that there is a significant difference within the group in the entire variable. Therefor control group also showed an improvement in all the outcome scale.

AKPS pre -Anterior Knee Pain Scale, LEFS pre -Lower extremity functional scale, and NPRS pre- numeral pain rating scale pre intervention data.





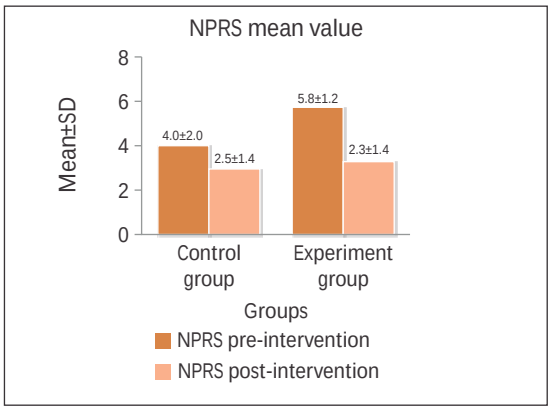


Table 7: Independent t test between the groups

Between the groups		Mean ±S.D	P value
AKPS	EG	18.60±7.53	0.002
	CG	9.66±6.83	
LEFS	EG	25.93±9.46	<0.001
	CG	9.73±7.05	
NPRS	EG	3.53±0.99	<0.001
	CG	1.66±0.97	

EG-Experimental group, CG-Control group

The above table illustrates the pre and post-test values in all the variable between the Experimental and Control group showed, experimental group is significantly more better AKPS (p=0.002), LEFS (P<0.001), NPRS (P<0.001) than a control group.

Result

After 4 weeks of treatment, the control group, pre and post-test value for AKPS (p<0.001),LEFS (P<0.001),NPRS (p<0.001) shows a statistical significance and even in the experimental group, pre and post-test value for AKPS (p<0.001),LEFS (P<0.001), NPRS (p<0.001) shows a statistical significance in pain and function, but comparing both the group, experimental group is significantly more better AKPS (p=0.002),LEFS (P<0.001),NPRS (P<0.001) than a control group.

Discussion

The results of the present study demonstrated that a 4-week intervention either consisting of knee-strengthening exercises or knee-strengthening exercises supplemented by eccentric hip-strengthening exercises both led to improved function and reduced pain in sedentary population with PFPS. For most outcome measures, greater improvement was noted in the group combining knee and hip exercises, the importance of hip abductor and lateral rotator muscle strengthening in the treatment of PFPS has received increased attention in recent years. This approach is based on several studies that have demonstrated weakness of the hip abductors and lateral rotators in patients with PFPS.[8,14.]

The eccentric hip strengthening was supported by Rodrigo de at all (2009) eccentric hip abduction mean peak torque was 28% lower in the PFPS group than in the control group .[15].A similar study done by Kimberly l. dolak at all (2012) showed that the patients with PFPS, initial hip strengthening may allow an earlier dissipation of pain than exercises focused only the quadriceps .[16]

Accordingly, some authors have also speculated that simple daily activities were sufficient to lead to poor knee and hip kinematics, leading to a reduction of the patellofemoral contact area and increased joint stresses .[17,18] Therefore in this study, these concepts were applied to sedentary population with PFPS.

This study witnessed more percentage of young and sedentary females with PFPS, possibly due to the commonly noted hip muscle weakness that may change lower limb kinematics.[14]

Conclusion

short term Knee strengthening exercises supplemented by eccentric hip abductor and lateral rotator musculature–strengthening exercises were more effective than knee exercises alone in improving function and reducing pain in sedentary people with PFPS.

Limitations of the study

- Sample size was small and each group had less male then a female and male so it's difficult to generalise the effect.
- The patients in both groups were allowed to take pain and anti-inflammatory medications for first 4 days as prescribed by an Orthopaedician.
- There was no follow up carried out to see the prolonged effect of the exercise
- In this study all outcome measurement used mainly concentrated on subjective assessment.

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