Advances in Environmental Biology, 10(6) June 2016, Pages: 75-81

AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: http://www.aensiweb.com/AEB/

The Effect of Hip Abductor and External Rotator Muscles Strengthening Exercises on pain and functional activities in Male with Patellofemoral pain Syndrome

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Received 12 May 2016; Accepted 28 June 2016; Available online 28 July 2016

ABSTRACT

Introduction Patellofemoral Pain Syndrome (PFPS) is one of the most common mechanical disorders that affect the knee region, most often occurs between the ages of 15 and 30 and is the most common diagnosis for patients who have knee pain. PFPS has previously been attributed to quadriceps dysfunction, while more recent research has linked this condition to the impairment of hip musculature. **Purpose:** to investigate the effect of hip abductor and external rotator muscle strengthening exercises on pain in males with PFPS. **Study Design**: A pre test post test control group design. **Material and Methods:** 40 patients aged between 15 to 35 years and diagnosed with PFPS were involved. They were divided into two equal groups with 20 patients each. Patients in group (A) were treated using traditional treatment. The traditional treatment was in the form of stretching exercises for hamstrings, Iliotibial band, and hip flexors (5 mins each) in addition to strengthening exercises for the quadriceps (5 sets of 10 repetitions each)[(6)]. Patients in group (B) were treated as patients in group (A) in addition to 5 sets of strengthening exercises for hip abductors and 5 sets (of 10 repetitions) of strengthening exercises for hip external rotators. The Treatment was done three times a week for four weeks. Level of pain and functional performance were measured before and after the treatment using Visual analogue scale (VAS) and WOMAC (Western Ontario and McMaster Universities index) respectively. **Results:** Differences in the level of pain and functional performance between the 2 groups were statistically studied and noted. The experimental group (B) showed better improvement as a compared to control group (A). **Conclusion;** Strengthening exercises of hip abductor and external rotator muscles have a significant effect in decreasing pain and improving the functional performance in male patients with Patellofemoral Pain syndrome.

KEYWORDS: Patellofemoral, Strengthening exercises, Hip Muscles

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is one of the most common knee pain syndromes seen in the physically active population, as is common musculoskeletal diagnosis for which individuals seek medical attention.[2,9]

The symptom most frequently reported is diffuse peripatellar and retropatellar pain associated with activities that load the Patellofemoral joint. These activities include ascending and descending stairs, squatting and sitting with flexed knees for a prolonged time.[3] One of the most commonly accepted causes of PFPS is abnormal tracking of the patella within the femoral trochlea.[19] Potential contributing factors that have been studied are vastus medialis oblique insufficiency, decreased quadriceps, hamstrings, and ilitibial band flexibility, femoral anteversion, increased quadriceps angle, and patellar hypermobility.[4,7]

The etiology of this condition remains unknown, although many intrinsic and extrinsic factors have been suggested. Thus, a variety of conservative treatments have been suggested including quadriceps strengthening, patellar taping and stretching exercises for hamstrings, Iliotibial band and quadriceps.[5,17]

Poor hip control may lead to abnormal patellar tracking, increasing Patellofemoral joint stress and causing wear on the articular cartilage. Recently, various authors have suggested an association between hip muscle weakness or motor control impairment and Patellofemoral pain syndrome.[13,12]

Recent studies have suggested that poor hip adduction and internal rotation control during weight bearing activities is related to PFPS in athletes. Excessive femoral adduction and internal rotation may increase the dynamic quadriceps angle and lead to greater lateral patellar contact pressure.[19,20] Repetitive movements during functional activities with this malalingment can overload the patellar retinaculum and retropatellar articular cartilage and cause pain.[14]

Poor eccentric hip abductors and lateral rotators muscle control can result in femoral adduction and medial rotation during weight bearing activities. Eventually, this can lead to a lateral patellar tracking as the femur medially rotates underneath the patella.[2,15]

Power *et al* demonstrated that during a weight bearing task, the femur internally rotates underneath the patella in female participants with PFPS. This eventually results in lateral subluxation of the patella. Increased hip adduction has also been reported in the same participants during functional activities.[1,6,19]

Conversely, it has been reported that individuals with PFPS have greater hip external rotation during walking, squatting, running, and jumping. This could be a possible compensatory mechanism to decrease the quadriceps angle. [16,9]

Many studies concentrated on the effect of strengthening exercises of hip abductor and external rotator muscles on female patients with PFPS. The efficiency of hip abductors and external rotators strengthening in females has been attributed to their wider pelvis. [19,19]

In this study we try to determine if the strengthening exercises of hip abductor and external rotator muscles also has an effect on male patients with PFPS.

MATERIAL AND METHODS

Subjects:

Forty male subjects with a confirmed diagnosis of PFPS and aged from 15 to 35 years participated in this study. They were divided into 2 equal groups (group A) control group and (group B) experimental group with 20 participants each.

The mean age, weight, and height is shown in table (1). The subjects were recruited from different governmental hospitals.

Table 1: Demographic characteristics of all participants

	Group (A)		Group (B)	
Range	Mean	±SD	Mean	±SD
Age (y)	21.7	8.2	22.1	8.4
Weight (kg)	72.5	13.3	73.2	13.8
Height (cm)	168.8	5.6	166.7	6.1

To be considered for the study, patients had to be male and have a diagnosis of PFPS. The diagnosis of PFPS was based on the location of symptoms (peripatellar and/or retropatellar) and the reproduction of pain with activities commonly associated with this condition such as stair descent, squatting, kneeling, and prolonged sitting.

Patients were screened by physical examination to rule out ligamentous laxity, meniscal injury, pes ansrine bursitis, iliotibial band syndrome, and patellar tendonitis. Patients were excluded from participation if they reported a history of previous patella dislocation, patellar fracture, or knee surgery.

Patients were invited to the study if they’ve had a diagnosis of unilateral PFPS for the past 6 months and had not previously received physical therapy. The patients enrolled in this study were relatively sedentary and only participated in activities of daily living (they did not participated in sports or recreational exercises). Prior to participation, all patients provided a written informed consent.

Materials:

All the patients were evaluated before starting the rehabilitation program and after four weeks of training. The level of pain was assessed using (VAS) and the functional performance was assessed using the (WOMAC).

Procedure:

For Evaluation:

The patients were referred with the diagnosis of PFPS and screened to make sure that they met the inclusion criteria. They were then asked to sign consent forms.

The patients were asked to determine the mean of the severity of pain during daily living activities using (VAS).

For functional performance, the patients determine the functional abilities of their knees using the WOMAC (Western Ontario and McMaster universities) index.

WOMAC index is used to assess patients with knee disorders using 24 parameters.

It can be used to monitor the course of knee disorders or the effectiveness of the treatment. It consists of three subscales: pain (5 items), stiffness (2 items) and physical function (17 items). It uses the following grades for all items: None, Mild-Moderate, Severe and Extreme. These grades correspond to an ordinal scale (0-4).

The scores are summed for items in each subscale, with possible ranges as follows: pain (0-20), stiffness (0-8), and functional performance (0-68). The total score of the scale (0-96) and the highest score on the WOMAC scale indicates the worst pain, stiffness, and functional limitations.

For Treatment:

The patients in this study were randomly divided into 2 equal groups (Group A and Group B) with 20 patients in each group. All the patients were treated by performing self stretching exercises for the hamstrings, Iliotibial band, and hip flexors for 5 min each.

For hamstrings, the patient was asked to sit on the floor with both legs straight out and the unaffected knee bent with its sole alongside the affected knee. The patient was then asked to bend forward with the back straight and touch the toes of the affected limb (20 seconds hold for 5 min). [12]

For the iliotibial band, the patient was asked to sit with legs stretched out in front of him. The knee of the affected limb was bent and the sole was placed on the ground outside the unaffected knee. The patient was then asked to pull the affected knee towards the contralateral shoulder and hold for 20 seconds for 5 min. [12]

For the hip flexor muscles, the patient was asked to start in a kneeling position and move the foot of unaffected limb past the affected knee. The patient was then asked to push himself forward through the hip as much as he can while keeping his back straight. The patient then held the position for 20 seconds and repeated this for 5 min. [12]

All the patients were treated by performing strengthening exercises for the Quadriceps muscle. The starting position of the patient was in sitting. The patient’s knee was bent to 90 degrees with elastic tubing tied just above the ankle at one end and attached to a rigid pole at the other end. The patient was asked to keep his back straight and slowly straighten his knee, tightening the front of his thigh. The patient then returns back to his starting position and performs 5 sets (10 repetitions each) with 1 minute breaks after every set of exercise. The exercises were performed within the painless range of motion.[10]

In addition to the previous exercises, the patients selected in group (B) (experimental group) performed strengthening exercises for hip abductors and hip external rotators muscles.

For hip abductor strengthening, the patient was to stand on both feet with elastic tubing tied above his ankle at one end and attached to a rigid pole at the other end. The tubing length was individualized based on the patient’s lower limb length (distance from anterior superior iliac spine to medial malleolus). The distance between the exercise limb and the pole was adjusted to remove slack from the tubing. The exercise was performed by abducting the hip against resistance to approximately 30 degrees from the elastic tubing, and back to the starting position (0 degrees). The pelvis had to be leveled and 5 sets of exercise (10 repetitions each) were performed with 1 minute breaks after every set.[10]

Isolated hip external rotator strengthening was performed with the patient seated at the edge of a treatment table and the knee flexed to 90 degrees. A strap was used to stabilize the thigh to prevent sagittal and frontal plane hip motion. Elastic tubing was tied around the ankle and was secured to a rigid pole. The tubing length was individualized based on the patient’s thigh length (distance from anterior superior iliac spine to medial femoral epicondyle). The distance between the exercise limb and the pole was adjusted to remove slack from the tubing. The exercise was performed by externally rotating the hip to approximately 30 degrees. The patient was asked to perform 5 sets (10 repetitions each) with 1 minute breaks after every set of exercise.[10]

Results:

The aim of this study was to determine the effect of hip Abductor and External Rotator muscle strengthening exercises on the pain in males with Patellofemoral pain syndrome. The hypothesis was that there is no effect of the hip abductor and external rotator muscle strengthening exercises on the level of pain in males with patellofemoral pain syndrome. Changes in functional performance and the level of pain in these patients was measured before and after treatment. The treatment of group (A) was the traditional treatment (control group). For patients in group (B) (experimental group), strengthening exercises for hip abductors and external rotators were added to the traditional treatment. The treatment continued for 12 sessions over 4 weeks (three sessions per week). Paired t-test was used to analyse whether there was a significant difference between the 2 groups.

Pain:

On average, the pre-treatment level of pain according to the visual analogue scale was 7±1. After treatment the average level of pain in group (A) was 4±0.5 and 2±0.5 in group (B). (p< 0.001) table (2) Figure (1).

Table 2: Average level of pain before and after treatment in both groups

		Range	±SD	Mean	P^b
Pre-Treatment		6-9	2.9	7.2	<0.001
After treatment	(A)	3-5	1.2	4.3	
	(B)	1-3	1.3	1.8	

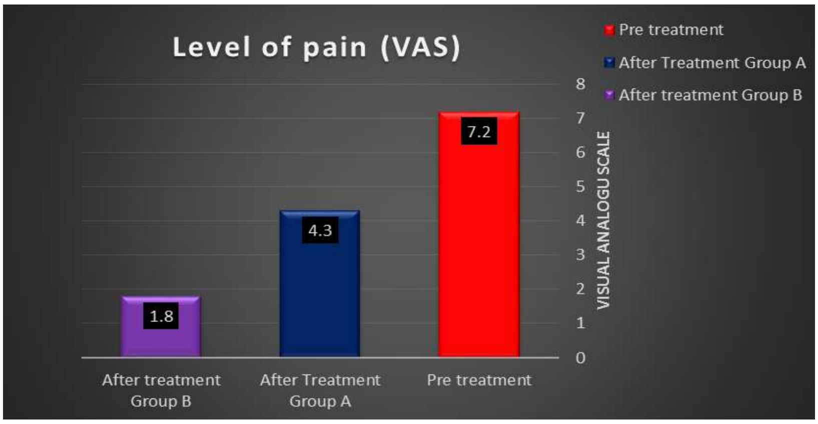

Fig. 1: The average Visual analogue Score before and after treatment in both groups

WOMEC Index:

The functional activities of patients were measured using WOMAC (Western Ontario and McMaster Universities). On average, it was found that the pretreatment score was 72±8. After treatment, the average scores in group (A) and group (B) were 41±6 and 30±8 respectively. (p<0.001).

Table 3: Average of WOMAC index score before and after treatment in both groups

		Range	±SD	Mean	P^b
Pre-Treatment		68-81	8.2	74	<0.001
After treatment	(A)	34-45	6.3	41	
	(B)	24-33	9.5	30	

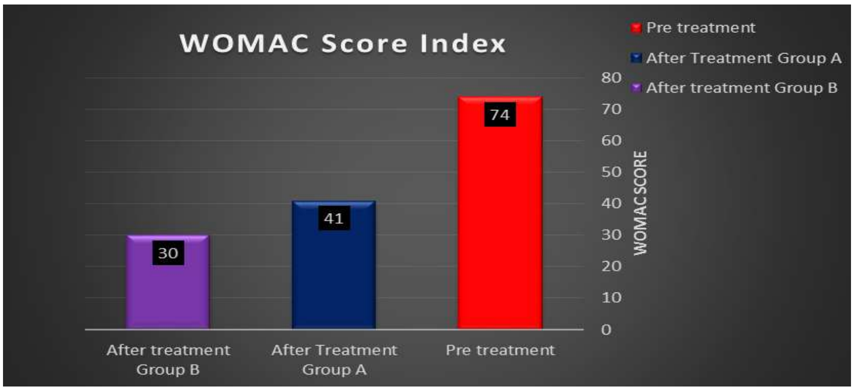

Fig. 2: The average of WOMAC index score before and after treatment in both groups

Level of pain between the groups:

According to the visual analogue scale, a significant difference was found between control group (A) and experimental group (B). After treatment the average level of pain was 4.3±1.2 for group (A) and 1.8±1.3 for group (B). (p<0.001) table (4) Figure (3).

Table 4: Average level of pain after treatment between both groups

	Range	±SD	Mean	p^b
Group (A)	3-5	1.2	4.3	<0.001
Group (B)	1-3	1.3	1.8	

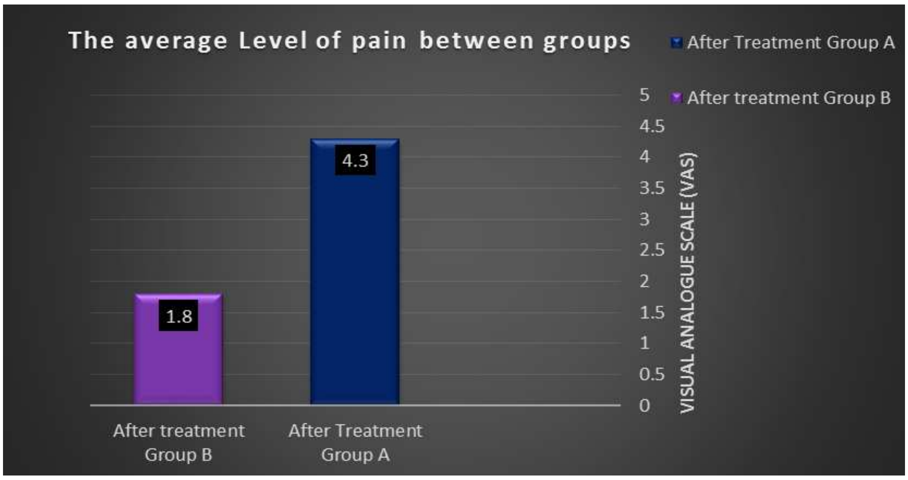

Fig. 3: The average Level of pain (VAS) after treatment between both groups

WOMEC Index after treatment between groups:

A significant difference was found between the two groups in the WOMAC index score. On average, the WOMAC index scores of group (A) and Group (B) after treatment were 41±6.3 and 30±9.5 respectively. (p<0.001) table (5) Figure (3).

Table 5: Average WOMAC index score after treatment between both groups

	Range	±SD	Mean	p^b
Group (A)	34-45	6.3	41	<0.001
Group(B)	24-33	9.5	30	

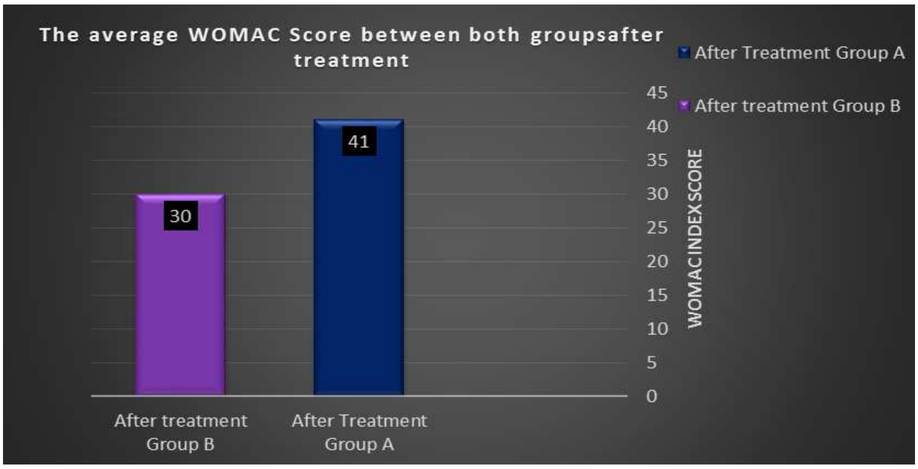

Fig. 4: The average WOMAC index score after treatment between both groups

Discussion:

The main purpose of this study was to determine the effect of hip abductor and external rotators strengthening exercises on the pain of males with patellofemoral pain syndrome (PFPS). Therapeutic exercises play an important role in the treatment of patients with (PFPS). These exercises include strengthening exercises for muscles around the knee joint (especially the vastus medialis obliquus muscle) and stretching exercises for the hamstrings and iliotibial band[8,10]. Recent studies have explained the effect of strengthening exercises for hip abductor and external rotator muscles. These muscles control the movement of the patella during knee flexion and extension and prevent the deviation of the patella during daily living activities.[11,18] As described by Mascal *et al*, hip muscle weakness is a well-documented impairment that contributes to abnormal patellofemoral joint kinematics and kinetics in females with PFPS. He also added that the wide pelvis of females facilitates lateral deviation of the patella during daily living activities. The findings of the present study support the results of many published studies. Mascal *et al* [12] was the first to demonstrate that an exercise program focusing on hip and trunk strength was effective in decreasing pain, improving hip kinematics, and restoring function in 2 patients with PFPS. Subsequent studies by Tumia *et al* [18] demonstrated that exercise programs which incorporate hip strengthening result in improved pain and functional outcomes in females with PFPS, and they suggest to apply the same program that they used on male patients with PFPS to study if the same program will effect on the male patients or not. On the other hand, Lee *et al* [10] performed a weight bearing program and reported that a 4 weeks hip strengthening program prior to it was more effective than an opposing 4 weeks strengthening program for the quadriceps. Similar to the previous study, Ferber *et al* [5] reported better improvement in function with hip strengthening as compared to knee strengthening in patients with PFPS. (The results of our study also matching with the results of Powers [15], who study the kinematics analysis of the runners with patellofemoral pain syndrome as by using 6 infrared cameras to study and analyze the movement of the knee during running they found that the foot contact of those runners associated with extra degrees of hip joint adduction in comparison with healthy runners and suggested that the hip adduction of the runners during foot contact may be resulting in the maltracking of the patella and that causing pain of the patellofemoral joint and decrease the runners competition. Therefore, the strengthening exercises for hip abductors and external rotators may help to prevent these extra degrees of hip adduction during daily living activities. There are two limitations to our study. Firstly, the scores of pain and functional activities at 6 months following the treatment could not be obtained and so, the long term effects of treatment for chronic cases were not considered. Secondly, the subjects in this study were not athletes and that could statistically interfere with the results of the study as different sports may affect the muscle power and endurance differently.

Conclusion:

The addition of hip abductor and external rotator muscle strengthening exercise to the traditional treatment was effective in improving pain and functional activities in male patients with PFPS.

REFERENCES

[1] Burnett, C.N., E.F. Betts, W.M. King, 2011. Reliability of isokinetic measurements of hip muscle torque in athletes. Phys Ther., 70(5): 244-249.

[2] Cowan, S.M., K.L. Bennell, K.M. Crossley, P.W. Hodges, J. MeConnell, 2002. Physical therapy alerts recruitment of the vasti in patellofemoral pain syndrome. Med Sci Sports Exerc., 34(12): 1879-1885.

[3] Crossley, K., K. Bennell, S. Cowan, S. Green, 2004. Analysis of outcome measures for persons with patellofemoral pain: which are reliable and vali? Arch Phys Med Rehabil., 85(5): 815-822.

[4] Crossley, K., K. Bennell, S. Green, S. Cowan, J. McConnell, 2007. Physical Therapy for Patellofemoral pain: a randomized, double-blinded, placebo-controlled trial. Am J Sports Med., 30(6): 857-865.

[5] Ferber, R., I.M. Davis, D.S. Williams, 2003. III. Gender differences in lower extremity mechanics during running. Clin Biomech (Bristol, Avon). 18(4): 350-357.

[6] Fulkerson, J.P., 2002. Diagnosis and treatment of patients with patellofemoral pain. Am J Sports Med., 30 (3): 447-456.

[7] Huberti, H.H., W.C. Hayes, 1999. Patellofemoral contact pressures: the influence of Q-angle and tendomeforal contact. J Bone Joint Surg Am., 66(5): 725-724.

[8] Ireland, M.L., J.D. Willson, B.T. Ballantine, I.M. Davis, 2003. Hip strength in female with and without patellofemoral pain. J Orthop Sports Phys Ther., 33(11): 671-676.

[9] Kujala, U.M., L.H. Jaakola, S.K. Koskinen, M.N. Hurme, O.I. Nelimarkka, 1999. Scoring of patellofemoral pain disorders. Arthroscopy, 9(5): 159-168.

[10] Lee, T.Q., G.M. Morris, R.P. Csintalan, 2003. The influence of tibial and femoral rotation on patellofemoral contact area and pressure. J Orthop Sports Phys Ther., 33(11): 686-693.

[11] Lindsay, D.M., M.E. Maitland, R.C. Lowe, T.J. Kane, 1992. Comparison of isokinetic internal and external rotation tourqe using different testing position. J Orthop Sports Phys Ther., 16(1): 43-50.

[12] Mascal, C.L., R. Landel, C. Powers, 2001. Management of Patellofemoral pain targeting hip, Pelvis, and Trunk Muscle Function: 2 case reports. J Orthop Sports Phys Ther, 33(11): 647-660.

[13] Powers, C.M., P.Y. Chen, S.F. Reischl, J. Perry, 2002. Comparison of foot pronation and lower extremity rotation in persons with and without patellofemoral pain. Foot Ankle Int., 23(7): 634-640.

[14] Powers, C.M., S.R. Ward, M. Fredericson, M. Gullit, F.G. Shellock, 2009. Patellofemoral kinematics during weight bearing and non weight-bearing knee extension in person with lateral subluxation of the patella: a preliminary study. J orthop sports phys ther., 33(11): 677-658.

[15] Powers, C.M., 2010. the influence of altered lower-extremity kinematics on patellofemoral joint dysfunction: a theoretical perspective. J Orthop Sports Phys Ther., 33(11): 639-646.

[16] Robinson, R.L., R.J. Nee, 2007. Analysis of hip strength in females seeking physical therapy treatment for unilateral patellofemoral pain syndrome. J Orthop Sports Phys Ther., 37(5): 232-238.
[17] Taunton, J.E., M.B. Ryan, D.B. Clement, D.C. McKenzie, D.R. Lloyd-Smith, B.D. Zumbo, 2010. A retrospective case control analysis of runners injuries. Br J Sports Med., 36(2): 95-101.
[18] Tumia, N., N. Maffulli, 2002. Patellofemoral pain in female athletes. Sports Med Arthrose Rev., 10(10): 69-75.
[19] Wilson, I.D., L.S. Davis, 2008. Lower extremity mechanics of females with and without patellofemoral pain across activities with progressively greater task demands. Clin Biomech (Brisyol, Avon). 23(2): 203-211.
[20] Witvrouw, E., R. Lysens, J. Bellemans, D. Cambier, G. Vanderstraeten, 2000. Intrinsic risk factors for the development of anterior knee pain in an athletic population: a two-year prospective study. Am J Sports Med., 28 4: 480-489.