ECRONICON OPEN ACCESS

EC ORTHOPAEDICS
Research Article

A Comparative Study of Effect of Hip Muscle Strength Training and Knee Muscle Strengthening Programme in Patellofemoral Pain Syndrome

Sandeep Negi[1]*, Shekhar Singh[2] and Chhewang Dorje[3]

[1]*Senior Physiotherapist, PGIMER, Chandigarh, India*

[2]*Assistant Professor, Jaipur Physiotherapy College and Hospital, MVGU, Jaipur, India*

[3]*Physiotherapist, PGIMER, Chandigarh, India*

***Corresponding Author**: Sandeep Negi, Senior Physiotherapist, PGIMER, Chandigarh, India.

Received: September 21, 2019; **Published:** October 16, 2019

Abstract

Patellofemoral pain syndrome (PFPS) is the common problem in athletes due to hip muscle weakness and excessive patellofemoral joint pressure. Thus the present studies is to compare the effect of hip muscle and knee muscle strength training programme in management of patients PFPS. A total of 100 subjects with diagnosis of patella femoral pain syndrome who satisfy the selection criteria were included into the study and they are randomly allocated into two groups. The two groups were homogeneous prior to treatment in respect to demographic, pain and functional status and Q angle data. Both the Hip and knee muscle strength training group (Group A) and knee muscle strength training group (Group B) showed significant improvement in the VAS, Kujala AKPS and Q angle. (P<.000 and P<.000, respectively). Improvements of pain and function were greater for the group that performed the hip muscle strength training group, but the difference was significant only for Kujala anterior knee pain rating scale (AKPS), thereby our study rejects null hypothesis and accepts experimental hypothesis.

Keywords: *Patellofemoral Pain Syndrome; Knee Muscle Strength Training Programme; Patella Femoral Pain Syndrome; Visual Analogue Scale; Kujala Anterior Knee Pain Rating Scale (AKPS)*

Introduction

Patellofemoral pain syndrome (PFPS) is a common orthopedic condition and is diagnosed at a higher frequency in female athletes when compared to male athletes [1-3]. During a 5-year span, Devereaux and Lachman demonstrated that 25% of all individuals with knee pain evaluated in a sports injury clinic were diagnosed with PFPS. The clinical diagnosis of PFPS typically encompasses retropatellar and/or pre-patellar knee pain that present insidiously and tend to be aggravated by prolonged sitting or activities that load the patellofemoral joint, such as ascending or descending stairs, squatting, running, jumping, or kneeling [4,5]. The most commonly accepted hypothesis of the cause of PFPS is that abnormal patellar tracking increases patellofemoral joint stress and causes ATC2 subsequent wear on the articular cartilage [6-8]. However, retropatellar pain and crepitus may also occur when the patella articulates against the femoral condyles, even in the absence of any measurable damage to the articular cartilage [6]. 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 [9-12]. Foot orthoses are also commonly used as an indirect approach to affect patellofemoral motion through control of foot pronation [13].

More recently, some researchers have recognized that the patellofemoral joint could be influenced by abnormal hip motion leading to excessive femoral movements in the transverse and frontal planes [10,14-16]. Powers., *et al.* [15] demonstrated that during weight-bearing activities, individuals with PFPS exhibited excessive femoral medial rotation, leading to a relative lateral displacement of the patella. Based on this study and considering that complaints of pain with PFPS are typically during weight-bearing activities, a growing body of clinical and biomechanical literature has been published on the influence of the hip musculature to control knee motion [11,17-20]. Several authors have documented significant weakness of the hip lateral rotators and abductors in women with PFPS [21,22]. 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 [22-24]. Based on these reports, few randomized controlled trials (RCTs) have been performed to determine whether increases in hip-muscle strength, improve rehabilitation outcomes for patients with PFPs. They reported that the addition of the hip-muscle-strengthening exercises resulted in better improvements in pain and function than did a knee-focused rehabilitation program. However, that study involved sedentary females and the rehabilitation protocol lasted only 4 weeks, whereas at least 6 weeks of rehabilitation may be necessary to gain the greatest treatment effect [25-27]. Thus, although the findings of previous studies suggest that including hip muscle strengthening is beneficial to PFP outcomes, no authors have directly compared a hip muscle strengthening program with a knee muscle strengthening program for PFPs.

Therefore, this study is aimed to assess the effectiveness of hip and knee muscle strength training programme and knee muscle strength training programme alone in improving pain and function in people with PFPs.

Materials and Methodology

100 participants with anterior knee pain, who were referred to physiotherapy department of PGI, Chandigarh for the treatment of 6 week. After obtaining informed consent from the subjects, they were randomly assigned in to 2 groups: Group A (Experimental group) received hip muscle strength training programme (abductors and lateral rotators) and knee muscle strength training programme and Group B (Control group) received only knee muscle strength training programme for the PFPS. Descriptive variables of all subjects, such as age, height and weight were recorded. All subjects underwent a baseline measurement of dependent variables such as intensity of knee pain using (VAS), functional status using Kujala Anterior Knee Pain scale and Q angle measured by using universal goniometer.

After measuring pretest outcome parameters, all the patients in both the group were advised to perform standard knee muscle strength training programme at a frequency of twice in a day, with a minimum of 6days per week for a period of six weeks. In addition experimental group also received instructions related to hip muscle strength training programme at a frequency of twice in a day six weeks. Progression of exercises, increases or decreases in sets and repetitions or duration of exercises were based on patient feedback, PFP, swelling and symptoms during rehabilitation progression. The Compliance was monitored and recorded within the home-exercise rehabilitation booklet. Then the post-test readings were taken two days after the last day of the 6-week training sessions was taken by the same therapist as explained earlier.

Statistical analysis

The outcome parameters were measured and recorded before and end of 6 week period of interventions and analyzed using inferential statistics tool SPSS version 20. Independent variables were i) Hip muscle strength training programme ii) Knee muscle strength training programme. Dependent variableswere i) Intensity of pain using (VAS) iii) Functional status using iii) Kujala Anterior Knee Pain scaleiv) Q angle measured by using universal goniometer. The dependent variables were analyzed for within group comparison using Paired t- test. Unpaired t-test was used for between- group analyses. A value of $p< 0.05$ was accepted as significant.

Results and Discussions

Analysis of pretest and posttest (end of 6weeks) values of VAS within the Group A (Experimental group) using paired t test shows that calculated value of t is 15.861, at probability level of .000 for a two- tailed test as shown in table 1. It reveals that after a 6weeks period of

intervention, intensity of pain in the Group A are reduced to the level, which is less than the value of baseline level. Analysis of pretest and posttest (end of 6weeks) values of Q angle within the Group A (Experimental group) using paired t test shows that calculated value of t is 3.934, at probability level of .000 for a two- tailed test. It reveals that after a 6weeks period of intervention, Q angle degrees in the Group A are changed significantly to the level, which is less than the value of baseline level. Analysis of pretest and posttest (end of 6weeks) values of Kujala anterior knee pain rating scale within the Group A (Experimental group) using paired t test shows that calculated value of t is -18.532, at probability level of .000 for a two- tailed test. It reveals that after a 6weeks period of intervention, functional status in the Group A are improved to the level, which is greater than the value of baseline level.

Group A	Paired Differences					t-test	df	α
	Mean	S. D.	S E	C I				
				Lower	Upper			
VAS Pre - Post	3.14	1.39985	0.19797	2.74217	3.53783	15.861	49	0
Q Angle Pre - Post	0.48	0.86284	0.12202	0.23478	0.72522	3.934	49	0
Kujala Pre - Post	-11.7	4.46414	0.63133	-12.9687	-10.4313	-18.532	49	0

Table 1: *Hip and knee muscle strength training group (Group A).*

SD: Standard deviation; SE: Standard Error Mean; CI:- 95% Confidence Interval of the Difference α- Sig. (2-tailed).

Analysis of pretest and posttest (end of 6 weeks) values of VAS within the Group B (Control group) using paired t test shows that calculated value of t is 14.876, at probability level of .000 for a two- tailed test as shown in table 2. It reveals that after a 6weeks period of intervention, intensity of pain in the Group B is reduced to the level, which is less than the value of baseline level. Analysis of pretest and posttest (end of 6weeks) values of Q angle within the Group B (Control group) using paired t test shows that calculated value of t is 6.187, at probability level of .000 for a two- tailed test. It reveals that after a 6weeks period of intervention, Q angle degrees in the Group B are changed significantly to the level, which is less than the value of baseline level. Analysis of pretest and posttest (end of 6weeks) values of Kujala anterior knee pain rating scale within the Group B (Control group) using paired t test shows that calculated value of t is -16.858, at probability level of .000 for a two- tailed test. It reveals that after a 6weeks period of intervention, functional status in the Group B is improved to the level, which is greater than the value of baseline level.

Group A	Paired Differences					t- test	df	α
	Mean	S. D.	S E	C I				
				Lower	Upper			
VAS Pre-Post	3.02	1.43555	0.20302	2.61202	3.42798	14.876	49	0
Q Angle Pre-Post	1	1.14286	0.16162	0.6752	1.3248	6.187	49	0
Kujala Pre-Post	-19	7.96933	1.12703	-21.26486	-16.73514	-16.858	49	0

Table 2: *Knee muscle strength training group (Group B).*

SD: Standard Deviation, SE: Standard Error Mean, CI: 95% Confidence Interval of the Difference, α- Sig. (2-tailed).

Comparison between group analysis of Group A and B are shown in table 3. Analysis of posttest measures (end of 6 weeks) for intensity of pain between groups A and B using unpaired t-test shows that calculated value of t is 0.573, at probability level of 0.569 for a two-tailed test. It reveals that after a 6weeks period of intervention, intensity of pain in both the groups is reduced to the level, which indicates there is no significant difference in improvement in intensity of pain. Analysis of posttest measures (end of 6 weeks) for Q angle between

groups A and B using unpaired t test shows that calculated value of t is 1.865, at probability level of 0.068 for a two-tailed test. It reveals that after a 6weeks period of intervention, Q angle in both the groups is changed to the level, which indicates there is a significant difference in Q angle. Analysis of posttest measures (end of 6 weeks) for Kujala anterior knee pain rating scale between groups A and B using unpaired t test shows that calculated value of t is -7.937, at probability level of 0 for a two-tailed test. It reveals that after a 6weeks period of intervention, functional status in both the groups is changed to the level, which indicates there is significant difference in improvement in Kujala anterior knee pain rating scale.

Group A	Paired Differences					t- test	df	α
	Mean	S. D.	S E	C I				
				Lower	Upper			
VAS Group A and B	0.14	1.72627	0.24413	-0.3506	0.6306	0.573	49	0.569
Q Angle Group A and B	0.44	1.66795	0.23588	-0.03402	0.91402	1.865	49	0.068
Kujala Group A and B	-13.12	11.68924	1.65311	-16.44205	-9.79795	-7.937	49	0

Table 3: *Post- test measures of Group A&B.*

SD: Standard Deviation, SE: Standard Error Mean, CI: 95% Confidence Interval of the Difference, α- Sig. (2-tailed).

This study was designed to find out the effect of Hip and knee muscle training program in Patello femoral pain syndrome. It primarily aimed to assess the effect of 6 weeks Hip and knee muscle training program on subjects knee pain, functional status and Q angle. Subjects were randomly allocated to two groups; Group A received Hip and knee muscle training program and Group B received only knee muscle training program. The dependent variables taken for this purpose were VAS score, Kujala anterior knee pain rating scale and Q angle measurement. The subjects with patella femoral pain syndrome satisfying the selection criteria were only included in this study. Subjects with other associated problem were not included. The hip and knee muscle strength training exercises used in this study have been described in the literature for PFP rehabilitation and reported as efficacious [29-35]. These above mentioned exercises applied to this study to find out the efficiency of treatment for patella femoral pain syndrome, according to the standardized protocols. The results of this study were analyzed statistically using paired and unpaired t test. The statistical analysis reveals that, within the group analysis of Group A and B showed more or less similar improvement in all three outcome parameters such as VAS score (Group A- t value is about 15.861; Group B- t value is about 14.876), Kujala anterior knee pain rating scale (Group A- t value is about -18.532; Group B- t value is about -16.858) and Q angle (Group A- t value is about 3.934; Group B- t value is about 6.187) after 6 weeks of intervention. The statistical analysis between the group A and B at the end 6 weeks showed that there is significant improvement in group A (Hip and knee muscle strength training group) especially kujala anterior knee pain rating scale (t value is about -7.937, at probability level of 0 for a two-tailed test) than the Q angle (t value is about 1.865, at probability level of 0.068 for a two-tailed test) and VAS score(t value is about 0.573, at probability level of 0.569 for a two-tailed test).

The findings of the present study support the growing body of literature which suggests that hip strengthening may be a viable intervention for PFP, due to the fact that biomechanical influences of hip abductors and external rotators muscles on femur alignment: a lack of motor control from the hip external rotators and abductor muscles would increase femur rotation under the patella while standing. Which would increase the lateral patellofemoral joint vector, leading to patellar facet overload [14,19,22,30]. Given that excessive hip adduction and internal rotation have been postulated to adversely affect patellofemoral joint kinematics and kinetics [39,40]. It is possible that the changes in hip muscle performance might have resulted in a decrease in patellofemoral joint loading and, therefore, decrease in pain. The findings of this study are consistent with the results of 3 RCTs that incorporated hip strengthening into an exercise program for females with PFP [36-38]. Nakagawa., *et al*. [38] concluded that the combination of hip abductor, hip external rotator and knee extensor exercises

was more effective than knee extensor strengthening alone in decreasing perceived pain during functional activities in females with PFP. Fukuda., *et al*. [37] reported that improvements in PFP and function were greater when knee-strengthening exercises were supplemented with hip-strengthening exercises Similarly, Dolak and colleagues [36] reported that 4 weeks of isolated hip strengthening prior to the initiation of 4 weeks of weight-bearing exercise reduced self-reported symptoms earlier than when 4 weeks of quadriceps strengthening were performed prior to the same weight-bearing program. Although these studies provide evidence to this study that combined hip and knee muscle strength training program is more effective than knee muscle strength training program in pain and functional disability and Q angle in people with patello femoral pain syndrome. Thus my study concludes that combined hip and knee muscle strength training program is more effective than knee muscle strength training program in pain and functional disability and Q angle in people with patellofemoral pain syndrome, thereby our study rejects null hypothesis and accepts experimental hypothesis.

Conclusion

Rehabilitation programs focusing on knee muscle strength training programme and knee muscle strength training programme supplemented by hip strength training programme were both effective in improving function and reducing pain and Q angle in people with PFPS. Improvements of pain and function were greater for the group that performed the hip muscle strength training group, but the difference was significant only for Kujala anterior knee pain rating scale (AKPS). Therefore this study concludes that combined hip and knee muscle strength training program is more effective than knee muscle strength training program in pain and functional disability and Q angle in people with patello femoral pain syndrome, thereby our study rejects null hypothesis and accepts experimental hypothesis.

Bibliography

1. DeHaven KE and Lintner DM. "Athletic injuries: comparison by age, sport, and gender". *American Journal of Sports Medicine* 14.3 (1986): 218-224.

2. Devereaux MD and Lachmann SM. "Patello-femoral arthralgia in athletes attending a Sports Injury Clinic". *British Journal of Sports Medicine* 180.1 (1984): 18-21.

3. Taunton JE., *et al*. "A retrospective case-control analysis of 2002 running injuries". *British Journal of Sports Medicine* 36.2 (2002): 95-101.

4. Crossley K., *et al*. "Physical therapy for patellofemoral pain: a randomized, double-blinded, placebo-controlled trial". *American Journal of Sports Medicine* 30.6 (2002): 857-865.

5. Wallace DA., *et al*. "Patellofemoral joint kinetics while squatting with and without an external load". *Journal of Orthopaedic and Sports Physical Therapy* 32.4 (2002): 141-148.

6. Grana WA and Kriegshauser LA. "Scientific basis of extensor mechanism disorders". *Clinics in Sports Medicine* 4.2 (1985): 247-257.

7. HeinoBrechter J and Powers CM. "Patellofemoral stress during walking in persons with and without patellofemoral pain". *Medicine and Science in Sports and Exercise* 34.10 (2002): 1582-1593.

8. Sanchis-Alfonso V., *et al*. "Pathogenesis of anterior knee pain syndrome and functional patellofemoral instability in the active young". *The American Journal of Knee Surgery* 12.1 (1999): 29-40.

9. Jan MH., *et al*. "The effects of quadriceps contraction on different patellofemoral alignment subtypes: an axial computed tomography study". *Journal of Orthopaedic and Sports Physical Therapy* 39.4 (2009): 264-269.

10. Powers CM. "The influence of altered lower extremity kinematics on patellofemoral joint dysfunction: a theoretical perspective". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 639-646.

11. Robinson RL and Nee RJ. "Analysis of hip strength in females seeking physical therapy treatment for unilateral patellofemoral pain syndrome". *Journal of Orthopaedic and Sports Physical Therapy* 37.5 (2007): 232-238.

12. Wilson T., *et al*. "A multicenter, single-masked study of medial, neutral, and lateral patellar taping in individuals with patellofemoral pain syndrome". *Journal of Orthopaedic and Sports Physical Therapy* 33.8 (2003): 437-443.

13. Gross MT and Foxworth JL. "The role of foot orthoses as an intervention for patellofemoral pain". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 661-670.

14. Mascal CL., *et al*. "Management of patellofemoral pain targeting hip, pelvis, and trunk muscle function: 2 case reports". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 647-660.

15. Powers CM., *et al*. "Patellofemoral kinematics during weight-bearing and non-weight-bearing knee extension in persons with lateral subluxation of the patella: a preliminary study". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 677-685.

16. Robinson RL and Nee RJ. "Analysis of hip strength in females seeking physical therapy treatment for unilateral patellofemoral pain syndrome". *Journal of Orthopaedic and Sports Physical Therapy* 37.5 (2007): 232-238.

17. Boling M C., *et al*. "Outcomes of a weight-bearing rehabilitation program for patients diagnosed with patellofemoral pain syndrome". *Archives of Physical Medicine and Rehabilitation* 87.11 (2006): 1428-1435.

18. Ireland ML., *et al*. "Hip strength in females with and without patellofemoral pain". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 671-676.

19. Lee TQ., *et al*. "The influence of tibial and femoral rotation on patellofemoral contact area and pressure". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 686-693.

20. Tyler TF., *et al*. "The role of hip muscle function in the treatment of patellofemoral pain syndrome". *American Journal of Sports Medicine* 34.4 (2006): 630-636.

21. Bolgla LA., *et al*. "Hip strength and hip and knee kinematics during stair descent in females with and without patellofemoral pain syndrome". *Journal of Orthopaedic and Sports Physical Therapy* 38.1 (2008): 12-18.

22. Powers CM. "The influence of abnormal hip mechanics on knee injury: a biomechanical perspective". *Journal of Orthopaedic and Sports Physical Therapy* 40.2 (2010): 42-51.

23. Heiderscheit BC. "Lower extremity injuries: is it just about hip strength?". *Journal of Orthopaedic and Sports Physical Therapy* 40.2 (2010): 39-41.

24. Souza RB and Powers CM. "Differences in hip kinematics, muscle strength, and muscle activation between subjects with and without patellofemoral pain". *Journal of Orthopaedic and Sports Physical Therapy* 39.1 (2009): 12-19.

25. Collins N., *et al*. "Foot orthoses and physiotherapy in the treatment of patellofemoral pain syndrome: randomised clinical trial". *British Journal of Sports Medicine* 43.3 (2009): 169-171.

26. Witvrouw E., *et al*. "Open versus closed kinetic chain exercises for patellofemoral pain: a prospective, randomized study". *American Journal of Sports Medicine* 28.5 (2000): 687-694.

27. Harrison EL., *et al*. "A randomized controlled trial of physical therapy treatment programs in patellofemoral pain syndrome". *Physiotherapy Canada* 51.2 (1999):93-106.

28. Ismail MM., *et al*. "Closed kinetic chain exercises with or without additional hip strengthening exercises in management of patellofemoral pain syndrome: a randomized controlled trial". *European Journal of Physical and Rehabilitation Medicine* 49.5 (2013): 687-698.

29. Cowan SM., *et al*. "Physical therapy alters recruitment of the vasti in patellofemoral pain syndrome". *Medicine and Science in Sports and Exercise* 34.12 (2002): 1879-1885.

30. Fulkerson JP. "Diagnosis and treatment of patients with patellofemoral pain". *American Journal of Sports Medicine* 30.3 (2002): 447-456.

31. Cowan SM., *et al*. "Simultaneous feedforward recruitment of the vasti in untrained postural tasks can be restored by physical therapy". *Journal of Orthopaedic Research* 21.3 (2003): 553-558.

32. Thomee RA. "Comprehensive treatment approach for patellofemoral pain syndrome in young women". *Physical Therapy* 77.12 (1997): 1690-1703.

33. Powers CM. "Rehabilitation of patellofemoral joint disorders: a critical review". *Journal of Orthopaedic and Sports Physical Therapy* 28.5 (1998): 345-354.

34. Malone T., *et al*. "Muscular control of the patella". *Clinics in Sports Medicine* 21.3 (2002): 349-362.

35. Davies GJ., *et al*. "Selective activation of the vastus medialis oblique: what does the literature really tell us?". *Physiotherapy Canada* 53 (2001): 136-151.

36. Dolak KL., *et al*. "Hip strengthening prior to functional exercises reduces pain sooner than quadriceps strengthening in females with patellofemoral pain syndrome: a randomized clinical trial". *Journal of Orthopaedic and Sports Physical Therapy* 41.8 (2011): 560-570.

37. Fukuda TY., *et al*. "Short-term effects of hip abductors and lateral rotators strengthening in females with patellofemoral pain syndrome: a randomized controlled clinical trial". *Journal of Orthopaedic and Sports Physical Therapy* 40.11 (2010): 736-742.

38. Nakagawa TH., *et al*. "The effect of additional strengthening of hip abductor and lateral rotator muscles in patellofemoral pain syndrome: a randomized controlled pilot study". *Clinical Rehabilitation* 22.12 (2008): 1051-1060.

39. Powers CM. "The influence of abnormal hip mechanics on knee injury: a biomechanical perspective". *Journal of Orthopaedic and Sports Physical Therapy* 40.2 (2010): 42-51.

40. Powers CM. "The influence of altered lowerextremity kinematics on patellofemoral joint dysfunction: a theoretical perspective". *Journal of Orthopaedic and Sports Physical Therapy* 33.11 (2003): 639-646.

41. Witvrouw E., *et al*. "Open versus closed kinetic chain exercises for patellofemoral pain. A prospective, randomized study". *American Journal of Sports Medicine* 28.5 (2000): 687-694.

42. Fulkerson JP. "Diagnosis and treatment of patients with patellofemoral pain". *American Journal of Sports Medicine* 30.3 (2002): 447-456.

43. Selfe J., *et al*. "Four outcome measures for patellofemoral joint problems: part 2. Reliability and clinical sensitivity". *Physiotherapy* 87.10 (2001b): 516-522.

44. Tyler TF., *et al*. "The role of hip muscle function in the treatment of patellofemoral pain syndrome". *American Journal of Sports Medicine* 34.4 (2006): 630-636.

Volume 10 Issue 11 November 2019