DOI: https://doi.org/10.53350/pjmhs22166185

ORIGINAL ARTICLE

Comparison between the Effect of Closed Kinetic Chain and Open Kinetic Chain exercises in the strengthening of Vastus Medialis Obliqus in subjects with Patello-Femoral Pain Syndrome - a randomized control trial

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ABSTRACT

Aim: To compare the effects of closed kinetic chain and open kinetic chain exercises in the strengthening of vastus medialis obliqus in subjects with Patello-femoral pain syndrome.

Methods: The study was a randomized controlled trial. It was conducted to compare the impact of open and closed kinetic chain exercises to strengthen the Vastus medialis obliqus in PFPS patients. For this purpose, 36 patients both males and females with age 20-40 years having PFPS were allocated randomly to two experimental (group A and group B) and one control group C. Group A, practised open kinetic chain exercises and the second group B practiced closed kinetic chain exercises, the control group C was given general physical therapy exercises, for four weeks. The assessment of Pain and function of the individual taking part in this study were was done before starting the treatment, at 2 weeks and at 4 weeks, using Numerical Pain rating scale and Kujala Anterior knee pain scale, respectively.

Results: In conclusion, significant changes i.e. in alleviating pain and enhancing overall functionality has been seen in Group B that performed closed kinetic chain exercises for about 4 weeks. Similarly, there was also a remarked change in pain reduction besides improved function in group A and group C. By comparing all the three groups, significant advantage has been noted with closed kinetic chain exercises as compared to open kinetic chain and conventional PT techniques.

Conclusion: Although, both exercise regimens were significant in pain reduction and enhancing function, but close kinetic chain exercises produced remarkable effects.

Keywords: Closed kinetic chain exercises, Function Open kinetic chain exercises, Pain, Patello-femoral pain syndrome, PFPS.

INTRODUCTION

Patello-femoral pain syndrome (PFPS)is considered as one of the commonly occurring problems of knee joint in young adults and older individuals. It constitutes for 20–40% of all knee issues in adults and young individuals who remain active[1]. The prevalence of PFPS are reported to be range from 15% to 33% in adults, and 21% to 45% in active adolescents[2]. In PFPS, the pain occurs behind the patella or aching pain occurring anterior to knee joint[3]. The pain may also occur within, around the patella and the retinaculum surrounding it[4]. Patient complains of pain for more than 6 weeks and It is aggravated by some specific tasks of routine living including running, ascending and descending stairs, squatting, and prolonged short sitting with knees in bend position[5]. The pain feels like diffusing in quality that occurs peripatellar i.e., around the patella or retropatellar; behind the patella and the pain is localized in nature. PFPS accounts for about 11% to 17% of all problems causing knee pain in usual clinical setting[2]. There is no underlying particular pathology, however patients symptomatically complain presence of crepitation's occurring together with pain in patella-femoral joint[6] when doing heavy tasks and after performing weight bearing activities[1]. The occurrence of PFPS is much greater in women than in men and it is significantly prevailing in females which are involved in athletic activities[7]. Most of the studies indicated over activity and injury as possible causes of patello-femoral pain syndrome. However, a large number of individuals with PFPS do not regard any traumatic incident in history. But all patients reported a brief duration of increased work of the patello-femoral joint and an increased physical activity[8]. Patello-femoral pain occurs most of the time amongst athletes that are involved in activities of running and jumping[9].

The risk factors involved in the pathogenesis of PFPS, are classified into two categories, as intrinsic or extrinsic risk factors. In addition to this, damage to soft tissue structures for example shortening of lateral retinaculum or decrease in strength of medial retinaculum, decreased elasticity of iliotibial band, stiffness of hamstring and gastrocnemius can directly or indirectly impart greater stress on the patella-femoral joint[10]. Some of these intrinsic risk factors can be varied such as decrease in the length of the quadriceps and plantar flexors most of the times, and decreased length of the hamstrings and the iliotibial band or tensor fascia lata complex[11]. The quadriceps angle that is dynamic in nature is enhanced by greater lateral moment at the knee and this resultantly increases the valgus forces acting on the patella that resultantly imposes increased forces on the lateral boarder of the patello-femoral joint[12]. Extrinsic risk consists of factors outside the human body such as some kind of sports activity, environmental condition, and the surface and apparatus used.

Altered tracking of the patella within trochlear groove that is located in the femur has an important role. As suggested that disturbance in the length-tension relationship between vastus medialis obliqus (VMO) versus vastus lateralis (VL) muscle activities results in increased shifting of patella to lateral side[13] causing friction of the lateral condyle of femur, that results in increased amount of stress on articular surface and produced pain.

Physical therapy treatment comprises mixture of therapeutic techniques such as manual therapy, exercises, and knee-taping processes[14] patellar taping[15]. One of the recuperative treatment protocol for this syndrome is the strengthening of quadriceps muscles. Muscle strength is always being increased when muscles are subjected to forceful contraction i.e. resisted muscle work, both types of kinetic chain exercises are used for this purpose.

Commonly the objective of treatment in PFPS patients is to counter the pain along with improving the physical activity. This study aims to define and differentiate the effects of open and closed kinetic chain exercises in strengthening program to decrease pain and improve functionality in patients suffering from PFPS. The hypothesis of the study is that the close kinetic chain exercises produce significant effects comparing to the other type of

Received on 25-10-2021
Accepted on 12-05-2022

exercise where extremity is not grounded. than open kinetic chain exercises. Different studies concluded different results, some studies favor OKC exercises to be more effective than CKC exercises, some studies concluded CKC exercises to bring more significant effects than OKC exercises.

MATERIALS AND METHODS

The study was taken in a randomized sampling manner, by purposive non probability sampling technique. It was conducted in accordance with the committee of ethical consideration. The study was conducted following the guidelines of the institutional ethical committee. The study included 36 patients both males and females of age between 20-40 years, this age interval has been chosen because after 40 years of age, the incidence of changes in hormones and arthritic changes start increasing. All the subjects were recruited from the orthopedic OPD and physical therapy unit Mayo Hospital, Lahore. All individuals were informed about the study protocol. Total 36 subjects were split up into 3 groups in a random manner; each Group includes 12 participants, Group A performed open kinetic chain exercises, Group B practiced closed kinetic chain exercises, and group C labelled as control group, received no specific intervention, except conventional Physical therapy exercises. Subjects confirmed for the diagnosis of patello-femoral pain syndrome were included that came under the inclusion criteria. The exclusion criteria include history of any inflammatory conditions the knee, pain and loss of function in the knee due to the occurrence of another pathology, pathologies of other joints, meniscal pathology etc. patellar dislocation, sub-luxation, any soft tissue injury to the knee in the past, knee fracture, present or past history of infective disorders of knee joint, and degenerating conditions of the knee joint. The inclusion criteria include increased symptoms while performing any two of the following activities such as: going up and down the stairs, hopping, jogging, sitting for a longer duration, kneeling or squatting. Before starting the treatment, permission of patients was taken with the explanation of treatment procedure and then the patients underwent proper assessment regarding the assessment protocol. Only a hot pack was prescribed for pain control.

A Base line therapy was given to all the three groups, it included the general physical therapy treatment that consisted of hot pack for 10 minutes and knee isometric contraction exercises. Patients were instructed to lie flat and placing a towel under the knee and pressing it by contracting their quadriceps muscles. Patients were advised to do 10 repetitions in the beginning three times a day after achieving this an addition of 5 repetitions was done to each exercise in each next week. Patients were advised to keep the muscle in contracted form for 5s in each exercise. The open kinetic chain exercises include: 'Straight leg raising' exercise and 'stopping up and down' exercise. Patients were advised to do 10 repetitions of the exercise three times a day. The exercise regimen consisted of practice 6 days a week, consisted of total 24 sessions. Time period for each session was 30 to 45 minutes, beginning with a short warm-up exercise program that included Quadriceps strengthening in low intensity and a cool-down program of dynamic stretching at the end. A few tests for the evaluation of functional activity of leg include such as Clarke's sign, Patellar grinding test, Patellar compression test, single limb hop test and step-down test were performed for assessment before treatment.

The Numeric pain rating scale (NPRS) and Kujala Anterior Knee pain scale (AKPS) were utilized to take outcome measures Both these measures were taken before starting the treatment Both these measures, after 2 weeks and at 4 weeks at the end of treatment Data was analysis through SPSS V21.0. Mean ± standard deviation for continuous variables were used to define descriptive statistics. Patients' personal and clinical history including age, gender, duration of symptoms, degree of joint stiffness, pain and functional activity level were taken by the therapist before starting the study, starting duration of pain and presence of other systemic diseases was assessed.

SPSS 21was used for data management and analysis .Mean ±SD was used for quantitative data such as age For Qualitative data that includes gender was shown in the form of percentage, and when applicable in the form of frequency table. Shapiro Wilk test was used to access the normality of the data. To find out the difference within all clinical parameters measuring associated pain repeated Measure ANOVA was used. To find out any significant difference between the three groups One-way ANOVA was used. The p value of less than 0.05 was considered significant, while a p value greater than 0.05 depicted insignificant difference.

RESULTS

Descriptive statistics for KUJALA

	N	Mean	Standard deviation
KUJALA Pre-treatment			
Group 1	12	58.2500	10.97207
Group 2	12	60.6667	13.16561
Group 3	12	56.1667	9.97117
KUJALA Post- treatment			
Group 1	12	94.0000	3.24738
Group 2	12	97.8333	2.36771
Group 3	12	94.6667	4.09730

ANOVA statistics for KUJALA

	Sum of squares	df	Mean square	F	Sig.
KUJALA Pre-treatment					
Between Groups	121.722	2	60.861	.464	.633
Within Groups	4324.583	33	131.048		
Total	4446.306	35			
KUJALA Post- treatment					
Between Groups	100.667	2	50.333	4.584	.018
Within Groups	362.333	33	10.980		
Total	463.000	35			

ANOVA Statistics for NPRS

	Sum of squares	df	Mean square	F	Sig.
NPRS Pre-treatment					
Between Groups	.722	2	.361	.418	.662
Within Groups	28.500	33	.864		
Total	23.000	35			
NPRS Post- treatment					
Between Groups	8.722	2	4.361	8.383	.001
Within Groups	17.167	33	.520		
Total	25.889	35			

DISCUSION

The result of this study indicates both types of kinetic chain exercises play its role in quadriceps strengthening resulting in pain alleviation and improved joint activity. Comparing the two ways of exercises emphasized closed kinetic chain exercises to bring significantly more proficient results. The previous studies results are in accordance with the conclusions of this study. Witvrouw et al figured out the impact of open and closed kinetic chain exercises on subjects suffering from patello-femoral pain syndrome for a loner time period. They documented both methods to have significant consistent irrefutable results on subjects. Likewise, Minoonejad et al demonstrated adequate results in appeasing pain and incrementing knee flexion in stair climbing and descending. The coincidence for this compatibility in the findings might be the use of same exercise convention. On the other hand, the findings of Peeler et al research brought contrasting conclusions. They observed the results of exercise therapy on the activity of patients with patello-femoral pain syndrome. Difference in the time period of therapy, in the study of Peeler et al it was 3 weeks, sessions conducted in each week, and sample size could probably be the reason . As previously mentioned, this study aimed at checking the proficiency of two techniques of exercises in pain reduction and

advancing joint function in subjects with PFPS. By open and closed kinetic chain the resultant correlation in contraction of muscle is certainly because of improvement in the strength of quadriceps muscles more specifically vastus medialis obliqus that resulted in pain relief and better activity performance; hence it would lead to correction of patellar maltracking and decrease the stress on knee joint. It would make joint function better and pain relief. Joint function is improved by strengthening of quadriceps muscle. Another important aspect in PFPS patients is inadequacy of neuromuscular system, probably an alternating process could be the effectiveness of open and closed kinetic chain exercise in improving neuromuscular system of knee joint along with improving proprioception in the joint. By improving the neuromuscular system and strengthening the muscle the way a muscle acts can be changed as well as increased stability of knee joint and specifically the stresses on the knee joint can be minimized[16].

There are many researches in which closed kinetic chain were recruited along with exercises that involve weight bearing, e.g., squatting in doubt legs and lunging to strengthen the VMO. The results of their studies supported these protocols can remarkably improve the activity of vastus medialis obliqus and vastus lateralis. A few studies concluded closed kinetic chain exercises to bring increased activity in the vastus medialis obliqus as compared to vastus lateralis. However, adding closed kinetic chain exercise with exercises that involve weight-bearing often produces greater muscle strengthening, and increasing the pressure of intra-articular space. The closed kinetic chain exercise might be beneficial in activation of vastus medialis obliqus patello-femoral pain syndrome individuals. This study observed the open kinetic chain exercise to have greater significance in vastus medialis obliqus activation than the closed kinetic chain exercise. Some studies indicated that open kinetic chain exercise is less effective on patello-femoral pain syndrome treatment, as vastus medialis obliqus activity could not possibly correct patellar tracking. Unlike, this study concluded that use of closed kinetic chain exercise can increase the vastus medialis obliqus activity greatly than that of the vastus lateralis. This beneficial effect is better than that of the open kinetic chain exercise. Both exercises can improve the vastus medialis obliqus muscle performance in patello-femoral pain syndrome patients, and the beneficial effect on vastus medialis obliqus to vastus lateralis of the closed kinetic chain exercise is greater compared to the open kinetic chain exercise[17].

It has been found that open chain exercises are not easy to perform in individuals having patello-femoral pain syndrome as they produce hyper tonicity of the cruciate ligament and defective methods of muscle recruitment. While, because of the combine tension development in quadriceps and hamstring muscles, and pressure increment on the patello-femoral joint closed kinetic chain exercises cause smaller shearing force and might facilitate functional muscle recruitment patterns caused by multipoint movements[18].

The results of this study are in accordance with the previous researches that closed kinetic chain exercises as well as open kinetic chain exercises on quadriceps muscle have a profound effect on pain relief and better joint performance. In comparison of the two protocols of exercises significant outcomes has been observed for close kinetic chain exercises.

CONCLUSION

On the whole, it has been seen both types of kinetic chain exercises proved itself beneficial in alleviating pain and strengthening of muscles in subjects having patello-femoral pain syndrome. Moreover, if we Compare these two protocols, closed kinetic chain exercises proved itself even better than open kinetic chain exercises.

Conflict of interest: Nil

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