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Original Research

Comparative effects of closed kinetic chain exercise with and without isometric hip adduction in patients with patellofemoral pain syndrome

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Keywords: Patellofemoral pain syndrome, Knee pain, Closed kinetic chain exercise, Isometric hip adduction

Abstract

The goal of the research was to assess the comparative impact of the Closed kinetic chain exercise in patellofemoral pain syndrome with and without isometric hip adduction. The quasi-experimental study was done on the athletic population of Gujrat with age between 16-40 of any gender. In this study 30 patients were recruited on the basis of sample selection criteria and randomly allocated in two groups each of 15 (N=15). Group A performed closed kinetic chain exercise through isometric hip adduction. Closed kinetic chain exercise included the semi squats of 600 with hip adduction. The group B performed CKC exercise without hip Adduction. CKC exercise included the semi squats of 600 without hip adduction. Both groups filled out a demographic data questionnaire, and signed a written consent. Pain severity in patients assessed through VAS. The function of the joints was also evaluated using a detailed questionnaire on Kujala impairment. In all patients the patellofemoral compression test and patellofemoral grinding test were performed and these tests were positive. At the next phase, groups A and B were treated over a span of 4 weeks through 12 therapy sessions. the session lasted 10 to 15 minutes. Each session included warmup of 5 minutes. Warmup included stretching of the Hamstrings, VMO and VL and then 3 sets of 10 repetitions each set followed by 30 second was performed. After the termination of study all the subjects was filled up the questionnaire again. At the end the VAS scale scoring, Kujala Questionnaire scoring and Patellofemoral compression test and patellofemoral grinding test was performed again. Evaluation of data was done by spss 23 version. The data for 30 participants were assessed, with 66.7% men and 33.3% women between the ages of 16 and 40. Both groups received improved results. In the experimental group, the mean difference between the pre- and post-test results was 9.1333 (p=0.016), while it was 8.2000 (p=0.02) in the control group. However, the participants of 1st group showed the more promising results as compared to the 2nd group. According to this study closed kinetic chain exercises with isometric hip adduction showed the more prominent result on the PFPS.

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Introduction: The patellofemoral dysfunction is one of the most publicly common muscle-skeletal disorders in knees. Its rate of occurrence in the population is almost 25 per cent. The general population's annual prevalence of patellofemoral pain was 22.7 percent, while that of adolescents was 28.9 percent. Patellofemoral pain is common, affecting between 11 and 17 percent of patients with knee pain who see a general practitioner. Signs contain of acute anterior knee pain, many of which are generally in the medial patella portion. The main symptom of this disease is diffused retro patellar and peripatellar pain with no specific pathology, aggravated by actions like climbing and descending of stairs, sitting, squatting, kneeling, running and jumping[1, 2,3].

The cardinal component of PFPS is torment in or around the front knee that escalates when the knee is flexed during weight-bearing exercises. PFPS pain often gets worse when you sit for a long time or go down stairs. Squatting pain is the physical examination finding with the greatest sensitivity. A patient's footwear, gait, and posture can all be examined to identify contributing factors[4]. Anatomical bone defects cause malalignment, and can predispose the patella to mal-track. Defaults in the composition of static and dynamic soft tissue have noteworthy effects on the biomechanics of patellofemoral[5]. PFPS is frequently referred to chondropathy, patellofemoral chondritis, chondromalacia, subluxation of the patella, anterior knee pain, patellar dislocation, or state of extreme over pression. PFPS differs from chondromalacia of patellar. A degeneration in hayaline cartilage, at the posterior side of the knee cap defines the patellar chondromalacia. PFPS is caused by many unbalanced forces which control movement of patella during flexion of knee and extension especially due to overloading in the joint [6]. It has been hypothesized that hip muscle weakness contributes to patella-femoral malalignment and the onset of PFPS [7]. Patients with PFPS frequently report having weaker knee extensors [8]. Crepitus and giving way are two additional common symptoms [9].

There are several theories concerning PFPS pathogenesis, including unbalanced muscle between quadricep muscles and hamstring muscles, Tensor fascia lata and gluteus medius , vastus medialis and vastus lateralis, lower extremity malalignments, overuse injuries, ligament and cartilage knee , and hormonal factors. Muscle imbalance between the vastus medialis and vastus lateralis, maltracking of the patella in the groove of the trochlea of the femur, and lateral patellar motion are all common theories, according to the authors. Lateral patellar movement results in a shift in the distribution of pressure on the articular surfaces and also in concentration and amplified pressure on the lateral patellar facet, which contributes towards patellar pain & PFPS [10].

The application of hip adduction to activate Vastus Medialis Oblique selectively is crucially proposed by Hanten and Schulthies. Studies of anatomical cadaver have revealed that fibers from the Vastus Medialis Oblique come from distal portion of the adductor magnus muscle and the Vastus Medialis Oblique has a "stable root from which to contract" by contracting the adductors. Hip adduction also produces a stretch of Vastus Medialis Oblique fibers which regulates the tension properties of muscle length and thus increases the contraction force [11]. In sharp contrast, Coqueiro et al. findings found that there was a substantial difference in favor of Vastus lateralis during a regular semi-squat exercise between Vastus lateralis and Vastus Medialis Oblique EMG activity[12]. Earl et al, made numerous claims that the combination of hip adduction isometrically and a mini squat in closed-chain resulted in more general quadriceps activity than a normal mini squat [13]. CKC exercises are better than OKC (open kinetic chain) exercises, as the earlier places less pressure in the functional ROM on the PF joint. Hence, patients with PFPS may better tolerate CKC (closed kinetic chain) exercises and hence might display improved functional outcomes after such a rehab program [14].

Maximum VMO activity was reached in open kinetic exercise with terminal knee extension with medial tibial rotation. Squats with external rotation were preffered during closed kinetic exercises for optimum VMO activation. Both open chain and closed chain exercises thus demonstrate the right progress in the recovery process [15]. A squat with adduction of hip is successful for specific activation of VMO and play important role in the balancing of VL and VMO ratio in PF pain. Because VL/VMO plays vital role in the maltracking of the patella [16].

In case of PFPS there is no proper research in Pakistan on the comparison of closed kinetic chain exercise with and without isometric hip adduction. This research helped to fill in the gaps left by prior studies in the field of ortho rehabilitation. Clinicians and ortho rehab experts can employ the more effective procedure on patients to get greater result in less time.

Methods: The quasi experimental study was done on the athletic population of Gujrat of age between 16-40 of any gender. In this study 30 patients nominated on the basis of inclusion criteria and randomly allocated in two groups each of 15 (N=15). Group A performed closed kinetic chain exercise through isometric hip adduction. Closed kinetic chain exercise included the semi squats of 600 with hip adduction. The group B performed CKC exercise without hip Adduction CKC exercise included the semi squats of 600 without hip adduction. Both participants filled out a demographic data questionnaire, and signed a written consent. Study Included both Males and females, Range of age sixteen to forty years, Bilateral Unilateral PF pain longer than one month, Keen to complete a 4-week rehab program of 12 sessions, Anterior or retro patellar pain registered on at least two of the following activities: sitting long, climbing or descending stairs, squatting, running, kneeling and hopping / springing, visual analog scale (VAS) minimum score of three, The Kujala value is under 65, Positive grind test followed by other clinical tests, Patellofemoral pain syndrome diagnosis confirmed by a doctor. Participants having A previous surgery or fracture to the knee, Weakness of the ligament and/or internal instability, The history of patellar dislocation or subluxation or laxity of patella, Serious injury, Real locking of the knee joints or giving way, Medical condition concomitant, Inflammatory joint disease, Infectious Diseases, Established tibiofemoral and/or patellofemoral joint osteoarthritis; Irregularities in the knee x-ray,

Neurological or circulatory malfunctions, Patella tendonitis, tendonitis of the iliotibial (IT) tract, Sinding-Larsen Johansson syndrome , Osgood Schlatter 's disease, knee plica or muscle tears. Subjects who cannot or do not wish to give printed consent form, Subjects undergoing surgery for another joint problem(s) with the lower limb, Lower back background, sacroiliac issues or ankle / feet issues more than 3 days, the subjects currently engaged in intensive lower limb training programs, Deterrence, Breastfeeding or pregnancy, Ongoing lower limb injury proceedings were excluded. Furthermore, there are at least two results from the following clinical exam: Pain in Patella, with manual patella compression to the femur, Tenderness in patella palpating the posteromedial and posterolateral patella margins, Pain in Patella during knee extension resisted dynamically, Pain in Patella with manual patella compression to femur during isometric contraction of the knee extension. Pain severity in patients assessed through VAS. Data collection tools: Kujala scaling questionnaire, VAS scale, Patellofemoral compression test, Patellofemoral grinding test were used. The function of the joints was also evaluated using a detailed questionnaire on Kujala impairment. In all patients the patellofemoral compression test and patellofemoral grinding test were performed and these tests were positive. At the next phase, groups A and B were treated over a span of 4 weeks through 12 therapy sessions. Could session have lasted 10 to 15 minutes. Each session included warmup of 5 minutes. Warm included stretching of the Hamstrings, VMO and VL and then 3 sets of 10 repetitions each set followed by 30 second was performed. After the termination of study all the subjects was filled up the questionnaire again. At the end the VAS scale scoring, Kujala Questionnaire scoring and Patellofemoral compression test and patellofemoral grinding test was performed again.

Results: The study aimed to compare the effects on patellofemoral pain of closed kinetic chain exercise with and without isometric hip adduction. For this the 30 participants of age 16-40 were randomly selected. The 30 participants were divided into 2 groups, each of 15 (n=15). 1st group showed the great response to the exercise with significance value of 0.016 and 0.014 for Kujala scale scoring and VAS value respectively. The 2nd group also showed the great response to the exercise with significance value of 0.20 and 0.27 for Kujala scoring and VAS value respectively. These results showed that both interventions were very effective for the treatment of the patellofemoral pain. Then at the end when independent test was performed for checking the more effective intervention the significance value was greater than 0.05 so which showed that both interventions are equally effected.

The data of 30 participants—66.7% men and 33.3% women—ranging in age from 16 to 40 were evaluated. In both groups, participants showed improvement. In the experimental group, the mean difference between the pre- and post-test results was 9.1333 (p=0.016), while it was 8.2000 (p=0.02) in the control group. However, the participants of 1st group showed the more prominent result as compared to the 2nd group. The data analysis showed that the significance value is greater than the 0.05 so according to rule if the significance value is greater than the 0.05 the the null hypothesis is accepted and the alternate hypothesis is rejected. So analysis showed that both interventions are equally effected.

Discussion: Patellofemoral dysfunction is one of the most common musculoskeletal disorders in the knees. Its incidence in the population is almost 25 percent. Symptoms include acute front knee pain, many of which are generally in the middle of the patella. However, discomfort can also be associated with retro patella and lateral face. Such symptoms are caused by changes in the structure or biomechanics of the joint that are associated with movements such as climbing up and down stairs, sitting, squatting or kneeling for long periods of time. Which results in the patellofemoral joint having increased compressive forces. There are also other signs and symptoms such as crepitus in the patella, inflammation and joint locking. The main symptom of this disease is diffuse retro patellar and peripatellar pain without specific pathology, aggravated by activities such as climbing and descending stairs, sitting, squatting, kneeling, running and jumping. A patient suffering from this condition reduces muscle activity. In addition, gait kinematics change in daily activities due to decreasing knee ROM. In general, it can be said that as a result of the pain and decreasing function of the knee, the patient may experience a certain degree of functional disability. This condition affects non-athletes and athletes and is a common knee problem in physically active young adults and teenagers. It is as yet not satisfactory what elements lead to the advancement of this pathology. The study's objective was to compare the effects on patellofemoral pain of closed kinetic chain exercise performed with and without isometric hip adduction. For this, 30 participants aged 16-40 were randomly selected. 30 participants were divided into 2 groups of 15 each (n=15). In the 1st group, a closed kinetic chain exercise with isometric hip adduction (half-squat with a pillow between the legs) was performed, and in the 2nd group, a closed kinetic chain exercise with isometric hip adduction (simple half-squats) was performed. A total of 12 sessions were provided to each group. One session lasted 15-20 minutes. Each session included a warm-up leg stretch followed by a closed kinetic chain exercise with either isometric hip adduction or no isometric hip adduction. Group 1 showed a large response to exercise with a significance value of 0.016 and 0.014 for Kujal scale scoring and VAS value, respectively. The second group also showed a large response to exercise with a significance value of 0.20 and 0.27 for the Kujal score and VAS value, respectively. These results showed that both interventions were very effective for the treatment of patellofemoral pain. Then, at the end, when an independent test was performed to check for the more effective intervention, the significance value was greater than 0.05, indicating that both interventions were equally effective.

A prospective randomized clinical trial comparing open and closed kinetic chain exercise for the treatment of patellofemoral pain was carried out by Witvrouw et al. A 5-week moderate program that only included closed dynamic chain exercise or reopened dynamic chain exercise was randomized to 60 patients. Muscle

characteristics, subjective symptoms, and functional performance were evaluated at the beginning of the study, at the end of treatment, and five years later. The two gatherings kept up with the positive emotional and practical outcomes they accomplished following moderate treatment at the 5-year follow-up. At the 5-year follow-up, there was no significant difference between the two groups for the majority of the parameters analyzed. In any case, the open dynamic chain bunch had altogether less protests than the shut active chain bunch on three of the 18 visual simple scales. The authors come to the conclusion that open dynamic chain programs and closed dynamic chain programs both produce the same long-term, useful result. The current study's findings were in line with these findings [17].

A study on patellofemoral syndrome and the effects of hip internal or external rotation exercises was carried out by Balci et al. The activities lasted for four weeks and included a total of twenty meetings. The MRFS system for muscle strength and proprioception, the Kujal questionnaire for functional assessment, and the visual analog pain scale were utilized to evaluate both groups before therapy, after four weeks of exercise, and after six weeks of home exercise. The only baseline characteristic that distinguished the two groups significantly (p 0.05) was mean height. The severity of pain significantly decreased in both groups following treatment and home exercise (p 0.05). Kujal scores, maximal forces (concentric and eccentric), and concentric proprioceptive deficit all improved significantly after treatment (p 0.05), whereas the improvement after home exercises was non-significant (p>0.05). In any case, neither treatment nor home activity fundamentally worked on the unusual proprioceptive shortage (p>0.05). None of the evaluated parameters showed any significant differences between the two groups during the monitored period (p>0.05). According to the findings, functional knee squat exercises performed in internally and externally rotated hip positions yield similar gains in muscle strength and proprioception for PFPS patients. These discoveries were steady with the ongoing review [18]. Research by Stiene et al. on isokinetic joint separation and shut dynamic chain practice for patients with patellofemoral brokenness: a relative report. 23 patients were divided into either a closed kinetic chain group or a joint isolation exercise group after eight weeks of training. An 8-inch (20.3 cm) retro step-up test was carried out at baseline, eight weeks, and one year. On an isokinetic dynamometer, peak concentric torque was measured at 90°/s, 180 Ys, and 360 Ys during baseline and eight-week seated knee extension testing. The perceived functional status was graded as excellent, fair, good, or bad based on the responses to the survey. The two gatherings further developed essentially in top force at all rates, as per factual examination; in any case, just the shut motor chain bunch further developed fundamentally in shut active chain testing and saw useful status. We conclude that closed kinetic chain training may be more effective at restoring function than joint isolation exercises in patients with patellofemoral dysfunction. These discoveries show comparative outcomes to the ongoing review [19].

Analysis of the activation of the VMO and VLL muscles in patellofemoral pain syndrome patients performing semi squat exercises with and without hip adduction was carried out by Coqueiro et al. Twenty female participants, divided into two groups of healthy and PFPS subjects (ten volunteers each), completed three double-leg semi-squat exercise trials with maximum hip adduction isometric contraction (DLSS-HA) and three double-leg semi-squat exercise trials without hip adduction (DLSS). The relationship of hip adduction with squat activity advanced a more prominent harmony between the average and horizontal quadriceps femoris muscles and might be demonstrated for studio treatment of PFPS patients, notwithstanding the absence of particular VMO muscle initiation. Isometric semi-squat activities and isometric hip adduction could be utilized for clinical restoration or muscle reinforcing programs since they delivered a more prominent by and large quadriceps action. The findings were in line with the present study [20].

Conclusion: According to this study closed kinetic chain exercises with isometric hip adduction showed the more prominent result on the PFPS.

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Table 1. showing paired sample T-Test for Kujala scale and VAS scale

Paired Samples Test							
		Paired Differences			t	df	P value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	kujala scale pre scoring - kujala scale post scoring	-9.13333	12.88336	3.32647	-2.746	14	.016

Table 2. Showing Independent Sample T-Test for Kujala scale and VAS scale

Independent Sample T Test						
Variables		t	df	Mean Difference	Std. Error Difference	P value
Kujala scale post scoring	Equal variances assumed	-.168	28	-.93333	5.54491	.868
	Equal variances not assumed	-.168	27.913	-.93333	5.54491	.868
VAS post value	Equal variances assumed	.384	28	.20000	.52129	.704
	Equal variances not assumed	.384	27.229	.20000	.52129	.704