RESEARCH ARTICLE

Effects of weight-bearing *versus* non-weight-bearing exercises for patellofemoral pain syndrome

Abstract

Background: Patellofemoral Pain Syndrome is an ailment that arises owing to overdoing doings that surges the pain and the compacting compulsion on the patellofemoral joint through activity. Patellofemoral Pain Syndrome (PFPS) is described as a dispersed pre-patellar and retro patellar suffering. Patellofemoral pain syndrome is frequently thought to be encountered by young and early adults.

Objective: The main objective of the study was to compare the effects of Weight-Bearing *Versus* non-weight-bearing Exercises for Patellofemoral Pain syndrome.

Methods: This study was a quasi-experimental design. This study was conducted in Sughra Physiotherapy and Polyclinic, Riphah Rehabilitation Clinic, Max Rehab clinic. 56 participants meeting the predetermined inclusive and exclusive criteria were indiscriminately allocated into two batches via consecutive sampling techniques. In individuals with patellofemoral pain syndrome, one group received multiple-joint weight-bearing quadriceps exercise whereas the other received single-joint non-weight bearing quadriceps exercises. The therapy consisted of a total of 6 weeks for all the workout classes and was carried out 3 days a week. A 5-minute static bike ergometer ride as a warm - up for each session. The training session was performed with 2-second rest repeated.

Results: There was no major difference in pain and function with a p-value >0.05 over the treatment for weight-bearing exercises and non-weight bearing exercise. There was however a substantial difference in each treatment group with a p-value <0.05.

Conclusion: All weight-bearing and non-weight-bearing exercises are equally successful in treating individuals with Patellofemoral Pain Syndrome (PFPS).

Keywords: patellofemoral pain syndrome, exercise, knee joint

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Introduction

Patellofemoral pain syndrome is also stated as anterior knee pain or chondromalacia patella [1]. They have similar symptoms, which are aggravated by similar actions. Changes in the definition of unsuitable terms cause issues in the description of their pathology [2]. Anterior knee pain is an extensive word that can include patellofemoral pain syndrome along with anterior knee issues like bursitis, fat pad fibrosis, plica when differentiated with chondromalacia patella, demanding softening or harm to the cartilage below the patella [3]. Through sports medicine, the suspected common knee disorder is Patellofemoral pain syndrome. In a small-scale analysis, the total number of knee-related injuries was reported to fluctuate between 8% and 33% [4,5]. Patellofemoral pain syndrome was also defined for military and physically active people as well as for the general population [6]. Patellofemoral pain syndrome is sometimes assumed to be experienced by both children and early adults. Results from the initial studies suggest that patellofemoral pain is the highest recorded pathology in individuals around 60 years of age [7]. As compared to men, the female has been recorded to experience 2 to 20 more times for Patellofemoral Pain Syndrome (PFPS) [8]. In the affected ones with Patellofemoral Pain Syndrome (PFPS), a frequent clinical finding is the shortage of knee extension and its intensity. The suggested physical activity therapy is to reinforce the quadriceps. Strengthening of quadriceps, the rehabilitation may be done by multi-joint weight-bearing or non-weight-bearing exercises [9] The goal of muscle strengthening is to combat the weaknesses,

which include quadriceps, power the muscle weaknesses, vastus medialis oblique muscle, faulty knee alignment, or soft tissue tightness. Physical activity in the stretching and open and closed kinetic chain exercises was used in various combinations of many different exercises to strengthen the muscles [10].

The purpose of this study was to compare in a randomized and prospective manner. The efficacy of a non-weight bearing quadriceps exercise i.e. knee extension and a weight-bearing quadriceps exercise i.e. seated leg press to improve quadriceps muscle strength, function, and status of the pain in individuals with patellofemoral pain syndrome [11-15].

Objective

The goal of this study was to compare the effectiveness of quadriceps Multi-Joint Weight-Bearing Exercises (MJWBE) *versus* quadriceps Single-Joint Non-Weight Bearing Exercises (SJNWBE) in patients with patellofemoral pain syndrome (PFPS).

Material and methods

■ Study design

The current study was a Quasi-Experimental Trial.

■ Setting

1. Sughra physiotherapy and polyclinic
2. Riphah Rehabilitation Center
3. Max Rehab

■ Duration of the study

The study was completed in six months' duration of time after the approval of the synopsis **TABLE 1**.

■ Study groups

The subjects were divided into two groups

Group A: Participants with patellofemoral pain syndrome received Multiple-Joint Weight-Bearing Quadriceps Exercise (MJWBE).

Group B: Participants with patellofemoral pain syndrome received Single-Joint Non-Weight Bearing Quadriceps Exercises (SJNWBE).

■ Sampling technique

Consecutive sampling was used to include subjects in the study while random allocation will be done to assign treatment groups.

■ Sample selection

Inclusion criteria:

1. Anterior knee pin symptoms for at least one month
2. The level of pain while stepping up and down at a height of 25 cm is 3 or more on the visual analogue
3. There are at least two types of retropatellar or anterior knee pain: excessive sitting, ascending stairs, squatting, running, kneeling, and hopping/jumping
4. Presence of 2 of the following clinical assessment criteria, pain in the anxiety test, pain in the patellar compression test, and crepitations in the compression test

Exclusion Criteria:

1. Knee arthritis or any previous knee surgery
2. History of spinal dislocation or subluxation, malalignment, or laxity of the ligament

TABLE 1. Sample size.

Mean 1	5.6
Variance 1	3.3
Mean 2	4
Variance 2	3.2
Confidence level	0.95
Power	0.8
Ratio of sample sizes (n2/n1)	1
Tails	2
Results	
Sample size	
Sample size 1 (n1)	20
Sample size 2 (n2)	20
Total sample size (both groups)	40

3. Pathology of the patellar tendon or chondral injury
4. Radiating spinal pain
5. Leg length abnormality
6. Medication or non-steroid anti-inflammatory drug or cortisone use over an extended period
7. Cartilage injury
8. Apophysitis
9. Meniscal injury
10. Ligamentous injury
11. Patellar subluxation or dislocation
12. Significant knee joint effusion
13. Previous surgery to the knee joint
14. Trauma to the knee joint affecting the presenting clinical condition

Data collection tool

1. VAS (100 mm)
2. KOOS
3. Modified Kujala Questionnaire

Random allocation

When considerations have been given to the above conditions of inclusion and exclusion, prospective participants must be considered. They had sought written, informed consent to be part of the analysis. Each participant had suggested that number one or two be drawn from the box. Number one was assigned to group A and number two was assigned to group B **TABLE 2**.

The first visit involved the following:

1. The researcher completed a thorough case history, full physical examination, and elbow regional examination
2. The participants completed the Visual Analogue Scale, KOOS, and Modified kujala Questionnaire
3. Treatment then continued according to the allocated groups
4. The therapy consisted of 6 weeks of exercises conducted 3 times a week for all exercises classes
5. For the training session, the training was carried out with a 2-second pause between repetitions after a 5-minute static cycle ergometer ride as a warm-up

Data analysis procedure

The data were analyzed using SPSS for Windows software, version 1.03. Statistical significance

TABLE 2. Treatment approach.

Group A (Weight Bearing)	Group B (non-weight bearing)
Warm-up: 5-minute static cycle ergometer ride.	**Warm-up:** 5-minute static cycle ergometer ride.
1. Squat: full squat, semi-squat, single-leg squat	1. Heel slide
2. Single leg standing with support	2. Straight leg rise
3. Sit to stand	3. Prone hip extension
Step-up	4. Side-lying leg lift
5. Forward lunges	5. Balance and reach exercises
	6. Slump stretch
The training session was carried out with a repetition of 2 seconds rest.	
Frequency and exercise dosage	The training session was carried out with a repetition of 2 seconds rest.
The duration of the treatment was for one hour, with 10 repetitions of 3 sets for each exercise. The intervention consisted of 6 months' duration and was performed 3 times per week.	**Frequency and exercise dosage:**
Follow up	The duration of the treatment was for one hour, with 10 repetitions of 3 sets for each exercise. The intervention consisted of 6 months' duration and was performed 3 times per week.
The evaluation was done after 6 weeks using Kujala, VAS, and KOOS scales.	**Follow up:**
	The evaluation was done after 6 weeks using Kujala, VAS, and KOOS scales.

was set at p=0.05. Following tests were used:

1. After assessing the normality by Shapiro-Wilk Test. The p-value is greater than 0.05 so the data were distributed normally. So parametric test was applied. If the p-value is less than 0.05 then non-parametric tests were applied
2. Descriptive Statistics: Frequency tables, pie charts, bar charts were used to show the summary of group measurements measured over time
3. Difference between Groups: Independent sample t-test
4. Difference within a group: Paired Sample t-test

Results

The total number of patients in group A with Weight-bearing exercises is 28 of which male patients are 12 (42.9) and female 16 (57.1). The total number of patients in group B with non-weight bearing exercises is 28 of which male patients are 12 (42.9) and female 16 (57.1). The patient in group A with weight-bearing exercises represents a minimum age of 38 years and maximum age of 70 years with a mean value of 51.32 and a standard deviation of 7.91. The patient in group B with non-weight-bearing exercises represents a minimum age of 35 years and maximum age of 70 years with a mean value of 47.67 and a standard deviation of 8.12.

Between the groups of independent, the pre-test of VAS with the patient in group A with weight-bearing exercises represents a mean value of 7.39 and a standard deviation of 0.92. The pre-test of VAS with the patient in group B with non-weight-bearing exercises represents a mean value of 7.25 and a standard deviation of 1.04. The mean difference in the pre-test of VAS is 0.142 and p-value is 0.588. The post-test of VAS with the patients in group A with weight-bearing exercises represented a with h mean value of 2.75 and a standard deviation of 1.00. The post-test of VAS with the patient in group B with non-weight-bearing exercises was represented with a mean value of 2.75 and a standard deviation of 0.88. The mean difference in the post-test of VAS is 0.00 and p-value is 1.00.

Within the groups of independent, the pre-test of VAS with the patient in group A with weight-bearing exercises represents a mean value of 7.39 and a standard deviation of 0.92. The pre-test of VAS with the patients in group B with non-weight-bearing exercises represented a mean value of 7.25 and a standard deviation of 1.04. The mean difference of VAS with the patient in group A with weight-bearing exercises is 4.64 and p-value is 0.00 [16-22].

The post-test of VAS with the patient in group A with weight-bearing exercises represented with a mean value of 2.75 and standard deviation 1.00. The post-test of VAS with the patient in group B with non-weight-bearing exercises was represented with a mean value of 2.75 and a standard deviation of 0.88. The mean difference of VAS with the patient in group B with non-weight-bearing exercises of VAS is 4.50 and p-value is 0.00.

Within the groups of independent, the pre-treat of KUJALA with patients in group A with weight-bearing exercises represent a mean value of 33.6 and a standard deviation of 5.82. The pre-treat of KUJALA with the patient in group B with non-weight-bearing exercises was represented with a mean value of 35.5 and a standard deviation of 7.64. The mean difference with patients in group A with weight-bearing exercises of KUJALA is 41.85 and p-value is 0.00.

The post-treat of KUJALA with the patient in group A with weight-bearing exercises represented with a mean value of 75.5 and standard deviation of 5.97. The post-treat of KUJALA with patients in group B with non-weight-bearing exercises represented a mean value of 75.0 and a standard deviation of 5.24. The mean difference with patients in group B with non-weight-bearing exercises of KUJALA is 39.53 and the p-value is 0.00 **(TABLES 3-10)**.

TABLE 3. Descriptive data of gender.

	Treatment Groups	
Gender	**Weight-bearing exercises (GROUP A) N (%)**	**Non-weight bearing exercises (GROUP B) N (%)**
Male	12 (42.9)	12 (42.9)
Female	16 (57.1)	16 (57.1)
Total	28(100)	28 (100)

TABLE 4. Table of age.

Groups of Patients (AGE)	
Group A	**Mean ± S.D**
	51.32 ± 7.91
	Min-Max
	38-70
Group B	**Mean ± S.D**
	47.67 ± 8.12
	Min-Max
	35-70

TABLE 5. Between the group comparison of VAS.

Variables	Group A (mean ± S.D)	Group B (mean ± S.D)	Mean difference	p-value
Pre-test VAS	7.39 ± 0.92	7.25 ± 1.04	0.142	0.588
Post-test VAS	2.75 ± 1.00	2.75 ± 0.88	0	1

TABLE 6. Within the group comparison of VAS.

Variables	Group A (mean ± SD)	Group B (mean ± SD)
Pre-test VAS	7.39 ± 0.92	7.25 ± 1.04
Post-test VAS	2.75 ± 1.00	2.75 ± 0.88
Mean Difference	4.64	4.5
P-value	0	0

TABLE 7. Between the group comparison of KOOS.

Variables	Group A (mean ± SD)	Group B (mean ± SD)	Mean difference	p-value
Pre-treat KOOS	35.6 ± 7.14	37.7 ± 10.0	41.82	0
Post-treat KOOS	77.4 ± 6.49	78.8 ± 5.85	41.07	0

TABLE8. Within the group comparison of KOOS.

Variables	Group A (mean ± SD)	Group B (mean ± SD)
Pre-treat KOOS	35.6 ± 7.14	37.7 ± 10.0
Post-treat KOOS	77.4 ± 6.49	78.8 ± 5.85
Mean difference	41.82	41.07
P-value	0	0

TABLE 9. Between the group comparison of KUJALA.

Variables	Group A (mean ± SD)	Group B (mean ± SD)	Mean difference	P-value
Pre-treat KUJALA	33.6 ± 5.82	35.5 ± 7.64	41.85	0
Post-treat KUJALA	75.5 ± 5.97	75.0 ± 5.24	39.53	0

TABLE 10. Within the group comparison of KUJALA

Variables	Group A (mean ± SD)	Group B (mean ± SD)
Pre-treat KUJALA	33.6 ± 5.82	35.5 ± 7.64
Post-treat KUJALA	75.5 ± 5.97	75.0 ± 5.24
Mean difference	41.85	39.53
P-value	0	0

Discussion

In an article, it was hypothesized that the weight-bearing quadriceps exercises were better than non-weight-bearing strengthening exercises for the strength of knee extensors, reduced pain, and functional development in patients with patellofemoral pain syndrome. Such results were associated with the present research in which there was also progress in weight-bearing exercises [23].

When compared to another study, the EMG-force relationship was found to be similar to the exercise given based on a comparison between Electromyographic surfaces (EMG) behaviour and quadriceps exercises. The findings of the current research are in resolution with other studies that are capable of shared methods for the advancement of the power of knee extension [24].

In another study, Witvrouw, et al. reported that after five weeks of treatment, a large increase in quadriceps strength was deprived of substantial improvement in weight-bearing and non-weight-bearing exercise groups. Since the duration of treatment was six months in the current study, hence there was a greater change in improvement in the exercise group, particularly in the weight-bearing group [25].

In a test, in patients with osteoarthritis, Simple knee flexion and extension movements in weight-bearing and non-weight-bearing were performed for eight weeks. It showed substantial improvements in the task scale and power of the knee at WOMAC. It concluded that non-weight-bearing exercise can be sufficient for advancing function and muscle strength individually. The added value of weight-bearing exercises will provide to improve difficult walking activities. This showed that in addition to patellofemoral pain syndrome, exercises in weight-bearing and non-weight-bearing can also prove beneficial for other diseases [18].

Stiene et al. performed a study in the treatment of patellofemoral pain syndrome on physical activity. According to this, there was no major impact in PFPS to enhance strength and flexibility in weight-bearing and non-weight-bearing exercises. The findings of this research compared with current studies since pain relief improved, function improved and muscle strength increased in the current study [26]. Stiene, et al. and Heintjes, et al. had previously pointed out that strengthening exercises for patients with patellofemoral pain may represent the right clinical management to rehabilitate function in patients with movement capacity and strength of quadriceps [26,27]. Current research is expected to lead to improving these problems in patients with patellofemoral syndrome, and to encourage further analysis into the vast and increasingly growing field of orthopaedic rehabilitation.

Conclusion

Weight-bearing and non-weight bearing quadriceps strengthening exercises are equally successful in treating individuals with PFPS patellofemoral pain syndrome.

Recommendations and limitations

■ Limitations

1. It was a quasi-experimental study, not RCT
2. Some patients left during the study
3. Patients feared physiotherapy
4. This study is limited to only patellofemoral syndrome patients
5. This study was limited to Lahore only

■ Recommendations

1. The study should be RCT in the future
2. A multi-modal, exclusively custom-made rehabilitation plan can be considered to aim the patient's detailed deficiencies and restrictions recognized in the assessment
3. Weight-bearing exercises and non-weight-

bearing exercises can be done along with taping and other modalities to treat patellofemoral syndrome patients

4. Therapists should plan out the objectives of therapy according to the requirement which will be Specific, Measurable, Attainable, Relevant, and Time-Oriented (SMART)

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