

## Effect of Physiotherapy Integrated Exercise Rehabilitation Protocol on Outcomes of Patients with Patellofemoral Pain Syndrome

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### Abstract

**Background:** Patellofemoral pain syndrome is characterized by anterior knee pain, which may limit the performance of functional daily activities. **Aim:** to evaluate the effect of physiotherapy integrated exercise rehabilitation protocol on outcomes of patients with patellofemoral pain syndrome **Methods: Research design:** A quasi - experimental (pre / post) design was used. **Setting:** The study was conducted in the Physiotherapy Department at Assiut University Hospital. **Sample:** A purposive sample of (60) adult patients aged 20- 65 years diagnosed with patellofemoral pain syndrome. **Tools:** two tools (I): Structured patient interview questionnaire; this tool consisted of two parts; Part 1: Patients demographic characteristics and Part 2: Patient's medical data assessment. Tool (II): Kujala Patellofemoral Questionnaire (KPQ) scale. **Results:** Exercise rehabilitation protocol resulted in a highly statistically significant difference in the pre / post protocol in the whole items of Kujala patellofemoral score. **Conclusion:** The exercise rehabilitation protocol was more effective in improving patient's outcomes (reducing pain, improving activities of daily living in patients with patellofemoral pain syndrome. **Recommendation:** Screening programs to identify the risk factors for prolonged pain and knee functional deficit, and the potential association with degenerative joint disease.

**Keywords:** *Integrated Exercise Rehabilitation Protocol, Patients' Outcomes, Patellofemoral Pain Syndrome & Physiotherapy.*

### Introduction

Patellofemoral pain syndrome (PFPS) is one of the most common disorders affecting the lower extremities. To improve knee functions and decrease pain, the affected patients often undergo a guided rehabilitation exercise program. Also (PFPS) is a syndrome characterized by knee pain ranging from severe to mild discomfort seemingly originating from the contact of the posterior surface of the patella (back of the kneecap) with the femur (thigh bone) **Dixit, et al., (2007).**

Patellofemoral pain syndrome is the second most prevalent musculoskeletal condition worldwide; in the United States an estimated 126.6 million Americans suffer from a Knee pain disorder, putting a burden onto the economy with an estimated cost of \$213 billion annually through healthcare costs and sickness absence **Crossley et al., (2016)**

The onset of the (PFPS) is usually gradual or appears suddenly following trauma. The most common symptom is diffuse peripatellar pain (vague pain around the kneecap) and localized retropatellar pain (pain focused behind the kneecap). Or over the anterior patella or described as a circle around the

patella (the "circle sign"). Pain is usually initiated when load is put on the knee extensor mechanism, e.g. ascending or descending stairs or slopes, squatting, kneeling, cycling, running or prolonged sitting with flexed (bent) knees. The latter feature is sometimes termed the "movie sign" or "theatre sign" because individuals might experience pain while sitting to watch a film or similar activity as stair climbing, and even prolonged sitting **Ferreira, et al., (2018)**

The knee pain can be classified as a handful of conditions sometimes referred to as runner's knee or other conditions being chondromalacia patellae, iliotibial band syndrome, and plica syndrome **Cook, et al., (2012).**

Risk factors for PFPS include: anatomic anomalies, mal-alignment and altered biomechanics of the lower extremity (static or dynamic), muscle dysfunction (as quadriceps muscles weakness, improper firing pattern), patellar hypermobility, poor quadriceps, or iliotibial band flexibility, surgery, tight lateral structures (i.e., lateral retinaculum and iliotibial band), training errors or overuse and trauma **Lun, et al., (2014).**

Rehabilitation exercise therapy is recommended as a first line treatment of PFPS. Various types of exercises are described to patients with PFPS according to three parameters; the first type is muscle activity (concentric, eccentric or isometric), the second is joints movement (dynamic, isometric or static) and the last is the reaction forces (closed or open kinetic chain) **Bolglia & Boling (2011)**.

The majority of exercise programs intended to treat PFPS is designed to strengthen the quadriceps muscles; it is considered to be the "gold" standard treatment for PFPS and is commonly suggested because the quadriceps muscles help to stabilize the patella. In addition hip abductor, extensor, and external rotator strengthening may help minimize pain syndrome **powers, (2010) & De Oliveira et al., (2016)**. Also many exercise programs include stretches designed to improve lower limb flexibility **Zaffagnini et al., (2010)**.

Also electromyographic biofeedback allows visualization of specific muscle contractions that help individuals in performing the exercises to target the intended muscles during the exercise. Electro stimulation may be used to apply external stimuli resulting in contraction of specific muscles **Collins et al., 2018)**.

Exercise is one of the most controversial non-pharmacologic management strategies for with PFPS. And have therapeutic benefits in lower extremity musculoskeletal strengthens. The professional nurse teach the patient the exercises in order to improve patient daily activity and become ready to practice a correct version of the appropriate exercises including stretching, strengthening, and endurance exercises and have shown a good beneficial effect on minimizing pain and function of knee **Esser and Bailey (2011)**.

### Significance of the study

From the researchers experience with the second years students in the faculty of nursing as instructor during hospital clinical round, it was observed that a continuous increasing of hospital flow of patients with patellofemoral pain syndrome (PFPS) approximately (200) cases in six months. And due to the fact that (PFPS) is a common musculoskeletal-related condition affecting millions worldwide which is characterized by insidious onset of symptoms that can restrict patient's participation in activities of daily living, and work, as well as it can recur and persist for years **Esculier, et al., (2018)**. So patients with (PFPS) need some specific measures to prevent early progression of the pain syndrome as patient education about exercise therapy that contribute to promoting knee function.

### Operational definitions

#### Patient's outcome

Pertaining to improved functional ability of patient's knee in activities of daily living and it is called secondary outcome and measured by questionnaires focusing on knee function **Abdullah et al., (2017)** (such as Kujala Patellofemoral Function Scale or Anterior Knee Pain Score (AKPS) **Kujala et al., (1993)**

#### Timing of outcome measurement

We considered patient outcomes fulfillment by improved functional ability of the knee regarding activities of daily living and minimizing the pain level measured in this study within two months after rehabilitation exercise therapy application.

#### Aim of the work was to

Evaluate the effect of physiotherapy integrated exercise rehabilitation protocol on outcomes of patients with patellofemoral pain syndrome

**Research hypothesis:** Patients with patellofemoral pain syndrome will have better outcomes post application of the physiotherapy integrated exercise rehabilitation protocol than before.

### Patients & Methods

**Study design:** a quasi - experimental (pre / post) design was used.

**Setting:** The study was conducted in the rehabilitation and physiotherapy department at the main Assiut University Hospital (Egypt).

#### Participants

Sixty adult patients diagnosed with patellofemoral pain syndrome and undergoing conservative treatment of patellofemoral pain syndrome with physiotherapy integrated exercise rehabilitation protocol were included in the study with the following criteria; age between 20 – 65 years, both male and female with a history of anterior knee pain more than six months.

**Exclusion criteria:** Anterior knee pain with degenerative pathology. Patellofemoral pain Syndrome with anatomic congenital mal alignment.

**Sample size:** was calculated by using the epi- info program with confidence level at 95% as the flow rate of patients was 200 cases in 6 months so the sample was calculated to be sixty patients.

**Pilot study:** The purpose of this pilot study was of 2 folds: first to ensure the clarity of the designated study tools. Second; to examine the utility of the designed tools and identify any difficulties or problems needed to be handled before application of the main study, it was carried out during September (2017) on (10%) of the sample (6 patients) those patients who were involved in the pilot study were included in the actual study because no modifications of data collection tools was done.

### Ethical considerations

- Research proposal was approved from ethical committee in the faculty of nursing.
- There was no risk for study subject during application of the research.
- The study followed common ethical- principles in clinical research.
- Informed consent was obtained from the patients who are willing to participate in the study after explaining the nature and purpose of the study.
- Confidentiality and anonymity were assured.
- Patient had the right to refuse to participate and or withdraw from the study without any rationale any time.
- Patient privacy was considered during collection of data.

### Study tools

#### Tool I: Structured patient interview questionnaire:

This tool consists of two parts:  
Part 1: Assessment of patient's demographic characteristics which consisted of: age, sex, marital status and occupation.

Part 2: Assessment of patient's medical data included; presence of chronic diseases, duration of patellofemoral pain and risk factors that exaggerate or worsen knee function, obesity, activities of daily living and change in life style.

#### Tool II: Kujala Patellofemoral Questionnaire (KPQ):

This questionnaire was used to evaluate subjective symptoms and functional limitations in patellofemoral disorders and was developed by **Kujala et al., (1993)**.

The KPQ is a 13-item screening instrument designed to assess patellofemoral pain in adolescents and adults, with a variable ordinal response format. As the following a 'Limp' score would be scored as follows; none (5), slight/periodic (3), constant (0). Total scores range from 0 to 100. The questionnaire items dealing with abnormal painful patellar movements (subluxations) limp movement with; support, walking, stairs, squatting, running, jumping, prolonged sitting with the knees flexed, swelling, abnormal painful kneecap movements, atrophy of thigh, flexion deficiency. KPQ is a valid and reliable measure of anterior knee pain and appropriate for use as an epidemiologic screening tool with adolescent **Kay et al., (2004)** & **Richard et al., (2016)**.

#### The Physiotherapy Integrated Exercise Rehabilitation protocol

The exercise rehabilitation protocol was prepared by the researchers based on review of related literature in a simplified Arabic language and was supported by photo illustrations it consists of the following items;

overview of the knee joint function and causes of patellofemoral pain syndrome, the physiotherapy exercise protocol, and its importance in minimizing pain and improving activities of daily living. Each patient received 12 sessions (2 sessions per week for 6 weeks) of strengthening exercises including the following items; Hip strengthening exercises for hip-abductors and external rotators were performed and hip external rotation strengthening exercise. Knee exercises; protocol it included strengthening and stretching exercises as straight leg raisings and terminal knee extension exercises (short arc movements from 15° of knee flexion to terminal extension. Stretching exercises (for quadriceps, hamstring, iliotibial band and gastrocnemius) and..... etc.

### Methods

- An official permission to proceed with the proposed study was granted from the head of the rehabilitation and physiotherapy department.
- The researchers designed and tested the study tools and the exercise rehabilitation protocol after extensive literature review (textbooks, journals, internet resources, etc.) about physiotherapy integrated exercise rehabilitation protocol on outcomes of patients with patellofemoral pain syndrome, then the final form of the proposed protocol was checked by a panel of experts to test content validity.
- At initial interview the researchers introduced themselves to initiate line of communication, explained the nature & purpose of the study and filled out the tools (tool 1 part 1and 2) to assess patient's demographic characteristics and medical data
- To facilitate the implementation of the protocol; researchers prepared the booklet, teaching aids and media (pictures, handouts). This was followed by arranging for the protocol session schedule based on the contents, number of patients and time availability.
- The exercise rehabilitation protocol also was scheduled with the patient about teaching sessions for both theory and practicing the exercise at home.
- The exercise protocol was implemented for patients in form of sessions. There were a total of 2 sessions weekly. The duration of each session was an hour. The most effective patellofemoral pain syndrome management initially includes strengthening exercises for the hip external rotator and abductor muscles due to their roles in knee biomechanics. The addition of exercises for the extensor muscles and proprioceptive

neuromuscular facilitation stretching improves the pain relief in PFPS.

- Patients were taught about the importance of home exercises that should be performed 2 times/day until symptoms subside and then 3 times/week, the duration of the exercise protocol was 6 weeks. The exercises were conducted two-to-four times daily with 10 repetitions. Each patient was handed a list of instructions about home exercise rehabilitation protocol.

### Statistical Analysis

Collected data was analyzed and tabulated; the researchers used the appropriate statistical methods and tests for analysis of the result. The statistical package for (SPSS) version (23) was used to analyze data. Descriptive statistics was used for the quantitative data in all questionnaires and the demographic data. Descriptive statistics included: frequencies, and percentages. Pearson Correlation (Correlation is significant at the 0.05 level). The level of significance for this study was set at ( $p \leq 0.05$ ) to detect any indication of differences found in the data available.

## Results

**Table (1): Baseline characteristics distribution of the study sample regarding their demographic data (n=60).**

Variables	Frequency (n=60)	Percent (%)
<b>Age:</b>		
35 – < 50	28	46.7
50 – 65	32	53.3
<b>Mean <math>\pm</math> SD</b>	51.87 $\pm$ 6.8	
<b>Sex:</b>		
Male	2	3.3
Female	58	96.7
<b>Marital status:</b>		
Married	54	90.0
Unmarried	6	10.0
<b>Occupation:</b>		
Housewives	44	73.3
Employee	16	26.7

**Table (2): Percentage distribution of the study sample regarding their medical data and risk factors (n=60)**

Variables	Frequency (n=60)	Percent
<b>Presence of chronic diseases</b>	30	50.0
<b>Affected side</b>		
Right	10	16.7
Left	10	16.7
Bilateral	40	66.7
Duration of diagnoses by month Mean $\pm$ SD	6.43 $\pm$ 8.07	
Activities of daily living affected	58	96.6
Changes in lifestyle patterns affected	58	96.6

**Table (3): Distribution of the studied sample according to the Kujala score pre / post six weeks of protocol application regarding knee function.**

limb function:	Max Score	Pre protocol	Post protocol	P.value
		Mean $\pm$ SD	Six weeks Mean $\pm$ SD	
Limp movement	5	2.43 $\pm$ 0.5	3 $\pm$ 0.64	<0.001**
Support	5	2.73 $\pm$ 0.78	3.73 $\pm$ 1.16	<0.001**
Walking	5	1.93 $\pm$ 1.4	3.3 $\pm$ 1.11	<0.001**
Stairs	10	1.93 $\pm$ 2.92	6.73 $\pm$ 2.64	<0.001**
Squatting	5	0.17 $\pm$ 0.38	2.87 $\pm$ 1.21	<0.001**
Running	10	0 $\pm$ 0	5.53 $\pm$ 2.17	<0.001**
Jumping	10	0.33 $\pm$ 1.81	4.3 $\pm$ 3.23	<0.001**
Prolonged sitting with knees flexed	10	1.4 $\pm$ 2.61	5.6 $\pm$ 2.52	<0.001**
Pain	10	2.8 $\pm$ 2.88	6.4 $\pm$ 2.78	<0.001**
Swelling	10	6 $\pm$ 3.53	8.2 $\pm$ 1.83	<0.001**
Abnormal painful patellar movements	10	4.13 $\pm$ 1.87	6 $\pm$ 1.56	<0.001**
Atrophy of thigh	5	3.33 $\pm$ 1.26	4.4 $\pm$ 0.92	<0.001**
Flexion deficiency	5	2.43 $\pm$ 1.76	4.07 $\pm$ 1.01	<0.001**
<b>Kujala score</b>	<b>100</b>	<b>29.63<math>\pm</math>11.1</b>	<b>64.13<math>\pm</math>16.97</b>	<b>&lt;0.001**</b>

Chi-square test, \* statistically significant difference ( $p < 0.05$ ) \*\* highly statistically significant difference ( $p < 0.01$ ).

**Table (4): Relation between Kujala score with demographic data pre / post application of the protocol**

	N.	Pre protocol	Post protocol
		Mean $\pm$ SD	Mean $\pm$ SD
<b>Age group:</b>			
From 35-<50 years	28	26.79 $\pm$ 11.27	61.43 $\pm$ 20.56
50 - 65 years	32	32.13 $\pm$ 10.86	66.5 $\pm$ 13.69
<b>P. value</b>		0.062	0.252
<b>Sex</b>			
Male	2	20 $\pm$ 0	25 $\pm$ 0
Female	58	29.97 $\pm$ 11.24	65.48 $\pm$ 15.71
<b>P. value</b>		0.215	0.001**
<b>Occupation</b>			
Housewife	44	30.77 $\pm$ 12.47	65 $\pm$ 17.05
Employee	16	26.5 $\pm$ 6.09	61.75 $\pm$ 18.24
<b>P. value</b>		<b>0.190</b>	<b>0.517</b>
<b>Affected side:</b>			
Right	10	29.4 $\pm$ 17.53	47 $\pm$ 27.61
Lift	10	30.8 $\pm$ 15.67	67.4 $\pm$ 23.86
Bilateral	40	29.4 $\pm$ 8.63	67.6 $\pm$ 8.61
<b>P. value</b>		<b>0.938</b>	<b>0.001**</b>

Independent-samples T Test\*\* statistically significant difference ( $p < 0.01$ ) One-way ANOVA

**Table (1):** Reveals that the highest percentage of the studied sample (96.7 %) were female their age ranged from (50 to 65) years old with a mean  $\pm$  SD 51.87  $\pm$  6.8, regarding to marital status the majority of them were married and not working or housewives (90.0%), and (73.3%) respectively.

**Table (2):** Illustrates the distribution of the study sample regarding their medical data and risk factors; regarding presence of chronic diseases (50.0 %) of

the study sample were having chronic diseases and regarding affected side; 66.7 % were bilaterally affected and an equal percentage of them (96.6%) were either having changes in lifestyle patterns and activities of daily living.

**Table (3):** Represented the kujala score of the studied sample pre / post application of the protocol and it shows a highly statistically significant

difference in all items of the score pre / post protocol.

**Table (4):** Documenting the relation between kujala score and demographic data pre / post application of the protocol; there was no statistically significant difference between the Kujala score and age, marital status or occupation while there was a statistically significant difference between the kujala score and sex and also between the Kujala score and the affected side post application of the protocol.

## Discussion

The present study revealed that; the majority of the participants were married, females and were categorized by age into older adults with a mean  $\pm$  SD  $51.87 \pm 6.8$ . This result agree with **Boling, et al., (2010)** who stated that the incidence of “patellofemoral pain syndrome” is high in women and affects about more than twice as often as men.

This result disagree with **Rianne, et al., (2015)** who found that patellofemoral pain syndrome is a common knee problem, which particularly affects adolescents and young adults. The pain mostly occurs when load is put on the knee extensor mechanism when climbing stairs, squatting, running, cycling or sitting with flexed knees. Also it comes in disagreement with **Wolf, et al., (2014)** who mentioned that the patellofemoral pain syndrome (PFPS) is a common cause for “anterior knee pain” and mainly affects young women without any structural changes or significant pathological changes in articular cartilage.

From the researchers' point of view the difference on this topic may be related to the causes of anterior knee pain which are multifactorial in female. These include overuse injuries of the extensor apparatus (tendonitis, insertional tendinosis), patellar instability, chondral and osteochondral damage. Knee pain in female was associated with increased activity. Chronic overloading and overuse of the patellofemoral joint, rather than misalignment, can also contribute to patellofemoral pain. **Michael & James (2012):** suggested that females are more affected than males by a rapid increase in physical activity level, which in turn leads to a higher incidence of PFPS.

Regarding patient's lifestyle patterns and activities of daily living change; the present study demonstrated that the highest percentage of the study sample were having marked change in activities of daily living. This comes in agreement with **(Barton, et al., 2011)** who demonstrated that knee pain and discomfort can provoke PFPS causing change in activities of daily living during running, walking, up stair and downstairs. Also agree with **Kay et al., (2008)** declared that pain level associated with daily

activities such as walking and stair-climbing ultimately leads to profoundly reduced functional independence. We can consider changes in knee function measured on impairment level only (e.g. range of motion, muscle strength) that directly represent changes in the symptoms of patellofemoral pain syndrome, and we therefore consider them clinically relevant outcome measures.

The current study result verify that post application of the integrated exercise rehabilitation protocol the majority of patients had good improvement in mean Kujala score items related to limp walking and up/down stairs function this agree with **(Jeffrey et al., 2013)** who confirmed that quadriceps and hip strengthening combined with stretching in a structured physiotherapy program comprise the most effective treatment for reducing knee pain symptoms and improving functionality in patients with PFPS. Physiotherapy is a conservative intervention, which is non-toxic, inexpensive and promotes physical activity and self-management through exercise at home **Ordan et al., (2003)**

The result of the present study illustrated a highly statistically significant difference pre / post protocol in pain items of the Kujala score. This result is in concordance with **Thiago et al., (2010)** who found that rehabilitation exercise programs focusing on knee strengthening exercises one effective in improving function and reducing pain in women with PFPS. Improvements of pain and function were greater for the group that performed the strengthening exercises.

The current study reported positive effects for pain reduction and functional improvement post application of the exercise protocol. This result agrees with **Mullaney and Fukunaga, (2016)** who found a positive effect of physiotherapy exercise on pain reduction. Positive results have been described in particular with active stretching exercises, squats, ergometer, static quadriceps exercises, active leg raises, leg press, raising and lowering and climbing exercises. Four of the exercise protocol also included exercises to strengthen the hip abductors. Also agree with **Pollard et al., (2006)** who found a strong evidence for exercise in the treatment of PFPS in their study and these exercises should address hip muscles, trunk stability, and quadriceps exercises.

The current study revealed a highly statistically significant difference pre / post application of the exercises protocol in all items of the Kujala score this result was congruent with studies of **Razeghi et al., (2010)** who stated that exercise program should include iliotibial band stretching; hamstring stretching, gastrocnemius stretching, progressive resistance straight leg raising and hip adduction strengthening. These exercises should be performed 2 times /day until symptoms subside and then 3

times/week .also rehabilitation programs focusing on knee strengthening exercises in addition to hip flexors, abductors, and external rotators strengthening were related to successful treatment in PFPS.

From the researchers' point of view; patient education must be tailored to the patients based on knowledge and health needs, many patient education sessions may be required to facilitate adequate knowledge gains; for example, greater understanding of treatments supported by evidence, pain sensitization and psychological influences on pain or behavior change as; optimal load management, participation in exercise therapy for PFPS patient.

### Conclusion

Up on the results of the current study it can be concluded that; exercise protocol were more effective in reducing pain and improving physical function for patients with patellofemoral pain syndrome

### Recommendations

- Screening programs to identify the risk factors for prolonged pain and knee functional deficit, and the potential association with degenerative joint disease.
- Distribution of printed copies of the exercise rehabilitation protocol for patients attending to the rehabilitation and physiotherapy department with patellofemoral pain syndrome.
- Replication of the present study on a larger probability for generalization of the results.

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