

## Original article

# Impact of Open and Closed Kinetic Chain Exercises on Patellofemoral Pain Syndrome: A Study Performed at Al-Khums Teaching Hospital, Al-Khums City

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## Abstract

This research aimed to evaluate the efficacy of open kinetic chain (OKC) and closed kinetic chain (CKC) exercise regimens in the rehabilitation of individuals with Patellofemoral Pain Syndrome (PFPS). An exercise group for OKC patients and a group for CKC patients were each assigned 60 patients with PFPS randomly. Eight sessions were conducted over six weeks as an element of a rehabilitation program. The amount of discomfort was assessed using the Visual Analog Scale (VAS), the patient's functional status was evaluated using the Kujala Patellofemoral Score, and the strength and stability of the quadriceps muscles were determined by assessing muscle activity. We used SPSS software (version 26) to analyze the data, using paired t-tests for intra-group comparisons and independent t-tests for inter-group comparisons. A p-value of less than 0.05 was deemed as statistically significant. Both groups had significant improvements in job capacity, reduced discomfort, and enhanced leg strength after the intervention. The CKC group had superior performance in functional daily tasks, proprioception, and joint stability. While both CKC and OKC workouts may assist in managing PFPS, CKC exercises seem superior since they enhance joint stiffness and facilitate functional recovery.

**Keywords.** Patellofemoral Pain Syndrome, Open Kinetic Chain, Closed Kinetic Chain, Rehabilitation, Knee Stability.

## Introduction

Patellofemoral Pain Syndrome (PFPS) is a prevalent joint issue among individuals with demanding lifestyles. It accounts for about 25% of all knee injuries seen in sports medicine clinics [1]. Particularly in females, it affects up to 30% of adolescents and young adults, significantly diminishing quality of life and physical activity if left unmanaged [2]. The etiology of PFPS and optimal treatment modalities remain subjects of ongoing research, despite its prevalence and impact on individuals' everyday activities.

Diffuse anterior knee discomfort is indicative of PFPS. Activities that exert stress on the patellofemoral joint include crawling, jogging, and prolonged sitting. These activities exacerbate the discomfort [3]. Inaccurate patellar tracking, diminished quadriceps strength, insufficient hip musculature, alterations in lower limb dynamics, and inadequate neural regulation are factors associated with this syndrome [4].

The consensus among individuals is that exercise therapy is the most effective treatment for PFPS, with several studies demonstrating its efficacy in alleviating pain and enhancing mobility [5]. The Open Kinetic Chain (OKC) and Closed Kinetic Chain (CKC) exercises represent the two primary categories of physical activity. Certain OKC exercises, such as seated leg extensions, target particular muscle areas and are often used at the beginning of a rehabilitation regimen. Conversely, CKC workouts, such as squats and step-ups, use weight-bearing exercises that resemble functional activities and promote the coalescence of adjacent muscles [6].

Recent research examined the comparative effects of OKC and CKC training on alleviating pain, enhancing power, and increasing functionality in individuals with PFPS [7,8]. Researchers have determined that CKC motions may enhance joint stability and muscle balance; nevertheless, conclusive evidence supporting their superiority, particularly in short-term interventions and varied clinical contexts, remains insufficient. Limited information exists on the efficacy of these therapies in resource-constrained recovery environments. This research directly analyzes the effects of OKC and CKC exercise regimens on pain, function, thigh strength, and proprioception in individuals with PFPS. We hypothesize that, after a brief recovery period, CKC workouts will provide superior outcomes compared to OKC activities, particularly for joint stability and functional performance.

## METHODS

The research was conducted at Al-Khums Teaching Hospital between May and October 2022. This study examined the efficacy of open OKC and closed CKC movements in individuals with PFPS. Sixty patients aged

20 to 54 years, who had anterior knee discomfort persisting for over four weeks and attained a minimum score of 3 on the Visual Analog Scale (VAS), were enrolled after their consent. Individuals with a history of knee surgery, patellar instability, or neurological disorders were excluded from participation. Two identical cohorts of 30 patients each were randomly selected: the OKC cohort and the CKC cohort. The containers were secured. Each group participated in guided hydrotherapy sessions three times weekly for six weeks. The quadriceps were engaged with OKC workouts that excluded weight bearing, while CKC exercises emphasized functional activities necessitating weight bearing with the foot positioned. Pain intensity (VAS), functional capacity (Kujala Score), and quadriceps strength (handheld dynamometry) were evaluated at baseline and during the intervention. Statistical analysis was conducted using SPSS version 26. Statistical significance was established at  $p < 0.05$ .

## Results

Baseline variables such as age, gender, initial VAS, and Kujala scores did not exhibit significant differences between the two groups ( $p > 0.05$ ).

**Table 1. Pain Reduction**

Group	VAS Baseline	VAS Post 6 Weeks	% Reduction
OKC	$7.1 \pm 1.2$	$4.2 \pm 1.0$	-40%
CKC	$7.0 \pm 1.4$	$3.3 \pm 0.9$	-53%

Following six weeks of treatment, pain levels significantly decreased in both comparison groups. The mean VAS score in the OKC group decreased from  $7.1 \pm 1.2$  at baseline to  $4.2 \pm 1.0$  post-intervention, representing a 40% reduction. The CKC group had a decrease from  $7.0 \pm 1.4$  to  $3.3 \pm 0.9$  on average, representing a 53% reduction. Conversely, the CKC group had superior pain alleviation compared to the OKC group.

**Table 2. Functional Improvement**

Group	Kujala Score Baseline	Kujala Score Post	% Improvement
OKC	$58.3 \pm 9.1$	$79.8 \pm 8.4$	+37%
CKC	$57.9 \pm 8.7$	$85.1 \pm 7.2$	+47%

The Kujala Score indicated an improvement in knee function for both groups after the treatment regimen. The OKC group's score increased from  $58.3 \pm 9.1$  to  $79.8 \pm 8.4$  post-treatment, indicating a 37% difference. Conversely, the CKC group had a 47% change, increasing from  $57.9 \pm 8.7$  to  $85.1 \pm 7.2$ . In comparison to the OKC group, the CKC group had superior functional improvements.

**Table 3. Quadriceps Strength Increase**

Group	Strength Increase
OKC	+22%
CKC	+30%

The quadriceps of both groups exhibited increased strength after the recuperation period. The OKC group saw a 22% increase in thigh strength. Conversely, the CKC group had a 30% increase. The CKC group's superior enhancement in quadriceps strength indicates that CKC exercises are effective in augmenting muscular capacity around the knee. In comparison to the OKC group, the CKC group exhibited markedly superior improvements in dynamic knee control and proprioceptive accuracy ( $p < 0.05$ ) [9].

## Discussion

The findings of this research indicated that individuals with PFPS had reduced discomfort and exhibited improved proprioception, functionality, and performance in both CKC and OKC activities. Conversely, CKC exercises had superior outcomes in all aspects. The efficacy of CKC exercises may stem from their facilitation of coordinated function between the quadriceps and hamstrings, hence enhancing patellar tracking and reducing joint stress [5]. Furthermore, CKC exercises resemble practical everyday activities like as sitting and ascending stairs, hence rendering their advantages applicable in real-life scenarios [10].

From a scientific perspective, closed kinetic chain motions enhance muscle control and augment proprioceptive input via joint stress [9]. This likely contributed to the CKC group's superior ratings in dynamic stability and functional concerns.

These findings corroborate previous research indicating that CKC-based therapy is superior than OKC in the treatment of PFPS [7,1]. Nonetheless, OKC motions remain beneficial during the first phases of rehabilitation, particularly when weight-bearing is contraindicated.

Medical research indicates that PFPS treatment should prioritize CKC movements, although the development of individualized strategies must be tailored to each patient's specific requirements. Brief

training durations and limited sample numbers are two significant issues with this research. Researchers need to investigate the long-term implications and potential benefits of integrating the CKC and OKC methodologies in further research.

## Conclusion

Patellofemoral pain syndrome (PFPS) may be addressed by both open kinetic chain (OKC) and closed kinetic chain (CKC) activities. Nevertheless, CKC exercises are superior in alleviating discomfort, enhancing mobility, increasing thigh strength, and fortifying the patellofemoral joint. To expedite and prolong the healing process, CKC motions must be prioritized in rehabilitation strategies.

**Conflict of interest.** Nil

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