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The Relationship Between Osteoarthritis Stage and Pain, Functional Level and Quality of Life in Individuals with Patellofemoral Osteoarthritis

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ABSTRACT

Purpose: Patellofemoral osteoarthritis (PFOA) is a degenerative joint disease characterized by clinical symptoms starting in the patellofemoral joint and loss of function in the lower limb. However, limited information is available regarding the stage of PFOA and pain, functional level and quality of life. The aim of this study was to investigate the relationship between PFOA stage and pain, functional level and quality of life.

Method: A total of 20 patients diagnosed with PFOA (median age= 55.2±4.92 years, median BMI=26.99±3.09 kg/m^2) were included in the study. Visual analog scale was used assess pain severity. The Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire was used to determine the functional level and The Short Form 12 (SF-12) questionnaire was used to evaluate the quality of life.

Results: A strong positive correlation was found between OA stage and pain (r = 0.922, p = 0.001). A strong negative correlation was found between OA stage and the functional level total KOOS score (r = -0.685, p = 0.001). Additionally, a moderate negative correlation was identified between OA stage and SF-12 physical function (r = -0.556, p = 0.011).

Discussion: This study showed that pain, functional level and quality of life were associated with OA stage in PFOA. As the OA stage progressed, pain intensity increased, functional level and quality of life deteriorated.

Keywords: Osteoarthritis, pain, function, quality of life.

INTRODUCTION

Knee osteoarthritis (OA) is a prevalent degenerative and chronic condition that serves as a leading cause of knee pain and functional impairment (1). Based on the compartment involved, knee OA can be categorized into two subtypes: patellofemoral OA (PFOA) and tibiofemoral OA (TFOA). Studies on radiographic findings in knee OA reveal that 40% of cases involve both TFOA and PFOA, 24% are isolated PFOA, and 4% are isolated TFOA (2). The patellofemoral joint is frequently affected earlier than the tibiofemoral joint, and its involvement increases the risk of disease progression in TFOA. The Kellgren-Lawrence (KL) classification system is a valuable tool for identifying knee OA subtypes; patients are classified as having PFOA when the patellofemoral joint shows more advanced degeneration (Grade 3 or 4) than the tibiofemoral joint (1). The severity of symptoms often varies depending on which compartment is predominantly affected. Although there are studies in the literature that divide knee OA into compartments, studies specifically focusing on PFOA are less common (3-5).

Radiological findings are the gold standard for diagnosing OA (6). The progression and severity of the disease can be assessed using plain radiographs. Radiographic imaging plays a crucial role in detecting key features of joint degeneration. Among these are the narrowing of joint spaces, the thickening of subchondral bone (sclerosis), the formation of bony outgrowths known as osteophytes, and the presence of fluid-filled cavities or subchondral cysts. The most

commonly used grading system is the Kellgren and Lawrence (KL) classification (6). This classification divides OA into four stages: in stage 1, joint space narrowing begins; in stage 2, osteophytes start to appear; stage 3 is marked by the onset of sclerosis; and stage 4 is characterized by severe sclerosis (6). Patients are classified as having PFOA if degeneration in the patellofemoral joint is more advanced than in the tibiofemoral joint (7). In OA, as the disease progresses, functional levels decrease (8) . However, no studies in the literature have been identified regarding functional levels, pain, and quality of life in individuals with PFOA.

Pain is the most troubling symptom for individuals in their daily activities. Pain increases during weight-bearing activities involving the knee, such as sitting, climbing stairs, and walking (6). As the severity of OA increases, pain also worsens (9). The primary cause of functional loss is a combination of pain and muscle strength loss. Disuse due to pain eventually leads to muscle atrophy (10). Increased pain and stiffness, reduced range of motion, and muscle weakness negatively affect functional activities. Studies in the literature have shown that the speed of functional activities are lower in individuals with OA compared to healthy individuals (2,10). A decline in functional level adversely impacts daily living activities and overall quality of life (8).

Although pain, functional level, and quality of life have been studied different stages of OA, research on these factors in PFOA is limited. The aim of the study is to investigate the relationship between PFOA stage and pain, functional level and quality of life in individuals with PFOA. The hypothesis of our study is that there is a relationship between PFOA stage and pain, functional level and quality of life in individuals with PFOA.

METHODS

Study Design

The cross-sectional study was approval from the Institutional Review Board of the authors' affiliated institutions (Hacettepe University Physiotherapy and Rehabilitation Etic Board, 12.12.2024, 24/114). All participants provided written informed consent, and the study adhered to the principles outlined in the Declaration of Helsinki. The data was obtained between December 2024 and January 2025. The required sample size was determined through a priori power analysis using G*Power 3.1.9.2 software (Franz Faul, University of Kiel, Kiel, Germany). In the power analysis which The Knee Injury and Osteoarthritis Outcome Score (KOOS) was taken as the primary main outcome and calculations were made, it was found that the sample size of at least 20 participants was necessary to achieve a statistical power of 0.80, an effect size of 0.40, and an alpha level of 0.05 (11).

Patients

Patients with PFOA (n=20, median age= 55.2±4.92 years, median BMI=26.99±3.09 kg/m^2) were included in the study. The inclusion criteria were as follows; having a diagnosis of PFOA, being between 40-60 years old, experiencing pain during activities such as climbing stairs, kneeling, prolonged sitting, or squatting, presence of tenderness on palpation of the lateral or medial patellar facet or a positive patellar compression test, knee stiffness after sitting for more than 30 minutes (11). The exclusion criteria were having lower extremity surgery, having received any treatment for the knee within the last 3 months, conditions that cause congenital or developmental diseases, polyneuropathy/lower extremity neuropathy, cognitive dysfunction, vision or hearing loss, severe radiculopathy and BMI higher than 35 kg/m^2.

Assessments

Demographic Characteristics: Demographic data including age (year) and body mass index (BMI, kg/m^2) were recorded. Their dominant lower extremities and any existing medical conditions were noted. While determining the dominant side, the individuals were asked to hit the ball and the side they hit the ball was recorded as dominant (12). Educational status, occupations and exercise habits were also documented.

Evaluation of Osteoarthritis Stage: As part of the OA diagnosis, a standing anteroposterior and lateral knee radiograph, a routine assessment method, was performed. The patellofemoral joint was assessed using lateral views (1). OA staging was conducted based on the results of the radiograph using the Kellgren-Lawrence classification. The Kellgren-Lawrence classification divides OA into four stages:

Stage 1: Suspicious joint space narrowing; osteophytes may be visible.

Stage 2: Possible joint space narrowing; osteophytes may be visible.

Stage 3: Definite joint space narrowing; multiple osteophytes and early sclerosis may be observed.

Stage 4: Advanced joint space narrowing; multiple osteophytes and severe sclerosis are evident (6).

Evaluation of Pain Severity: The Visual Analog Scale (VAS) will be used to assess pain severity. Participants will be asked to mark their pain level on a horizontal 10 cm line ranging from 0 to 10. Before the test, participants will be informed that a score of 0 indicates "no pain," while a score of 10 represents "the most intense pain imaginable." After participants mark their pain level, the distance from the starting point will be measured in centimeters using a ruler and recorded (13).

Evaluation of Functional Level: The Knee Injury and Osteoarthritis Outcome Score (KOOS) will be used to evaluate functional level. KOOS is a 42-question survey consisting of five subscales: pain, functional level related to daily living activities, function in sports and recreational activities, and quality of life. Scores range from 0 to 100, with lower scores indicating severe problems and higher scores indicating minimal or no issues (14).

Assessment of Quality of Life: The Short Form 12 (SF-12) questionnaire will be utilized to assess quality of life. This tool comprises 12 items that are distributed across eight subscales (15). These subscales include physical function, social function, physical role limitations, emotional role limitations, pain, vitality, general health, and mental health. Each subscale is scored independently, with higher scores reflecting better quality of life and lower scores indicating poorer quality of life (15).

Statistical Analysis

The data analysis was carried out using the Statistical Product and Service Solutions (SPSS) software, version 23.0 (SPSS Inc., Chicago, IL, USA). Data normality was evaluated through both visual and analytical approaches, including histograms, Q-Q plots, and the Kolmogorov-Smirnov test. The distributions for pain, functional level, and quality of life metrics did not meet the criteria for normality. Consequently, Spearman's rank correlation test was applied to examine the relationships between pain, functional level, quality of life, and PFOA stage. Correlation strength was categorized as weak (0.1–0.35), moderate (0.36–0.67), or strong (0.68–1). Statistical significance was determined at a threshold of $p < 0.05$.

RESULTS

The demographic and clinical characteristics of the individuals PFOA are presented in Table 1.

Table 1. Demographic and clinical characteristics of the individuals with PFOA

Characteristics (n=20)		**Mean±SD**
Age (year)		55.2±4.92
Height (cm)		168.85±6.61
Weight (kg)		76.90±9.39
BMI (kg/m^2)		26.99±3.09
Gender*	Female	14 (70%)
	Male	6 (30%)
Affected side*	Right	7 (35%)
	Left	9 (45%)
	Bilateral	4 (20%)
KL scores*	Grade 1	0
	Grade 2	7 (35%)
	Grade 3	8 (40%)
	Grade 4	5 (25%)
Pain severity (cm)		5.45±1.31

*Values are given as n (%); PFOA: Patellofemoral osteoarthritis, BMI: Body mass index, SD: Standard deviation, KL: Kellgren-Lawrence Classification System.

A strong positive correlation was found between PFOA stage and pain ($r = 0.922$, $p = 0.001$). As the PFOA stage progressed, the severity of pain in individuals also increased. A strong negative correlation was found between PFOA stage and the functional level total KOOS score ($r = -0.685$, $p = 0.001$), and a moderate negative correlation was observed between PFOA stage and the KOOS parameters ($p<0.005$) (Table 2). Individuals with advanced PFOA stages were found to have lower functional levels. Additionally, a moderate negative correlation was identified between PFOA stage and SF-12 physical function ($r = -0.556$, $p = 0.011$), but there was no correlation with other parameters of the SF-12 (Table 2).

Tablo 2. The relationship between PFOA stage and other results

Characteristics	PFOA Stage	
	r	p
Pain severity (cm)	0.922	**0.001***
KOOS Total (Score)	-0.685	**0.001***
Symptoms	-0.466	**0.001***
Pain	-0.413	**0.001***
Functional status related to daily living activities	-0.576	**0.001***
Functional status related to sports and recreational activities	-0.594	**0.001***
Quality of Life SF 12 (Score)	-0.588	**0.001***
Physical Function	-0.556	**0.011***
Social Function	0.234	0.320
Physical Role Limitations	0.364	0.358
Emotional Role Limitations	-0.089	0.709
Pain	-0.313	0.208
Vitality	-0.236	0.317
General Health	-0.293	0.209
Mental Health	-0.103	0.665

*p<0.05. Spearman correlation test; PFOA: patellofemoral osteoarthritis, KOOS: Knee injury and Osteoarthritis Outcome Score; SF12: Short Form 12.

DISCUSSION

The main finding of the present study was pain severity, functional level and quality of life were associated with PFOA stage. As the PFOA stage progressed it was found that pain severity increased. Additional functional level decreased and physical function an indicator of quality of life declined.

Previous studies have shown that as the OA stage progresses, pain increases (8,9,16). In knee OA, biomechanical and structural factors contribute to pain. Increased pain is often accompanied by muscle strength loss and kinesiophobia (8, 17). A negative relationship has been demonstrated between pain and both functional level and daily living activities. As pain increases, individuals tend to avoid movement, which further exacerbates muscle strength loss, creating a vicious cycle (11). O'Neill et al. (9) reported that muscle strength loss is positively associated with pain and joint degeneration and negatively associated with physical activity level in individuals with knee OA (10). Increased pain and loss of muscle strength reduce physical capacity and limit functional performance during daily activities such as walking and getting up from a chair (18). Duncan et al. (2) reported that pain intensity increased as the condition worsened in individuals with knee OA according to the Kellgren Lawrence classification. However, there is no study in the literature examining the relationship between PFOA stage and pain. The results of our study showed that pain increased as the PFOA stage increased, similar to the relationship between OA stage and pain in the literature.

The present study revealed that functional status worsens as the PFOA stage increases. In our study, a negative correlation was found between PFOA stage and KOOS scores. This is because KOOS is scored between 0-100 points and low scores indicate poor functional level and high scores indicate good functional level. In other words, as the PFOA stage increases, KOOS scores decrease and functional level worsens. Farrokhi et al. (19) evaluated patients with PFOA accompanying with TFOA and grouped them as “No PFOA”, “Mild PFOA” and “Severe PFOA”. They found that muscle strength was less in the “Severe PFOA” group. They stated that loss of muscle strength would also negatively affect the functional level. Duncan et al. (20) examined pain and functional level using WOMAC in radiographic OA. In their study, OA was divided into groups as TFOA and PFOA. The study revealed a significant correlation between the radiographic severity and compartmental distribution of osteoarthritis (OA) with the severity of symptoms and functional impairment. Although the questionnaires we used to measure functional level in this study are different, our results are similar. A another study, Lankorst et al.(21) studied the prognosis of PFOA and grouped the patients as isolated PFOA, isolated TFOA and combined OA and followed them for 2 years. They reported that pain levels and functional status measured by WOMAC increased in all 3 groups over

the years. They concluded that combined OA starts in the patellofemoral joint and then progresses to combined OA. Although this study did not stage OA, it reported that pain increased and functional level decreased within 2 years. Similar to the studies in the literature, our study showed that the functional level decreased as the PFOA stage progressed.

Several previous studies have shown that OA stage is correlated with quality of life (8,9,18). Tosun et al. (22) analyzed the factors affecting the quality of life in individuals with knee OA, 117 individuals were examined and SF-36 questionnaire was used. They found that scores of physical function and pain subscale were lower in those with advanced OA stage. Muraki et al.(23) used WOMAC and SF-8 to assess functional status and quality of life in individuals with knee OA in a large cohort study. They found that the physical function score of SF-8 and the pain and quality of life score of WOMAC were significantly lower in individuals with KL=3 or KL=4. However, they reported that there was no difference in other parameters of SF-8. In the present study, there was a relationship between the physical function sub-parameter of SF-12 and PFOA stage, but not between the other parameters. Tangtrakulwanich et al.(24) examined the quality of life among individuals with different knee OA patterns and severities. They divided the individuals into groups as isolated PFOA, isolated TFOA and combined OA and used WOMAC and SF-36 for evaluation. They found that quality of life scores were worse in moderate or severe OA than in mild severity. They also reported that quality of life results of isolated PFOA and combined OA were worse than isolated TFOA. Similar to the literature, the results of present study showed that PFOA stage was associated with quality of life. Quality of life worsened as the PFOA stage progressed.

This study has some limitations. Firstly, our findings are based on a cross-sectional design, highlighting the need for longitudinal studies to better understand the progression rate of PFOA and its relationship with changes in pain, functionality, and quality of life over time. Another limitation is that the physical activity level of the individuals participating in the study was not evaluated. In future studies, the physical activity level in individuals with PFOA can be evaluated in detail and the relationship between PFOA stage and pain, functional status and quality of life can be presented. This study contributes to the literature by examining the relationship between osteoarthritis stage and functional status in individuals with PFOA, which has a low prevalence in the community. However, future studies with larger sample sizes are needed.

CONCLUSION

The results of this study revealed that pain, functional level and quality of life were associated with PFOA stage in individuals with PFOA. It has been found that pain intensity increases, functional level and quality of life deteriorate as the PFOA stage progresses. Future research should focus on longitudinal studies to investigate the causal relationship between PFOA stage and these clinical outcomes, and to explore the effectiveness of interventions aimed at slowing disease progression and improving quality of life in individuals with PFOA. In the rehabilitation of PFOA patients, the pain that increases with the progressive disease stage should be taken into account, and approaches should be developed to improve the functional level and quality of life affected accordingly.

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