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RESEARCH

Proximal fibular osteotomy in medial compartment knee osteoarthritis: a comparative study

Medial kompartman diz osteoartritinde proksimal fibula osteotomisi: karşılaştırmalı çalışma

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Abstract

Purpose: This study aims to compare the clinical and radiological outcomes of proximal fibular osteotomy (PFO) combined with arthroscopic debridement (AD) versus arthroscopic debridement alone in patients with medial compartment knee osteoarthritis (MCOA).

Materials and Methods: This retrospective study included 85 knees from 74 patients with MCOA who were treated at our hospital between May 2019 and January 2023. Group I comprised 44 knees that underwent AD alone, while Group II included 41 knees that received PFO combined with AD. Preoperative and postoperative clinical and radiological parameters were evaluated within each group. Postoperative outcomes and complication rates were also compared between the groups.

Results: The mean postoperative pain score (VAS) was significantly lower in Group II (3.21 ± 2.04) compared to Group I (6.45 ± 1.62). The mean postoperative Oxford Knee Score was significantly higher in Group II (33.26 ± 7.38) than in Group I (27.14 ± 5.61). Additionally, postoperative radiological parameters, including medial joint space, lateral joint space, and the joint space ratio, were significantly better in Group II compared to Group I.

Conclusion: PFO combined with AD is an effective treatment option for MCOA, providing both clinical and radiological improvements with a low complication rate.

Keywords:. Arthroscopic debridement, knee osteoarthritis, oxford knee score, proximal fibular osteotomy.

Öz

Amaç: Bu çalışmanın amacı, medial kompartman diz osteoartriti (MKDOA) olan hastalarda artroskopik debridman (AD) ile kombine edilen proksimal fibula osteotomisi (PFO) ile yalnızca artroskopik debridman uygulanan hastaların klinik ve radyolojik sonuçlarını karşılaştırmaktır.

Gereç ve Yöntem: Bu retrospektif çalışma, Mayıs 2019 ile Ocak 2023 tarihleri arasında hastanemizde tedavi edilen MKDOA tanılı 74 hastaya ait 85 dizi kapsamaktadır. Grup I, yalnızca AD uygulanan 44 dizi; Grup II ise PFO + AD uygulanan 41 dizi içermektedir. Her iki grupta da preoperatif ve postoperatif klinik ve radyolojik parametreler değerlendirildi. Gruplar arasında postoperatif sonuçlar ve komplikasyon oranları karşılaştırıldı.

Bulgular: Postoperatif ortalama ağrı skorları (VAS), Grup II'de (3.21 ± 2.04), Grup I'e (6.45 ± 1.62) göre anlamlı olarak düşüktü. Postoperatif ortalama Oxford Diz Skoru, Grup II'de (33.26 ± 7.38), Grup I'e (27.14 ± 5.61) kıyasla anlamlı olarak yüksekti. Ayrıca, postoperatif radyolojik parametreler (medial eklem aralığı, lateral eklem aralığı ve eklem aralığı oranı) Grup II'de Grup I'e kıyasla anlamlı ölçüde daha iyiydi.

Sonuç: AD ile kombine edilen PFO, MKDOA tedavisinde etkili bir seçenek olup, düşük komplikasyon oranıyla hem klinik hem de radyolojik iyileşme sağlamaktadır.

Anahtar kelimeler: Artroskopik debridman, diz osteoartriti, Oxford Diz Skoru, proksimal fibula osteotomisi.

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INTRODUCTION

Knee osteoarthritis is a chronic, degenerative, and painful joint disease that restricts both mobility and physical activity. Recent studies report a symptomatic knee osteoarthritis prevalence ranging between approximately 22% and 34% in various populations, indicating a growing burden on public health[1-3], with the lifetime risk of developing symptomatic knee osteoarthritis estimated at 44.7%.[4]. As life expectancy increases and the elderly population continues to grow, the prevalence of osteoarthritis is expected to rise. The medial compartment is the most commonly affected region in knee osteoarthritis, with radiographic evidence of medial joint space narrowing observed in approximately 75% of patients[5,6].

Although various surgical options, including arthroscopic debridement (AD), high tibial osteotomy (HTO), and unicondylar or total knee arthroplasty (TKA), are available, each presents notable limitations. AD alone generally provides only temporary pain relief and is associated with a high rate of recurrence[7]. HTO is technically demanding and carries risks such as neurovascular injury, iatrogenic fracture, and nonunion, in addition to requiring delayed full weight-bearing[8-10]. While TKA effectively alleviates pain, corrects deformities, and improves function, it may not be ideal for younger patients with mild to moderate osteoarthritis[11]. The complexity of the procedure, the potential need for revision due to aseptic loosening or periprosthetic joint infection, and the high cost of both primary and revision surgeries limit the widespread use of unicondylar knee arthroplasty and TKA[12].

Given the limitations of existing surgical techniques, ongoing research continues to explore optimal treatment strategies for medial compartment knee osteoarthritis (MCKO), particularly in younger patients or those with mild to moderate disease. In recent years, proximal fibular osteotomy (PFO) has gained increased interest as a novel surgical approach for managing medial compartment knee osteoarthritis (MCKO). Growing evidence suggests that PFO can reduce pain and improve joint function by modifying the mechanical axis of the lower limb and shifting the load away from the medial compartment[13]. A number of clinical studies have reported significant improvements in pain scores, functional outcomes, and even gait parameters following PFO in patients with MCKO[14]. In addition to being minimally invasive and cost-effective, PFO has shown low complication rates and shorter rehabilitation times compared to more complex procedures like HTO or TKA[15]. However, some recent studies have raised concerns regarding the durability of these outcomes, indicating that the clinical benefits may diminish over time. Further high-quality, long-term studies are still needed to fully understand the efficacy and mechanisms of PFO[16].

Although clinical interest in PFO is increasing, there remains a lack of high-quality comparative studies evaluating PFO combined with arthroscopic debridement (AD) versus AD alone. This study aims to address this gap by comparing the clinical and radiological outcomes of these two surgical strategies. We hypothesize that combining PFO with AD will provide greater pain relief, improved function, and more favorable radiographic outcomes compared to AD alone.

MATERIALS AND METHODS

Sample

We conducted a retrospective review of data from 85 patients (97 knees) diagnosed with medial compartment knee osteoarthritis (MCKO) who underwent arthroscopic debridement (AD) or a combination of AD and proximal fibular osteotomy (PFO) at Medical Park Gaziantep and NCR International Hospital between May 2019 and January 2023. The study included patients with Kellgren and Lawrence (K/L) grade II or III osteoarthritis. Exclusion criteria included bicompartmental or tricompartmental osteoarthritis, valgus deformity, rheumatologic diseases, morbid obesity (body mass index >40), a history of fractures or previous surgical interventions involving the knee, and a follow-up period of less than 12 months (Figure 1).

Procedure

Since May 2019, our clinic has recommended performing PFO in conjunction with AD for all eligible patients with MCKO. However, in cases where patients declined PFO but consented to AD, AD alone was performed, with continued follow-up. Patients were categorized into two groups: Group I included those who underwent AD alone, and Group II included those who underwent AD combined with PFO. Clinical and radiological outcomes were

assessed for patients with a minimum follow-up of 12 months. Additionally, complication rates, including superficial and deep infections, extensor hallucis longus (EHL) weakness, and lower leg numbness, were compared between the groups.

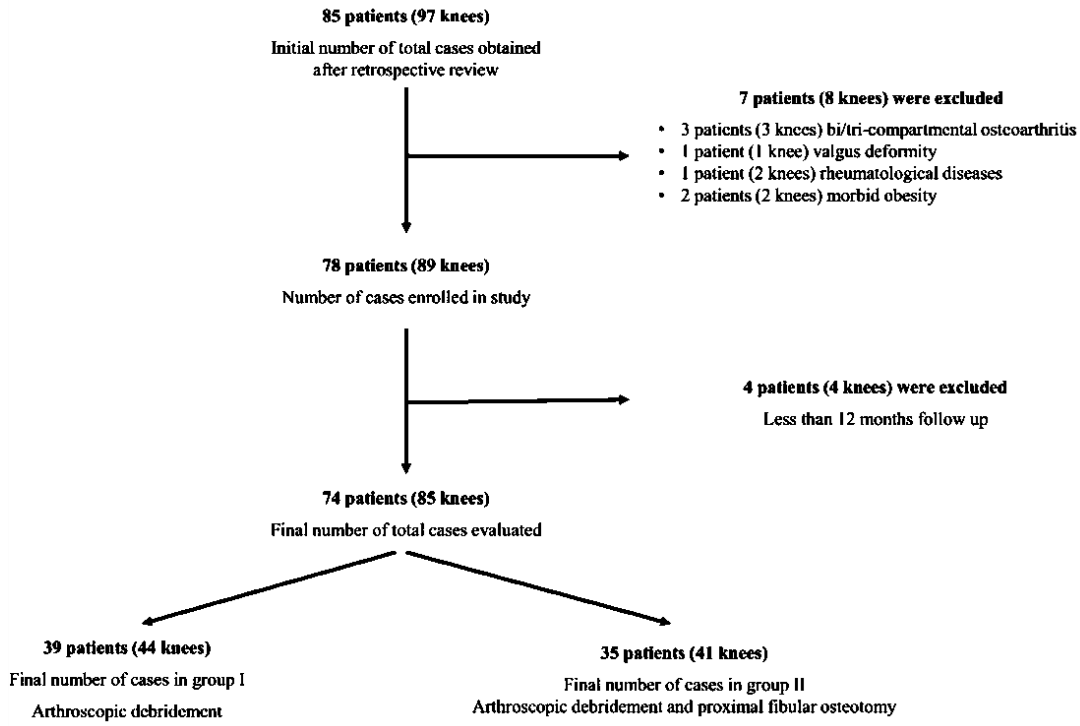


Figure 1. Flowchart showing case numbers and exclusion criteria.

All procedures were performed by a single orthopedic surgeon experienced in arthroscopy and knee procedures, using the same standardized surgical technique for all cases. Patient data were retrospectively obtained from archived hospital files and radiological examinations stored within the hospital's Picture Archiving and Communication System (PACS). The integrity and completeness of the records were confirmed by cross-checking clinical documentation with corresponding radiological data prior to analysis. Kellgren and Lawrence (K/L) grading was performed by the first author based on preoperative radiographs. To minimize inter-rater variability, the second author independently reassessed the grading for all patients. Intra-rater reliability was evaluated by repeating the grading process two weeks after the initial assessments. Intra-class correlation coefficients (ICCs) were used to assess the reliability of these measurements

All participants were thoroughly informed about the study and provided written informed consent before enrollment. The study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from the Sanko University Clinical Studies Ethics Committee (Approval date and number: 2023/04-89528399-000-11)

Surgical procedure

The entire surgical procedure was performed in the supine position under pneumatic tourniquet control and regional anesthesia with sedation. Initially, AD was performed in all patients across both groups. For knee arthroscopy, standard anteromedial and anterolateral portal incisions were made. Meniscal tears were excised using shavers and punches, and chondral lesions in the medial compartment were debrided. Additionally, microfracture was performed

to promote cartilage regeneration. The surgical procedure for patients in Group I was completed at this stage.

Patients in Group II proceeded with PFO. First, the fibular head was identified and marked, followed by a longitudinal incision of approximately 4 cm made 6–10 cm distal to the fibular head (Figure 2-a). The fascia was incised along the septum between the peroneus and soleus muscles. The peroneus brevis and peroneus longus muscles were retracted anteriorly, while the soleus was retracted posteriorly to expose the fibula (Figure 2-b). A blunt retractor was placed behind the fibula for neurovascular protection. A Gigli saw was then passed underneath the fibula (Figure 2-c), and a 1.5–2 cm segment of the fibula was excised (Figure 2-d). The cut ends were subsequently rasped and sealed with bone wax, marking the completion of the procedure.

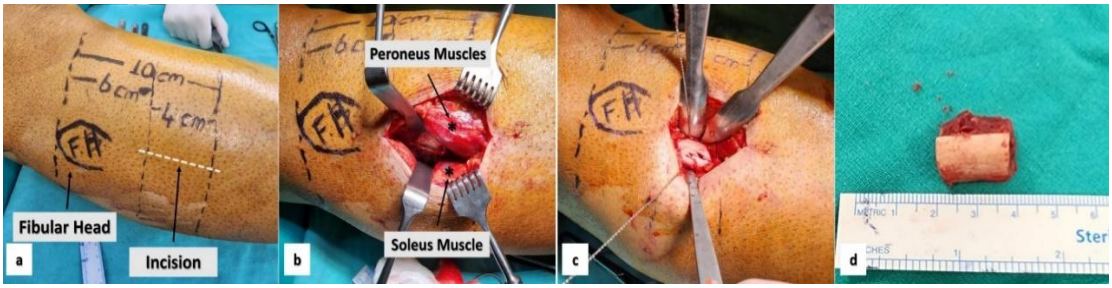


Figure 2. Surgical technique for proximal fibular osteotomy

a) Determination of osteotomy level and incision according to fibular head

b) The approach between the peroneus and soleus muscle planes to reach the fibula

c) Osteotomy using Gigli saw

d) Removed fibula segment

Postoperative period

All patients, regardless of group, were permitted full weight-bearing ambulation four hours postoperatively. Isotonic and isometric quadriceps exercises, along with both active and passive range of motion exercises for the entire lower extremity, were initiated on the first postoperative day without restriction.

All patients were discharged the day after surgery. Follow-up assessments were conducted at 3 and 6 weeks postoperatively, followed by evaluations at 3, 6, and 12 months, and subsequently every 6 months thereafter. Suture removal was performed during the 3-week follow-up visit.

Outcome assessment

Clinical outcomes were assessed using the Visual Analogue Scale (VAS) and the Oxford Knee Score, while radiological evaluation included measurements of medial joint space, lateral joint space, and the joint space ratio. These assessments were conducted preoperatively and at the final follow-up visit. Medial and lateral joint spaces were measured on full weight-bearing radiographs, and the joint space ratio (medial joint space/lateral joint space) was subsequently calculated.

The medial joint space was measured as the vertical distance between a horizontal line passing through the lowest point of the femoral condyle and another horizontal line at the tibial plateau (Figure 3). Similarly, the lateral joint space was measured as the vertical distance between a horizontal line passing through the lowest point of the lateral femoral condyle and another horizontal line at the tibial plateau[17]. Additionally, complications were recorded for each group, including superficial infection, deep infection, extensor hallucis longus (EHL) weakness, and lower leg numbness.

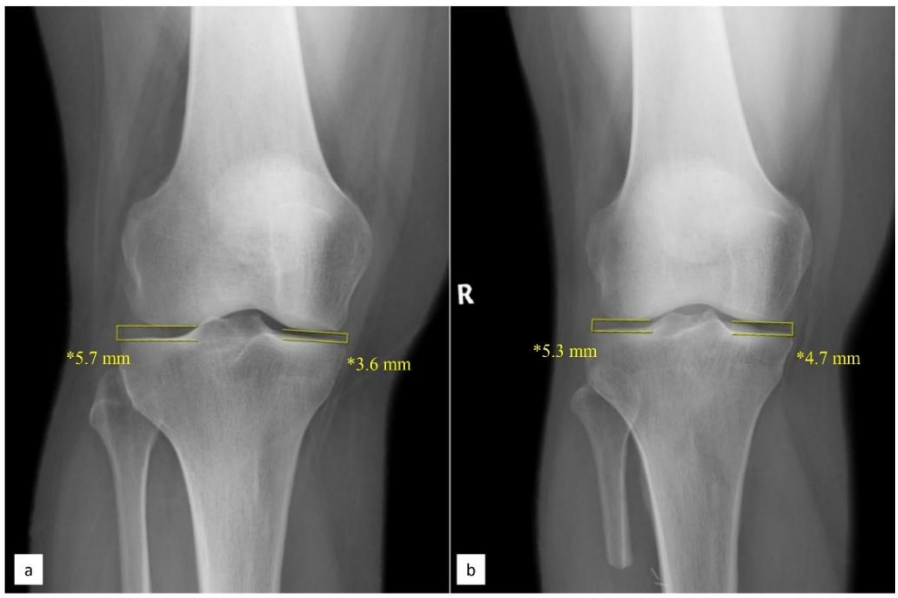


Figure 3. Preoperative and postoperative radiographs showing medial and lateral joint spaces in patients who underwent PFO with AD.

Statistical analysis

Statistical analyses were conducted using SPSS for Windows, version 25.0. The normality of the distribution of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. In the Kolmogorov-Smirnov test, a p-value greater than 0.05 was considered indicative of a normal distribution. Descriptive statistics were reported as follows: continuous variables were expressed as mean ± standard deviation or as median with minimum and maximum values, while categorical variables were presented as frequencies and percentages. For group comparisons, the Student's t-test was used to assess differences in means when parametric assumptions were met, while the Mann-Whitney U test was applied when these assumptions were not satisfied. The chi-squared test was used to compare categorical variables between groups. A p-value of <0.05 was considered statistically significant.

Between-group comparisons of continuous demographic variables, including age and follow-up duration, were performed using the Student's t-test. Categorical variables, such as sex and the side of the operated knee, were assessed using the chi-squared test. Intra-group comparisons (preoperative vs. postoperative) for VAS scores, Oxford Knee Scores, and joint space ratio were performed using the Wilcoxon signed-rank test. Between-group comparisons (Group I vs. Group II) for these same variables were performed using the Mann-Whitney U test. Medial and lateral joint space measurements, were analysed using the Student's t-test.

The total sample size and power analysis were calculated using G*Power software (Version 3.1.9, Universität Kiel, Germany). The analysis was conducted with a significance level (α) of 0.05, an effect size of $f^2 = 0.54$, and a desired statistical power of 0.80. The calculations determined that a minimum of 21 cases would be required to achieve 80% power. The results of the study confirmed that the sample was adequately powered, with a statistical power of 99.9%.

RESULTS

A total of 74 patients (85 knees) met the inclusion criteria and were included in the study. Group I (AD alone) comprised 39 patients (44 knees), while Group II (PFO with AD) included 35 patients (41 knees). The distribution of patients between the groups was

comparable in terms of age, sex, follow-up duration, and operated side. Additionally, no significant differences were observed between the groups in preoperative parameters, including VAS, Oxford Knee Score, medial and lateral joint space measurements, and joint space ratio (Table 1). The mean follow-up duration was 17.66 months (range: 12–32 months) in Group I and 16.90 months (range, 12–31 months) in Group II (Table 1).

Table 1. Demographic characteristics, clinical and radiological findings between groups

Variable	Group I /AD alone n=44	Group II / PFO with AD n=41	P
Sex: M (%) /F (%)	18 (40.9 %) / 26 (59.1 %)	17 (41.2 %) / 24 (58.5 %)	***0.567
Age (Years) Mean ± SD (Range)	48.30 ± 8.24 (29-63)	52 ± 12.82 (25-76)	**0.11
Operated Side Right: n (%) Left: n (%)	23 (52.3 %) 21 (47.7 %)	18 (43.9 %) 23 (56.1 %)	***0.29
Follow-up time (Months) Mean ± SD (Range)	17.66 ± 4.63 (12-32)	16.9 ± 4.42 (12-31)	**0.44
Pre-operative VAS Mean ± SD Median (Range)	6.91 ± 0.98 7 (5-9)	7.24 ± 1.11 7 (5-10)	**0.14
Post-operative VAS Mean ± SD Median (Range)	6.45 ± 1.62 6 (3-9)	3.21 ± 2.04 3 (0-8)	*<0.001
Pre-operative Oxford Knee Score Mean ± SD Median (Range)	24.59 ± 4.22 25 (14-34)	22.53 ± 5.10 22 (15-33)	*0.52
Post-operative Oxford Knee Score Mean ± SD Median (Range)	27.14 ± 5.61 27 (14-41)	33.26 ± 7.38 36 (20-44)	*p<0.001
Pre-operative Medial Joint Space (mm) Mean ± SD	3.69 ± 0.44	3.62 ± 0.52	*0.67
Post-operative Medial Joint Space (mm) Mean ± SD	3.58 ± 0.46	4.2 ± 0.69	*p<0.001
Pre-operative Lateral Joint Space (mm) Mean ± SD	6.70 ± 0.59	6.91 ± 0.57	*0.12
Post-operative Lateral Joint Space (mm) Mean ± SD	6.87 ± 0.57	6.18 ± 0.60	*p<0.001
Pre-operative Joint Space Ratio Mean ± SD	0.55 ± 0.11	0.53 ± 0.1	*0.26
Post-operative Joint Space Ratio Mean ± SD	0.53 ± 0.11	0.68 ± 0.15	*p<0.001
Superficial Infection n (%)	3 (6.8%)	4 (9.8 %)	***0.622
Deep Infection n (%)	-	-	-
EHL weakness n (%)	-	2 (4.9 %)	***0.13
Lower leg numbness n (%)	-	3 (7.3 %)	***0.068

Statistical Method: * Mann-Whitney U test, **. Student t test, ***Chi-square test,
AD: Arthroscopic Debridement, EHL: Extensor Hallucis Longus, M: Male, F: Female, PFO: Proximal Fibular Osteotomy, SD: Standard Deviation, VAS: Visual Analogue Scale

In Group I, the mean preoperative and postoperative VAS scores were 6.91 ± 0.98 and 6.45 ± 1.62, respectively. The mean medial joint space was 3.69 ± 0.44 mm preoperatively and 3.58 ± 0.46 mm postoperatively, while the lateral joint space measured 6.70 ± 0.59 mm and 6.87 ± 0.57 mm,

respectively. The joint space ratio was 0.55 ± 0.11 before surgery and 0.53 ± 0.11 after surgery. No statistically significant differences were observed in VAS scores, joint space measurements, or joint space ratio within Group I. However, the mean Oxford Knee Score demonstrated a significant improvement, increasing from 24.54 ± 4.36 preoperatively to 26.88 ± 5.53 postoperatively ($p = 0.037$) (Table 2).

Patients in Group II experienced significant pain relief. The mean VAS score decreased markedly from 7.24 ± 1.11 preoperatively to 3.21 ± 2.04 postoperatively, indicating a statistically significant improvement ($p < 0.001$). Similarly, the mean Oxford Knee Score improved significantly from 22.53 ± 5.10 preoperatively to 33.26 ± 7.38 postoperatively ($p < 0.001$). Radiological assessments also demonstrated notable changes in Group II. The medial joint space increased from 3.62 ± 0.52 mm preoperatively to 4.20 ± 0.69 mm postoperatively ($p < 0.001$), while the lateral joint space decreased from 6.91 ± 0.57 mm to 6.18 ± 0.60 mm ($p < 0.001$). Additionally, the joint space ratio improved significantly from 0.53 ± 0.10 preoperatively to 0.68 ± 0.15 postoperatively ($p < 0.001$) (Table 2).

Table 2. Comparison of preoperative and postoperative findings within the group

Variable	Group	Pre-operative value	Post-operative value	*P*
VAS Mean ± SD Median (Range)	AD alone	6.91 ± 0.98 7 (5-9)	6.45 ± 1.62 6 (3-9)	*0.34
	PFO with AD	7.24 ± 1.11 7 (5-10)	3.21 ± 2.04 3 (0-8)	*p<0.001
Oxford Knee Score Mean ± SD Median (Range)	AD alone	24.59 ± 4,22 25 (14-34)	27.14 ± 5.61 27 (14-41)	**0.037
	PFO with AD	22.53 ± 5.10 22 (15-33)	33.26 ± 7.38 36 (20-44)	*p<0.001
Medial Joint Space (mm) Mean ± SD	AD alone	3.69 ± 0.44	3.58 ± 0.46	*0.678
	PFO with AD	3.62 ± 0.52	4.2 ± 0.69	*p<0.001
Lateral Joint Space (mm) Mean ± SD	AD alone	6.7 ± 0.59	6.87 ± 0.57	*0.588
	PFO with AD	6.91 ± 0.57	6.18 ± 0.6	*p<0.001
Joint Space Ratio Mean ± SD	AD alone	0.55 ± 0.11	0.53 ± 0.11	**0.305
	PFO with AD	0.53 ± 0.1	0.68 ± 0.15	**p<0.001

Statistical Method: * Mann-Whitney U test **. Student t test ; AD: Arthroscopic Debridement, PFO: Proximal Fibular Osteotomy, SD: Standard Deviation, VAS: Visual Analogue Scale

Postoperative pain levels were significantly lower in Group II, with a mean VAS score of 3.21 ± 2.04, compared to 6.45 ± 1.62 in Group I ($p < 0.001$) (Table 1). Additionally, the mean postoperative Oxford Knee Score was significantly higher in Group II (33.26 ± 7.38) than in Group I (27.14 ± 5.61, $p < 0.001$) (Figure 4). Postoperative radiological parameters also demonstrated significantly better outcomes in Group II. The medial joint space was greater in Group II (4.20 ± 0.69 mm) than in Group I (3.58 ± 0.46 mm, $p < 0.001$). Conversely, the lateral joint space was lower in Group II (6.18 ± 0.60 mm) compared to Group I (6.87 ± 0.57 mm, $p < 0.001$). Similarly, the joint space ratio was significantly higher in Group II (0.68 ± 0.15) than in Group I (0.53 ± 0.11, $p < 0.001$) (Table 1). Postoperative complications were recorded in both groups. Superficial infections occurred in 3 patients (6.8%) in Group I and 4 patients (9.7%) in Group II, all of which were successfully treated with oral antibiotics for 7–30 days. No cases of deep infection were observed in either group. Extensor hallucis longus (EHL) weakness was not reported in Group I but was observed in 2 patients (4.9%) in Group II; however, full recovery was achieved within six months. Lower leg numbness was reported exclusively in Group II, affecting 3 patients (7.3%), all of whom experienced spontaneous resolution within four months (Table 1).

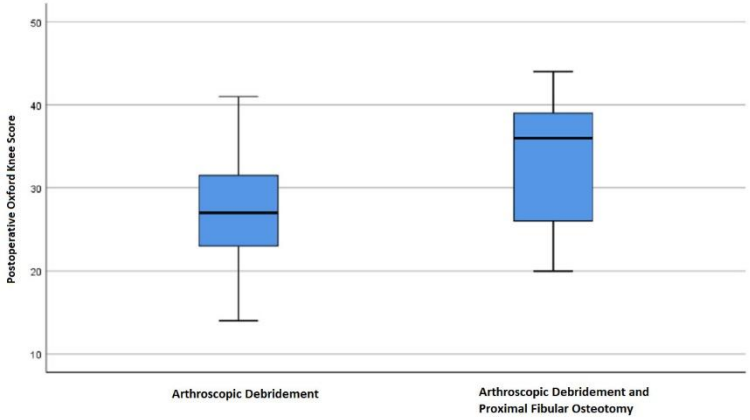


Figure 4. The post-operative Oxford Knee Score of patients according to groups in the box and whisker plot graph.

DISCUSSION

In the AD group, no significant postoperative improvements were observed in any parameter except for the Oxford Knee Score. In contrast, patients who underwent PFO combined with AD demonstrated significant improvements in all clinical and radiological parameters compared to their preoperative assessments. Furthermore, the extent of clinical and radiological improvement was significantly greater in the PFO with AD group than in the AD-alone group. Although the complication rate was higher in the PFO with AD group, the difference between the groups was not statistically significant.

PFO is emerging as a promising surgical technique for alleviating pain and improving joint function in patients with medial compartment osteoarthritis (MCOA). In addition to reducing pain in the medial compartment, the most intriguing aspect of the procedure is its capacity to increase the medial joint space [18]. While several studies have demonstrated the effectiveness of PFO alone and the limited efficacy of AD alone [19], research on the combined outcomes of PFO with AD remains limited. Arthroscopic surgery does not alter the mechanical axis of the limb, whereas PFO does not directly address meniscal tears or chronic intra-articular inflammation. In this study, we combined PFO with AD in Group II patients to evaluate the potential synergistic benefits of these procedures.

Yang et al. reported the outcomes of 110 patients who underwent PFO, with a mean follow-up period of 49.1 months (range, 24–189 months). They observed a significant increase in the American Knee Society Score (KSS), from 45.0 ± 21.3 preoperatively to 92.3 ± 31.7 postoperatively ($p < 0.001$). Additionally, the femorotibial angle decreased from 182.7° ± 2.0° to 179.4° ± 1.8° ($p < 0.001$). Their study also demonstrated that postoperative radiographs revealed a widened medial joint space and a narrowed lateral joint space compared to preoperative images [6]. Similarly, Wang X et al. evaluated 46 patients who underwent PFO and reported their clinical and radiological outcomes in 2017. In patients with a follow-up period of 13.38 months (range, 12–18 months), the mean VAS score significantly decreased from 8.02 ± 1.50 preoperatively to 2.74 ± 2.34 postoperatively. Additionally, the KSS improved from 44.41 ± 8.90 to 69.02 ± 11.12 ($p < 0.001$), and the joint space ratio increased from 0.40 ± 0.28 to 0.58 ± 0.30 ($p < 0.001$) [17]. Utomo et al. published the outcomes of 15 patients with stage 4 osteoarthritis who underwent PFO. Their findings demonstrated a significant increase in the Oxford Knee Score, from 25.66 ± 4.18 preoperatively to 36.80 ± 3.00 postoperatively, while the joint space ratio increased from 0.40 ± 0.02 to 0.57 ± 0.04. The authors concluded that PFO is a promising treatment option for patients with stage 4 osteoarthritis who are ineligible for TKA [18]. In the present study, no significant postoperative improvement was observed in VAS or Oxford Knee Score among patients who underwent AD alone

(preoperative VAS: 6.91, Oxford Knee Score: 24.54; postoperative VAS: 6.45, Oxford Knee Score: 26.88). However, the improvements in VAS and Oxford Knee Score observed in patients who underwent PFO combined with AD (preoperative VAS: 7.24, Oxford Knee Score: 22.53; postoperative VAS: 3.21, Oxford Knee Score: 33.26) were consistent with previous studies. In our study, PFO was performed in patients with stage 2 and 3 osteoarthritis, but not in those with stage 4 disease. We believe that further studies reporting favorable outcomes are needed to better define the role of PFO in the treatment of stage 4 osteoarthritis.

Several studies have reported low complication rates associated with PFO. Yang et al. documented lower leg numbness in 4 patients (3.6%) [6]. Qin et al. observed superficial peroneal nerve palsy in 8 of 67 patients (12%) and extensor hallucis longus (EHL) weakness in 1 patient (1.5%), all of which were reversible [20]. Huda N et al. reported lower leg numbness in 9 of 56 patients (16%) but did not observe any cases of EHL weakness [21]. Prakash et al. documented foot drop in 1 patient (1.1%), EHL weakness in 8 patients (9%), and numbness in 7 patients (8%) [22]. Notably, foot drop had not been reported in any previous studies except for that of Prakash et al. Wang YM et al. reported no complications in their series of 12 patients [23], while Wang X et al. similarly reported no postoperative complications in 46 patients with a 12-month follow-up after PFO [17]. In the present study, EHL weakness was observed in 2 of 41 knees (4.9%), while lower leg numbness was noted in 3 knees (7.3%). However, all cases resolved spontaneously within six months. Notably, a higher incidence of complications was observed in the initial patients undergoing PFO compared to those who underwent the procedure at a later stage. Complications such as EHL weakness and lower leg numbness may result from peroneal nerve injury due to excessive retraction of the peroneus muscles or increased compartment pressure caused by edema and hematoma when the fascia is sutured.

We observed a reduction in complication rates after implementing several precautions, including making longer incisions to minimize soft tissue tension, performing osteotomy with a Gigli saw instead of an oscillating saw to prevent potential mechanical or thermal damage to the peroneal nerve, placing a Hohmann retractor behind the fibula for neurovascular protection, and closing the surgical site without suturing the fascia. Additionally, a posterolateral approach through the interval between the peroneus longus and brevis muscles and the soleus muscle, as well as performing the osteotomy at least 6 cm distal to the fibular head, has been recommended to further reduce the risk of iatrogenic nerve injury [6, 24]. Based on these findings, we recommend that clinicians adopt these surgical precautions to minimize complication rates associated with PFO.

In conclusion, PFO combined with AD appears to be an effective treatment modality for MCOA, providing both clinical and radiological improvements while maintaining a low complication rate. However, our study has several limitations, including a small sample size, retrospective design, and relatively short mean follow-up period. Given the growing interest in minimally invasive and joint-preserving techniques, further studies focusing on the standardization of surgical indications and techniques for PFO, as well as the identification of ideal patient subgroups, could provide valuable guidance for clinical decision-making in this evolving field.

Author Contributions: Concept/Design : İHR; Data acquisition: İHR; Data analysis and interpretation: NG; Drafting manuscript: İHR, NG; Critical revision of manuscript: İHR, NG; Final approval and accountability: İHR, NG; Technical or material support: İHR, NG; Supervision: İHR; Securing funding (if available): n/a.
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Peer-review: Externally peer-reviewed.
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Informed Consent: All participants were informed about the study and signed written informed consent before enrollment.

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