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Mid-term functional, clinical, and radiological outcomes with factors affecting revision of mobile-bearing medial unicompartmental knee arthroplasty

Erdal Uzun [a,*], Abdulhamit Misir [b], Turan Bilge Kizkapan [c], Mustafa Ozcamdalli [d], Ali Eray Gunay [e], Kazim Husrevoglu [e]

[a] Department of Orthopaedics and Traumatology, Erciyes University, Faculty of Medicine, Kayseri, Turkey
[b] Department of Orthopaedics and Traumatology, Health Sciences University Gaziosmanpasa Taksim Training and Research Hospital, Istanbul, Turkey
[c] Department of Orthopaedics and Traumatology, Bursa Cekirge State Hospital, Bursa, Turkey
[d] Department of Orthopaedics and Traumatology, Ahi Evran University Faculty of Medicine, Kirsehir, Turkey
[e] Department of Orthopaedics and Traumatology, Health Sciences University Kayseri City Hospital, Kayseri, Turkey

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ABSTRACT

Background: To evaluate and compare the clinical and radiological outcomes of patients subjected to medial unicompartmental knee arthroplasty (UKA).
Methods: The study included 146 knees of 115 consecutive medial UKAs patients with a minimum five-year follow-up. Pre- and postoperative functional and clinical outcomes were measured using the Visual Analog Scale (VAS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Oxford Knee Score (OKS), American Knee Society Score (AKSS-O), knee range of motion (ROM), and Short-Form Health Survey (SF-36). The Kellgren–Lawrence osteoarthritis (OA) grading system was used for the evaluation of the OA status. The joint line convergence angle (JLCA) of the operated and contralateral knee, the tibiofemoral coronal angle (TFCA), and the tibial slope angle were used in the radiological evaluation.
Results: The mean age of patients was 58.8 ± 7.0 years. The mean follow-up period was 7.41 ± 1.54 years. Good to excellent functional outcomes were obtained according to VAS, WOMAC, OKS, AKSS-O, and SF-36 scores. Insert dislocation was the main reason for revision surgery (nine patients, 90%). Preoperative body mass index (BMI), postoperative BMI, American Society of Anesthesiologists (ASA) Score, postoperative knee flexion contracture, mean increase in postoperative medial joint space (PMJS) height, and OA progression were found to affect the revision status.
Conclusions: Good to excellent functional, clinical, and radiological outcomes were obtained with medial UKA at a minimum follow-up of five years. Differences in preoperative and postoperative radiological parameters except an increase in PMJS height had no impact on revision status.

* Corresponding author at: Department of Orthopaedics and Traumatology, Erciyes University Faculty of Medicine, Kosk mah, Dede Efendi sk, PK 38030 Melikgazi, Kayseri, Turkey.
E-mail address: erdaluzun@erciyes.edu.tr. (E. Uzun).

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1. Introduction

Unicompartmental knee arthroplasty (UKA) is a widely used option in the treatment of isolated unicompartmental osteoarthritis (OA) [1–3]. Over the past two decades, indications for UKA have been expanded due to the advantages of reduced invasiveness, less blood loss, faster postoperative recovery, reduced perioperative morbidity, bone stock preservation, closer knee kinematics to a normal knee, and a more normal gait compared with total knee arthroplasty (TKA) [4–7]. In addition, the superiority of UKA in terms of patient satisfaction and disease-specific outcome measures has been proven [5,8]. However, the risk of revision surgery is higher following UKA [8,9]. Although there are many studies evaluating UKA revisions in the literature, there have been no studies comprehensively evaluating the effects of patient characteristics, or clinical and radiological outcomes on revision status. Therefore, a detailed evaluation of cases undergoing revision of UKA is important. The aim of this study was to evaluate the mid-term outcomes of patients who underwent mobile-bearing medial UKA and to assess risk factors for revision surgery.

2. Materials and methods

2.1. Patient enrollment

Between 2006 and 2014, a single non-designer surgeon from our institution with 10 years of experience in knee surgery performed medial UKA on 226 knees. Inclusion criteria were: (1) patients underwent medial UKA due to primary medial knee OA; (2) surgery performed by the same surgeon; (3) patients with a minimum five-year follow-up; and (4) presence of complete preoperative, intraoperative and postoperative data. The body mass index (BMI), age, activity level, or presence of mild patellofemoral OA was not considered as contraindications [10,11]. Patients that had undergone previous surgery (e.g., anterior cruciate ligament (ACL) reconstruction, high tibial osteotomy, distal femoral osteotomy, cartilage restoration surgery in the lateral compartment due to full-thickness cartilage defects), inflammatory arthritis, valgus malalignment of >5°, varus malalignment of >10° (these patients underwent a corrective distal femoral or proximal tibial osteotomy prior to UKA), an active range of motion (ROM) of <90°, or patients with functionally impaired ACL or any collateral ligament of the knee were excluded. Informed consent was obtained from all participating patients. The study was approved by the Local Ethics Committee of Kayseri City Hospital (protocol no: 76397871–20/15.11.18).

2.2. UKA surgical technique

Primary UKAs were performed using the Oxford Phase III mobile-bearing prosthesis (Zimmer Biomet, Warsaw, IN, USA) in all consecutive cases. Surgery was performed using a medial parapatellar approach without dislocation of the patella. Components were fixed with or without cement. Immediate full weight bearing with crutches and active knee flexion and extension exercises were started immediately.

2.3. Follow-up and assessment

Routine follow-up was performed at two weeks, six weeks, three months, six months, one year, and annually thereafter. Patient characteristics and demographic data were recorded. Operative reports were prepared and pre- and postoperative clinical and radiological evaluations were performed.

Pre- and postoperative functional outcomes were measured using the Visual Analog Scale (VAS; ranging from 0 to 10; where 0 = no pain to 10 = worst pain ever), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [12], Oxford Knee Score (OKS; 0–48, with 48 the best outcome) [13], American Knee Society Score (AKSS-O) [14], and Short-Form Health Survey (SF-36) [15]. The degree of knee flexion, knee extension, and the flexion contracture were measured using an analog goniometer on the lateral aspect of the leg, with the patient in the supine position.

Radiological analysis was performed with a focus on the progression of arthritis in the lateral and patellofemoral compartments according to the Kellgren–Lawrence OA grading system (KLS) [16]. In addition, changes in preoperative versus postoperative measurements of the joint line convergence angle (JLCA) of the operated and contralateral knee, the tibiofemoral coronal angle (TFCA), and the tibial slope angle were analysed by a single examiner (A.E.G.) who was blinded to the study protocol. Any complications and reoperations were recorded.

Next, patients were divided into two groups according to their revision status (group 1 (revision −) versus group 2 (revision ±). Subgroup parameters were assessed according to demographic data, as well as by functional, clinical, and radiological outcome parameters.

2.4. Statistical analysis

The distribution of the variables was measured using the Kolmogorov–Smirnov test. Mean ± standard deviation (SD), median, minimum and maximum values, and frequency ratios were used in descriptive statistics of the data. The independent sample *t*-test and Mann–Whitney *U*-test were used in the analysis of independent quantitative data. The Wilcoxon test was used in the analysis of dependent quantitative data. The Chi-squared test was used in the analysis of qualitative independent data and the Fischer exact test was used when the chi-squared test requirements were not met. A P-value of <0.05 was considered to be significant. All statistical analyses were performed using SPSS v22.0 for Windows (SPSS Inc., IL, USA).

3. Results

This study included 146 consecutive medial UKAs having a minimum five-year follow-up. The mean age of patients was 58.8 ± 7.0 years. The mean follow-up duration was 7.41 ± 1.54 years. There were 13 males and 102 female patients. Anteromedial OA (139 knees) and avascular necrosis (seven knees) were the indications for surgery. Patient characteristics and demographic data are summarised in Table 1. There was a statistically significant difference between the two groups regarding preoperative body weight, BMI and American Society of Anesthesiologists (ASA) Score (Table 1).

Good to excellent outcomes with significant improvements in functional scores were obtained at the last follow-up. Preoperative and postoperative functional and clinical outcomes are summarised in Tables 2 and 3. Differences in VAS, WOMAC scores, and flexion contracture were statistically significant between the revision (−) and revision (+) groups ($P < .05$) (Table 2). In addition, a statistically significant difference in postoperative scores and changes in pre- to postoperative OKS, AKSS-O scores between groups was found ($P < .05$).

The flexion contracture degree and BMI were significantly decreased in both groups. However, there was a statistically significant difference between groups regarding postoperative flexion contracture degree and BMI (Table 2). A statistically significant difference was found in mean postoperative knee flexion and mean postoperative knee extension (Table 2).

SF-36 scores are summarised in Table 2. There was a significant difference between subgroups regarding postoperative SF-36 scores and changes in pre- to postoperative SF-36 scores ($P < .05$). Radiological analysis revealed no significant differences in preoperative and postoperative measurements except for a mean increase in PMJS and OA progression (Table 4).

A total of 10 patients (10 knees) underwent revision surgery during the follow-up period. The reason for revision surgery was insert dislocation in nine patients (90%) and lateral compartment OA in one patient (10%). Five patients were revised by TKA. One TKA was due to the progression of OA in the lateral compartment. Five patients with insert dislocation were revised by replacing the previous insert with a thicker one (Figure 1). There was one medial collateral ligament (MCL) injury and one ACL rupture in revised cases. Radiologically, none of the surviving implants appeared to be loosened. No patients developed deep infection. In addition, none of the patients developed periprosthetic tibial or femoral fractures during the follow-up period.

4. Discussion

The main findings of the study were that good to excellent postoperative functional and radiologic results were obtained using Oxford mobile-bearing UKA for medial compartment arthritis with a survival rate of 93.2% (136 of 146 knees) at a minimum follow-up of five years. The cause of revision was insert dislocation in 90% of patients who underwent revision. Lower preoperative

Table 1
Patient characteristics and demographic data. Bold-italic values indicate statistical significance.a, b, c

		Total		Revision (−)		Revision (+)		P
		Mean ± SD/n (%)	Median	Mean ± SD/n (%)	Median	Mean ± SD/n (%)	Median	
Age		58.8 ± 7.0	58.5	58.9 ± 7.1	59.0	57.0 ± 5.1	58.0	0.405[b]
Sex	Female	131 (89.7%)		121 (89%)		10 (100%)		0.599[c]
	Male	15 (10.3%)		15 (11%)		0 (0%)		
Height		159.7 ± 3.5	160.0	159.7 ± 3.5	160.0	159.1 ± 3.2	160.0	0.673[a]
Weight		74.1 ± 6.0	75.0	73.8 ± 6.0	75.0	78.2 ± 3.9	78.0	***0.011***[a]
BMI		29.1 ± 2.7	29.3	29.0 ± 2.7	29.3	30.9 ± 2.2	30.9	***0.025***[a]
ASA	I	26 (17.8%)		24 (17.6%)		2 (20%)		***0.012***[c]
	II	100 (68.5%)		96 (70.6%)		4 (40%)		
	III	19 (13.0%)		14 (11.0%)		4 (40%)		
	IV	1 (0.7%)		1 (0.8%)		0 (0%)		
Side	Right	67 (45.9%)		62 (45.6%)		5 (50%)		0.616[c]
	Left	48 (32.9%)		46 (33.8%)		2 (20%)		
	Bilateral	31 (21.2%)		28 (20.6%)		3 (30%)		
Anaesthesia type	General	36 (24.7%)		34 (25%)		2 (20%)		0.723[c]
	Spinal	110 (75.3%)		102 (75%)		8 (80%)		
Hospital stay		4.5 ± 1.3	4.0	4.5 ± 1.2	4.0	4.6 ± 2.2	4.0	0.676[m]
Co-morbidity	(−)	77 (52.7%)		72 (52.9%)		5 (20%)		0.857[c]
	(+)	69 (47.3%)		64 (47.1%)		5 (80%)		
Preoperative flexion contracture	(−)	21 (14.4%)		21 (15.4%)		0 (20%)		0.358[c]
	(+)	125 (85.6%)		115 (84.6%)		10 (80%)		
Follow up time		7.41 ± 1.54	7.0	7.42 ± 0.13	7.0	7.2 ± 1.58	7.0	0.372[a]

ASA, American Society of Anesthesiologists Score; BMI, body mass index; SD, standard deviation.

[a] Mann–Whitney *U*-test.

[b] *t*-test.

[c] Ki-kare test.

Table 2
Clinical and surgical results. Bold-italic values indicate statistical significance.

		Revision (−)		Revision (+)		*P*	Total		
		Mean ± SD/n (%)	Median	Mean ± SD/n (%)	Median		Mean ± SD/n (%)	Median	*P*
VAS score									
Preoperative		8.5 ± 0.8	9.0	9.3 ± 0.7	9.0	***0.025***[a]	8.6 ± 0.9	9.0	***0.000***[b]
Postoperative		2.2 ± 1.4	2.0	6.5 ± 1.8	7.0	***0.001***[a]	2.5 ± 1.8	2.0	
Pre–post difference		−6.4 ± 1.7	−6.0	−2.8 ± 1.7	−3.0	***0.005***[a]			
Pre–post difference *p*		***0.000***[b]		***0.007***[b]					
WOMAC score									
Preoperative		79.5 ± 6.1	80.0	84.9 ± 6.0	86.0	***0.011***[a]	79.9 ± 6.2	80.0	***0.000***[b]
Postoperative		27.9 ± 12.9	28.0	68.6 ± 16.2	73.5	***0.000***[a]	30.7 ± 16.6	28.0	
Pre-post difference		−51.6 ± 14.9	−52.0	−16.3 ± 13.4	−12.0	***0.000***[a]			
Pre–post difference *P*		***0.000***[b]		***0.005***[b]					
AKSS-O score									
Preoperative		30.6 ± 9.6	30.0	27.0 ± 12.3	25.0	0.169[a]	30.3 ± 9.8	30.0	***0.000***[b]
Postoperative		78.8 ± 14.0	80.0	37.5 ± 21.1	30.0	***0.000***[a]	76.0 ± 17.9	80.0	
Pre–post difference		48.2 ± 17.9	50.0	10.5 ± 24.2	10.0	***0.000***[a]			
Pre–post difference *p*		***0.000***[b]		0.201[b]					
OKS									
Preoperative		24.1 ± 5.7	24.0	21.7 ± 7.0	21.0	0.187[a]	24.0 ± 5.8	24.0	***0.000***[b]
Postoperative		36.7 ± 5.5	37.0	23.3 ± 9.3	23.0	***0.000***[a]	35.7 ± 6.7	36.0	
Pre–post difference		12.5 ± 8.4	13.0	1.6 ± 10.9	3.5	***0.003***[a]			
Pre–post difference *P*		***0.000***[b]		0.610[b]					
BMI									
Preoperative		29.0 ± 2.7	29.3	30.9 ± 2.2	30.9	***0.025***[a]	29.1 ± 2.7	29.3	***0.000***[b]
Postoperative		28.0 ± 2.7	28.1	31.0 ± 2.2	30.9	***0.001***[a]	28.2 ± 2.8	28.1	
Pre–post difference		−1.0 ± 0.8	−0.9	0.1 ± 1.2	0.8	***0.005***[a]			
Pre–post difference *P*		***0.000***[b]		0.610[b]					
Flexion contracture									
Preoperative		16.8 ± 4.4	15.0	22.5 ± 4.2	22.5	***0.000***[a]	17.2 ± 4.6	15.0	***0.000***[b]
Postoperative		6.2 ± 4.5	5.0	17.0 ± 4.2	15.0	***0.000***[a]	7.0 ± 5.3	5.0	
Pre–post difference		−10.6 ± 4.0	−10.0	−5.5 ± 2.8	−5.0	***0.000***[a]			
Pre–post difference *P*		***0.000***[b]		***0.005***[b]					
Knee flexion		118.4 ± 4.4	120.0	109.0 ± 4.6	110.0	***0.000***[a]	117.8 ± 5.0	120.0	
Knee extention		174.4 ± 3.4	175.0	168.0 ± 6.7	168.0	***0.000***[a]	175.9 ± 4.3	175.0	
Cement	(−)	26	(19.1%)	4	(40%)	0.857[c]	30	20.5%	
	(+)	110	(80.9%)	6	(60%)		116	79.5%	
Insert size			3.0		3.5	0.420[a]		3.0	
Revision due to ID	(−)	136	100.0%	1	10%	***0.000***[c]	137	93.8%	
	(+)	0	0.0%	9	90%		9	6.2%	
Revision due to LCA	(−)	136	100.0%	9	90%	0.068[c]	145	99.3%	
	(+)	0	0.0%	1	10%		1	0.7%	
Preop flexion contracture	(−)	21	15.4%	0	20%		21	14.4%	
	(+)	115	84.6%	10	80%		125	85.6%	

AKSS-O, American Knee Society Score; BMI, body mass index; ID, insert dislocation; LCA, lateral compartment arthrosis; OKS, Oxford Knee Score; SD, standard deviation; VAS, Visual Analog Scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.
[a] Mann–Whitney *U*-test.
[b] Wilcoxon test.
[c] Ki-kare test.

clinical scores, higher BMI, higher flexion contracture, and increased PMJS were found to negatively affect the outcomes and dislocation status.

Reasons for failure or revision after UKA application have varied across early to long-term studies [17–21]. Aseptic loosening, progression of OA, unexplained pain, instability, infection and polyethylene wear were the possible reasons for revision after UKA [22]. In a recent study, it was reported that the majority of early failures (before five years) were from aseptic loosening, OA progression, and insert dislocation, while the mid-term and later revisions were performed primarily due to OA progression [23]. In addition, Jennings et al. [24] reported a wide variability in the indications for revision after UKA, indicating that the most common reasons were aseptic loosening and progression of OA. In their systematic review, Ro et al. [25] reported that although total reoperation rates after UKA were similar in Asian and Western populations, a higher rate of reoperation for bearing dislocation was found in Asians. They attributed this difference mainly to differences in lifestyle: people living in many parts of Asia kneel, squat, sit cross-legged, or sit on the floor during activities of daily living or while performing religious activities with great ROM, increasing the force on the ACL and resulting in anterior subluxation of the proximal tibia, consequently bearing dislocation occurs during deep squatting. Our results were comparable with these studies. Similar to the findings of Ro et al. [25], the main reason for revision surgery was insert dislocation in nine patients (90%), although there was a statistically significant OA progression pre- to postoperatively in at least one joint. In one patient, advanced lateral compartmental OA developed, which was subsequently revised with TKA. We believe that these results could be attributed to the mid-term follow-up in our study, the use of

Table 3
Short-Form Health Survey (SF-36) scores. Bold-italic values indicate statistical significance.

	Revision (−)		Revision (±)		P	Total		P
	Mean ± SD	Median	Mean ± SD	Median		Mean ± SD	Median	P
SF-36 Physical functioning								
Preoperative	38.2 ± 11.6	40.0	33.0 ± 14.9	32.5	0.145[a]	37.9 ± 11.9	35.0	***0.000***[b]
Postoperative	77.5 ± 12.3	75.0	46.0 ± 17.8	45.0	***0.000***[a]	75.3 ± 15.0	75.0	
Pre–post difference	39.3 ± 18.1	40.0	13.0 ± 26.4	17.5	***0.003***[a]			
Pre–post difference P	***0.000***[b]		0.151[b]					
SF-36 Bodily pain								
Preoperative	76.6 ± 14.0	77.5	81.0 ± 10.2	82.5	0.475[a]	77.9 ± 13.8	77.5	***0.000***[b]
Postoperative	36.1 ± 15.4	35.0	68.5 ± 15.1	67.5	***0.000***[a]	38.4 ± 17.4	35.0	
Pre–post difference	−41.5 ± 20.4	−42.5	−12.5 ± 11.5	−12.5	***0.000***[a]			
Pre–post difference P	***0.000***[b]		***0.016***[b]					
SF-36 Physical role								
Preoperative	24.8 ± 18.1	25.0	47.5 ± 14.2	50.0	***0.000***[a]	26.4 ± 18.7	25.0	***0.000***[b]
Postoperative	74.8 ± 14.1	75.0	47.5 ± 18.4	50.0	***0.000***[a]	72.9 ± 15.9	75.0	
Pre–post difference	50.0 ± 27.4	50.0	0.0 ± 28.9	0.0	***0.000***[a]			
Pre–post difference P	***0.000***[b]		1.000[b]					
SF-36 General health								
Preoperative	38.4 ± 11.4	40.0	38.5 ± 8.2	40.0	0.169[a]	38.4 ± 11.2	40.0	***0.000***[b]
Postoperative	67.2 ± 15.5	70.0	50.0 ± 22.9	60.0	***0.038***[a]	66.0 ± 16.6	60.0	
Pre–post difference	28.8 ± 20.0	30.0	11.5 ± 28.7	20.0	***0.043***[a]			
Pre–post difference P	***0.000***[b]		0.168[b]					
SF-36 Vitality								
Preoperative	33.8 ± 11.0	30.0	30.0 ± 10.0	27.5	0.227[a]	33.5 ± 10.9	30.0	***0.000***[b]
Postoperative	79.3 ± 11.0	80.0	45.0 ± 20.8	40.0	***0.000***[a]	76.9 ± 14.6	80.0	
Pre–post difference	45.5 ± 16.2	45.0	15.0 ± 24.8	12.5	***0.000***[a]			
Pre–post difference P	***0.000***[b]		0.085[b]					
SF-36 Social role								
Preoperative	80.2 ± 17.5	75.0	73.8 ± 19.9	75.0	0.309[a]	79.8 ± 17.7	75.0	***0.000***[b]
Postoperative	27.3 ± 19.6	25.0	77.5 ± 21.9	81.3	***0.000***[a]	30.7 ± 23.4	25.0	
Pre–post difference	−52.9 ± 26.3	−50.0	3.8 ± 24.3	0.0	***0.000***[a]			
Pre–post difference P	***0.000***[b]		0.605[b]					
SF-36 Emotional role								
Preoperative	8.6 ± 16.2	0.0	6.7 ± 21.1	0.0	0.409[a]	8.4 ± 16.5	0.0	***0.000***[b]
Postoperative	86.5 ± 21.6	100.0	20.0 ± 35.8	0.0	***0.000***[a]	81.9 ± 28.3	100.0	
Pre–post difference	77.9 ± 26.7	100.0	13.3 ± 45.0	0.0	***0.000***[a]			
Pre–post difference P	***0.000***[b]		0.357[b]					
SF-36 Mental health								
Preoperative	46.4 ± 19.1	40.0	38.0 ± 14.0	40.0	0.203[a]	45.8 ± 18.9	40.0	***0.000***[b]
Postoperative	56.5 ± 19.6	60.0	20.8 ± 9.4	18.0	***0.000***[a]	54.0 ± 21.1	60.0	
Pre–post difference	10.1 ± 22.7	10.0	−17.2 ± 15.0	−16.0	***0.000***[a]			
Pre–post difference P	***0.000***[b]		***0.009***[b]					

SD, standard deviation.
[a] Mann–Whitney *U*-test.
[b] Wilcoxon test.

mobile inserts, or ethnicity and lifestyle differences. Different outcomes may be obtained when prolonged long-term results are evaluated.

Bearing exchange and conversion to TKA are the most preferred options in the presence of bearing dislocation. Bearing exchange is preferred if the dislocation is associated with impingement. However, conversion to TKA is recommended if there is implant loosening, MCL damage or flexion or extension gap mismatch [26]. In our study, four patients underwent bearing exchange due to impingement of osteophytes. Conversion to TKA was performed in four patients with bearing dislocation. The reasons were MCL injury in one patient, ACL rupture in one patient and flexion and extension gap mismatch in two patients.

In the literature, there are conflicting data relative to the effects of obesity on the outcomes of UKA. Some studies have reported significantly higher complication rates, decreased implant survival, and higher revision rates in patients undergoing UKA associated with obesity [27,28]. In contrast, Xia et al. [29] evaluated the change in BMI following UKA. They demonstrated that postoperative BMI changes did not appear to adversely affect the short-term outcomes of UKA, where UKA may potentially lead to weight reduction in patients with high preoperative BMI. Furthermore, they declared that weight loss after UKA did not appear to benefit patients regarding revision status. In addition, Alnachoukati et al. proposed that BMI did not appear to affect survivorship of UKA [30]. Plate et al. showed that BMI does not affect clinical outcomes and readmission rates in robotic-assisted UKA in the mid-term [31]. In our study, we found statistically significant difference between revision+ and revision- groups regarding outcomes. While this may be a statistical difference, it may not be clinically relevant, given the size of the patient cohort in the current study.

Table 4
Radiological results. Bold-italic values indicate statistical significance.

		Revision (−)		Revision (+)		*P*	Total		*P*
		Mean ± SD/n (%)	Median	Mean ± SD/n (%)	Median		Mean ± SD/n (%)	Median	*P*
JLCA									
Preoperative		−3.3 ± 1.7	−3.0	−4.8 ± 2.3	−5.0	0.052[a]	−3.4 ± 1.8	−3.0	***0.000***[b]
Postoperative		1.3 ± 1.2	5.0	1.2 ± 1.9	1.0	0.658[a]	1.3 ± 1.3	1.0	
Pre–post difference		4.6 ± 2.1	4.0	6.0 ± 2.9	7.0	0.133[a]			
Pre–post difference *P*		***0.000***[b]		***0.005***[b]					
Contralateral JLCA									
Preoperative		−2.1 ± 1.6	−2.0	−3.2 ± 1.9	−2.5	0.052[a]	−2.1 ± 1.6	−2.0	***0.000***[b]
Postoperative		−0.2 ± 1.3	0.0	−0.3 ± 1.7	−1.0	0.596[a]	−0.2 ± 1.3	0.0	
Pre–post difference		1.8 ± 2.0	1.0	2.9 ± 3.3	1.0	0.493[a]			
Pre–post difference *P*		***0.000***[b]		***0.007***[b]					
Tibiofemoral angle									
Preoperative		−1.8 ± 2.2	−2.0	−2.2 ± 1.1	−2.5	0.562[a]	−1.8 ± 2.2	−2.0	***0.000***[b]
Postoperative		5.6 ± 1.8	6.0	4.8 ± 1.4	−1.0	0.596[a]	5.5 ± 1.8	6.0	
Pre–post difference		7.3 ± 2.7	7.0	7.0 ± 1.8	7.0	0.731[a]			
Pre–post difference *P*		***0.000***[b]		***0.005***[b]					
SLOP									
Preoperative		10.4 ± 2.0	10.0	10.5 ± 2.0	11.0	0.831[a]	10.4 ± 2.0	10.0	***0.000***[b]
Postoperative		6.9 ± 1.8	7.0	7.8 ± 2.3	8.5	0.160[a]	7.0 ± 1.2	7.0	
Pre–post difference		−3.5 ± 2.0	−3.0	−2.7 ± 1.8	−2.5	0.120[a]			
Pre–post difference *P*		***0.000***[b]		***0.005***[b]					
PMJS increase		1.8 ± 0.6	1.8	2.3 ± 0.9	2.4	***0.032***[a]	1.8 ± 0.6	1.8	
Arthrosis progression	(−)	94	69.1%	1	10%	***0.000***[c]	95	65.1%	
	(+)	42	30.9%	9	90%		51	35.9%	
Preoperative MCA grade	II	73	53.7%	5	50%		78	53.4%	
	III	48	35.3%	3	30%	0.917[c]	51	34.9%	
	IV	15	11.0%	2	20%		17	11.6%	
Preoperative PFA grade	I	34	25.0%	1	10%		35	24.0%	
	II	83	61.0%	6	60%	0.520[c]	89	61.0%	
	III	19	14.0%	3	30%		22	15.0%	
Postoperative PFA grade	I	33	24.3%	1	10%		34	23.3%	
	II	88	64.7%	7	70%	0.643[c]	95	65.1%	
	III	15	11.0%	2	20%		17	11.6%	
Postoperative LCA grade	I	72	52.9%	4	50%		76	52.1%	
	II	59	43.4%	6	30%	0.643[c]	65	44.5%	
	III	5	3.7%	0	0%		5	3.4%	

JLCA, joint line convergence angle; LCA, lateral compartment arthrosis; MCA, medial compartment arthrosis; PFA, patellofemoral arthrosis; PMJS, postoperative medial joint space; SD, standard deviation.
[a] Mann–Whitney *U*-test.
[b] Wilcoxon test.
[c] Ki-kare test.

Pre- and postoperative flexion contracture affected the revision status and higher flexion contracture degrees increased the revision rates. Yeh et al. [32] evaluated the influence of postoperative fixed flexion deformity on clinical outcomes 10 years after UKA. Similar to our study they determined that patients with a preoperative fixed flexion deformity (FFD) were more likely to have postoperative FFD, and a postoperative FFD of 10° or more led to a significantly poorer functional outcome after UKA. Furthermore, this recent study revealed a significant difference in the preoperative and postoperative values of JLCA in the operated and contralateral knee and TFCA without any impact on the revision status. Our results are in line with previously reported studies that found no correlation between revision and postoperative alignment of the limb although they reported higher revisions due to lateral compartment OA [33].

While performing knee arthroplasty, the level of the joint line is an important factor affecting knee kinematics. Takayama et al. [34] investigated the relationship between medial tibial joint line elevation and the improvement of ROM in UKA. They reported that a medial joint line elevation reduced the improvement of knee extension, and resulted in an elevation value of >5 mm in UKA. They concluded that medial joint line elevation should be avoided to prevent postoperative flexion contracture. In addition, postoperative medial joint line elevation may cause overstuffing [31]. Proper ligament balance is restored by accurately positioned components and appropriate thickness of insert [35]. In our study, we found that patients with insert dislocations had a greater increase in PMJS; this may be associated with possible overstuffing. We evaluated the medial joint line elevation, flexion, and extension angles. It was found that a lower flexion and extension range and a higher medial joint line had a significantly negative impact on dislocation and revision status.

The strength of this study was that all the procedures were performed by a single non-designer surgeon and with single implant type Oxford Phase III mobile-bearing knee prosthesis, which favoured the homogeneity of the outcomes. There are some limitations to the study to be mentioned. First, this study was retrospective in nature, although we used the prospectively

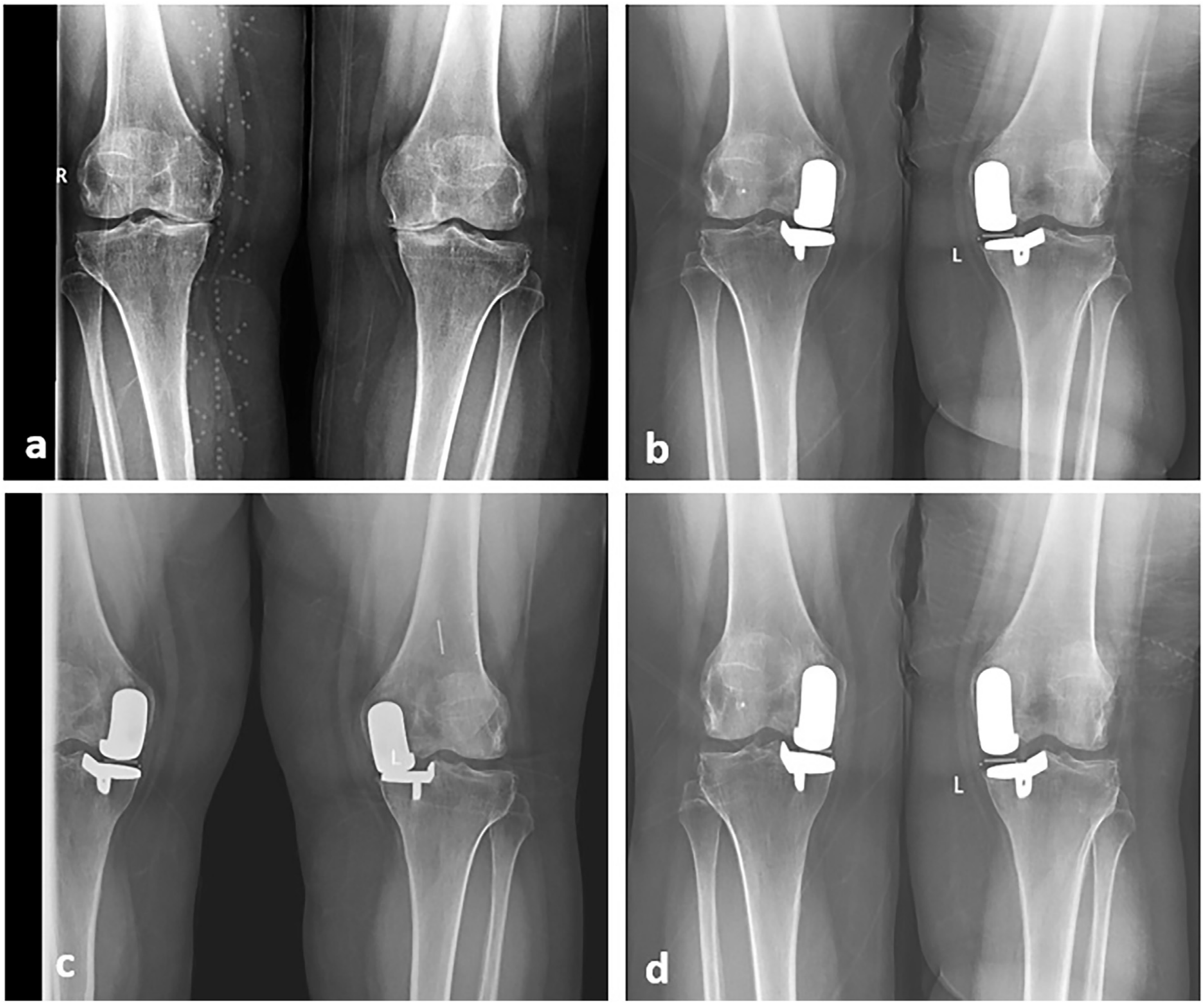

Figure 1. Example of insert dislocation in a patient with bilateral medial compartment osteoarthritis (a, b and c). Revision was performed with a thicker insert (d).

collected data of patients not lost to follow-up to achieve more accurate results. Second, this study had a relatively small sample size and almost all of the revision reasons were insert dislocations. We attributed these results to the use of mobile inserts or to the ethnicity and lifestyle characteristics of our cohort. In larger cohorts with homogeneous application of fixed and mobile prostheses, causes, number of revisions, and variables may be more pronounced. Third, this study had a relatively short follow-up period following the surgical procedures. Long-term functional and radiologic outcomes may differ. Despite these limitations the results of the current study might be useful for choosing suitable patients and treatment options for unicompartmental knee OA taking patient factors, functional and radiologic evaluation into careful consideration. However, further research is required to determine the impact of patient characteristics, clinical and radiologic outcomes on UKA revision in the long-term.

5. Conclusion

Good to excellent results with significant improvements in functional scores were obtained with mobile-bearing UKA, with no aseptic loosening at a minimum follow-up of five years. Lower preoperative clinical scores, higher BMI, higher flexion contracture, and increased PMJS negatively affected the results in terms of revision status. Differences in preoperative versus postoperative radiological measurements, except for an increase in PMJS, had no impact on dislocation and revision status.

Declaration of competing interest

The authors have no conflicts of interest to declare. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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