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A Comparison of Mobile and Fixed-Bearing Unicompartmental Knee Arthroplasty at a Minimum 10-Year Follow-up

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ABSTRACT

Background: The long-term survivorship and functional outcomes of the mobile-bearing (MB) compared to the fixed-bearing (FB) unicompartmental knee arthroplasty (UKA) implant design remain a topic of debate. The aim of the current study was to compare the survivorship and functional outcomes of MB and FB UKA at a minimum 10-year follow-up.

Methods: We retrospectively reviewed 106 consecutive medial UKAs (89 patients) from our institution with a minimum 10-year follow-up. The 38 MB and 68 FB knees had follow-up of 14.2 years (12.9-15.5) and 11.5 years (10.2-15.1), respectively. Validated patient-reported outcomes and radiographs were evaluated as were etiology, timing, and complexity of revision. Kaplan-Meier 10-year survival was calculated with revision to total knee arthroplasty as the end point.

Results: The 10-year survival was 82.9% (95% confidence interval [CI] 65.8-91.9) for MB and 90.9% (95% CI 79.4-96.2) for FB UKA ($P = .102$), and 88.0% (95% CI 79.3-93.2) for the entire cohort. Patient outcomes were similar between groups, as were timing and etiologies for revision to total knee arthroplasty. One-third of revisions required either stems or tibial augments, and of these, all were of MB design.

Conclusion: Survival and functional outcomes were similar between MB and FB designs. One-third of revisions required either stems or augments, all were of MB design.

Unicompartmental knee arthroplasty (UKA) is an alternative to total knee arthroplasty (TKA) for the treatment of isolated medial compartment arthritis of the knee. The benefits of UKA include fewer complications, faster recovery [1,2], improved functional outcomes [3], and cost-effectiveness [4]. The long-term survivorship of modern design UKAs has been reported as similar to that of TKA [5,6]. However, registry data consistently report revision rates 2 to 3 times higher for UKA when compared to TKA [7,8], and the literature has reported mixed results [9–11].

Two fundamentally different design concepts exist for UKA: mobile-bearing (MB) or fixed-bearing (FB). While both designs have cited advantages, a recent systematic review and meta-analysis of the literature showed no difference between MB and FB designs in terms of survivorship or functional outcomes [11]. Comparative studies between MB and FB UKA have also demonstrated similar survivorship and functional outcomes [12]. A majority of the comparative studies are limited to short-term and midterm follow-up, and only one study has a minimum follow-up of greater than 10 years [12,13]. Thus, the long-term superiority of MB vs FB UKA design remains a topic of debate.

The primary aim of this study was to compare implant survivorship of the MB and FB UKA performed in our institution with a minimum 10-year follow-up. Secondary aims included patient-reported outcomes, the timing and reason for revision to TKA, and the complexity of revision surgery.

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Table 1
Patient Demographics and Baseline Data, Subdivided by Bearing Type.

Variable	Total UKA, N = 106 Knees (89 Patients)	MB Knees, N = 38 (35.8%) (33 Patients)	FB Knees, N = 68 (64.2%) (56 Patients)	*P* Value
Diagnosis, n (%)				0.824
AMOA	101 (95.3)	37 (97.4)	64 (94.1)	
ON	4 (3.8)	1 (2.6)	3 (4.4)	
PTOA	1 (0.9)	0	1 (1.5)	
Gender, n (%)				0.434
Male	50 (47.2)	16 (42.1)	34 (50)	
Female	56 (52.8)	22 (57.9)	34 (50)	
Side				0.909
Left	51 (48.1)	18 (47.4)	33 (48.5)	
Right	55 (51.9)	20 (52.6)	35 (51.5)	
Mean age (y)	63.0 (41.4-84.3)	60.3 (41.4-81.3)	64.6 (45.1-84.3)	0.024
Mean BMI (kg/m^2)	30.8 (21.8-50.6)	32.7 (22.8-50.3)	29.7 (21.8-50.6)	0.009
Bilateral, n (%)				0.928
Staged	20 (18.9)	6 (15.8)	14 (20.6)	
Simultaneous	14 (13.2)	4 (10.5)	10 (14.7)	
Grade PF OA, n (%)				0.654
Merchant I	57 (53.8)	24 (63.2)	33 (48.5)	
Merchant II	27 (25.5)	8 (21.1)	19 (27.9)	
Merchant III	3 (2.8)	1 (2.6)	2 (2.9)	
Merchant IV	0	0	0	
Missing Data	19 (17.9)	5 (13.2)	14 (20.6)	
Preoperative functional outcome score (IQR)				
Median WOMAC	53.1 (43.8-64.2)	54.7 (46.9-65.6)	53.1 (42.8-64.2)	0.457
Median SF-12 PCS	33.5 (29.1-38.5)	34.8 (31.3-37.4)	31.7 (28.4-39.4)	0.513
Median SF-12 MCS	47.6 (36.1-60.6)	48.7 (34.4-62.1)	47.1 (40.8-60.3)	0.681
Median OKS	38 (31.5-42.5)	36 (32.5-42)	38 (31-43)	0.922

AMOA, anterior medial osteoarthritis; BMI, body mass index; FB, fixed-bearing; IQR, interquartile range; MB, mobile-bearing; OA, osteoarthritis; OKS, Oxford knee score; ON, osteonecrosis; PF, patellofemoral; PTOA, Post-traumatic osteoarthritis; SF-12 PCS, Short Form 12 physical component score; SF-12 MCS, Short form 12 mental component score; UKA, unicompartmental knee arthroplasty; WOMAC, Western Ontario and McMaster Universities osteoarthritis index.

Patients and Methods

We performed a retrospective review of our institutional arthroplasty database to identify all 89 patients in whom 106 consecutive medial UKAs had been performed between October 2000 and May 2006, to allow for a minimum of 10-year follow-up. Baseline data extracted included diagnosis, gender, age at time of surgery, date of surgery, body mass index (BMI), unilateral or bilateral surgery, and UKA implant used.

Surgery was performed by or under the direct supervision of 3 surgeons (NVG, DSG, BAM), and the learning curve of all surgeons was included in the study. The MB implant used was the Phase 3 Oxford UKA (Zimmer Biomet, Warsaw, IN). The FB implants used were the Miller-Galante UKA and the Zimmer Unicompartmental High Flex Knee System (Zimmer Biomet). The decision to use a MB or FB UKA was based solely on the availability of implants at our institution. The MB UKA was used from October 2000 to June 2003. The FB Miller-Galante UKA was used 3 times before 2003 and then regularly from 2003 to October of 2004. The FB Zimmer High Flex UKA was first used in October 2004 and has been the sole UKA in use at our institution since November 2004. All 3 surgeons used the MB and FB UKAs.

This patient cohort consisted of 9.7% (106 of 1088) of all primary knee arthroplasty operations performed during the study time period. Surgical indications included a diagnosis of isolated medial compartment osteoarthritis or osteonecrosis, localized medial knee pain, fixed flexion contracture <10°, knee flexion >115°, a correctable varus deformity of <10°, and preserved cartilage in the lateral compartment on radiographs. Contraindications included synovitis or inflammatory arthritis, anterior or lateral knee pain, a varus deformity >10°, or an anterior cruciate ligament-deficient knee by history or on physical examination. Age and BMI were not contraindications; however, we restricted UKA to patients under 250 lb of weight. Patellofemoral (PF) pain was a contraindication; however, radiographic evidence of mild PF osteoarthritis in the absence of pain was not. The final decision to proceed with UKA was determined intraoperatively after examining the lateral compartment and status of the anterior cruciate ligament. During that period of time, only 1 UKA was converted to a TKA because of intraoperative findings, suggesting the robustness of our preoperative selection criteria.

All implants were cemented and used standard minimally invasive techniques. All patients received prophylactic antibiotics for the first 24 hours, received low-molecular-weight heparin for postoperative deep vein thrombosis prophylaxis, and were mobilized with no restrictions.

Patients were contacted by mail with questionnaires and X-ray requisitions or by telephone within 2 weeks of the mail out if there was no response. A review of medical records and contact with family doctors was conducted for updated contact information when we were unable to successfully contact the patient using our database.

Survival of the UKA implant was evaluated using patient questionnaire, telephone, and medical record review. If patients died, time of death and status of the UKA were documented. We recorded the timing, cause of, and complexity of revision to TKA surgery. Complexity was based on the use of revision TKA components: stems, augments, or increased constraint.

Functional outcome scores were assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [14], the Short Form 12-item Survey (SF-12) [15], and the Oxford Knee Score (OKS) [16]. Overall patient satisfaction was rated as "very satisfied," "somewhat satisfied," "somewhat dissatisfied," or "very dissatisfied." Preoperative WOMAC, SF-12, and OKS were recorded in our database. Functional outcomes were assessed at last (minimum 10-year) follow-up, and compared between the MB and FB groups.