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ORIGINAL PAPER

The forgotten joint score in total and unicompartmental knee arthroplasty: a prospective cohort study

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Abstract

Purpose The purpose of this study was to assess whether unicompartmental knee arthroplasty (UKA) results in better patient-reported and clinical outcome than total knee arthroplasty (TKA). The study hypothesis was UKA yields better patient-reported and clinical outcomes than TKA.

Methods Our prospective cohort study compared patients who underwent medial UKA or TKA from February 2014 through June 2015. Forgotten Joint Score (FJS), the short form of the Knee Injury and Osteoarthritis Outcome Score (KOOS PS), EuroQOL Five Dimensions Questionnaire (EQ-5D), and the Knee Society Score (KSS) were completed at two weeks, six weeks, three months, six months, and one year post-operatively. The KOOS PS, EQ-5D, and the KSS were also documented pre-operatively.

Results Fifty-seven patients (57 knees) were allocated to the UKA group and 62 patients (62 knees) to the TKA group. At baseline, no statistically significant differences were observed between groups regarding patient demographics and pre-operative scores. Except for FJS at 2 weeks ($p = 0.326$), all postoperative scores revealed significant differences as early as two weeks and up to 12 months ($p < 0.05$).

Conclusions Our findings suggest UKA patients are less aware of their joint replacements than TKA patients for medial osteoarthritis of the knee. UKA conserves more soft tissue and bone than TKA, which may be the reason for the differences observed.

Keywords Cohort study · Forgotten joint score · Osteoarthritis · Knee · Patient-reported outcome · Total knee arthroplasty · Unicompartmental knee arthroplasty

Introduction

Osteoarthritis (OA) is a major cause of disability in the aging population, and the lifetime risk of symptomatic knee OA is 50% [1]. Medial OA of the knee with lesser changes to the lateral and patellofemoral compartments affects up to 50% of OA patients [2]. Surgical options to treat patients with bone-on-bone medial OA of the knee are total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) [3–5]. However, the proportion of dissatisfied patients and suboptimal treatment results after TKA remains high, and ranges from 75 to 82% [6–9]. Approximately, 30% of TKA patients believe that their expectations were not fully achieved [10, 11].

For select patients, UKA is a viable alternative to TKA [4, 12]. However, UKA is still considered to be a controversial option for the management of unicompartmental arthritis [12–14]. It has been reported that UKA is more likely to fail than TKA due to aseptic loosening and progression of arthritis in the unresurfaced compartments [15]. This has resulted in TKA being recommended over UKA for the treatment of unicompartmental knee arthritis [16–19]. Clinical outcomes and survival rates for conversion of UKA to TKA are comparable to the results achieved with revision TKA, and significantly inferior to those for primary TKA [13, 20–24]. Nevertheless, compared with TKA, UKA can yield superior functional outcomes, faster recovery, improved patient satisfaction, and reduced risk of peri-operative complications

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[25–28]. In addition, several studies have shown that UKA yields clear economic advantages compared with TKA [29–31]. Because of the potential benefits of UKA with regard to functional outcome, as well as the ongoing discussion about post-operative residual complaints following TKA [32], there has been an increased interest in the comparison of UKA with TKA, and there has been a particular focus on how patients perceive functional outcome.

A recent analysis of a large cohort of registry patients found no difference between TKA and UKA in terms of either quality of life (EuroQoL 5D) or knee-specific (Oxford Knee Score) outcomes [19]. The authors of this paper concluded that the use of UKA should be questioned because the lack of evidence of any significant benefit fails to mitigate the significantly higher revision rates observed in worldwide registries.

Patients' ability to forget their joint replacements in everyday life is an important expectation and goal of the surgery, as it reflects patient satisfaction [7, 33–35]. The Forgotten Joint Score (FJS) may, for this reason, be an important proxy of success of the surgical intervention. However, current literature has only shown a paucity of outcome studies in which the FJS is considered. The purpose of this study was to establish whether UKA results in better patient-reported outcome and clinical outcome than TKA. We hypothesized that UKA would lead to a higher FJS at one year follow-up.

Materials and methods

This study analyzed a prospective consecutive cohort of patients from the senior author's arthroplasty registry. Adult patients who underwent medial UKA or TKA between February 2014 and June 2015 were eligible for the study. Demographics and clinical data, including age, gender, and body mass index (BMI) were collected. Patients presenting with degenerative osteoarthritis of the knee requiring unilateral TKA or UKA were eligible for the study. In order to warrant exchangeability of the two groups, the same eligibility criteria were applied to both groups. Exclusion criteria for this study were the presence of anterior knee pain and pre-operative Kellgren-Lawrence grade III–IV of the lateral or patellofemoral compartments, which are considered to be surgical contraindications for medial UKA. Other contraindications were flexion contractures > 10°, ASA class III and higher, presence of systemic disease such as rheumatoid arthritis, malignancies, revision arthroplasty, and post-infection. Also excluded from this study were patients with a history of complex knee surgery, inflammatory arthropathy, BMI > 40 kg/m^2, trauma, and simultaneous bilateral TKA or UKA. Group allocation was based on patients' preference.

The senior author, who has extensive experience in UKA and TKA, performed all of the surgery.

The uncemented Oxford Phase 3 (Zimmer Biomet, Warsaw, IN) was used for the UKA procedure. The aim was to avoid degenerative progression of the lateral compartment by maintaining a small residual varus of the lower extremity.

The Vanguard Complete Total Knee (Zimmer Biomet) with posterior stabilized insert was used for the TKA procedure. Patella resurfacing was performed in all patients. A tourniquet was not applied.

A bleeding index (BI) was calculated for each patient by measuring the drop in haemoglobin level (g/dL) between the day before surgery and the third post-operative day, and adding the number of units of packed red blood cells (PRBCs) transfused within that same time period [36]. Walking with full weight-bearing commenced on the day of surgery. A walker was initially used to mobilize patients, and this was replaced with a pair of crutches once sufficient stability was attained. On day three after surgery, patients were routinely discharged, with all patients in the UKA and 85% in the TKA group discharged home. In the TKA group, 15% went to an inpatient rehabilitation facility for an additional two weeks.

All patients were asked to complete the FJS [33], the short form of the Knee Injury and Osteoarthritis Outcome Score KOOS PS [37], the EuroQOL Five Dimensions Questionnaire (EQ-5D) [38], and the Knee Society Knee Score (KS) and Function Score (FS) [39] at two weeks, six weeks, three months, six months, and one year post-operatively. The KOOS PS and the clinical questionnaire were also documented pre-operatively. All patient-reported outcomes were provided by the patients electronically via a touch-screen device, and the physician was not present during the self-assessment.

The FJS is used to evaluate patients' ability to forget their artificial joint in daily life. It consists of 12 questions and the score ranges from 0 to 100. The higher the score, the more favourable the outcome. The score was calculated in accordance with the original publication [33].

The KOOS-PS is a self-administered questionnaire that was designed for objective measurement of physical function [40]. The assessment form has a score from 0 to 100, with 0 being the optimal score, representing no difficulty in performing specific tasks.

The EQ-5D is a standardized generic instrument for use as a measure of health outcome, with a score from − 0.59 to 1.00, where 1.00 is the maximum score representing perfect health [41].

This study was approved by the ethics committee at our hospital. All patients provided informed consent prior to study commencement.

Statistical analysis

Categorical variables are presented as frequencies and percentages. Continuous data are presented as mean and

Table 1 Baseline characteristics of the study cohorts

	TKA ($n = 62$)	UKA ($n = 57$)	p value
Age	66.5 ± 9.4	64.0 ± 9.9	0.168
Women (%)	42 (67.7)	30 (47.3)	0.092
KOOS-PS	61.1 (57.8–64.5)	56.6 (53.9–59.4)	0.041
EQ-5D	0.35 (0.32–0.39)	0.34 (0.30–0.38)	0.660
KS	45.4 (43.4–47.4)	41.1 (38.0–44.2)	0.025
FS	38.0 (35.6–44.4)	37.8 (33.4–42.2)	0.503

TKA, total knee arthroplasty; *UKA*, unicompartmental knee arthroplasty; *KOOS-PS*, Knee injury and Osteoarthritis Outcome Score (KOOS)—Physical Function Shortform; *EQ-5D*, EuroQOL Five Dimensions; *KS*, Knee Score; FS, Function Score

standard deviation. The Fisher exact test for categorical variables and the Student's t test for continuous variables were used to perform univariate analysis.

Treatment comparisons for longitudinal continuous outcomes were based on linear mixed models [42] which are extensions of the commonly used linear regression models. However, in linear regression models, independence of all observations is assumed. Linear mixed models take into account correlations between successive measurements of the same patient. These models are, therefore, suitable for the analysis of longitudinal data, as they show the development of outcomes over time. Models were fitted containing the main effects treatment group, time, and their interaction (group–time interaction). Separate intercepts and time terms were estimated for each group. Random effects were included for each group and the time term. Linear contrasts of fitted model estimates were constructed, and Wald tests were used to calculate statistical significance of the differences in outcome for each time point. Two-tailed tests were used throughout. Two-sided p values < 0.05 were considered to be significant. An independent statistician used Stata/SE 12 (StataCorp, College Station, TX, USA) to analyze all outcome variables.

Results

Fifty-seven patients (57 knees) were allocated to the UKA group and 62 patients (62 knees) to the TKA group. Baseline data indicated no statistically significant differences between the groups in terms of patient demographics, but the baseline values for KOOS-PS and KS were slightly better for the TKA group (Table 1).

There were significant differences between UKA and TKA in intra-operative objective measures. Mean bleeding index was 1.8 ± 1.0 and 2.6 ± 0.9 for UKA and TKA, respectively ($p < 0.001$). A single patient in the TKA group with a known myelodysplastic syndrome required autologous blood transfusion post-operatively. The mean duration of surgery were 44 ± 8 minutes and 90 ± 11 minutes for UKA and TKA, respectively ($p < 0.001$).

None of the patients was lost to follow-up after surgery. One patient in the TKA group required revision for aseptic loosening of the tibial baseplate 11 months post-operatively. One additional patient in the TKA group was stented for popliteal artery stenosis seven months post-operatively. Finally, one patient in the TKA group experienced a deep venous thrombosis early post-operatively. In the UKA group, one patient required exchange of the bearing surface after four months due to dislocation of the polyethylene insert.

The number of missed visits at two weeks, six weeks, 12 weeks, six months, and one year is presented in Table 2. Patients in the UKA group had a mean FJS of 6.2 (95% CI, −2.3–14.6) at two weeks, improving to 18.8 (95% CI, 14.6–23.1) at six weeks, 48.2 (95% CI, 43.1–53.2) at 12 weeks, 79.1 (73.2–84.9) at six months, and 91.2 (85.3–97.4) at one year (Fig. 1). Patients in the TKA group had a mean FJS of 0.9 (− 5.4–7.2) at two weeks, 7.5 (3.8–11.2) at six weeks, 19.1 (14.9–23.3) at 12 weeks, 39.6 (34.7–44.4) at six months, and 54.8 (49.3–60.2) at one year (Fig. 1). Differences were not significant at two weeks ($p = 0.326$), but reached the level of significance at six and 12 weeks and at six and 12-month follow-up intervals ($p < 0.001$ at all successive time points) (Table 3). Similar patterns were also found for KOOS-PS, EQ-5D, KS, and FS, with

Table 2 Number of patient assessments and missed visits

	TKA		UKA	
	No. of assessed	Missed visits	No. of assessed	Missed visits
Included	62		57	
2 weeks	59	3	57	0
6 weeks	58	4	56	1
12 weeks	57	5	55	2
6 months	57	5	57	0
1 year	58	4	54	3

TKA, total knee arthroplasty; *UKA*, unicompartmental knee arthroplasty

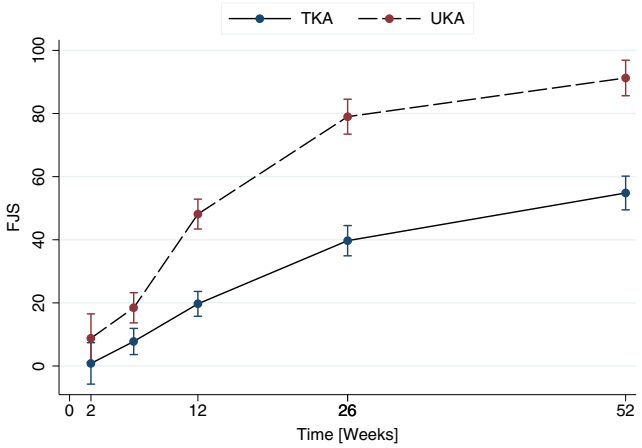

Fig. 1 Post-operative Forgotten Joint Score at each follow-up is shown. The vertical bars indicate 95% confidence interval

significant differences as early as two weeks postoperatively (Table 4). Radiographic measurements demonstrated reliable implant positioning in both groups without any changes during the follow-up period (Figs. 2 and 3). Radiolucent lines were not observed in the UKA group but were seen in six patients in the TKA group ($p = 0.028$). Radiolucent lines were non-progressive and incomplete in all cases.

Discussion

The study's main findings are that medial UKA is superior to TKA in terms of patients' awareness of their artificial joint, functional outcome, clinical outcome, and quality of life. We found that medial UKA resulted in a significantly higher FJS than TKA at the one year follow-up. Furthermore, our data suggest that the difference in joint awareness was significant as early as the six week follow-up, and was sustained until one year follow-up. Other clinical and patient-reported outcomes were significant at two weeks post-operatively, and the effect was sustained until the last follow-up at one year.

The literature has no consensus regarding these outcomes for medial UKA compared to TKA. This study's purpose was to compare outcomes for the two procedures using several patient-reported outcomes up to one year follow-up. There is a paucity of comparative studies between UKA and TKA, and, as far as we are aware, there have only been a few comparative studies between UKA and TKA using the FJS. Kulshrestha et al. reported no differences in their randomized clinical trial analyzing Knee Outcome Survey-Activities of Daily Living Scale, High Activity Arthroplasty Score, EQ-5D, and Oxford Knee Score at two year follow-up [43]. The FJS was not documented in this study. Thienpont et al. concluded from their observational study that no significant differences in the FJS between UKA and TKA exist at an average of two years following surgery (range, 1–3 years), with score values of 76.4 ± 19 and 73.2 ± 22 for UKA and TKA, respectively ($p = 0.436$) [34]. In contrast, Zuiderbaan et al. reported FJS at one year of 59.3 ± 29.5 for TKA and 73.9 ± 22.8 for UKA ($p = 0.002$) [44]. Hence, our score value for TKA is similar to the value found by Thienpont et al. and significantly lower than the value reported by Zuiderbaan et al. Our score value for UKA is significantly higher than the scores reported by Zuiderbaan and Thienpont. Whether these differences can be explained by clinical heterogeneity or by methodological variances remains unknown.

Regarding the functional differences between UKA and TKA, our findings contrast with those from the Norwegian

Table 3 Post-operative Forgotten Joint Score

		TKA	UKA	*p* value
FJS	2 weeks	0.91 (− 5.4–7.2)	6.2 (− 2.3–14.6)	0.326
	6 weeks	7.5 (3.8–11.2)	18.8 (14.6–23.1)	< 0.001
	12 weeks	19.1 (14.9–23.3)	48.2 (43.1–53.2)	< 0.001
	6 months	39.6 (34.7–44.4)	79.1 (73.2–84.9)	< 0.001
	1 year	54.8 (49.3–60.2)	91.3 (85.3–97.3)	< 0.001

TKA, total knee arthroplasty; *UKA*, unicompartmental knee arthroplasty; *FJS*, Forgotten Joint Score

Table 4 Post-operative KOOS-PS, EQ-5D, and KSS

		TKA	UKA	*p* value
KOOS-PS	2 weeks	72.7 (66.6–78.8)	44.7 (38.2–66.6)	< 0.001
	6 weeks	61.5 (56.4–66.6)	44.8 (41.4–48.2)	< 0.001
	12 weeks	48.6 (43.5–53.7)	30.5 (27.1–34.0)	< 0.001
	6 months	38.4 (33.2–43.6)	14.0 (10.5–17.4)	< 0.001
	1 year	28.2 (22.7–33.7)	5.3 (1.8–8.8)	< 0.001
EQ-5D	2 weeks	0.30 (0.23–0.37)	0.54 (0.46–0.62)	0.001
	6 weeks	0.40 (0.34–0.46)	0.57 (0.52–0.61)	< 0.001
	12 weeks	0.55 (0.49–0.61)	0.71 (0.66–0.76)	< 0.001
	6 months	0.69 (0.62–0.76)	0.83 (0.79–0.89)	0.009
	1 year	0.80 (0.72–0.87)	0.92 (0.87–0.97)	0.074
KS	2 weeks	36.7 (30.7–42.8)	50.5 (44.6–56.3)	< 0.001
	6 weeks	38.7 (33.6–57.7)	54.2 (50.8–57.7)	< 0.001
	12 weeks	57.2 (52.2–62.3)	70.9 (67.6–74.3)	< 0.001
	6 months	74.3 (68.6–80.0)	89.2 (85.6–92.8)	0.001
	1 year	87.3 (81.1–93.4)	96.0 (92.4–99.7)	0.007
FS	2 weeks	16.9 (8.2–25.6)	35.7 (25.9–45.5)	0.005
	6 weeks	26.9 (20.2–33.6)	43.1 (39.1–48.9)	< 0.001
	12 weeks	45.0 (38.5–51.6)	66.5 (61.5–71.5)	< 0.001
	6 months	66.1 (59.3–72.8)	86.1 (81.1–91.1)	< 0.001
	1 year	79.0 (72.0–85.9)	93.1 (88.0–98.1)	0.001

TKA, total knee arthroplasty; *UKA*, unicompartmental knee arthroplasty; *KOOS-PS*, Knee injury and Osteoarthritis Outcome Score (KOOS)—Physical Function Shortform; *EQ-5D*, EuroQOL Five Dimensions; *KSS*, Knee Society Score; *KS*, Knee Score, *FS*, Function Score

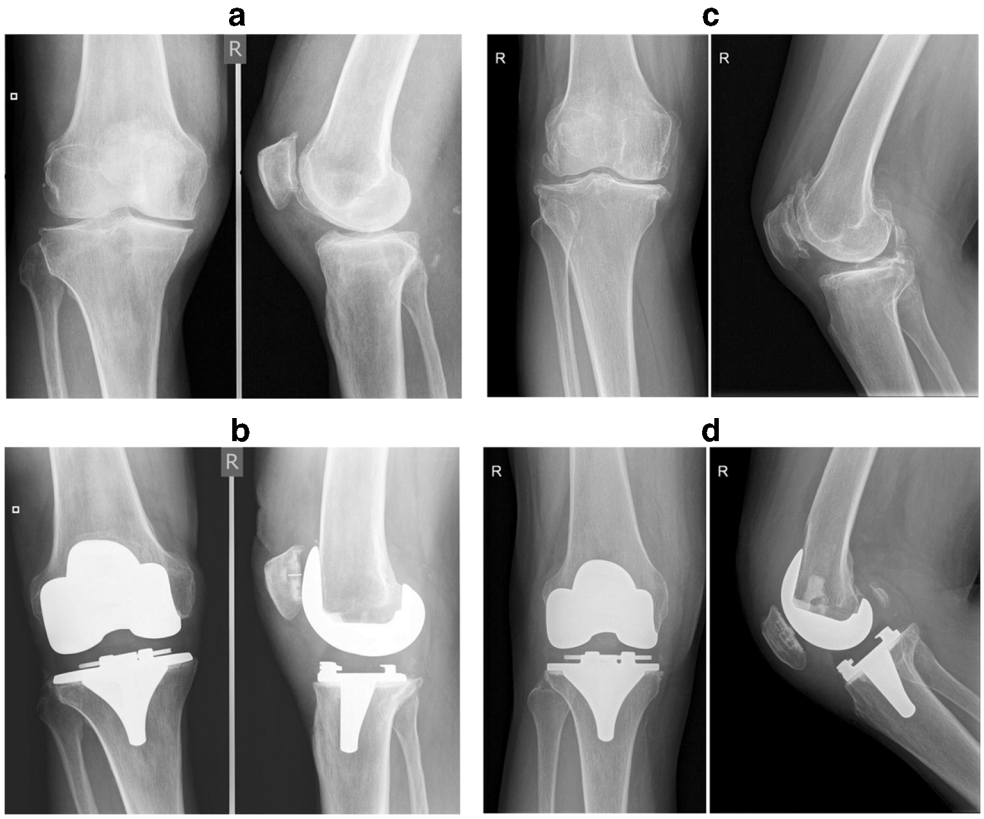

Fig. 2 Total knee arthroplasty and anteroposterior and lateral radiography, pre-operatively and at latest follow-up (1 year). **a** 71-year old male patient. Pre-operative radiography. **b** Radiography of the same patient at follow-up. Forgotten Joint Score 52. **c** 54-year old female patient. Pre-operative radiography. **d** Radiography of the same patient at follow-up. Forgotten Joint Score 65

Arthroplasty Register, in which the patient-reported outcome scores of 972 TKAs and 372 UKAs were compared at a minimum two year follow-up (mean, 6.5 years) [45]. Three outcome questionnaires were used: the Knee Injury and Osteoarthritis Outcome Score (KOOS), the visual analogue scale (VAS), and the EQ-5D. The authors found some significant differences that

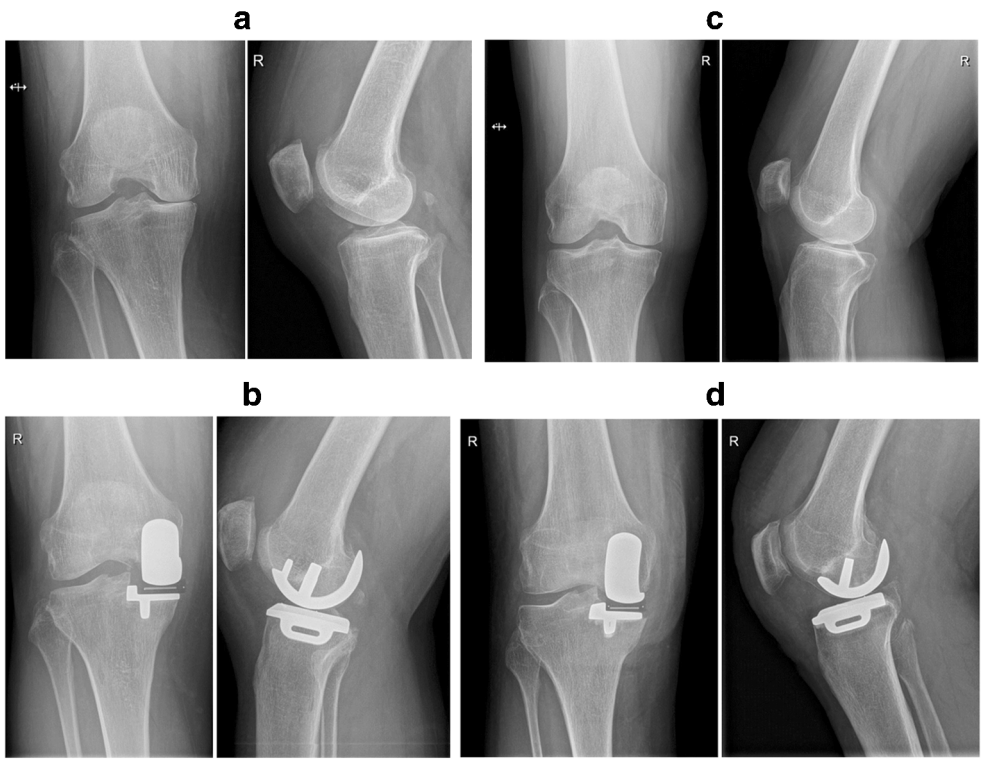

Fig. 3 Unicompartmental knee arthroplasty and anteroposterior and lateral radiography, pre-operatively and at latest follow-up (1 year). **a** 70-year old male patient. Pre-operative images. **b** Radiography of the same patient at final follow-up. Forgotten Joint Score 73. **c** 70-year old female patient. Pre-operative radiography. **d** Radiography of the same patient at follow-up. Forgotten Joint Score 50

favoured the UKA group, but they were too small to be considered clinically relevant.

The National Registry of England and Wales compared 23,393 TKAs and 505 UKAs (median follow-up of 6.6 months), and found no differences for either the Oxford Knee Score or the EQ-5D [19]. However, patients were only assessed six months post-operatively, and no assessment of the development of the score over time was made. A retrospective study recently published by Siman et al. found no significant differences in terms of KSS between UKA and TKA, with follow-up times of 3.5 and 4.6 years for UKA and TKA, respectively [46].

Our study has a number of limitations. First, group allocation was based on patient preference. No relevant differences in baseline characteristics that could have explained the post-operative advantages of UKA were measured. However, it cannot be precluded that confounding-by-indication has influenced our results, as patients' preference for UKA or TKA may be linked to prognostic factors of outcome, such as disease severity. We have tried to minimize the impact of confounding by including only patients eligible for UKA.

Second, the senior author, who has considerable experience with UKA implantation, performed all of the procedures. Liddle et al. [47] and Hamilton et al. [48] have shown that a small UKA caseload is inversely correlated with a high revision rates, and we hypothesize the same principle holds true for clinical outcome. Therefore, it is possible that results are influenced by the issues specific to the respective surgical techniques and may not be readily generalizable to different surgical settings. Third, patients were not randomly allocated to treatment. Finally, this study did not address whether the differences were sustained over time, and follow-up time was too short to assess differences in revision rates.

In conclusion, our data suggest that patients undergoing UKA are less aware of their artificial joints in daily life compared to patients undergoing TKA for medial OA of the knee. Compared with TKA, UKA conserves more soft-tissue and bone, and we speculate that this could be the reason for the differences observed in this study. Therefore, we suggest that joint-conserving surgical strategies should be considered in order to optimize outcomes following knee arthroplasty.

Compliance with ethical standards

Conflict of interest GP is a Consultant for Zimmer Biomet. The other authors have no conflicts of interest.

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