The Journal of Arthroplasty 32 (2017) 761–766

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Primary Arthroplasty

The Role of Patient Characteristics on the Choice of Unicompartmental versus Total Knee Arthroplasty in Patients With Medial Osteoarthritis

Jelle P. van der List, MD *, Harshvardhan Chawla, BS, Jordan C. Villa, MD, Andrew D. Pearle, MD

Computer Assisted Surgery Center, Department of Orthopaedic Surgery, Hospital for Special Surgery, Weill Medical College of Cornell University, New York, New York

ARTICLE INFO

Article history:
Received 11 May 2016
Received in revised form
26 July 2016
Accepted 12 August 2016
Available online 24 August 2016

Keywords:
medial osteoarthritis
total knee arthroplasty
unicompartmental knee arthroplasty
age
gender
BMI

ABSTRACT

Background: Medial unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA) are both viable treatment options for medial osteoarthritis (OA). However, it remains unclear when to choose for which arthroplasty treatment. Goals of this study were therefore to (1) compare outcomes after both treatments and (2) assess which treatment has superior outcomes in different patient subgroups.
Methods: In this retrospective cohort study, 166 patients received the RESTORIS MCK Medial UKA and 63 patients the Vanguard TKA and were radiographically matched on isolated medial OA. Western Ontario and McMaster Universities Arthritis Index scores were collected preoperatively and postoperatively (mean: 3.0 years, range: 2.0-5.0 years).
Results: Preoperatively, no differences were observed, but medial UKA patients reported better functional outcomes than TKA (89.7 ± 13.6 vs 81.2 ± 18.0, $P = .001$) at follow-up.Better functional outcomes were noted after medial UKA in patients younger than age 70 years (89.5 ± 14.2 vs 78.6 ± 20.0, $P = .001$), with body mass index below 30 (90.3 ± 11.4 vs 83.6 ± 14.9, $P = .005$), with body mass index above 30 (88.3 ± 17.5 vs 78.8 ± 21.0, $P = .034$) and in females (90.6 ± 11.0 vs 78.1 ± 19.4, $P = .001$) when compared with TKA. No differences were found in males and older patients between both arthroplasties.
Conclusion: Superior functional outcomes were noted after medial UKA over TKA in patients presenting with medial OA with these prostheses. Subgroup analyses suggest that medial UKA is the preferred treatment in younger patients and females while no differences were noted in older patients and males after medial UKA and TKA. This might help the orthopedic surgeon in individualizing arthroplasty treatment for patients with medial OA.

The most common treatment options for medial osteoarthritis (OA) of the knee are unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA). UKA is an increasingly popular treatment option [1-4], conferring advantages such as faster recovery [5,6], better range of motion [7], better functional outcomes [8-11], easier revisions [12], and higher cost-effectiveness [13,14] when compared with TKA. Because TKA survivorship is reported to be higher than that of medial UKA [1,2,15], some authors prefer TKA over UKA. As a result, medial UKA may be underutilized in the setting of medial OA [16-18].

With distinct advantages of both treatment options, it is important to identify which patients may benefit most from which arthroplasty [19]. To identify the optimal treatment for each individual patient, studies are necessary that (1) compare outcomes of medial UKA with those of TKA, (2) have the same indication of medial OA for both treatments, and (3) perform subgroup analysis to individualize treatment. Although several studies showed that different outcomes can be expected in different patient subgroups [20-26] and others compared UKA and TKA for the same surgical indication of medial OA [9,10,27-30], no studies have compared UKA and TKA outcomes in different patient subgroups.

To determine the optimal arthroplasty treatment for each patient, the purpose of this study was therefore to compare short-term patient-reported outcomes between medial UKA and TKA in

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.08.015.

* Reprint requests: Jelle P. van der List, MD, Hospital for Special Surgery, 535 E. 70th Street, New York, NY 10021.

http://dx.doi.org/10.1016/j.arth.2016.08.015
0883-5403/

patients with medial OA. The research questions of this study were (1) which arthroplasty treatment has better functional outcomes for the indication of medial OA and (2) in which patient should which arthroplasty be performed? The hypotheses of this retrospective study were that (1) medial UKA patients had better postoperative patient-reported outcomes than TKA patients and (2) younger patients and patients with lower body mass index (BMI) would benefit more from medial UKA while older patients and those with higher BMI would benefit more from TKA due to a lower activity level.

Materials and Methods

Following Institutional Review Board approval (No. 2013-056), a search in the database of the senior author was performed for patients who underwent medial UKA or TKA between January 2008 and October 2013. Patients were included in the medial UKA cohort when (1) they underwent medial UKA surgery for the indication of OA, (2) a tibial onlay implant was used, (3) they had an intact anterior cruciate ligament, and (4) minimum 2-year and maximum 5-year follow-up score was available. Patients were included in the TKA cohort when (1) they underwent TKA surgery for the indication of OA and (2) minimum 2-year and maximum 5-year follow-up was available. After inclusion, patients were radiographically matched using the Kellgren–Lawrence (KL) score for all 3 compartments [31]. Patients were excluded from either cohort if (1) there was significant lateral compartment OA (ie, quantified by a KL score of >1) or (2) there was severe patellofemoral OA (ie, quantified by a KL score of >2). By excluding these patients, 2 cohorts were created with patients who underwent either unicompartmental or total knee replacement for medial OA (Fig. 1). Patients were not matched by age, BMI, or gender since the goal of this study was to compare outcomes of UKA and TKA in these subgroups and matching by these factors may lead to a selection bias.

All surgeries were performed by the senior author (A.D.P.). The preference of the senior author was to perform UKA in the setting of medial OA. However, patients were explained the advantages and disadvantages of both treatments and were encouraged to make their own decision to either receive UKA or TKA, which they did in all cases. Medial UKA surgery was performed using a robotic-assisted technique (MAKO Surgical Corp, Ft. Lauderdale, FL) [32-34]. Patients who preferred UKA received a RESTORIS MCK Medial Onlay implant (MAKO Surgical Corp; Fig. 1). TKA surgery was performed using computed tomography–based computer navigation-assisted technique [35]. Patients who preferred TKA received a posterior stabilized Vanguard Total Knee (Biomet, Warsaw, IN; Fig. 1). Cementation was used in both medial UKA and TKA surgery. The patella was resurfaced in all TKA surgeries. No patients were intraoperatively converted from UKA to TKA surgery.

Preoperative and postoperative Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores were routinely and prospectively collected. The WOMAC score is a questionnaire that consists of 24 Likert scale questions and is validated for knee OA [36,37]. This questionnaire reports overall outcome (all 24 questions) and the subdomains pain (5 questions), stiffness (2 questions), and function (17 questions). The overall score and subdomain scores were indexed with 0 as worst possible score and 100 as best possible score.

For this retrospective analysis, 166 medial UKA patients were included, of which 56 completed preoperative surveys and all 166 completed postoperative surveys (mean follow-up 2.8 years; range 2.0-5.0 years). Of a cohort of 239 patients, 63 TKA patients met the inclusion criteria and were included, of which 32 completed preoperative surveys and all 63 completed postoperative surveys (mean follow-up 3.3 years; range 2.0-5.0 years). Demographic and radiological data collected were age, BMI, gender, side, OA severity of all 3 compartments using the KL score, and preoperative and postoperative alignment. This is shown in Table 1.

All patients were plotted in a scatter plot graph using Microsoft Excel 2011 (Microsoft Corp, Redmond, WA) with either BMI or age on the horizontal axis and total WOMAC score on the vertical axis. Trend lines were added, and the intersection points of the trend lines were used as a cutoff point for further analysis. This resulted in

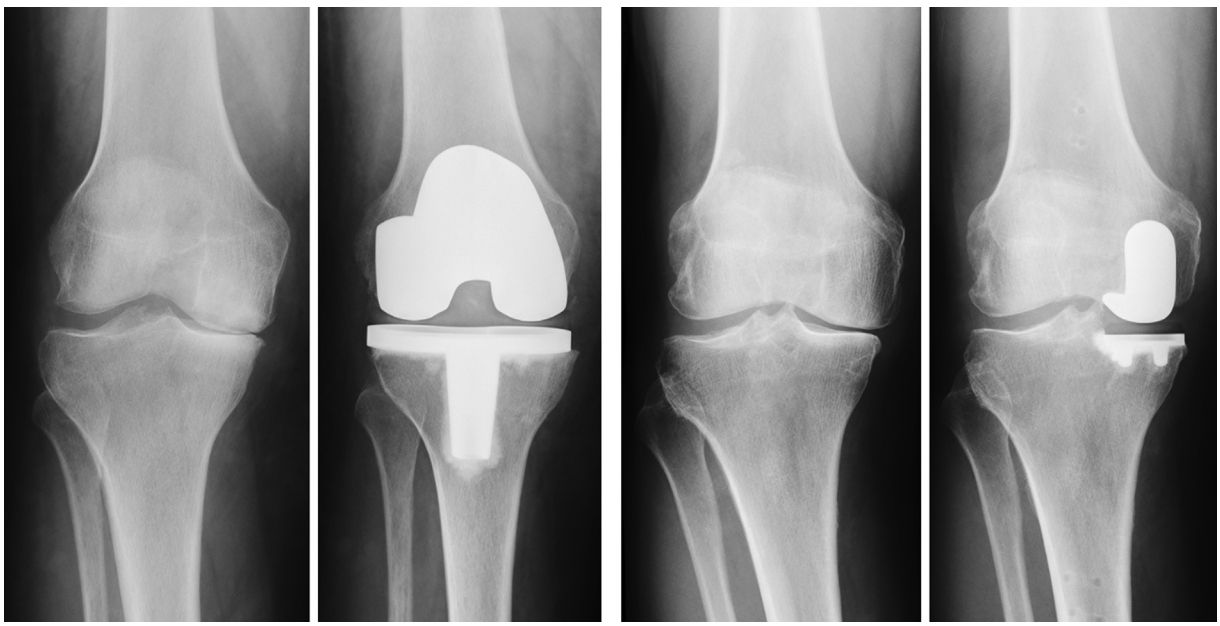

Fig. 1. On the left 2 images, the preoperative and postoperative anteroposterior radiographs are shown of a patient with medial osteoarthritis that underwent total knee arthroplasty. On the right 2 images, the preoperative and postoperative anteroposterior radiographs are shown of a patient with medial osteoarthritis that underwent unicompartmental knee arthroplasty.

Table 1
Patient Demographics of Patients Undergoing Medial UKA and TKA.

Patient Characteristics	N	Medial UKA (n = 166); Mean (±SD)	N	TKA (n = 63); Mean (±SD)	*P* Value
Age (y)	166	64.9 (±9.2)	63	65.6 (±8.9)	.576
BMI (kg/m^2)	154	29.2 (±5.3)	60	31.5 (±5.6)	.005
Gender (M:F)	166	93:73	63	30:33	.255
Side (R:L)	166	82:84	63	29:34	.649
Follow-up (y)	166	2.8 (±1.0)	63	3.3 (±1.3)	.003
OA severity MC	166	3.1 (±0.7)	63	3.5 (±0.5)	<.001
OA severity LC	166	0.7 (±0.7)	63	0.8 (±0.7)	.123
OA severity PFC	140	0.7 (±0.7)	63	1.2 (±0.6)	<.001

UKA, unicompartmental knee arthroplasty; TKA, total knee arthroplasty; SD, standard deviation; BMI, body mass index; OA, osteoarthritis; MC, medial compartment; LC, lateral compartment; PFC, patellofemoral compartment.

a BMI cutoff value of 30 kg/m^2, as is also used by the World Health Organization [38] to define obesity (>30 kg/m^2) and resulted in an age cutoff of 70 years.

Statistical analysis was performed using SPSS, version 21 (SPSS Inc, Armonk, NY). Independent *t* tests for continuous data and chi-square tests for nominal data were used to compare patient demographic data. Independent *t* tests were used to compare preoperative and postoperative functional outcomes between medial UKA and TKA for analysis and subgroup analyses. All tests were 2 sided, and a significance of $P < .05$ was considered significant.

Sample size calculation showed that 42 medial UKA and 17 TKA patients were necessary to show a clinically significant 10.0 WOMAC score difference, using a standard deviation of 12.5 (preliminary data), an alpha of 0.05, power of 80%, and an enrollment ratio of 2.5:1. This was sufficient for all subgroup analyses. This enrollment ratio was chosen because of the larger number of patients that underwent medial UKA compared with TKA.

Results

With regard to demographic data, no differences were seen in age, gender, side, and lateral compartment OA severity (Table 1). TKA patients had a higher BMI (31.5 ± 5.6 vs 29.2 ± 5.3; $P = .005$), and more severe OA of the medial (3.5 ± 0.5 vs 3.1 ± 0.7, $P < .001$), and patellofemoral compartment (1.2 ± 0.6 vs 0.7 ± 0.7, $P < .001$) compared with medial UKA patients (Table 1).

Preoperatively, no differences in pain, stiffness, or function were observed between medial UKA and TKA (55.5 ± 14.3 and 52.3 ± 15.1, respectively, $P = .316$). Postoperatively, medial UKA patients reported better overall outcomes (89.7 ± 13.6 vs 81.2 ± 18.0, $P = .001$), less pain, less stiffness, and better function compared with TKA patients (Table 2).

Subgroup Analysis

In patients younger than 70 years, medial UKA patients reported better overall outcomes (89.5 ± 14.2 vs 78.6 ± 20.0, $P = .001$), less pain, less stiffness, and better function than TKA patients. In patients older than 70 years, however, no statistically significant or clinically relevant differences between medial UKA and TKA were observed in overall outcome (90.3 ± 12.0 and 87.7 ± 9.3, respectively, $P = .410$) or subdomain scores (Table 3).

In patients with BMI below 30, medial UKA patients reported better overall outcomes (90.3 ± 11.4 vs 83.6 ± 14.9, $P = .005$), less pain, less stiffness, and better function compared with those undergoing TKA. In patients with BMI above 30, patients undergoing medial UKA also reported better overall outcomes (88.3 ± 17.5 vs 78.8 ± 21.0, $P = .034$), less pain, and better function when compared with patients undergoing TKA (Table 4).

With regard to gender, females undergoing medial UKA reported significantly better overall outcomes (90.6 ± 11.0 vs 78.1 ± 19.4, $P = .001$), less pain, less stiffness, and better function compared with females undergoing TKA. However, no statistically significant or clinically relevant differences were seen in overall outcomes (89.0 ± 15.3 and 84.5 ± 16.0, respectively, $P = .170$) or subdomain scores between males undergoing medial UKA and TKA (Table 5). When looking at the role of gender in patients younger than 70 years, it was also noted that females younger than 70 years undergoing medial UKA reported significantly better outcomes (90.1 ± 11.7 vs 75.8 ± 20.7, $P = .003$), less pain, less stiffness, and better function when compared with females younger than 70 years undergoing TKA. Similarly, no differences were seen in males undergoing medial UKA and TKA (Table 6).

Discussion

The main findings of this study were that, in the setting of medial OA, patients undergoing medial UKA reported better functional outcomes compared with TKA and that medial UKA was the preferred treatment in (1) younger patients, (2) females, and (3) this is independent from BMI. Medial UKA and TKA resulted in similar outcome scores in patients older than 70 years and males. To our knowledge, no other study has directly compared functional outcomes of UKA and TKA in different patient subgroups while radiographically matching the cohorts.

Table 2
Preoperative and Postoperative WOMAC Scores After Medial UKA and TKA for the Indication of Isolated Medial Osteoarthritis.

WOMAC Scores	Medial UKA		TKA		*P* Value
	N	Mean (±SD)	N	Mean (±SD)	
Preoperative total	56	55.5 (±14.3)	32	52.3 (±15.1)	.316
Preoperative pain	56	56.2 (±15.9)	32	50.3 (±16.1)	.103
Preoperative stiffness	56	49.8 (±18.6)	32	44.3 (±22.4)	.224
Preoperative function	56	55.2 (±15.0)	32	53.7 (±16.4)	.474
Postoperative total	163	89.7 (±13.6)	63	81.2 (±18.0)	.001
Postoperative pain	163	92.1 (±12.4)	63	81.7 (±18.8)	<.001
Postoperative stiffness	163	83.5 (±19.1)	63	76.7 (±21.4)	.020
Postoperative function	163	90.0 (±13.5)	63	81.6 (±18.2)	.001

WOMAC, Western Ontario and McMaster Universities Arthritis Index; UKA, unicompartmental knee arthroplasty; TKA, total knee arthroplasty; SD, standard deviation.

Table 3
Postoperative WOMAC Scores After Medial UKA and TKA for the Indication of Isolated Medial Osteoarthritis Stratified by Age.

Age	Medial UKA		TKA		*P* Value
	N	Mean (±SD)	N	Mean (±SD)	
<70					
Postoperative total	118	89.5 (±14.2)	45	78.6 (±20.0)	.001
Postoperative pain	118	92.1 (±12.5)	45	79.3 (±20.9)	<.001
Postoperative stiffness	118	82.5 (±19.5)	45	74.3 (±23.3)	.023
Postoperative function	118	89.9 (±14.2)	45	78.9 (±20.1)	.001
≥70					
Postoperative total	48	90.3 (±12.0)	18	87.7 (±9.3)	.410
Postoperative pain	48	92.1 (±12.4)	18	87.8 (±10.5)	.196
Postoperative stiffness	48	86.1 (±14.3)	18	82.8 (±14.3)	.491
Postoperative function	48	90.3 (±12.0)	18	90.3 (±10.1)	.556

WOMAC, Western Ontario and McMaster Universities Arthritis Index; UKA, unicompartmental knee arthroplasty; TKA, total knee arthroplasty; SD, standard deviation.

Table 4
Postoperative WOMAC Scores After Medial UKA and TKA for the Indication of Isolated Medial Osteoarthritis Stratified by BMI.

BMI	Medial UKA		TKA		*P* Value
	N	Mean (±SD)	N	Mean (±SD)	
<30					
Postoperative total	97	90.3 (±11.4)	28	83.6 (±14.9)	.012
Postoperative pain	97	92.1 (±13.0)	28	83.0 (±16.0)	.003
Postoperative stiffness	97	83.5 (±19.1)	28	76.5 (±19.6)	.091
Postoperative function	97	90.6 (±11.3)	28	84.7 (±15.1)	.027
≥30					
Postoperative total	57	88.3 (±17.5)	32	78.8 (±21.0)	.034
Postoperative pain	57	91.6 (±12.5)	32	80.0 (±21.8)	.009
Postoperative stiffness	57	83.2 (±20.1)	32	75.9 (±23.6)	.123
Postoperative function	57	88.6 (±17.4)	32	78.8 (±21.1)	.029

WOMAC, Western Ontario and McMaster Universities Arthritis Index; UKA, unicompartmental knee arthroplasty; TKA, total knee arthroplasty; BMI, body mass index; SD, standard deviation.

Several limitations are, however, present in this study. First of all, this study is not a matched patient cohort but a radiographically matched cohort for medial OA and therefore differences existed in BMI and preoperative OA grades of medial and patellofemoral compartment. Patients were not matched for age, gender, and BMI since this may create a selection bias in the subgroup analysis since patients would then be excluded for these analyses. However, since BMI was higher in the TKA group, one should be careful on the conclusion of the general comparison of UKA and TKA since BMI could be a confounder in this analysis [24,39,40]. On the other hand, it was noted that the preference for an arthroplasty option in this study was not depended on BMI (Table 4). It was also noted that OA severity of the medial and patellofemoral compartment was higher in the TKA group. This was not considered relevant since patellofemoral OA of mild severity does not influence outcomes in medial UKA patients [24,41,42], the patella was resurfaced in TKA procedure, and the medial compartment is replaced in both procedures. It was therefore also not surprising that no preoperative differences in WOMAC scores were found between both groups. Finally, the 6-month difference in follow-up time between both groups was not considered clinically relevant.

A second limitation was that not all patients completed the preoperative WOMAC scores, which made it impossible to assess the improvement of functional outcome scores. To our opinion, however, enough patients completed the preoperative questionnaires to use in this study when looking at the sample size calculation and size of standard deviations. Third, this study is a retrospective study, which has its limitations due to the nature of the study, including that it was not possible to assess the activity level of the patients or the ligamentous status of the anterior cruciate ligament. Despite these limitations, this study is the first to compare functional outcomes in different patient subgroups after medial UKA with TKA for the same indication. This study is, to our opinion, relevant for the orthopedic surgeon since it simulates the choice of UKA or TKA for a specific patient presenting with medial OA.

Table 5
Postoperative WOMAC Scores After Medial UKA and TKA for the Indication of Isolated Medial Osteoarthritis Stratified by Gender.

Gender	Medial UKA		TKA		*P* Value
	N	Mean (±SD)	N	Mean (±SD)	
Males					
Postoperative total	93	89.0 (±15.3)	30	84.5 (±16.0)	.170
Postoperative pain	93	92.1 (±14.1)	30	85.7 (±17.2)	.087
Postoperative stiffness	93	84.1 (±20.1)	30	80.1 (±17.3)	.332
Postoperative function	93	89.4 (±15.0)	30	84.8 (±16.2)	.155
Females					
Postoperative total	73	90.6 (±11.0)	33	78.1 (±19.4)	.001
Postoperative pain	73	93.4 (±9.9)	33	78.2 (±19.8)	<.001
Postoperative stiffness	73	82.8 (±17.8)	33	73.6 (±24.3)	.030
Postoperative function	73	90.6 (±11.4)	33	78.7 (±19.7)	.002

WOMAC, Western Ontario and McMaster Universities Arthritis Index; UKA, unicompartmental knee arthroplasty; TKA, total knee arthroplasty; SD, standard deviation.

Table 6
Postoperative WOMAC Scores After Medial UKA and TKA for the Indication of Isolated Medial Osteoarthritis Stratified by Gender in Patients Younger Than 70 y.

Gender	Medial UKA		TKA		*P* Value
	N	Mean (±SD)	N	Mean (±SD)	
Males <70 y					
Postoperative total	62	88.9 (±16.2)	20	82.0 (±18.9)	.114
Postoperative pain	62	91.2 (±14.1)	20	83.0 (±20.2)	.104
Postoperative stiffness	62	83.8 (±20.3)	20	79.5 (±19.6)	.413
Postoperative function	62	89.5 (±15.9)	20	82.1 (±18.9)	.089
Females <70 y					
Postoperative total	56	90.1 (±11.7)	25	75.8 (±20.7)	.003
Postoperative pain	56	93.1 (±10.6)	25	76.4 (±21.3)	.001
Postoperative stiffness	56	81.2 (±18.6)	25	70.1 (±25.5)	.031
Postoperative function	56	90.3 (±12.1)	25	76.3 (±21.0)	.004

WOMAC, Western Ontario and McMaster Universities Arthritis Index; UKA indicates unicompartmental knee arthroplasty; TKA, total knee arthroplasty; SD, standard deviation.

It was noted that patients undergoing medial UKA reported better functional outcomes than patients undergoing TKA. These findings echo those of several studies in the existing literature [9,10,27,43-45]. Yang et al [27] were the first to compare medial UKA with TKA in the setting of medial OA. They found less blood loss, quicker rehabilitation, and lower hospital costs in the medial UKA group at 6-month follow-up. Similarly, Manzotti et al [9] compared outcomes of medial UKA and TKA in patients matched by preoperative OA severity. The authors also reported no preoperative differences in functional outcomes but better postoperative functional scores in patients undergoing medial UKA. Finally, Newman et al [10] performed a randomized clinical trial in patients with medial OA undergoing either medial UKA or TKA in which they found that more patients going medial UKA reported excellent function than TKA patients at long-term follow-up. These studies suggest that, similar to the findings of this present study, functional outcomes after medial UKA are superior to those of TKA in the setting of medial OA. Interestingly, Willis-Owen et al [14] not only found superiority in functional outcomes of medial UKA over TKA but also found that medial UKA was more cost-effective. Several other studies have compared cost-effectiveness of medial UKA and TKA in different age groups (eg, younger than 55, 55-65, 65-75 years and older than 75 years) [13,46-48]. Data in this study suggest that further cost-effectiveness would be valuable in other groups based on patient characteristic.

To our knowledge, this study is unique in directly comparing outcomes of both arthroplasties in different patient subgroups following the same radiographic indication. It was noted that in patients younger than 70 years, significantly better functional outcomes were noted in patients undergoing medial UKA compared with TKA but that no differences were found in patients older than 70 years (Table 3). The inferior outcomes in younger TKA patients have previously been reported by Keeney et al [49], who found that younger patients undergoing TKA had significantly worse functional Knee Society Score and WOMAC score compared with older patients undergoing TKA. Furthermore, Parvizi et al [50] assessed the outcome of TKA in young patients in a multicenter study. They reported that in 661 young patients undergoing TKA,

33% reported pain, 41% stiffness, 33% swelling or tightness, and 54% difficulty with stairs. The results of this present study suggest that medial UKA may be the preferred treatment in patients younger than 70 years with medial OA. A likely explanation for this phenomenon may be the higher demand of younger and active patients in combination with several UKA advantages over TKA, including better range of motion [7,51] and better return to sports [52-54]. In older patients, the results suggest that functional outcomes are satisfying following both procedures without a preference for 1 type of arthroplasty. In these patients, several factors such as patient expectations, level of daily activity, patients' health, and revision rates may be more important for the treatment choice [19].

Another interesting finding in this study was the difference in outcomes after UKA and TKA with regard to gender. This has, to our knowledge, not been reported before in the literature [55,56]. When reviewing the included patients, no differences between males and females existed in age, BMI, or OA severity that could explain the differences found in this study. Furthermore, it seems that the lower outcome scores in females undergoing TKA are responsible for these differences since outcomes in gender are similar after UKA (Table 5) and since these differences are also seen when only analyzing patients younger than 70 years (Table 6). Two studies have, to our knowledge, compared outcomes after UKA [55,56]. Lustig et al [56] reported that no differences in Knee Society Score after UKA between 40 males and 40 females while Kuipers et al [55] could not detect gender to be a significant predictor of failure in a regression analysis in 437 patients undergoing medial UKA. The inferior outcomes in females after TKA compared with males may be explained by the fact that implant designs are designed according to the male aspect of the femoral condyle [57,58]. Since the knee is significantly smaller and has different ratios in females compared with males, usage of a non–gender-specific prosthesis might cause pain and inferior outcomes in females after TKA [49,57-59]. Although clearly more research is needed in this field of interest, results in this study suggest that a different preference for treatment options might exist for males and females and that medial UKA may be the preferred treatment in females with medial OA.

There has been much debate on the role of BMI on outcomes of knee arthroplasties. Several studies have shown that a higher BMI has a negative effect on the functional outcomes of both UKA [22,60,61] and TKA [39,40] while several other studies have reported that BMI does not influence outcomes of these procedures [62-67]. Although the outcome scores were indeed slightly lower in the higher BMI groups (Table 4), this present study did not assess the role of BMI on functional outcomes but rather assessed a possible preference of 1 arthroplasty treatment over the other in different BMI groups. It was found in this present study that for both groups, medial UKA resulted in significant better outcomes when compared with TKA (Table 4). These results suggest that BMI itself may not be the most relevant factor in the decision which arthroplasty to choose for a patient with medial OA since the outcomes of medial UKA are superior to TKA in both BMI groups. In our thorough literature review, only 1 study could be identified that reported outcomes in high and low BMI in both UKA and TKA [64]. Since no direct comparative analysis was performed and the surgical indications were not standardized, it was not possible to compare the results. Further studies and preferably randomized clinical trials are therefore needed to assess these differences in patients with similar indications.

In conclusion, the results of this study show that for patients with medial OA better functional outcomes were reported after UKA than TKA at short-term follow-up with these prostheses. Subgroup analyses suggest that medial UKA is the preferred treatment in females and in patients younger than 70 years, and that this is independent of BMI. In patients older than 70 years and males, both treatment options had equivalent results. This might help the orthopedic surgeon in further individualizing arthroplasty treatment in patients presenting with medial OA.

References

1. Annual report 2013 Swedish knee arthroplasty register; 2013.
2. Annual report 2014 Australian hip and knee arthroplasty register; 2014.
3. Baker PN, Jameson SS, Deehan DJ, et al. Mid-term equivalent survival of medial and lateral unicondylar knee replacement: an analysis of data from a National Joint Registry. J Bone Joint Surg Br 2012;94(12):1641.
4. Riddle DL, Jiranek WA, McGlynn FJ. Yearly incidence of unicompartmental knee arthroplasty in the United States. J Arthroplasty 2008;23(3):408.
5. Lombardi Jr AV, Berend KR, Walter CA, et al. Is recovery faster for mobile-bearing unicompartmental than total knee arthroplasty? Clin Orthop Relat Res 2009;467(6):1450.
6. Smith TO, Chester R, Glasgow MM, et al. Accelerated rehabilitation following Oxford unicompartmental knee arthroplasty: five-year results from an independent centre. Eur J Orthop Surg Traumatol 2012;22(2):151.
7. Laurencin CT, Zelicof SB, Scott RD, et al. Unicompartmental versus total knee arthroplasty in the same patient. A comparative study. Clin Orthop Relat Res 1991;(273):151.
8. Isaac SM, Barker KL, Danial IN, et al. Does arthroplasty type influence knee joint proprioception? a longitudinal prospective study comparing total and unicompartmental arthroplasty. Knee 2007;14(3):212.
9. Manzotti A, Confalonieri N, Pullen C. Unicompartmental versus computer-assisted total knee replacement for medial compartment knee arthritis: a matched paired study. Int Orthop 2007;31(3):315.
10. Newman J, Pydisetty RV, Ackroyd C. Unicompartmental or total knee replacement: the 15-year results of a prospective randomised controlled trial. J Bone Joint Surg Br 2009;91(1):52.
11. Zuiderbaan HA, van der List JP, Khamaisy S, et al. Unicompartmental knee arthroplasty versus total knee arthroplasty: which type of artificial joint do patients forget? Knee Surg Sports Traumatol Arthrosc 2015. http://dx.doi.org/10.1007/s00167-015-3868-1.
12. Siddiqui NA, Ahmad ZM. Revision of unicondylar to total knee arthroplasty: a systematic review. Open Orthop J 2012;6:268.
13. Ghomrawi HM, Eggman AA, Pearle AD. Effect of age on cost-effectiveness of unicompartmental knee arthroplasty compared with total knee arthroplasty in the U.S. J Bone Joint Surg Am 2015;97(5):396.
14. Willis-Owen CA, Brust K, Alsop H, et al. Unicondylar knee arthroplasty in the UK National Health Service: an analysis of candidacy, outcome and cost efficacy. Knee 2009;16(6):473.
15. van der List JP, McDonald LS, Pearle AD. Systematic review of medial versus lateral survivorship in unicompartmental knee arthroplasty. Knee 2015;22(6):454.
16. Arno S, Maffei D, Walker PS, et al. Retrospective analysis of total knee arthroplasty cases for visual, histological, and clinical eligibility of unicompartmental knee arthroplasties. J Arthroplasty 2011;26(8):1396.
17. Riddle DL, Jiranek WA, Neff RS, et al. Extent of tibiofemoral osteoarthritis before knee arthroplasty: multicenter data from the osteoarthritis initiative. Clin Orthop Relat Res 2012;470(10):2836.
18. Ritter MA, Faris PM, Thong AE, et al. Intra-operative findings in varus osteoarthritis of the knee. An analysis of pre-operative alignment in potential candidates for unicompartmental arthroplasty. J Bone Joint Surg Br 2004;86(1):43.
19. Khatri PJ, O'Connor AM, Dervin GF. Decision support needs of patients choosing between unicompartmental and total knee arthroplasty for advanced medial compartment osteoarthritis of the knee. J Arthroplasty 2011;26(8):1343.
20. Kandil A, Werner BC, Gwathmey WF, et al. Obesity, morbid obesity and their related medical comorbidities are associated with increased complications and revision rates after unicompartmental knee arthroplasty. J Arthroplasty 2015;30(3):456.
21. Liddle AD, Pandit H, Judge A, et al. Optimal usage of unicompartmental knee arthroplasty: a study of 41 986 cases from the National Joint Registry for England and Wales. Bone Joint J 2015;97-B(11):1506.
22. Thompson SA, Liabaud B, Nellans KW, et al. Factors associated with poor outcomes following unicompartmental knee arthroplasty: redefining the “classic” indications for surgery. J Arthroplasty 2013;28(9):1561.
23. Zuiderbaan HA, van der List JP, Chawla H, et al. Predictors of subjective outcome after medial unicompartmental knee arthroplasty. J Arthroplasty 2016;31(7):1453.
24. van der List JP, Chawla H, Zuiderbaan HA, et al. Patient selection criteria for unicompartmental knee arthroplasty: a meta-analysis critique. J Arthroplasty 2016. http://dx.doi.org/10.1016/j.arth.2016.04.001.
25. Gustavson AM, Wolfe P, Falvey JR, et al. Men and women demonstrate differences in early functional recovery after total knee arthroplasty. Arch Phys Med Rehabil 2016;97(7):1154.
26. Bin Abd Razak HR, Tan CS, Chen YJ, et al. Age and preoperative Knee Society Score are significant predictors of outcomes among Asians following total knee arthroplasty. J Bone Joint Surg Am 2016;98(9):735.

27. Yang KY, Wang MC, Yeo SJ, et al. Minimally invasive unicondylar versus total condylar knee arthroplasty—early results of a matched-pair comparison. Singapore Med J 2003;44(11):559.
28. Jiang L, Chen JY, Chong HC, et al. Early outcomes of unicompartmental knee arthroplasty in patients with preoperative genu recurvatum of non-neurological origin. J Arthroplasty 2016;31(6):1204.
29. Longo UG, Loppini M, Trovato U, et al. No difference between unicompartmental versus total knee arthroplasty for the management of medial osteoarthtritis of the knee in the same patient: a systematic review and pooling data analysis. Br Med Bull 2015;114(1):65.
30. Arirachakaran A, Choowit P, Putananon C, et al. Is unicompartmental knee arthroplasty (UKA) superior to total knee arthroplasty (TKA)? A systematic review and meta-analysis of randomized controlled trial. Eur J Orthop Surg Traumatol 2015;25(5):799.
31. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis 1957;16(4):494.
32. Pearle AD, O'Loughlin PF, Kendoff DO. Robot-assisted unicompartmental knee arthroplasty. J Arthroplasty 2010;25(2):230.
33. Werner SD, Stonestreet M, Jacofsky DJ. Makoplasty and the accuracy and efficacy of robotic-assisted arthroplasty. Surg Technol Int 2014;24:302.
34. van der List JP, Chawla H, Pearle AD. Robotic-assisted knee arthroplasty: an overview. Am J Orthop 2016;45(4):202.
35. Lombardi Jr AV, Berend KR, Adams JB. Patient-specific approach in total knee arthroplasty. Orthopedics 2008;31(9):927.
36. Bellamy N, Campbell J, Hill J, et al. A comparative study of telephone versus onsite completion of the WOMAC 3.0 osteoarthritis index. J Rheumatol 2002;29(4):783.
37. Bellamy N, Campbell J, Stevens J, et al. Validation study of a computerized version of the Western Ontario and McMaster Universities VA3.0 Osteoarthritis Index. J Rheumatol 1997;24(12):2413.
38. Physical status: the use and interpretation of anthropometry. Report of a WHO expert consultation. In: WHO technical report. Geneva: World Health Organization;1995.
39. McElroy MJ, Pivec R, Issa K, et al. The effects of obesity and morbid obesity on outcomes in TKA. J Knee Surg 2013;26(2):83.
40. Si HB, Zeng Y, Shen B, et al. The influence of body mass index on the outcomes of primary total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2015;23(6):1824.
41. Song EK, Park JK, Park CH, et al. No difference in anterior knee pain after medial unicompartmental knee arthroplasty in patients with or without patellofemoral osteoarthritis. Knee Surg Sports Traumatol Arthrosc 2014;24(1):208.
42. Thein R, Zuiderbaan HA, Khamaisy S, et al. Medial unicondylar knee arthroplasty improves patellofemoral congruence: a possible mechanistic explanation for poor association between patellofemoral degeneration and clinical outcome. J Arthroplasty 2015;30(11):1917.
43. Lygre SH, Espehaug B, Havelin LI, et al. Pain and function in patients after primary unicompartmental and total knee arthroplasty. J Bone Joint Surg Am 2010;92(18):2890.
44. Lyons MC, MacDonald SJ, Somerville LE, et al. Unicompartmental versus total knee arthroplasty database analysis: is there a winner? Clin Orthop Relat Res 2012;470(1):84.
45. Von Keudell A, Sodha S, Collins J, et al. Patient satisfaction after primary total and unicompartmental knee arthroplasty: an age-dependent analysis. Knee 2014;21(1):180.
46. Soohoo NF, Sharifi H, Kominski G, et al. Cost-effectiveness analysis of unicompartmental knee arthroplasty as an alternative to total knee arthroplasty for unicompartmental osteoarthritis. J Bone Joint Surg Am 2006;88(9):1975.
47. Xie F, Lo NN, Tarride JE, et al. Total or partial knee replacement? cost-utility analysis in patients with knee osteoarthritis based on a 2-year observational study. Eur J Health Econ 2010;11(1):27.
48. Smith 2nd WB, Steinberg J, Scholtes S, et al. Medial compartment knee osteoarthritis: age-stratified cost-effectiveness of total knee arthroplasty, unicompartmental knee arthroplasty, and high tibial osteotomy. Knee Surg Sports Traumatol Arthrosc 2015. http://dx.doi.org/10.1007/s00167-015-3821-3.
49. Keeney JA, Nunley RM, Wright RW, et al. Are younger patients undergoing TKAs appropriately characterized as active? Clin Orthop Relat Res 2014;472(4):1210.
50. Parvizi J, Nunley RM, Berend KR, et al. High level of residual symptoms in young patients after total knee arthroplasty. Clin Orthop Relat Res 2014;472(1):133.
51. Walker T, Gotterbarm T, Bruckner T, et al. Total versus unicompartmental knee replacement for isolated lateral osteoarthritis: a matched-pairs study. Int Orthop 2014;38(11):2259.
52. Walton NP, Jahromi I, Lewis PL, et al. Patient-perceived outcomes and return to sport and work: TKA versus mini-incision unicompartmental knee arthroplasty. J Knee Surg 2006;19(2):112.
53. Witjes S, Gouttebarge V, Kuijer PP, et al. Return to sports and physical activity after total and unicondylar knee arthroplasty: a systematic review and meta-analysis. Sports Med (Auckland, NZ) 2016;46(2):269.
54. Ho JC, Stitzlein RN, Green CJ, et al. Return to sports activity following UKA and TKA. J Knee Surg 2016;29(3):254.
55. Kuipers BM, Kollen BJ, Bots PC, et al. Factors associated with reduced early survival in the Oxford phase III medial unicompartment knee replacement. Knee 2010;17(1):48.
56. Lustig S, Barba N, Magnussen RA, et al. The effect of gender on outcome of unicompartmental knee arthroplasty. Knee 2012;19(3):176.
57. Johnson AJ, Costa CR, Mont MA. Do we need gender-specific total joint arthroplasty? Clin Orthop Relat Res 2011;469(7):1852.
58. Xie X, Lin L, Zhu B, et al. Will gender-specific total knee arthroplasty be a better choice for women? A systematic review and meta-analysis. Eur J Orthop Surg Traumatol 2014;24(8):1341.
59. Cherian JJ, O'Connor MI, Robinson K, et al. A prospective, longitudinal study of outcomes following total knee arthroplasty stratified by gender. J Arthroplasty 2015;30(8):1372.
60. Bonutti PM, Goddard MS, Zywiel MG, et al. Outcomes of unicompartmental knee arthroplasty stratified by body mass index. J Arthroplasty 2011;26(8):1149.
61. Murray DW, Pandit H, Weston-Simons JS, et al. Does body mass index affect the outcome of unicompartmental knee replacement? Knee 2013;20(6):461.
62. Baker P, Muthumayandi K, Gerrand C, et al. Influence of body mass index (BMI) on functional improvements at 3 years following total knee replacement: a retrospective cohort study. PLoS One 2013;8(3):e59079.
63. Cavaignac E, Lafontan V, Reina N, et al. Obesity has no adverse effect on the outcome of unicompartmental knee replacement at a minimum follow-up of seven years. Bone Joint J 2013;95-B(8):1064.
64. Lash H, Hooper G, Hooper N, et al. Should a patients BMI status be used to restrict access to total hip and knee arthroplasty? functional outcomes of arthroplasty relative to BMI—single centre retrospective review. Open Orthop J 2013;7:594.
65. Liao CD, Huang YC, Lin LF, et al. Body mass index and functional mobility outcome following early rehabilitation after a total knee replacement: a retrospective study in Taiwan. Arthritis Care Res (Hoboken) 2015;67(6):799.
66. Plate JF, Augart MA, Seyler TM, et al. Obesity has no effect on outcomes following unicompartmental knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2015. http://dx.doi.org/10.1007/s00167-015-3597-5.
67. Xing Z, Katz J, Jiranek W. Unicompartmental knee arthroplasty: factors influencing the outcome. J Knee Surg 2012;25(5):369.