

# Unicompartmental knee arthroplasty versus total knee arthroplasty: Which type of artificial joint do patients forget?

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## Abstract

**Purpose** During recent years, there has been an intensive growth of interest in the patient's perception of functional outcome. The Forgotten Joint Score (FJS) is a recently introduced score that measures joint awareness of patients who have undergone knee arthroplasty and is less limited by ceiling effects. The aim of this study was to compare the FJS between patients who undergo medial unicompartmental knee arthroplasty (UKA) and patients who undergo total knee arthroplasty (TKA) 1 and 2 years post-operatively.

**Methods** This prospective study compares the FJS at a minimum of one (average 1.5 years, range 1.0–1.9) and a minimum of 2 years (average 2.5 years, range 2.0–3.6)

post-operatively between patients who underwent medial UKA and TKA.

**Results** One-hundred and thirty patients were included. Sixty-five patients underwent medial UKA and 65 patients underwent TKA. At both follow-up points, the FJS was significantly higher in the UKA group (FJS 1 year  $73.9 \pm 22.8$ , FJS 2 year  $74.3 \pm 24.8$ ) in contrast to the TKA group (FJS 1 year  $59.3 \pm 29.5$  ( $p = 0.002$ ), FJS 2 year  $59.8 \pm 31.5$ , ( $p = 0.004$ )). No significant improvement in the FJS was observed between 1- and 2-year follow-up of the two cohorts.

**Conclusion** Patients who undergo UKA are more likely to forget their artificial joint in daily life and consequently may be more satisfied.

**Level of evidence** II.

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## Introduction

Total knee replacement surgery is the accepted treatment for end-stage arthritis of the knee. In 2008, more than 600,000 cases were performed in the USA [28]. Recently, the utilization of unicompartmental knee arthroplasty (UKA) has dramatically increased for end-stage arthritis of the knee localized to a single compartment [12, 18, 20]. Less perioperative blood loss, better range of motion, better quadriceps function and a subsequently quicker recovery with a more normal gait [5] following UKA may all have contributed to the increasing utilization of the implant.

As a result of the reported advantages of UKA, there has been increasing interest in comparing the outcomes of

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UKA and total knee arthroplasty (TKA), with a particular focus on patients' perception of functional outcome. The outcomes of joint replacement have historically been evaluated based on implant survivorship, physician-assessed clinical outcome measures, complication rates and radiological parameters. Although these outcomes are critically important to report, they do not provide any information pertaining to patient perception of outcome. Therefore, patient-reported outcome (PRO) scores were developed and validated for clinical use. These scores are, however, limited firstly by ceiling effects [15], particularly in young and active patients, and secondly by the heterogeneity of scores in current use, making it difficult to compare outcomes with previously published data [2, 13, 14, 19, 24].

The Forgotten Joint Score (FJS) [3] is a recently validated PRO score which is not limited by a ceiling effect [27]. The rationale thought behind the FJS was to develop an instrument that reflects the ability of a patient to perform activities of daily living (ADL) without any form of interference from their artificial joint replacement. Since the FJS is a relatively new score, prospective data of patients undergoing knee arthroplasty using the FJS are very scarce. Therefore, the aim of this study was to compare the FJS between patients undergoing either medial UKA or TKA in order to evaluate the artificial joint awareness in both groups at 1 and 2 years following surgery.

## Materials and methods

This study was based on a prospective cohort of patients assembled for the senior author's surgical arthritis registry. Patients were eligible for this analysis if they were adult participants in the registry and underwent medial UKA or TKA between 2011 and 2013. Patient demographics and clinical data were collected including age, body mass index (BMI) and gender. The surgical indications of patients who underwent medial UKA consisted of: (I) isolated medial compartment OA, (II) an intact anterior cruciate ligament based on clinical and intraoperative assessments, (III) flexion contracture  $<10^\circ$  and (IV)  $>90^\circ$  of tibiofemoral flexion. The indications for TKA were (I) symptomatic OA changes of at least two compartments of the knee and (II) symptomatic OA of medial or lateral compartment of the knee in patients who did not wish to undergo UKA or in patients with proven anterior cruciate ligament deficiency. The presence of anterior knee pain and pre-operative Kellgren and Lawrence grade III–IV of the lateral or patellofemoral compartments was considered as surgical contraindications for medial UKA, and those patients therefore underwent TKA. Patients with a history of complex knee surgery, trauma, inflammatory arthropathy, BMI  $>40 \text{ kg/m}^2$  and simultaneous bilateral TKA or UKA were excluded.

All surgeries were performed by the senior author who has extensive experience in computer-navigated robotic surgery. For the UKA resurfacing procedure of the femur and tibia, a robotic arm-assisted technique was used, which has previously been described [21, 23] (MAKO Surgical Corp, Ft. Lauderdale, FL, USA). The goal was an under-correction of the varus deformity in order to avoid degenerative progression of the lateral compartment. All patients who underwent medial UKA received the RESTORIS<sup>®</sup> MCK Medial Onlay implant (MAKO Surgical Corporation, Ft. Lauderdale, FL, USA).

All patients who underwent TKA received the Vanguard<sup>®</sup> Complete Total Knee (Biomet, Warsaw, USA) utilizing patient-specific cutting jigs based on pre-operative computed tomography. All procedures were performed under tourniquet control, with patellar resurfacing, and cementation of all implants.

## Outcome measurements

All patients were asked to complete the FJS at a minimum of 1- and 2-year follow-up. The date of the 2-year data collection had to be at least 12 months later than the date of the 1-year data collection. Since the FJS is a questionnaire following arthroplasty, it is not possible to collect pre-operative scores (Appendix). The FJS consists of 12 questions. It has been devised to evaluate the ability of a patient to forget their artificial joint in daily life. The score is reported on a scale from 0 to 100. A higher score is representative of a more favourable outcome. A detailed description on how the score should be calculated is given in the "Appendix".

This study was approved by the institutional review board at our hospital (Hospital for Special Surgery, New York, NY, USA. IRB number: 2013-056-CR2).

## Statistical analysis

All analyses were conducted using SAS for Windows 9.3 (SAS Institute Inc., Cary, NC). A priori power analysis was conducted using a two-sample *t* test. Sixty-four patients in each group were needed to reach 80 % power for detecting a 12-point (standard deviation 24) difference on the FJS scale with a two-sided significance level set at 0.05. Two-sample *t* tests were used to compare the FJS results between the medial UKA and TKA groups and between male and female subjects. A multiple linear regression analysis was performed to assess the relationship between surgery type and FJS score, controlling for age, sex, BMI and duration of follow-up. All tests were two-sided. A *p* value  $<0.05$  was considered as statistically significant.

**Table 1** Baseline characteristics

	Medial UKA			TKA			<i>p</i> value
	<i>N</i>	Mean	SD	<i>N</i>	Mean	SD	
Female sex. <i>N</i> (%)	28 (43.1 %)			37 (56.9 %)			n.s.
Age (years)		66.6	10.5		67.9	8.4	n.s.
BMI (kg/m <sup>2</sup> )		28.6	3.7		30.3	4.7	<b>0.02</b>
1 year F/U (range)		1.5 (1.0–1.9)	0.4		1.4 (1.0–1.9)	0.3	n.s.
2 year F/U (range)		2.4 (2.0–3.4)	0.7		2.6 (2.0–3.6)	0.6	n.s.

## Results

One-hundred and thirty patients were able to complete the outcome questionnaires at a minimum of 1-year follow-up. Both groups consisted of 65 patients (Table 1); 2 years following surgery, three patients were lost to follow-up (1 medial UKA, 2 TKA) because they moved away from the area. There were no significant differences in age, gender distribution and average follow-up at 1- and 2-year follow-up between the two cohorts. The average BMI in the medial UKA group ( $28.6 \pm 3.7$  kg/m<sup>2</sup>) was significantly lower than in the TKA group ( $30.3 \pm 4.7$  kg/m<sup>2</sup>) ( $p = 0.02$ ) (Table 1). During the follow-up none of the included patients were re-operated or underwent revision surgery.

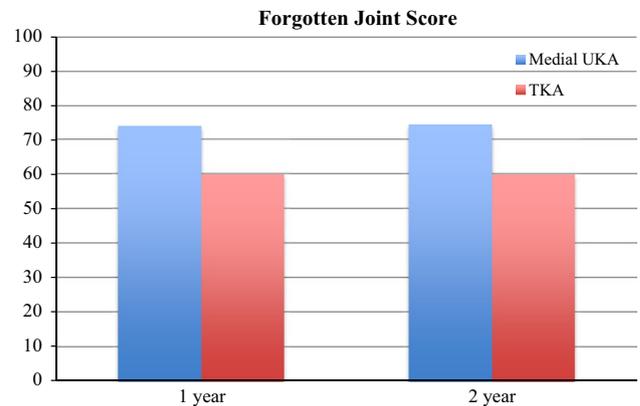
## Outcome measurements

One year following surgery, the mean FJS in the medial UKA group ( $73.9 \pm 22.8$ ) was significantly higher than the TKA group ( $59.3 \pm 29.5$ ,  $p = 0.002$ ); 2 years following surgery, the FJS remained significantly higher in the medial UKA group ( $74.3 \pm 24.8$ ) in comparison with the TKA group ( $59.8 \pm 31.5$ ,  $p = 0.004$ ) (Fig. 1). No significant improvement in the two groups was observed over time when comparing the 1- and 2-year FJS data (Table 2).

No significant differences were found in the FJS between men and women in both the medial UKA and TKA groups at 1 and 2 years following surgery (Table 3). Multivariate regression analysis showed the FJS in the medial UKA group 1 year following surgery to be significantly higher than the TKA group (72.2 vs. 61.1,  $p = 0.02$ ), after controlling for BMI, age, sex and follow-up. This significant difference of the FJS remained at 2-year follow-up in favour of the medial UKA group (72.4 vs. 61.2,  $p = 0.01$ ).

## Discussion

The most important finding of the present study is that patients who have undergone medial UKA are less aware of their artificial joint than patients who have undergone TKA. The FJS has the ability to distinguish between good and excellent outcomes and is therefore not limited



**Fig. 1** Forgotten Joint Score 1 and 2 years following surgery. Note that the medial unicompartmental knee arthroplasty (UKA) group showed significant higher scores at 1- and 2-year follow-up (FJS 1 year  $73.9 \pm 22.8$ , FJS 2 year  $74.3 \pm 24.8$ ) in contrast to the total knee arthroplasty (TKA) group (FJS 1 year  $59.3 \pm 29.5$ ,  $p = 0.002$ , FJS 2 year  $59.8 \pm 31.5$ ,  $p = 0.004$ )

by ceiling effects. There is no consensus in the literature regarding the efficacy of medial UKA compared to TKA with respect to patient satisfaction. The purpose of this study was to compare outcomes of medial UKA and TKA using the FJS at a minimum of 1- and 2-year follow-up. We found that patients undergoing medial UKA had a significantly higher FJS compared to patients undergoing TKA at a mean of 1.5-year follow-up. This significant difference remained at 2.4 years as well in favour of patients who had undergone medial UKA. Furthermore, our data suggest that no improvement in functional outcome is observed after 1-year follow-up since we did not note any significant changes when comparing our 1- and 2-year data of both cohorts. This last finding corresponds to the work of Pynsent [22] and Fitzgerald [7] who also reported no significant changes in PRO scores beyond 1-year follow-up of patients who underwent arthroplasty. However, Giesinger et al. [8] and Ko et al. [11] noted significant improvement when comparing their 2-year follow-up data with respectively 1-year and 6-month follow-up data. Our data might be explained by our average follow-up of 1.5 and 2.4 years following surgery and not 12 and 24 months. Lastly, we did not note a significant influence of gender on joint

**Table 2** Forgotten Joint Score

FJS	1 year	2 year	<i>p</i> value
UKA	73.9	74.3	n.s.
TKA	59.3	59.8	n.s.
<i>p</i> value	<b>0.002</b>	<b>0.004</b>	

Note that no significant improvement was observed after 1 year of surgery for both groups

**Table 3** Forgotten Joint Score by gender

	1 year	2 year
UKA		
Male	74.9	76.1
Female	73.0	72.1
<i>p</i> value	n.s.	n.s.
TKA		
Male	57.7	58.3
Female	59.1	60.8
<i>p</i> value	n.s.	n.s.

awareness of patients who had undergone medial UKA or TKA (Table 3).

There is a paucity of outcome studies utilizing the FJS in the literature. To our knowledge there has been only one comparative study between the UKA and TKA using the FJS. Thienpont and associates [25] found no significant differences in the FJS between patients after UKA and patients after TKA at an average of 2 years following surgery (range 1–3 years). However, in our prospective cohort of patients significantly higher scores are noted for patients who have undergone medial UKA (FJS 1 year  $73.9 \pm 22.8$ , FJS 2 year  $74.3 \pm 24.8$ ) than patients who have undergone TKA (FJS 1 year  $59.3 \pm 29.5$ , FJS 2 year  $59.8 \pm 31.5$ ). Since both differences are significant at both moments of follow-up, our data indicate that this difference is present at 1 year following implantation and does not improve in the time that will follow.

Comparing the baseline characteristics of both groups, we noted significant higher BMI in the TKA group ( $28.6 \pm 3.7$  vs.  $30.3 \pm 4.7$ ,  $p = 0.02$ ). The potential influence of BMI on the functional outcome, survivorship and complication rate following arthroplasty has been extensively studied. Most of the published studies have shown that obesity leads to a higher rate of infections [10, 17] and inferior implant survival [4, 6, 9]. No consensus exists, however, on the influence or relation between obesity and functional outcomes following medial UKA [16, 26] or TKA [1]. In a recent systematic review of 9 studies (670 patients), the influence of obesity on the outcome following TKA was evaluated [10]. The Knee Society Score between

obese patients, defined as a BMI  $\geq 30$  kg/m<sup>2</sup>, and non-obese patients, defined as a BMI  $\leq 30$  kg/m<sup>2</sup>, differed significantly by 3.23 points in favour of the non-obese group. However, this minimal difference is unlikely to be clinically relevant. Baker et al. [1] recently reported the association of BMI and outcome following TKA using data from the National Joint Registry of England and Wales (pre- and post-operative questionnaires; Oxford Knee Score, EQ-5D index and EQ-5D VAS). Patients were divided by BMI in the following groups: non-obese (BMI  $< 25$  kg/m<sup>2</sup>), obese (BMI 25–39.9 kg/m<sup>2</sup>) and morbidly obese (BMI 40–60 kg/m<sup>2</sup>). A total of 13,673 patients were included with an average BMI of  $31.0 \pm 5.5$ . They found that the improvements in outcomes between the non-obese and obese patients did not differ significantly. Furthermore, the morbidly obese group had significantly lower post-operative scores than the non-obese and obese groups. Murray et al. [16] evaluated the effect of BMI on the clinical outcome of 2438 medial Oxford UKAs and found no relation between weight and outcome following medial UKA. In terms of BMI of our two cohorts, we noted a significant pre-operative difference. However, since we excluded patients with a BMI  $> 40$  kg/m<sup>2</sup>, we believe that the difference of BMI (i.e. 1.7 kg/m<sup>2</sup>) between our two cohorts is too marginal to influence outcome. Furthermore, when we stratified our data for BMI, gender, age and follow-up, the significant FJS differences remained.

With respect to registry data, the Norwegian Arthroplasty Register compared the PRO scores between TKA and UKA [13]. At a minimum follow-up of 2 years (mean, 6.5 years), 972 TKAs and 372 UKAs were compared. The outcome questionnaires being used were the Knee Injury and Osteoarthritis Outcome Score (KOOS), the EQ-5D and the visual analogue scale (VAS). The authors found that there were some significant differences in favour of the UKA group. However, the differences were too small to be considered clinically relevant. The National Registry of England and Wales compared the Oxford Knee Score (OKS) and the EQ-5D between 23,393 patients who underwent TKA and 505 patients after UKA (median follow-up of 6.6 months) [2]. No differences in both scores were reported. The authors highlighted that these PRO scores are unable to detect top-end differences and therefore are suboptimal measures in assessing outcomes following knee arthroplasty. Due to the ceiling effects of the traditional scores, we decided to conduct this study using the recently introduced FJS without this limitation.

Despite these results, there are several limitations to the present study. First, all procedures were performed by the senior author who has extensive experience in robot-assisted UKA implantation and TKA using patient-specific guides. Therefore, results may be influenced by the subtleties specific to the respective surgical techniques and may

not be duplicable in low-volume centres. Second, the use of the FJS has the advantage of not being influenced by ceiling effects. However, the score can only be used following surgery since it measures the ability of patients to forget their artificial joint in daily life. Since patients undergoing medial UKA were only affected by medial compartment OA and patients undergoing TKA by multicompartmen-tal OA, it might be possible that they both show the same improvement following knee replacement since pre-operative differences might be present. Unfortunately, this ques-tion cannot be answered with use of the FJS. Therefore, future outcome scores, which are not limited by ceiling effects and are usable pre-operative, are needed to address these questions.

## Conclusion

Our data suggest that patients who undergo UKA are bet-ter able to “forget” their artificial joint in daily life com-pared to patients undergoing TKA. We speculate that this observed difference may be due to the fact that UKA is a more soft-tissue and bone-conserving surgical procedure than TKA. In order to optimize the outcome of patients undergoing knee arthroplasty, this study suggests that—if possible—joint-conserving surgical strategies should be pursued.

## Appendix: FJS-12 score

The following 12 questions refer to how aware you are of your artificial hip/knee joint in everyday life. Please tick one answer from each question.

Are you aware of your artificial joint...

1. ... in bed at night?  
 never  almost never  seldom  sometimes  mostly
2. ... when you are sitting on a chair for more than 1 h?  
 never  almost never  seldom  sometimes  mostly
3. ... when you are walking for more than 15 min?  
 never  almost never  seldom  sometimes  mostly
4. ... when you are taking a bath/shower?  
 never  almost never  seldom  sometimes  mostly
5. ... when you are traveling in a car?  
 never  almost never  seldom  sometimes  mostly
6. ... when you are climbing stairs?  
 never  almost never  seldom  sometimes  mostly
7. ... when you are walking on uneven ground?  
 never  almost never  seldom  sometimes  mostly
8. ... when you are standing up from a low-sitting position?  
 never  almost never  seldom  sometimes  mostly

9. ... when you are standing for long periods of time?  
 never  almost never  seldom  sometimes  mostly
10. ... when you are doing housework or gardening?  
 never  almost never  seldom  sometimes  mostly
11. ... when you are taking a walk/hiking?  
 never  almost never  seldom  sometimes  mostly
12. ... when you are doing your favorite sport?  
 never  almost never  seldom  sometimes  mostly

Scoring: For scoring the FJS-12, all responses are summed (never, 0 points; almost never, 1 point; seldom, 2 points; sometimes, 3 points; mostly, 4 points) and then divided into the number of completed items. This mean value is subsequently multiplied by 25 to obtain a total score range of 0–100. Finally, the score is subtracted from 100, to change the direction of the final score in a way that high scores indicate a high degree of “forgetting” the arti-ficial joint, that is, a low degree of awareness.

If more than four responses are missing, the total score should not be used.

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