



## Patient and Intraoperative Factors Influencing Satisfaction Two to Five Years After Primary Total Knee Arthroplasty



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### ABSTRACT

The purpose of this study was to compare patient demographics and factors recorded at the time of surgery between patients that were either satisfied or dissatisfied with their TKA at mid-term follow-up. From our prospective outcomes database, 989 primary TKAs with complete preoperative and intraoperative data were identified. At mean follow-up of 3.5 years, 94/989 TKAs (9.5%) were not satisfied with their TKA. African American patients were 3.0 times more likely to be dissatisfied than Caucasians (95% CI = 1.5–6.0,  $P = .003$ ). Patients with less severe degenerative changes were 2.1 times more likely to be dissatisfied (95% CI = 1.3–3.2,  $P = .001$ ).

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Between 10% and 20% of primary total knee arthroplasty (TKA) patients have been reported to be dissatisfied with the operation [1–3]. Further, clinical outcomes and complication rates for individual orthopedic surgeons in the United States will soon be made publically available. As such, efforts have been made to better understand factors that are related to postoperative patient satisfaction. Postoperative pain and passive knee flexion have been reported to be related to patient satisfaction, whereas satisfaction was not related to age, sex, body mass index (BMI), or preoperative pain or range of motion [3]. The purpose of this study was to better understand differences between osteoarthritis patients that are either satisfied or dissatisfied two to five years after primary TKA. Specifically, we questioned whether patient factors, the severity of degenerative changes at the time of surgery, and/or technical factors related to the surgery differed between the two patient groups.

### Methods

All patients included in this study had previously consented to participate in our IRB-approved outcomes registry. To eliminate preoperative diagnosis and surgical technique as potential confounding variables, we elected to only include osteoarthritis patients that had undergone cruciate-retaining TKA performed by a single surgeon. A medial parapatellar approach was used in all cases, and the patella was resurfaced using a domed, 3-pegged, all-polyethylene component. We then identified 989 primary

TKAs (755 patients; 248 male, 507 female; age =  $65.0 \pm 9.0$  years, BMI =  $34.3 \pm 6.9$  kg/m<sup>2</sup>) meeting these inclusion criteria that had complete preoperative and intraoperative data with a minimum two-year follow-up. Intraoperatively, the grade of degenerative change on the distal medial and lateral femoral condyle, proximal medial and lateral tibial plateau, patella, and trochlea was graded with the Outerbridge grading system [4]. As well as grading the degenerative changes in each individual compartment, the total Outerbridge grade was defined as the sum of the Outerbridge grades of the six joint surfaces. Total Outerbridge grades could range from 0 to 24, with a total grade of 0 indicating no degenerative changes, and a total grade of 24 indicating severe degenerative changes on each joint surface. Gap balancing techniques were used for all procedures, and we recorded the amount of femoral component rotation necessary to create a rectangular flexion gap with a dual-piston tensiometer as previously described [5]. Details of the bony resection were recorded and included the angle of the distal femoral cut, the amount of distal femur that was resected (mm), and the amount of proximal tibia that was resected (mm). The specific soft tissue structures that were released to balance the knee were recorded, as was the need for lateral release and/or synovectomy. Patient satisfaction was determined at each patient's most recent follow-up by asking patients if they were satisfied with their TKA, and were given the options of answering "Yes", "No", or "I'm not sure." For the purposes of this study, we defined satisfied patients as only those that answered "Yes", with either the response of "No" or "I'm not sure" being indicative of a lack of satisfaction.

### Statistical Analyses

All continuous variables were compared between the groups of satisfied and dissatisfied TKA patients using Mann-Whitney tests. Categorical or dichotomous variables such as sex, race, or the whether a lateral release was performed were compared between satisfied

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and dissatisfied patients using chi square tests. However, Fisher exact tests were utilized if any cells had values less than ten. For variables that were found to differ between the two groups of patients, odds ratios were calculated based on the mean of each group in order to better understand the relationship between each variable and patient satisfaction. For continuous variables such as the total Outerbridge grade, a receiver operating characteristic (ROC) curve was evaluated to determine the most appropriate cut-off value to use for odds ratio calculations. Mann-Whitney, chi square, Fisher exact tests, and ROC curves were performed using SPSS Statistics 21 (IBM, Armonk, New Jersey) and odds ratios were calculated using MedCalc version 12.7.5 (MedCalc Software, Ostend, Belgium). For all analyses,  $P < 0.05$  was considered statistically significant.

## Results

At a mean follow-up of  $3.5 \pm 1.5$  years, 94/989 TKAs (9.5%) were not satisfied with their procedure. Patient demographics of the satisfied and dissatisfied patients are presented in Table 1. The two groups did not differ in age, BMI, or the ratio of female: male patients. There was a significantly greater number of African American patients in the dissatisfied group (11/94 (11.7%)) than the satisfied group (38/875 (4.5%),  $P = 0.002$ ). Excluding the three TKAs performed in Hispanic patients, African American patients were 3.0 times more likely to be dissatisfied with their surgery than Caucasian patients (OR = 3.0, 95% CI = 1.5–6.0,  $P = 0.003$ ).

In general, satisfied patients had more severe degenerative changes at the time of surgery (Table 2). Outerbridge grades were significantly greater in the satisfied group for the distal medial femoral condyle ( $P = 0.01$ ), proximal medial tibia ( $P = 0.01$ ), and trochlea ( $P = 0.02$ ). The majority of technical aspects of the surgeries did not differ between the satisfied and dissatisfied patients, with the sole exception being the amount of tibial resection. The satisfied patients had significantly greater tibial resection ( $8.6 \pm 1.4$  mm vs.  $8.1 \pm 1.3$  mm,  $P < 0.001$ ). Based on the result of the ROC curve analysis of total Outerbridge grade and patient satisfaction, we defined a moderately arthritic knee as being one with a total Outerbridge grade less than 15 (area under curve = 0.61,  $P = 0.001$ ). Of the 989 TKAs in this study, 109 (11.0%) were categorized as moderately arthritic. Moderately arthritic knees were 2.3 times more likely to be dissatisfied with their operation when compared to those with more severe degenerative changes at the time of surgery (OR = 2.3, 95% CI = 1.3–3.9,  $P = 0.004$ ).

## Discussion

The purpose of this study was to compare patient factors and technical aspects of the TKA procedure between satisfied and dissatisfied TKA patients. The two factors that appeared to be associated with the greatest risk of dissatisfaction were African American race and less severe degenerative changes at the time of surgery.

**Table 1**  
Demographics of Satisfied and Dissatisfied TKA Patients.

	Satisfied TKA Patients	Dissatisfied TKA Patients	<i>P</i>
Number of TKAs	895	94	-
Age (years)	$65.1 \pm 8.9$	$64.3 \pm 10.0$	0.73
BMI (kg/m <sup>2</sup> )	$34.2 \pm 6.8$	$35.3 \pm 7.3$	0.22
Sex (Male: Female)	301:594 (33.6%)	25:69 (26.6%)	0.17
Race (African American:Caucasian) <sup>a</sup>	38:847 (4.5%) <sup>b</sup>	11:83 (11.7%) <sup>b</sup>	0.002

<sup>a</sup> Race information was unavailable for 7 patients and 3 patients were of Hispanic descent.

<sup>b</sup> Significantly different ( $P < 0.05$ ).

**Table 2**  
Comparison of Intraoperative Factors Between Satisfied and Dissatisfied TKA Patients.

	Satisfied TKA Patients	Dissatisfied TKA Patients	<i>P</i>
Outerbridge grades			
Medial femoral condyle	$3.6 \pm 0.7^b$	$3.4 \pm 1.0^b$	0.005
Medial tibial plateau	$3.6 \pm 0.8^b$	$3.4 \pm 0.9^b$	0.009
Patella	$3.1 \pm 0.8$	$2.9 \pm 0.9$	0.14
Trochlea	$3.0 \pm 0.8^b$	$2.8 \pm 0.9^b$	0.02
Lateral femoral condyle	$2.6 \pm 1.1$	$2.4 \pm 1.1$	0.25
Lateral tibial plateau	$2.5 \pm 1.1$	$2.4 \pm 1.1$	0.34
Distal femoral resection (mm)	$9.2 \pm 1.4$	$9.0 \pm 1.4$	0.06
Angle of femoral resection (°)	$5.3 \pm 1.0$	$5.4 \pm 0.8$	0.77
Femoral component rotation (°)	$4.3 \pm 4.1$	$5.1 \pm 3.9$	0.09
Proximal tibial resection (mm)	$8.6 \pm 1.4^b$	$8.1 \pm 1.3^b$	<0.001
Number of structures released <sup>a</sup>	$1.8 \pm 0.9$	$1.9 \pm 0.9$	0.68
Native patellar thickness (mm)	$22.4 \pm 2.5$	$22.0 \pm 2.3$	0.28
Resurfaced patellar thickness (mm)	$23.5 \pm 2.3$	$23.3 \pm 2.1$	0.61
Lateral release performed	22/895 (2.5%)	3/94 (3.2%)	0.73
Synovectomy performed	33/895 (3.7%)	0/94 (0%)	0.07

<sup>a</sup> Number of structures release on the side of deformity (medial structures for a varus knee, lateral structures for a valgus knee).

<sup>b</sup> Significantly different ( $P < 0.05$ ).

## Race

Our finding of a threefold increased risk of postoperative dissatisfaction for African American patients following primary TKA was consistent with other reports. African American patients have been reported to be at significantly greater risk of revision within the first five postoperative years (hazard ratio = 1.39) [6], and African American patients were twice as likely to require manipulation under anesthesia (odds ratio = 2.13) [7]. Furthermore, Kamath et al reported that African American TKA patients had significantly lower Knee Society Scores at minimum follow-up of two years [8].

While the literature appears to consistently point toward poorer outcomes for African American patients, we can definitely state that race alone was the sole factor involved with the reduced rate of satisfaction in the current study. Lower socioeconomic status has been reported to be related to poorer pain and functional results 6 months after TKA [9], and socioeconomic status tends to differ by race [10–12]. Barrack et al reported that socioeconomic status was more strongly related to patient satisfaction and functional outcomes than was race [13]. However, after adjusting for socioeconomic status, minority patients in that study were more likely to have functional limitations such as walking with a limp or getting in and out of a car. Further, several other groups of authors have reported that socioeconomic status or income was not directly related to subjective patient satisfaction [14], functional outcomes [15], or the need for early revision [16].

Our results may be limited as we did not quantify socioeconomic status as part of the current investigation. Despite this potential limitation, the current results support the concept of developing targeted educational interventions for the patients with the greatest risk of a poor outcome. The utilization of total knee arthroplasty in minority groups has been reported to be significantly lower than for Caucasians [17]. Ibrahim et al reported that African American osteoarthritis patients have less confidence in the efficacy of TKA and a greater belief that non-operative treatments such as physical therapy, acetaminophen, herbal medicine, massage, or prayer will effectively treat their condition [18]. In response to these findings, Ibrahim et al evaluated the efficacy of an educational intervention for African American patients with knee osteoarthritis, and reported that a greater percentage of patients were willing to consider TKA after the educational intervention [19]. However, they also reported that the willingness to undergo TKA decreased 12 months after the educational intervention and suggested that patient education may need to be repeated over time [19]. Based on the preoperative results of Ibrahim et al [19] and the current study's finding of a 3-fold greater risk of

being dissatisfied postoperatively, we feel improved preoperative and postoperative education for African American TKA patients is vital to creating the optimal environment for a successful clinical outcome.

#### Severity of Degenerative Changes

The severity of degenerative changes present at the time of surgery was inversely related to the risk of dissatisfaction. Patients with severely arthritic knees were twice as likely to be satisfied with their procedure. Our study was consistent with other studies that have evaluated the severity of preoperative radiographic changes and postoperative outcomes. Schnurr et al reported that patients with Kellgren-Lawrence grade II or III changes were 3.0 and 2.6 times more likely to be dissatisfied after TKA than those with grade IV changes, respectively [20]. Keurentjes et al also reported that patients with more severe radiographic osteoarthritis had superior postoperative patient satisfaction, general health, and functional outcomes [21], and Merle-Vincent et al reported that those with greater preoperative joint space narrowing had a greater likelihood of being satisfied with their procedure [22].

Reduced satisfaction for those with less severe disease may be related to several factors. First, TKA may generally result in a greater degree of pain relief for those with more severe disease. For example, consider two osteoarthritis patients; one with severe osteoarthritis and a preoperative VAS pain score of 9/10 and while the other has moderate degenerative changes and rate his/her pain at 5/10. If both patients reported their pain to be 3/10 postoperatively, the patient with more severe preoperative pain may be more satisfied due to the greater magnitude of change. However, while the concept of greater magnitudes of pain relief for more severe patients seems logical, recent reports have demonstrated that preoperative pain scores were not related to postoperative patient satisfaction [3].

However, there may be other underlying mechanisms involved. Psychological factors such as depression and/or anxiety have been reported to negatively influence outcomes after primary TKA [9,23]. Yet it has been unclear whether anxiety and depression prior to TKA amplify symptoms or if these psychological symptoms themselves are the results of chronic pain in the knee osteoarthritis patient [24]. Kim et al reported that depressive characteristics were related to increased subjective symptoms, but only for those with mild to moderate degenerative changes [23]. The relationship between depression and pain was not present for those with Kellgren-Lawrence grade IV changes [23].

Others have suggested that depression and anxiety alone do not fully explain the wide variability in pain responses to mild or moderate degenerative changes [25–28]. Finan et al demonstrated that the concept of central sensitization was involved with the severe pain response in those without severe osteoarthritic changes [25]. Central sensitization involves multi-level neuroplastic alterations that amplify pain [28]. The central nociceptive circuits become sensitized in some knee osteoarthritis patients, thus amplifying pain despite the presence of less severe stimuli [26,27]. With this subset of patients, there is risk of developing chronic pain as central sensitization has been associated with activation of neural circuits that may also be involved with the descending facilitation of pain [29–31].

As such, it may be difficult to differentiate whether an abnormal pain response to less severe degenerative changes is due to psychological factors or an abnormal nociceptive response to painful stimuli. While our current results are limited in that we did not attempt to quantify the absence or presence of depression or anxiety, the finding of a greater rate of dissatisfaction in those with less severe degenerative changes suggests that preoperative screening for psychological disorders may be warranted for those considering TKA with less severe radiographic changes. Additional preoperative and postoperative counseling may also be required for the subset of patients with an abnormal pain response to less severe radiographic osteoarthritis that do not present evidence of psychological disorder.

#### Conclusions

The patient's and surgeon's expectations following TKA widely differ with more than 50% of TKA patients have higher expectations in regards to their surgical outcome than their surgeon [31]. The first step to bridging the gap between patient and surgeon expectations is to achieve a better understanding of which patient and operative factors are related to satisfaction after TKA. In the current study of 989 TKAs, African American patients were three times more likely to be dissatisfied with their TKA. Intraoperatively, those with less severe degenerative changes were 2.1 times more likely to be dissatisfied. We are now actively pursuing both preoperative and postoperative educational interventions for the specific patient populations at greatest risk of being dissatisfied to create more realistic expectations and the optimal environment for a successful clinical outcome.

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