



Predictors of functional outcome after revision total knee arthroplasty following aseptic failure



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ABSTRACT

Background: There are a limited number of studies related to quality of life and functional outcome after revision total knee arthroplasty (TKA). The present study aimed to identify predictors of functional outcome after revision TKA for aseptic failure.

Methods: One hundred seventy-five patients with mean age of 66.6 years (range, 35–88) who underwent revision TKA for aseptic failure at our institute from 2003 to 2007 were identified. Short-form 36 (SF-36), Western Ontario and McMaster Osteoarthritis Index (WOMAC) and Knee Society Scores (KSS) collected preoperatively and at 2 years follow up were evaluated. Univariate and multivariate analyses were performed to determine predictors of functional outcome in studied patients.

Results: Both physical and mental dimensions of SF-36, pain, functional, and stiffness subscales of WOMAC and both functional and clinical scores of KSS improved significantly after revision TKA ($p < 0.001$). In the multivariate analysis, male gender, a lower Charlson comorbidity index, and higher preoperative functional KSS were predictors of higher functional KSS at 2 years after revision. Lower preoperative pain and higher clinical KSS were predictors of better outcome as measured by pain scale of WOMAC. Body mass index (BMI) and preoperative clinical KSS were significant predictors of function and stiffness as measured by WOMAC.

Conclusions: BMI is a modifiable predictor of functional outcome after revision TKA. Moreover, patients with higher preoperative functional scores appear to have better postoperative function.

Level of evidence: Level II.

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1. Introduction

Total joint arthroplasty, including total knee arthroplasty (TKA), is safe and is the treatment of choice for advanced degenerative joint disorders [1]. During recent years, the number of total TKA increased in the United States (US) [2]. Although the incidence of failure after TKA is low [3], as a result of an increasing number of TKAs, the number of revision TKA has also increased in the US [4] and more than 30000 revision procedures were performed in 2005 [2].

Compared with primary knee replacement, revision surgery is technically more difficult and is associated with considerably higher costs [5]. Moreover, it has been demonstrated that the survival rate after revision TKA is less favorable than for primary TKA and some patients may need another revision in the future [2,6,7]. However, due to fewer number of studies on revision TKA compared to primary TKA, predictors of functional outcomes after revision surgery have been poorly defined [2,8].

Functional improvement after joint arthroplasty is a multidimensional factor and multiple outcome measures have been described for

assessment of revision TKA [9]. Although radiographic and clinical outcomes after revision TKA are considered acceptable outcome measures [10], the overall health status of patients is another important end point measure that needs to be investigated. Although quality of life and functional outcome after revision TKA have been evaluated in some studies [2,9–12], most of these studies have limitations, such as low number of patients, assessment of few functional outcomes, and evaluating both septic and aseptic patients together. As a result, predictors of functional outcome following revision TKA, particularly due to aseptic failure, have not yet been well defined. In the present study, we aimed to identify predictors of functional outcome in patients undergoing revision TKA for aseptic failure.

2. Patients and methods

After Institutional Review Board approval, we reviewed our computerized institutional arthroplasty database to identify those patients who underwent revision TKA from 2003 to 2007. Patients who needed unilateral revision due to aseptic loosening of one or both components were included in the study. Patients with diagnosis of rheumatoid arthritis or other inflammatory arthritis and those who needed revision due to infection, fracture, polyethylene wear, or patellar tendon rupture were excluded from the study.

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In addition to demographics, data on Charlson comorbidity index [13] (which was categorized in two groups of ≤ 3 and > 3), severity of knee arthroplasty failure [5], the Short-form 36 (SF-36), the Western Ontario and McMaster Universities Arthritis (WOMAC) and Knee Society Score (KSS) were also obtained.

The SF-36 is a standardized 36-item questionnaire that is completed by the patient and used to determine 8 dimensions of health (physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health). The SF-36 profiles the physical and mental health of the patient and is scored on a scale of 0–100 [14]. In the present study, we divided SF-36 scores into two categories of physical and mental with scores for each ranging from 0 to 100 (with 100 being optimal health). SF-36 scores obtained preoperatively and 2 years after the revision surgery were evaluated for this study.

The WOMAC is a 24-item questionnaire completed by the patient and focuses on joint pain (5 items), stiffness (2 items) and loss of function (17 items) related to osteoarthritis of the knee and hip [15]. Each item is represented by a Likert scale response between 0 (best health state) and 4 (worst state) [16]. In this study we evaluated all 3 domains (pain, stiffness, and function) as well as the total score of the WOMAC measured preoperatively and 2 years after the surgery.

The KSS has two categories, including functional ability and clinical examination scores, each with a 100-point denominator. The functional score includes walking distance, stair-climbing ability, and the use of walking aids. The scores from walking distance and stair-climbing ability are cumulative whereas use of walking aid makes deduction. A patient without limitation in walking distance and normal stair-climbing without the use of a walking aid will be given 100 points. Pain, knee motion, stability, and alignment are components of clinical examination. The examination score also has 100 points comprised of 50 points for the evaluation of motion, stability, and alignment; and 50 points for pain. A well-aligned knee with no pain, 125° of motion, and negligible anteroposterior and mediolateral instability will obtain 100 points [17]. For this study, we also evaluated scores from both domains of KSS measured preoperatively and 2 years after the revision surgery.

2.1. Statistical analysis

Sample size was estimated to be a minimum of 136 subjects for multiple regressions with 12 predictors, 90% power, alpha of 0.05, and correlation of 0.15.

Preoperative and postoperative data were assessed using descriptive statistics and compared with paired two-tailed t-tests. Univariate analysis was performed for each outcome measure (physical health and mental health of SF-36; pain, stiffness, and function domains of WOMAC; and clinical and functional scores of KSS) using linear regression analysis. Multiple regression models were developed using preoperative patient characteristics and functional scores as independent variables, and postoperative scores for various WOMAC subscales and KSS functional score as dependent outcomes. B-coefficients, which indicate the relative contribution of a variable to the overall model and the direction of the linear relationship between the covariate and the dependent variable, were reported for covariates. To further investigate the effect of revision surgery on postoperative pain score, patients were grouped into low, intermediate, or high levels of pain using the 33rd and 67th percentiles as cutoffs for the WOMAC pain score. Analysis of variances (ANOVA) was used to compare improvement in low, intermediate, and high pain groups. For all tests, a p-value < 0.05 was considered to be statistically significant.

3. Results

One hundred seventy-five patients were enrolled in the study. The mean age of patients was 66.0 years (range 34.7 to 88.8) and 63% of the patients were female. Table 1 demonstrates other characteristics of studied patients.

Preoperative and postoperative scores for various outcome measures have been summarized in Table 2. As the data demonstrate, mean postoperative scores for all outcome measures improved significantly at 2 years after revision TKA. Univariate analysis failed to show any significant association between postoperative scores of any outcome measures with severity of TKA failure, length of hospital stay, and number of previous revisions. Therefore, these variables were not included in the multiple regression analysis. Using multivariate analysis, significant predictors of higher postoperative pain were higher preoperative WOMAC pain score and lower preoperative KSS clinical scores (Table 3). The relationship between preoperative and postoperative pain was investigated further in low (0 to 8), intermediate (9 to 12), and high (13 to 20) WOMAC pain groups. As Fig. 1 depicts, patients with higher preoperative pain still had more pain postoperatively than patients in the other two groups. However, the slope is steepest for the highest pain group, indicating greater improvement in pain for this group than for patients with less initial pain. The differences in improvement between low, intermediate, and high-level pain groups were statistically significant ($p < 0.001$).

Independent predictors of greater postoperative stiffness were found to be higher body mass index (BMI) and lower preoperative KSS clinical scores. Preoperative stiffness did not have a statistically significant association with postoperative stiffness when controlling other variables (Table 3). Lower BMI and higher preoperative KSS clinical scores were independent predictors of higher postoperative functional WOMAC scores (Table 3). The KSS function score was also used to assess postoperative functional outcome. Male gender, lower Charlson comorbidity index, and higher preoperative KSS functional scores were found to be independent predictors of postoperative functional KSS score (Table 4).

4. Discussion

The study found that improvement of functional outcome after revision TKA was similar in pattern to primary TKA, but the magnitude was smaller [2,18]. Thus, it was not surprising to observe significant improvement in preoperative functional outcome of patients undergoing revision TKA. The results of our study revealed that all functional outcomes, including both the patient-reported WOMAC and physician-assessed KSS outcomes, significantly improved after revision surgery. Studied patients had lower pain, better function, and less stiffness at 2 years postoperatively. These results are consistent with previous studies which showed improvement in functional outcome of patients following revision TKA [10,14,19–22].

Overall, there was a trend toward better preoperative status correlating with better outcome. These findings are significant because knowledge of the predictors provides information to indicate which patients are likely to benefit most from revision, as well as the general improvement that individual patients might experience. Our results are similar to previous reports for both primary and revision total knee and hip arthroplasty [22–28]. These studies have found that older age, female gender, preoperative pain, poor function, low mental health, and multiple comorbid conditions are predictors of poorer outcomes. We identified BMI and KSS clinical scores as predictors of WOMAC function, while Charlson comorbidity index, gender, and preoperative functional KSS were predictors of postoperative functional KSS. In this regard, our results are consistent with previous reports [26,27,29–32]. Foran et al. [29] and Mulhall et al. [30] found that patients with higher BMI have lower KSS or WOMAC function scores after TKA. Comorbidity has also been shown to be a negative prognostic factor for functional outcomes, including functional KSS [2,29,30].

The WOMAC questionnaire was used to assess pain in this study. Preoperative pain was found to be a strong predictor of postoperative pain, which has also been demonstrated for primary joint arthroplasty

Table 1
Characteristics of 175 studied patients.

Age (years)	
Mean (range)	66.0 (34.7–88.8)
Sex (female)	110 (62.9%)
Mean BMI in kg/m ² (range)	32.1 (18.6–52.1)
Mean Charlson index (range)	2.6 (0–7)
Number of previous revisions	
Single	144 (88.9%)
Multiple	18 (11.1%)
Mean severity of failure score (range)	8.0 (1–25)
Mean length of hospital stay in day (range)	4.3 (2.4–14.3)

BMI: body mass index.

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