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Elevated Body Mass Index Is Associated With Early Total Knee Revision for Infection

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ABSTRACT

Background: Obesity affects over half a billion people worldwide, including one-third of men and women in the United States. Obesity is associated with higher postoperative complication rates after total knee arthroplasty (TKA). It remains unknown whether obese patients progress to revision TKA faster than nonobese patients.

Methods: A total of 666 consecutive primary TKAs referred to an academic tertiary care center for revision TKA were retrospectively stratified according to body mass index (BMI), reason for revision TKA, and time from primary to revision TKA.

Results: When examining primary TKAs referred for revision TKA, increasing BMI adversely affected the mean time to revision TKA. The percent of referred TKAs revised by 5 years was 54% for a normal BMI, 64% for an overweight patient, 71% for an obese class I patient, 68% for an obese class II patient, and 73% for a morbidly obese patient. There was a significant difference in time to revision TKA between patients with normal BMI and elevated BMI ($P = .005$). There was a significant increase in early revision TKA for infection in patients with an elevated BMI (54%, 74/138) when compared with the normal BMI patients (24%, 8/33, $P < .003$, relative risk ratio = 2.3, absolute risk = 30%, number needed to treat = 3.3). There was no significant increase in acute, early, midterm, or late revision TKA for aseptic loosening and/or osteolysis, instability, stiffness, or other causes between patients with normal BMI and elevated BMI.

Conclusion: An elevated BMI is a risk factor for early referral to a tertiary care center for revision TKA. Specifically, orthopedic surgeons should convey to overweight and obese patients that they have at least a 130% increased relative risk and a 30% absolute risk of revision TKA for an early infection if referred for revision TKA. Patient expectations and counseling as well as reimbursement should account for the greater risks when performing a TKA on patients with an elevated BMI.

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The demand for total knee arthroplasty (TKA) is growing exponentially. One million TKAs are projected to be performed in 2015 in the United States alone [1]. In 2013, 4 million adults in the United States live with a knee arthroplasty [2]. Unfortunately, some of these primary TKAs will require revision. In 2010, 67,534 revision

TKAs were performed along with 632,862 primary TKAs, representing a revision TKA burden of 9.6% [3].

Causes of revision TKA include infection, mechanical loosening, implant failure, dislocation, osteolysis, periprosthetic fracture, and other mechanical complications (eg, instability) [4]. Obesity adversely affects perioperative morbidity and mortality after TKA [5–8]. Specifically, obese patients have a significantly higher rate of all-cause revision with an odds ratio (OR) of 1.30 [9]. Whether obesity is implicated as a risk factor for specific complications of TKA is controversial, however. A recent systematic review of 20 studies by Kerkhoffs et al [9] concluded that obesity is associated with higher risk of infection (OR = 1.9) and deep infection requiring surgical debridement (OR = 2.4) but not associated with an

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increased risk of aseptic loosening, intraoperative fracture, nerve injury, tendon and/or ligament rupture, or venous thromboembolism. Another systematic review by McElroy et al [5] evaluated the complication rates for nonobese, obese, and morbidly obese patients and found that the complication rates varied significantly (9%, 15%, and 22%, respectively). A recent review of 13,250 total joint arthroplasty patients in the American College of Surgeons—National Surgical Quality Improvement Program database showed that obesity was associated with 30-day adverse outcomes, including overall, medical, and surgical complications, particularly superficial and deep wound infection, return to OR, and length of stay [8].

Although there is mounting evidence that obesity is associated with high postoperative complication, implant failure, and TKA revision rates, it remains unknown whether patients with an elevated body mass index (BMI) progress to revision TKA at a faster rate than patients with a normal BMI. This study seeks to identify whether BMI affects the duration of implant survival and indication for revision TKA.

Materials and Methods

Using the total joint registry of our institution (a tertiary care center), we retrospectively reviewed 680 primary TKAs (656 patients) that were referred to our institution for revision TKA (ie, the primary TKA was performed elsewhere) over a 10-year period from January 2005 to December 2014. Fourteen patients were excluded from this study because they did not have a preoperative BMI or documented date of primary TKA. As such, 666 revision TKAs in 642 patients were reviewed for the final analysis. Authors J.I.H., W.J.M., S.B.G., and D.F.A. contributed patients for this study. Age, gender, reason for revision TKA (eg, aseptic loosening and/or osteolysis, infection, instability, stiffness, and miscellaneous), preoperative BMI, and time from primary to revision TKA in years were identified.

Statistical Analysis

To compare proportions of overweight or obese (≥ 25 kg/m²) and normal BMI (< 25 kg/m²) patients in the cohort, a 2-sided 2-sample z-test for proportions was used. To compare age at surgery (primary and revision) between overweight or obese and normal BMI, a 2-sided 2-sample t-test was used. The percentage of TKAs revised was evaluated after stratifying the patients by BMI into 5 groups (normal < 25 kg/m², overweight 25–30 kg/m², obese class I 30–35 kg/m², obese class II 35–40 kg/m², and morbidly obese > 40 kg/m²). Differences in time to revision between BMI groups were calculated using a 5-sample log-rank test and a *P* value of $\leq .005$ after Bonferroni correction for multiple comparisons. The log-rank test was calculated using a MATLAB (MathWorks, Natick, MA) script written by Cardillo [10]. A sample size of 666 patients divided between a proportion of 86% (elevated BMI) and 14% (normal BMI) provided a power of 80% to detect a 14% difference in percent revision curves [11].

To compare complication rates between patients with normal BMI and higher-than-normal BMI, we stratified patients by time to revision TKA and by BMI with a cutoff of 25 kg/m². Each cause of failure was compared within a given time to revision group and as an aggregate using a Fisher exact test and a *P* value of $\leq .005$ after Bonferroni correction for multiple comparisons.

Results

Mean time from primary TKA to revision TKA after referral for revision TKA at our academic tertiary care was 5 ± 5 years. Time to revision curves (Fig. 1) were generated to compare the normal,

overweight, obese I, obese II, and morbidly obese groups. The percent of referred TKAs revised by 1 year was 16% for a BMI of 18–25, 21% for a BMI of 25–30, 11% for a BMI of 30–35, 17% for a BMI of 35–40, and 17% for a BMI of over 40. The percent of referred TKAs revised by 5 years was 16% for a BMI of 18–25, 21% for a BMI of 25–30, 11% for a BMI of 30–35, 17% for a BMI of 35–40, and 17% for a BMI of over 40. The percent of referred TKAs revised by 10 years was 76% for a BMI of 18–25, 84% for a BMI of 25–30, 88% for a BMI of 30–35, 88% for a BMI of 35–40, and 91% for a BMI of over 40. There was a significant difference in time to revision TKA between obese class II patients and patients with a normal BMI (Fig. 2, *P* = .005, after Bonferroni correction for multiple comparisons). There was a significant difference in time to revision TKA between patients with normal BMI and elevated BMI (Fig. 3, *P* = .005, after Bonferroni correction for multiple comparisons). All other comparisons between BMI groups did not reach statistical significance.

Mean preoperative BMI was 32 ± 7 kg/m². A total of 91 patients had a BMI between 18 and 25 kg/m² (normal), 214 patients between 25 and 30 kg/m² (overweight), 169 patients between 30 and 35 kg/m² (obese class 1), 105 patients between 35 and 40 kg/m² (obese class 2), and 87 patients with a BMI > 40 kg/m² (morbidly obese). Of the 666 revision TKAs, 171 (26%) were performed for infection, 149 (22%) for instability, 138 (21%) were performed for aseptic loosening, 86 for stiffness (13%), 22 (3%) for failed unilateral knee arthroplasty, 21 (3%) for extensor mechanism disruption, 17 for periprosthetic fracture (3%), 17 (3%) for pain, 13 (2%) for issues related to patellofemoral tracking, 12 (2%) for osteolysis, and 20 (3%) for other causes.

Overweight or obese patients represented a significantly larger proportion of our revision TKAs than normal BMI patients (86% vs 14%, *P* < .001). Mean age at primary TKA for overweight or obese patients was 65 ± 13 years and for normal BMI patients 63 ± 11 years (*P* = .140). Mean age at revision TKA was 71 ± 12 years for overweight or obese patients and 66 ± 10 years for normal BMI patients (*P* < .001). One hundred three (15%) of our referred revision TKAs were performed less than 1 year after the primary TKA (4% for aseptic loosening, 40% for infection, 20% for instability, 17% for stiffness, and 18% for miscellaneous causes). Overall, 335 (50%) of our referred revision TKAs were performed within 1–5 years of the primary TKA (19% for aseptic loosening, 25% for infection, 25% for instability, 14% for stiffness, and 18% for miscellaneous causes). A total of 123 (18%) of our referred revision TKAs were performed within 5–10 years of the primary TKA (33% for aseptic loosening, 21% for infection, 24% for instability, 11% for stiffness, and 11% for

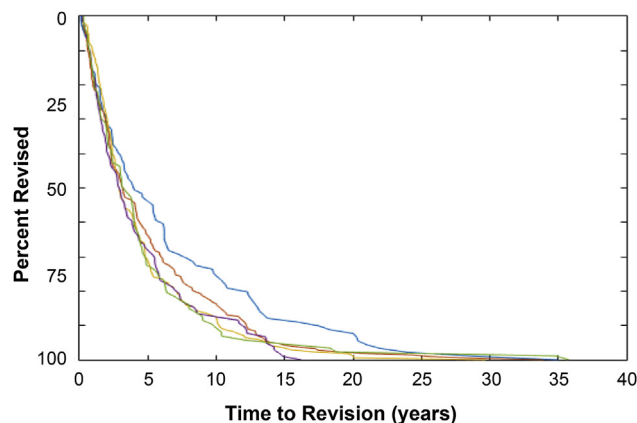


Fig. 1. Rate of revision curves correlating interval from primary total knee arthroplasty (TKA) to referral for revision TKA at our tertiary care center stratified by body mass index (BMI): > 25 kg/m² = reference [blue]; 25–30 kg/m²: *P* = .037 [red]; 30–35 kg/m²: *P* = .006 [yellow]; 35–40 kg/m²: *P* = .005 [purple]; > 40 kg/m²: *P* = .055 [green].

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