An Original Study

The Effect of Obesity on Quality-of-Life Improvement After Total Knee Arthroplasty

David A. McQueen, MD, Michael J. Long, PhD, Amit M. Algotar, MBBS, John R. Schurman, II, MD, and Vinay G. Bangalore, MD

Abstract

Obesity has been consistently implicated as a major risk factor in the development and progression of osteoarthritis (OA), and total joint arthroplasty (TJA) has emerged as one of the most efficacious and cost-effective OA treatments. The effectiveness of this treatment manifests itself in both clinical and quality of life (QOL) measures. Given the interrelatedness of obesity and OA, and given the success of TJA in improving QOL, we conducted a study to determine whether obesity would adversely affect QOL improvement in 50 patients who underwent primary total knee arthroplasty for primary knee OA. Our results show that, 6 months after surgery, QOL measures improved more for obese patients than for overweight patients and patients with ideal body weight.

For many years, obesity has been identified as a health care crisis in the United States. In 1999, 61% of the US population was characterized as being overweight (14% obese); in addition, 35% of 20- to 74-year-olds were identified as overweight. The cost of being overweight or obese in the United States has been estimated at $70 to $100 billion annually, and an estimated 40 million workdays are lost.[1] Kort and colleagues[2] reported that the costs associated with specific obesity-related diseases in the United States represent as much as 7.8% of total health care expenditures. This epidemic is not confined to the United States. Birmingham and colleagues[3] reported that almost one third of adult Canadians are obese and that the estimated total direct cost of obesity is $1.8 billion, or 2.4% of total health care expenditures in 1997.

Dr. McQueen is Professor, Department of Orthopaedic Surgery, University of Kansas School of Medicine, Wichita, Kansas.
Dr. Long is Professor, Department of Public Health Sciences, and Dr. Algotar is a graduate student, Department of Public Health Sciences, Wichita State University, Wichita, Kansas.
Dr. Schurman is Associate Professor, Department of Orthopaedic Surgery, University of Kansas, Wichita, Kansas.
Dr. Bangalore is a graduate student, Department of Public Health Sciences, Wichita State University, Wichita, Kansas.

Requests for reprints: David A. McQueen, MD, Department of Surgery, Section of Orthopaedics, University of Kansas School of Medicine—Wichita, Via Christi Regional Medical Center–St. Francis, 929 N. St. Francis St., Wichita, KS 67214 (tel, 316-268-5988; fax, 316-291-7799; e-mail, dmcqueen@via-christi.org).

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A corollary to such costs is that obesity is implicated as an important predictor of osteoarthritis (OA) progression[4] and a significant risk factor in specific soft-tissue rheumatic conditions.[5] Wellman and Friedberg[1] reported that obesity is an independent risk factor in heart disease, hypoxia, sleep apnea, hernia, and arthritis and is the seventh leading cause of death in the United States. Wendelboe and colleagues[6] argued that obese people are more likely to develop generalized OA leading to knee and hip arthroplasty. Mehrotra and colleagues[7] found that 28% of adults with arthritis (vs only 16% of adults without arthritis) were obese, and Kirkhorn and colleagues[8] found that obesity was an additional independent factor in OA in a rural population.

The Centers for Disease Control and Prevention[9] cited arthritis and other rheumatic conditions as among the most common chronic diseases, affecting 70 million adults in the United States. The prevalence of arthritis increases with age, affecting approximately 60% of the population aged 65 years or older. If the mean age of the US population continues to rise, and if prevalence rates remain stable, the number of affected people in the population that is 65 years old or older will nearly double by 2030.[9] Bijlsma[10] reported that as much as 80% of the population older than 75 years shows radiologic signs of arthritis. In a study of community-dwelling adults born before 1924, Dunlop and colleagues[11] found that 48% of non-Hispanic white adults, 57% of non-Hispanic black adults, and 56% of Hispanic adults reported having arthritis plus other chronic conditions. Reginster[12] reported evidence that arthritis prevalence is not limited to the United States. He indicated that 1.3 to 1.75 million people in England and Wales have OA, that a further 0.25% to 0.5% have rheumatoid arthritis, and that approximately 6 million new OA diagnoses are made each year in France.

According to Wendelboe and colleagues,[6] total knee arthroplasty (TKA) has emerged as one of the most common and efficacious treatments for advanced OA of the knee and has a consistent record of quality of life (QOL) improvement. In a study of 622 patients who underwent TKA, Kiebzak and colleagues[13] found the most postoperative improvement on health-related QOL measures at 3-month follow-up, with total hip arthroplasty (THA) scores improving sooner and more substantially than TKA scores. Walker and colleagues[14] found 79% mean improvement in ambulation at 6 months, and Arslanian and Bond[15] found statistically significant improvement on 7 of the 8 domains of the Medical Outcomes Study 36-Item Short Form (SF-36) 3 months after surgery, with further statistically signifi-

Table I: Preoperative and Postoperative WOMAC Scores: All Patients

WOMAC Category	Preoperative (mean)	Postoperative (mean)	Difference	*t*-value (2-tailed)	Significance (*P*)
Pain	9.73	17.18	7.44	9.22	<.001
Stiffness	3.43	5.54	2.10	4.44	<.001
Physical Functioning	33.47	56.66	22.79	9.03	<.001
Combined Score	47.05	79.39	32.34	9.23	<.001

Table II: Preoperative and Postoperative WOMAC Scores by Body Weight Category

WOMAC Category	Preoperative (mean)	Postoperative (mean)	Difference	*t*-value (2-tailed)	Significance (*P*)
a. Ideal Body Weight (BMI<25.00) n =7					
Pain	9.52	14.13	4.61	1.99	.094
Stiffness	2.67	4.16	1.48	1.34	.229
Physical Functioning	31.99	48.06	16.07	13.72	.021
Combined Score	44.19	66.36	22.17	2.60	.040
b. Overweight (BMI 25.00-30.00) n =13					
Pain	11.97	17.70	5.72	3.48	.004
Stiffness	4.24	5.12	0.88	3.65	.402
Physical Functioning	40.06	54.96	14.90	2.93	.012
Combined Score	56.29	77.80	21.51	3.19	.008
c. Obese (BMI>30.00) n =30					
Pain	8.81	17.67	8.85	9.26	<.001
Stiffness	3.26	6.04	2.77	4.73	<.001
Physical Functioning	31.63	56.40	27.77	8.85	<.001
Combined Score	43.71	83.12	39.40	9.14	<.001

Table III: Preoperative and Postoperative SF-36 Scores: All Patients

SF-36 Category	Preoperative (mean)	Postoperative (mean)	Difference	*t*-value (2-tailed)	Significance (*P*)
Physical Functioning	14.26	20.05	5.79	8.11	<.001
Role Limit-Physical	4.72	6.28	1.56	4.98	<.001
Social Functioning	6.77	8.67	1.90	4.84	<.001
Bodily Pain	5.00	8.02	3.02	9.84	<.001
General Mental Health	18.31	19.17	0.85	2.46	.018
Role Limit-Emotional	4.68	5.25	0.57	2.93	.005
Vitality	12.47	14.70	2.23	3.14	.003
General Health Perceptions	18.17	18.33	0.17	0.37	.713
Physical Component Summary	24.20	34.60	10.40	8.63	<.001
Mental Component Summary	30.02	33.19	3.16	3.80	.001

cant improvement over the next 6 months. In an assessment of the cost-effectiveness of TKA and THA, Hirsch[16] argued that these surgeries will continue to offer cost-effective relief to patients with advanced arthritis. A clinical caveat to these findings was introduced by Ahlberg and Lunden,[17] who argued that obesity increased the risk for complications in TKA. Booth[18] also found that, in the obese, wound complications were more common, and more pressure was placed on the surgeon to achieve perfect alignment and balance, as a patient's weight could "unmask the imperfections of arthroplasty."

Given the interrelatedness of obesity and arthritis and given the demonstrated effectiveness of TKA and THA in improving QOL, it is important to know whether obesity attenuates any potential improvement in QOL after total joint arthroplasty (TJA). The purpose of our study was to determine whether obesity affects QOL improvement in patients who undergo TKA for OA.

Materials and Methods

The study was conducted at a major orthopedic surgery center, affiliated with a teaching hospital where approxi-

Table IV: Preoperative and Postoperative SF-36 Scores: Ideal Body Weight Patients (BMI<25.00)

SF-36 Category	Preoperative (mean)	Postoperative (mean)	Difference	*t*-value (2-tailed)	Significance (*P*)
Physical Functioning	13.60	17.60	4.00	2.64	.058
Role Limit-Physical	4.00	6.20	2.20	3.32	.029
Social Functioning	6.00	7.75	1.75	1.85	.162
Bodily Pain	4.67	7.33	2.67	2.53	.053
General Mental Health	15.29	16.71	1.43	1.47	.192
Role Limit-Emotional	4.50	4.67	0.17	1.00	.363
Vitality	10.14	13.43	3.29	2.23	.068
General Health Perceptions	17.86	16.43	-1.43	-1.64	.151
Physical Component Summary	22.25	31.00	8.75	2.21	.115
Mental Component Summary	26.50	29.00	2.50	1.11	.348

Table V: Preoperative and Postoperative SF-36 Scores: Overweight Patients (BMI 25.00-30.00)

SF-36 Category	Preoperative (mean)	Postoperative (mean)	Difference	*t*-value (2-tailed)	Significance (*P*)
Physical Functioning	14.50	20.08	5.58	4.50	.001
Role Limit-Physical	5.45	6.55	1.09	1.54	.154
Social Functioning	8.45	9.73	1.27	2.05	.067
Bodily Pain	5.77	8.38	2.62	5.68	<.001
General Mental Health	19.58	19.92	0.33	0.51	.615
Role Limit-Emotional	5.00	5.36	0.36	0.93	.371
Vitality	14.92	16.25	1.33	0.82	.427
General Health Perceptions	19.00	18.31	-0.69	-0.56	.581
Physical Component Summary	25.80	35.20	9.40	5.07	.001
Mental Component Summary	32.77	34.22	1.44	0.99	.350

Table VI: Preoperative and Postoperative SF-36 Scores: Obese Patients (BMI>30.00)

SF-36 Category	Preoperative (mean)	Postoperative (mean)	Difference	*t*-value (2-tailed)	Significance (*P*)
Physical Functioning	14.28	20.52	6.24	6.21	<.001
Role Limit-Physical	4.56	6.19	1.63	4.14	<.001
Social Functioning	6.13	8.33	2.21	4.00	.001
Bodily Pain	4.70	8.00	3.30	7.85	<.001
General Mental Health	18.52	19.45	0.93	2.02	.053
Role Limit-Emotional	4.59	5.33	0.74	2.74	.011
Vitality	12.00	14.36	2.36	2.57	.016
General Health Perceptions	17.86	18.82	0.96	2.18	.038
Physical Component Summary	23.80	35.00	11.19	6.63	.001
Mental Component Summary	29.56	33.52	3.95	3.57	.002

mately 40 joint arthroplasties are performed each week. Although consideration of the long-term effects of TKA is desirable, studies that attempt to evaluate patients 1, 2, or 3 years after surgery are often at the mercy of loss to follow-up. The orthopedic literature has recognized the benefits of evaluating patients 3 and 6 months after surgery.[4,13,15] It is also important to recognize that there is no reason to expect, a priori, that patients classified by body mass index (BMI) will experience a differential effect in the short term or that any long-term improvement would not be consistent with the short-term effects. That determination is beyond the scope of this work. Given the generally accepted value of short-term evaluation, we chose to evaluate patients before surgery and 6 months after surgery. We used scores from 2 QOL outcome measures—the disease-specific Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) and the general Medical Outcomes Study 36-Item Short Form (SF-36). Preoperative and 6-month postoperative data were obtained voluntarily from patients who underwent TKA for primary knee OA between September 1996 and May 1999. The sample size of 50 used in this study was determined as follows:

Expected effect size (E) = 3
Estimated SD = 5
Standardized effect size (E/SD) = .60
α (2-tailed) = .05
β = .20 (power = .80)
Required sample size = 44

In this study, obesity was measured by BMI (kg/m^2). Consistent with the work of Sturmer and colleagues[19] and Kalantar-Zadeh and colleagues,[20] we then classified study participants as having ideal body weight (BMI, <25.00 kg/m^2) or being overweight (BMI, 25.00-30.00 kg/m^2) or obese (BMI, >30.00 kg/m^2).

WOMAC and SF-36 scores were obtained from self-report questionnaires. Separate analyses of WOMAC and SF-36 scores were conducted for all patients and within each body-weight category using a 2-tailed, paired-samples *t* test.

Results

All 50 patients had a primary diagnosis of primary knee OA. At time of surgery, mean age was 68 years (range, 54-80 years). One patient was African American; the other 49 were Caucasian. Thirty-six patients (72%) were female, and 14 (28%) were male. Seven patients (14%) had ideal weight, 13 (26%) were overweight, and 30 (60%) were obese. Although our sample was not drawn as representative of the US population, its obesity level (60%) turned out to be representative.

Paired-samples *t*-test results (Table I) indicate, for all patients, a statistically significant improvement (P<.001) in total WOMAC score and in all WOMAC component scores.

Table II shows statistically significant improvement in postoperative WOMAC Physical Functioning score (P = .021) and total score (P = .040) for patients with ideal weight (BMI, <25.00 kg/m^2); in Pain score (P = .004), Physical Functioning score (P = .012), and total score (P = .008) for overweight patients (BMI, 25.00-30.00 kg/m^2); and in all scores, Pain (P<.001), Stiffness (P<.001), Physical Functioning (P<.001), and total (P<.001), for obese patients (BMI, >30.00 kg/m^2). The t values further indicate that, for Pain, Physical Functioning, and total scores, there was increased postoperative improvement for obese patients.

Similar results were found when SF-36 was used as the QOL measure. Table III shows that, for all patients, there was statistically significant improvement in postoperative SF-36 scores: Physical Functioning (P<.001), Role Limitation–Physical (P<.001), Social Functioning (P<.001), Bodily Pain (P<.001), General Mental Health (P = .018), Role Limitation–Emotional (P = .005), Vitality (P=.003), Physical Component Summary (P<.001), and Mental Health Component Summary (P = .001).

Table IV lists SF-36 results for patients with ideal weight. These patients showed statistically significant improvement in scores on only 1 of the 10 components of the SF-36: Role Limitation–Physical (P = .029). Table V lists SF-36 results for overweight patients, who showed statistically significant improvement in Physical Functioning (P = .001), Bodily Pain (P<.001), and Physical Component Summary (P = .001). Table VI lists SF-36 results for obese patients, who showed statistically significant improvement in all components except General Mental Health (P=.053).

Discussion

Our finding of significant improvement in postoperative WOMAC and SF-36 scores over preoperative scores is consistent with previous results indicating that TKA is extremely efficacious in treating severe knee OA. These preoperative–postoperative differences can be interpreted as indicating significant improvement in QOL for patients undergoing TKA.

Ahlberg and Lunden[17] argued that obesity increased the risk for complications. Booth[18] indicated that wound complications were more common in obese patients and that more pressure was placed on the surgeon to achieve perfect alignment and balance, "because a patient's weight could unmask the imperfections of arthroplasty." Miric and colleagues[21] found that the risk for postoperative complications was highest for patients with BMI higher than 35 kg/m^2. Contrary to these previous findings, our results indicate that obese patients show more improvement on WOMAC and SF-36 than do patients with ideal weight or overweight patients. In fact, these findings indicate that obesity should not be considered a contraindication for TJA.

Our finding that ideal-weight patients did not improve as much as obese patients may seem counterintuitive. Although we do not have data to support such speculation, it is possible that ideal-weight patients tend to be more active and to engage in the physical activity usually associated with their age, sex, and occupation. These patients would be more likely to engage in physical activity soon after surgery and therefore more likely to experience higher levels of pain and stiffness. Overweight patients, on the other hand, would be less likely to engage in physical activity so soon after surgery and therefore more likely to experience lower levels of pain and stiffness. Consistent with their preoperative lifestyle, obese patients would be even less likely to engage in physical activity after surgery and would therefore place less stress on the joint and surgery site and be more likely to experience the lowest levels of pain and stiffness. It is also possible that ideal-weight patients would expect more from surgery and would therefore underreport improvement in symptoms in comparison with their obese and overweight counterparts. These speculations are offered as guidance for additional, longer term follow-up studies.

Two caveats are in order with respect to this study. First, all patients but 1 were Caucasian, and only 2 orthopedic surgeons performed all the surgeries. A more representative patient population and more surgeons would help to generalize our results. Second, postoperative complications data were collected at 6-month follow-up. A longer follow-up period would provide important information regarding the potential for the documented short-term improvement to decay or persist over time.

Author's Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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(Continued on page E127)

(Continued from page E120)

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