Joint Replacement Surgery in Elderly Patients With Severe Osteoarthritis of the Hip or Knee

Decision Making, Postoperative Recovery, and Clinical Outcomes

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Background: Osteoarthritis (OA) of the hip and knee is a common cause of pain and disability in elderly patients. Joint replacement surgery can alleviate pain and restore function but is associated with risks and discomfort.

Methods: We conducted a prospective cohort study to examine decision making and clinical outcomes for elderly patients (age ≥65 years) with severe OA of the hip or knee with symptoms inadequately controlled with conservative treatments. Osteoarthritis symptoms and functional status were assessed at baseline and at 12 months. Postoperative symptoms and function were assessed 6 weeks, 6 months, and 12 months after surgery.

Results: For the 174 patients studied (mean age, 75 years; 76% were female, 17% were nonwhite, 69% had knee OA, and 31% had hip OA), the mean Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score was 56 on a 100-point scale. During a 12-month follow-up, 29% had joint replacement surgery. Of patients who had surgery, no patients died, 17% had postoperative complications, and 38% had postoperative pain lasting more than 4 weeks. The median time to recovery of independence in walking was 12 days and to ability to perform household chores was 49 days, with similar times for patients 65 to 74 years old and those 75 years or older. At 12 months, WOMAC scores improved by 24 points in the patients who had surgery and 0.5 point in the patients who did not have surgery ($P < .001$); improvements were 19 and 0.3 points in patients 75 or older ($P < .001$). Among patients who did not have surgery, 45% reported that surgery was not offered as a potential treatment option.

Conclusions: Elderly patients who had hip or knee replacements for severe OA took several weeks to recover but experienced excellent long-term outcomes. Physicians often do not discuss joint replacement surgery with elderly patients who might benefit.

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SEVERE OSTEOARTHRITIS (OA) of the hip or knee causes debilitating pain and is a common cause of mobility impairment in elderly individuals.[1] In advanced stages of OA of the hip and knee, noninvasive treatments such as medications and physical therapy are of limited value. Joint replacement can effectively alleviate pain and restore function; however, it is associated with risk and does not prolong life.[2-12] The potential benefits of joint replacement must be weighed against the risk of surgical mortality and morbidity and the discomfort and inconvenience associated with recovery.

Owing to the changing demographics of the US population,[13] the number of elderly patients with advanced OA is increasing, and joint replacement surgery among Medicare recipients has become more common.[14] Studies have demonstrated good outcomes of arthroplasty in elderly patients[8,15]; however, in general, mortality and complication rates from major surgery rise with increased age,[16-18] and the impact of advanced age on postoperative recovery has not been well studied. More information about the risks and benefits of joint replacement surgery for elderly patients is needed to help them and their physicians make difficult decisions about whether to pursue major surgery. In this prospective study, we examined decision making and clinical outcomes for elderly patients with severe OA of the hip or knee with symptoms and functional limitations inadequately controlled with conservative treatments.

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METHODS

OVERVIEW OF STUDY DESIGN

We conducted a prospective cohort study of elderly patients with severe OA of the hip or knee. Patients were interviewed at baseline and at 12 months. For patients who had surgery during

the study period, interviews were conducted 6 weeks, 6 months, and 12 months after surgery. Medical records were also reviewed to assess complications of joint replacement surgery.

PATIENTS

Inclusion criteria for the study were (1) age 65 years or older, (2) radiograph demonstrating severe OA of the hip or knee,[19,20] and (3) moderate or severe pain or stiffness of the knee or hip and functional impairments for at least 6 months that were not controlled with medical therapy.[2-5,21] Eligibility criteria were designed to study a group of patients who were potentially appropriate candidates for joint replacement surgery.

Patients 65 years or older who had had a radiograph of the hip or knee from August 2001 to July 2004 at Beth Israel Deaconess Medical Center radiology facilities in Boston, Massachusetts, were screened for eligibility. The Beth Israel Deaconess radiology services perform radiographs at 5 clinical sites in Boston and the surrounding areas, and a database contains full reports of radiographs. We searched the database weekly to identify reports with terms suggesting severe OA. Search terms consisted of 60 phrases that required pairing of the words "severe" (or synonyms such as "advanced" or "marked") and "osteoarthritis" (or synonyms such as "degenerative arthritis" or "DJD") or other phrases such as "complete loss of joint space." The list of 60 phrases was developed based on review of the literature and pilot testing. Two physicians (M.B.H. and M.T.) reviewed reports flagged by the electronic search to determine patients' eligibility. Patients who had acute fractures were excluded.

After obtaining permission from patients' physicians, potentially eligible patients were sent a letter describing the study. Patients who did not return a postcard or call to decline participation were called to assess their eligibility and to conduct baseline interviews if they were eligible and agreed to participate. Verbal informed consent was obtained from each patient. The study was approved by the Beth Israel Deaconess Medical Center's institutional review board.

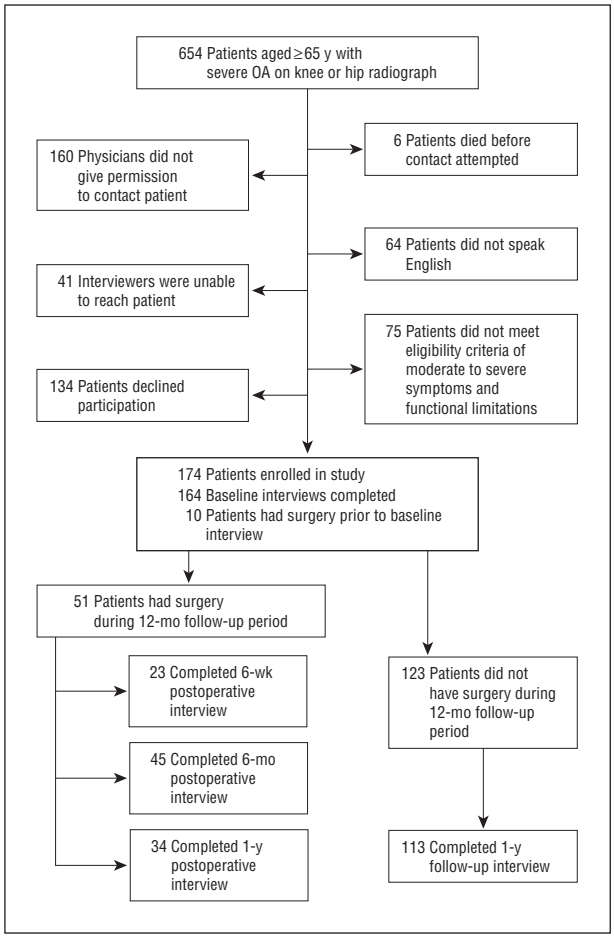

Figure 1. Patient enrollment and interviews. OA indicates osteoarthritis.

DATA COLLECTION

Baseline Interviews

One experienced professional interviewer conducted all of the interviews. Baseline interviews were conducted within 6 weeks of radiographs for 62% of patients, within 8 weeks for 82%, and within 12 weeks for 96%. The baseline interview included the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), a validated instrument to assess pain, stiffness, and functional limitations related to OA.[22] Patients were eligible for the study if they reported "moderate," "severe," or "extreme" pain or stiffness in response to at least 1 of the 5 pain questions (pain with walking, climbing stairs, reclining, sitting, or standing) and the 2 stiffness questions (morning stiffness, stiffness later in day) *and* if they reported "moderate," "severe," or "extreme" difficulty with at least 1 of the 17 activities. Patients were eligible if they had tried medications or other treatments for their OA and had first tried treatment at least 6 months previously. Eligibility also required a score of at least 10 of 22 on a modified Mini-Mental State Examination (mMMSE)[23] (**Figure 1**).

General health status was assessed with the 12-Item Short-Form Health Survey (SF-12)[24] and functional status with a modified version of the Katz basic activities of daily living (BADL)[25,26] and instrumental activities of daily living (IADL) scales[27,28] A series of questions assessed communication with physicians about joint replacement surgery and patients' views of the risks and benefits of surgery. Patients were asked about their race and ethnicity, income, education, marital status and living situation, height, and weight. A telephone version of the Charlson Comorbidity Index[29] assessed patients' other health problems.

Follow-up Interviews

A survey similar to the baseline survey was administered to patients who had not had surgery at 12 months (78% of surveys were completed after 11-14 months; 15%, at 8-10 months; 5%, at 15-16 months; and 3%, after 16 months).

Electronic hospital information was assessed monthly to identify patients who had undergone surgery at the 2 affiliated hospitals where the target population typically has orthopedic surgery. Patients were also contacted at months 4 and 8 to inquire if they had or were scheduled to have joint replacement surgery. Patients who had undergone surgery were interviewed 6 weeks, 6 months, and 12 months after surgery. The 6-week, 6-month, and 12-month interviews were conducted an average of 7.7 weeks, 27.3 weeks, and 53.5 weeks after surgery, respectively. Interviews included the items in the baseline interview as well as a series of questions about the patients' postoperative symptoms (pain, nausea, confusion), functional recovery after surgery (BADLs and IADLs), and satisfaction with surgery.

Hospital discharge summaries (available for 42 of 51 patients who had surgery) were reviewed by 1 physician (M.T.) to determine if patients had any postoperative complications. The interviewer documented all complications reported, including assessment for 21 complications used in prior research.[30]

Table 1. Baseline Patient Characteristics

Characteristic	All Patients (N=174)[a]	Patients Aged 65-74 Years (n=91)	Patients Aged ≥75 Years (n=83)	*P* Value
Demographics				
Age, median (range), y	74.0 (65.0-96.0)	69.0 (65.0-4.0)	80.0 (75.0-6.0)	NA
Mean (SD)	75.2 (7.2)	69.6 (3.1)	81.3 (4.9)	
Sex, No. (%)				
Female	133 (76.4)	72 (79.1)	61 (73.5)	.38
Male	41 (23.6)	19 (20.9)	22 (26.5)	
Race/ethnicity, No. (%)				
White	144 (82.8)	73 (80.2)	71 (85.5)	.75
Black	26 (14.9)	15 (16.5)	11 (13.3)	
Asian	1 (0.6)	1 (1.1)	0 (0)	
Other	3 (1.7)	2 (2.2)	1 (1.2)	
Hispanic	5 (3.0)	3 (3.6)	2 (2.4)	>.99
Education, No. (%)				
Some high school	25 (15.2)	17 (20.5)	8 (9.9)	.22
High school	49 (29.9)	20 (24.1)	29 (35.8)	
Some college	45 (27.4)	21 (25.3)	24 (29.6)	
College graduate	24 (14.6)	14 (16.9)	10 (12.4)	
Some postgraduate	21 (12.8)	11 (13.3)	10 (12.4)	
Income, $, No. (%)				
<11 000	15 (8.6)	9 (9.9)	6 (7.2)	.45
11 000-25 000	55 (31.6)	25 (27.5)	30 (36.1)	
25 000-50 000	43 (24.7)	20 (22.0)	23 (27.7)	
>50 000	33 (19.0)	20 (60.6)	13 (15.7)	
Missing/do not know/refused	28 (16.1)	17 (18.7)	11 (13.3)	
Living alone, No. (%)	76 (46.3)	31 (37.4)	45 (55.6)	.03
Clinical data				
Knee OA, No. (%)	120 (69.0)	6 (67.0)	59 (71.1)	.56
Hip OA, No. (%)[b]	55 (31.6)	30 (33.0)	25 (30.1)	.69
WOMAC, mean (SD)				
Total score	56.2 (13.2)	56.7 (13.1)	55.7 (13.5)	.63
Pain subscale	53.8 (14.0)	55.4 (13.4)	52.1 (14.6)	.12
Stiffness subscale	60.9 (16.5)	63.0 (16.2)	58.8 (16.7)	.10
Function subscale	56.4 (14.7)	56.3 (14.7)	56.4 (14.9)	.98
SF-12, mean (SD)				
Physical	33.2 (9.2)	33.3 (9.1)	33.1 (9.3)	.90
Mental	41.4 (6.6)	40.6 (6.2)	42.2 (7.0)	.13
BADLs, mean dependencies (SD)[c]	0.2 (0.7)	0.1 (0.5)	0.3 (0.8)	.20
IADLs (Physical subset), mean dependencies (SD)[d]	2.4 (1.8)	2.1 (1.6)	2.8 (1.9)	.01
Assistance needed in IADLs, No. (%)[d]				
Preparing food	16 (9.8)	6 (7.4)	10 (12.5)	.25
Household chores	88 (53.7)	41 (48.8)	47 (58.8)	.20
Going shopping	53 (32.3)	20 (23.8)	33 (41.3)	.02
Doing laundry	42 (25.6)	17 (20.2)	25 (31.3)	.11
Outdoor activities (eg, gardening)	151 (92.1)	75 (89.3)	76 (95.0)	.18
Driving or using public transportation	45 (27.4)	15 (17.9)	30 (37.5)	.01
Charlson comorbidity scale, mean (SD)[e]	1.5 (1.5)	1.4 (1.5)	1.6 (1.5)	.41
mMMSE score, mean (SD)	18.9 (2.5)	19.4 (2.5)	18.4 (2.5)	.01
BMI, mean (SD)	30.1 (8.4)	31.5 (9.7)	28.7 (6.6)	.04

Abbreviations: BADLs, basic activities of daily living; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); IADLs, instrumental activities of daily living; mMMSE, modified Mini-Mental State Examination; NA, not applicable; OA, osteoarthritis; SF-12, 12-Item Short-Form Health Survey; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Range of scales: WOMAC, 0-100 (higher scores indicate more severe symptoms); SF-12, 0-100 scale (higher scores indicate less severe symptoms); BADLs, 6-point scale (a higher score indicates more disability); IADLs (physical subset): 0-6 (higher scores indicate more disability); Charlson comorbidity scale, 0-27 (higher scores indicate more comorbid illness); mMMSE, 0-22 (higher scores indicate better cognitive function).

[a] Ten patients did not complete the baseline interview. The number of missing for each item in the table was 10 except for the following variables: age (0 missing), sex (0), race (0), ethnicity (8), income (28), Charlson comorbidity (11), and BMI (8).

[b] One patient had both hip and knee OA.

[c] Basic ADLs items in scale: getting out of bed or chair, change night clothes, washing, eating, toilet or bathroom use, and walking. One point was assigned for each ADL with which the patient requires assistance.

[d] IADLs items in scale: food preparation, household chores, going shopping, doing laundry, outside activities (eg, gardening), driving or using public transportation. One point was assigned for each activity with which the patient requires assistance.

[e] The Charlson comorbidity score was computed in the following manner (points assigned): myocardial infarction (1), heart failure (1), lower extremity bypass surgery (1), stroke (1), difficulty moving an arm or leg as a result of stroke (2), asthma and/or chronic obstructive pulmonary disease (1), ulcer (1), diabetes mellitus (1-2), renal failure (1-2), arthritis (1), dementia (1), cirrhosis or severe liver disease (3), leukemia (2), lymphoma (2), and other cancer (≤6).

Table 2. Association Between Baseline Patient Characteristics and Joint Replacement Surgery

Characteristic	Unadjusted Results[a]			Adjusted Results, Adjusted OR (95% CI)[c]
	Surgery Group (n=51)	Nonsurgery Group (n=123)	Unadjusted OR (95% CI)[b]	
Age group, No. (%), y				
≥75	18 (35.3)	65 (52.9)	0.49 (0.25-0.96)[d]	0.53 (0.25-1.13)
65-74	33 (64.7)	58 (47.15)		
Age, mean (SD), y	73.2 (5.7)	76.1 (7.55)	0.94 (0.90-0.99)[d]	0.95 (0.90-1.01)
Sex, No. (%)				
Female	36 (70.6)	97 (78.4)	0.64 (0.31-1.35)	0.48 (0.20-1.17)
Male	15 (29.4)	26 (21.1)		
Race/ethnicity, No. (%)				
Nonwhite	5 (9.8)	25 (19.3)	0.43 (0.15-1.18)	0.46 (0.13-1.66)
White	46 (90.2)	98 (79.7)		
Education, No. (%)				
<Some college	19 (44.2)	55 (45.5)	0.95 (0.47-1.91)	1.47 (0.64-3.40)
≥Some college	24 (55.8)	66 (54.6)		
Income, $, No. (%)				
0-25 000	14 (27.5)	56 (45.5)	0.51 (0.97-1.09)[d]	0.36 (0.14-0.91)[d]
≥25 001	25 (49.0)	51 (41.5)		
Marital status, No. (%)				
Not married	21 (48.8)	79 (65.3)	0.51 (0.25-1.03)	0.77 (0.31-1.91)
Married	22 (51.2)	42 (34.7)		
Living situation, No. (%)				
Living alone	17 (39.5)	59 (48.8)	0.69 (0.34-1.39)	0.85 (0.38-1.89)
Not living alone	26 (60.5)	62 (51.2)		
OA-specific clinical data				
Knee OA, No. (%)	30 (58.8)	90 (73.2)	0.52 (0.26-1.04)	0.70 (0.30-1.60)
Total WOMAC, mean (SD)	58.9 (13.7)	55.3 (13.0)	1.02 (0.99-1.05)	1.05 (1.01-1.09)[d]
SF-12, mean (SD)				
Physical	31.6 (9.5)	33.8 (9.0)	0.97 (0.93-1.01)	0.98 (0.93-1.03)
Mental	42.0 (7.7)	41.2 (6.2)	1.02 (0.97-1.07)	1.02 (0.96-1.08)
BADLs, mean dependencies (SD)	0.20 (0.68)	0.17 (0.59)	1.09 (0.61-1.92)	1.16 (0.60-2.22)
IADLs (physical subset), mean (SD)	2.3 (1.7)	2.5 (1.8)	0.94 (0.76-1.16)	0.90 (0.67-1.20)
Charlson comorbidity, mean (SD)	1.5 (1.5)	1.5 (1.4)	0.98 (0.77-1.26)	0.90 (0.69-1.19)
mMMSE, mean (SD)	19.8 (2.1)	18.5 (2.6)	1.25 (1.07-1.46)[d]	1.17 (0.98-1.40)
Patients' attitudes toward joint replacement surgery at baseline, No. (%)				
How helpful would surgery be in relieving pain?				
Helpful with pain	37 (100)	76 (85.4)	NA[e]	NA
Not helpful with pain	0	13 (14.6)		
Do not know=36				
Missing=12				
How helpful would surgery be in relieving stiffness?				
Helpful with stiffness	32 (97.0)	69 (85.2)	5.57 (0.69-44.66)	4.01 (0.47-34.36)
Not helpful with stiffness	1 (3.0)	12 (14.8)		
Do not know=46				
Missing=14				
How risky do you think surgery would be for you?				
Risky	24 (66.7)	80 (74.1)	0.70 (0.31-1.58)	0.70 (0.29-1.70)
Not risky	12 (33.3)	28 (25.9)		
Do not know=18				
Missing=12				
How worried are you about dying during surgery?				
Worried about dying	10 (25.0)	60 (50.4)	0.33 (0.15-0.73)[d]	0.27 (0.11-0.67)[d]
Not worried about dying	30 (75.0)	59 (49.6)		
Do not know=3				
Missing=12				

(continued)

STATISTICAL ANALYSIS

Baseline characteristics were summarized using descriptive statistics, and comparisons were made between patients aged 65 to 74 years and those 75 years or older using t, χ^2, and Fisher exact tests. Age 75 years was chosen as the dividing point to allow comparisons between an elderly group and very elderly age group, with approximately 50% in each group.

Postoperative symptoms and recovery were described, and comparisons were made between the 2 age groups using Fisher exact tests. Kaplan-Meier plots were used to report patients' time to recovery of ADLs after surgery, and recov-

Table 2. Association Between Baseline Patient Characteristics and Joint Replacement Surgery (cont)

Characteristic	Unadjusted Results[a]			Adjusted Results, Adjusted OR (95% CI)[c]
	Surgery Group (n=51)	Nonsurgery Group (n=123)	Unadjusted OR (95% CI)[b]	
Patients' attitudes toward joint replacement surgery at baseline (cont)				
How worried are you about having a complication from surgery?				
Worried about complications	20 (48.8)	86 (71.1)	0.39 (0.19-0.80)[d]	0.34 (0.16-0.77)[d]
Not worried	21 (51.2)	35 (28.9)		
Missing=12				
How worried are you about a long recovery from surgery?				
Worried about recovery	24 (58.5)	102 (84.3)	0.26 (0.12-0.58)[d]	0.33 (0.14-0.78)
Not worried about recovery	17 (41.5)	19 (15.7)		
Missing=12				
How worried are you about the discomforts of surgery?				
Worried about discomfort	27 (65.9)	90 (77.6)	0.56 (0.26-1.21)	0.68 (0.29-1.59)
Not worried about discomfort	14 (34.2)	26 (22.4)		
Missing=17				
How worried are you about needing help from others?				
Worried about needing help	24 (58.5)	93 (76.9)	0.43 (0.20-0.90)[d]	0.44 (0.19-1.01)
Not worried about help	17 (41.5)	28 (23.1)		
Missing=12				
How worried are you about the expense of surgery?				
Worried about expense	6 (14.6)	30 (25.6)	0.50 (0.19-1.30)	0.66 (0.24-1.83)
Not worried about expense	35 (85.4)	87 (74.4)		
Do not know=2				
Missing=14				

Abbreviations: BADL, basic activities of daily living; CI, confidence interval; IADL, instrumental activities of daily living; mMMSE, modified Mini-Mental State Examination; NA, not applicable; OA, osteoarthritis; OR, odds ratio; SF-12, 12-Item Short-Form Health Survey; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

[a] Ten patients did not complete the baseline interview. The number of missing for the demographic and clinical items in the table was 10 except for the following variables: age (0 missing), sex (0), race (0), ethnicity (8), income (28), and Charlson comorbidity (11). Missing values for patient attitudes are listed in the table.

[b] The ORs compare the first category with the second category for each variable.

[c] Adjusted ORs and corresponding CIs were derived from a multivariate model that included knee OA vs hip OA, age, income, sex, Charlson comorbidity score, and WOMAC total score.

[d] $P<.05$.

[e] Unable to divide by 0; $P=.01$.

ery was compared between age groups using the log-rank test.[31]

We tested for unadjusted associations between baseline characteristics and whether patients had surgery during the 12-month follow-up period using χ^2, Fisher exact, and logistic regression analysis. In multivariate logistic regression analyses, we adjusted for sex, age, income, hip vs knee OA, Charlson comorbidity, and total WOMAC score to adjust for the potential confounding effect of patients' demographic and disease severity characteristics.

We computed change in OA symptoms and functional status between baseline and 12-month follow-up for nonsurgical patients and between baseline and 12-month follow-up for surgical patients. For surgical subjects who did not have a 12-month follow-up interview, we used information from 6-month interviews, if available. In all, follow-up data were available for 161 subjects. For the 10 patients who did not complete baseline interviews, the median values were imputed to allow computation of change between baseline and follow-up. In a sensitivity analysis, these 10 patients were excluded, and results were similar.

To account for potential baseline differences between patients who had surgery and those who did not, we created a propensity score[32] to estimate each patient's probability of having surgery based on a logistic regression model including sex, income, knee vs hip OA, Charlson comorbidity score, and total WOMAC score. In multivariate linear regression models, we examined the association between surgery and the continuous outcomes (WOMAC and SF-12 scores) after adjustment for each patient's probability of having surgery (propensity score). The IADL physical score was categorized as having improved by at least 1 dependency, no change, or worsened by at least 1 dependency since baseline and analyzed using χ^2 test for unadjusted analyses and logistic regression modeling comparing improvement to no improvement for adjusted analyses. For WOMAC scores, we computed the proportion with 50% or greater improvement. Analyses were performed using SAS statistical software (version 9.1; SAS Inc, Cary, North Carolina).

RESULTS

ENROLLMENT AND BASELINE PATIENT CHARACTERISTICS

Of the 654 potentially eligible patients identified, 341 patients or their physicians declined participation or could not be contacted (Figure 1). Of the remaining 313 who were screened for eligibility, 139 were excluded (75 had only mild or no symptoms, and 64 did not speak English), and 174 were enrolled in the study.

The mean age of the patients was 75.2 years; 76.4% were female, 17.2% were nonwhite, 69.0% had knee OA, and baseline WOMAC scores indicated severe OA (a mean

Table 3. Postoperative Complications and Symptoms for Patients Who Had Knee or Hip Replacement Surgery[a]

Complication or Symptom	All Patients (n=51)	Patients Aged 60-74 Years (n=33)	Patients Aged ≥75 Years (n=18)	*P* Value
Mortality within 60 d after surgery (n=51)	0	0	0	
Postoperative complications (n=41)				
Any complications	7 (17.1)	4 (16.0)	3 (18.8)	
Anemia	1	0	1	
Pulmonary embolism	1	1	0	
Pulmonary edema	1	0	1	>.99
Deep wound infection	1	0	1	
Peripheral neuropathy	1	1	0	
Delirium	2	2	0	
Duration of postoperative symptoms, wk (n=47)[b]				
Pain				
No pain	0	0	0	
<1	6 (12.8)	5 (17.2)	1 (5.6)	.64
1-4	23 (48.9)	13 (44.8)	10 (55.6)	
>4	18 (38.3)	11 (37.9)	7 (38.9)	
Nausea				
No nausea	35 (74.5)	22 (75.9)	13 (72.2)	
<1	6 (12.8)	2 (6.9)	4 (22.2)	.33
1-4	5 (10.6)	4 (13.8)	1 (5.6)	
>4	1 (2.1)	1 (4.0)	0	
Confusion				
No confusion	34 (72.3)	21 (72.4)	13 (72.2)	
<1	8 (17.0)	4 (13.8)	4 (22.2)	.63
1-4	5 (10.6)	4 (13.8)	1 (5.6)	
>4	0	0	0	

[a]Hospital discharge summaries were available for 41 patients and were reviewed to assess for the occurrence of the following postoperative complications: wound complications (superficial wound infection, deep wound infection, wound dehiscence); respiratory complications (pneumonia, unplanned intubation, pulmonary embolism, failure to wean from ventilatory support within 48 hours after surgery); urinary tract complications (progressive renal insufficiency, renal failure requiring dialysis, urinary tract infection); central nervous system complications (cerebrovascular accident, coma persisting more than 24 hours after surgery, other neurological deficits, eg, peripheral neuropathy, delirium); cardiac complications (cardiac arrest, myocardial infarction, pulmonary edema); other complications (prolonged ileus, bleeding requiring more than 4 U of blood transfused, graft or prosthesis failure or both, deep vein thrombophlebitis, systemic sepsis). Data are given as number (percentage).

[b]Postoperative symptoms were assessed by interview 6 weeks and 6 months after surgery; data were missing for 4 patients.

score of 56.2 on a 100-point scale) (**Table 1**). Eligibility criteria required symptoms that persisted despite conservative treatments, and this was reflected in the sample, 100% of whom had tried medications (68% had tried nonselective nonsteroidal anti-inflammatory medication; 50% had tried Cox-2 inhibitors; 65%, acetaminophen; 34%, chondroitin and glucosamine; and 13%, narcotic drugs), and many had also tried other treatments (including physical therapy [41%], steroid injections [35%], and home exercises [55%]).

PATIENT CHARACTERISTICS ASSOCIATED WITH JOINT REPLACEMENT SURGERY

After 12 months of follow-up, 51 patients (29%) had joint replacement surgery (30 knee and 21 hip replacements). In multivariate models including age, income, and other potential confounders (sex, hip vs knee OA, total WOMAC score), and number of comorbid illnesses), income was independently associated with surgery. Attitudes about surgery were also associated with joint replacement surgery (**Table 2**). Patients who thought surgery would help their pain were more likely to have surgery. Patients who were worried about dying during surgery were less likely to have surgery, as were patients who were worried about a complication, a long recovery, or needing help from others after surgery (Table 2).

POSTOPERATIVE COMPLICATIONS, SYMPTOMS, AND RECOVERY

Among the 51 patients who had joint replacement surgery, none died after surgery, and 7 had postoperative complications (**Table 3**). The complication rate was 16.0% for patients aged 60 to 74 years and 18.8% for those 75 years or older; $P > .99$).

All patients reported postoperative pain; 38.3% reported pain lasting more than 4 weeks. Postoperative nausea was reported by 25.5% of patients, and about half with nausea reported resolution within 1 week. The rates and duration of postoperative confusion were similar to nausea. There were no statistically significant differences between younger and older patients in postoperative symptoms (see Table 3 for *P* values).

Patients first recovered their abilities to, without assistance, get out of a chair (median time to recovery, 7 days), go to the bathroom (7 days), walk (12 days), dress (14 days) (**Figure 2**). Recovery of independence in bathing (21 days), food preparation (21 days), housework (49 days),

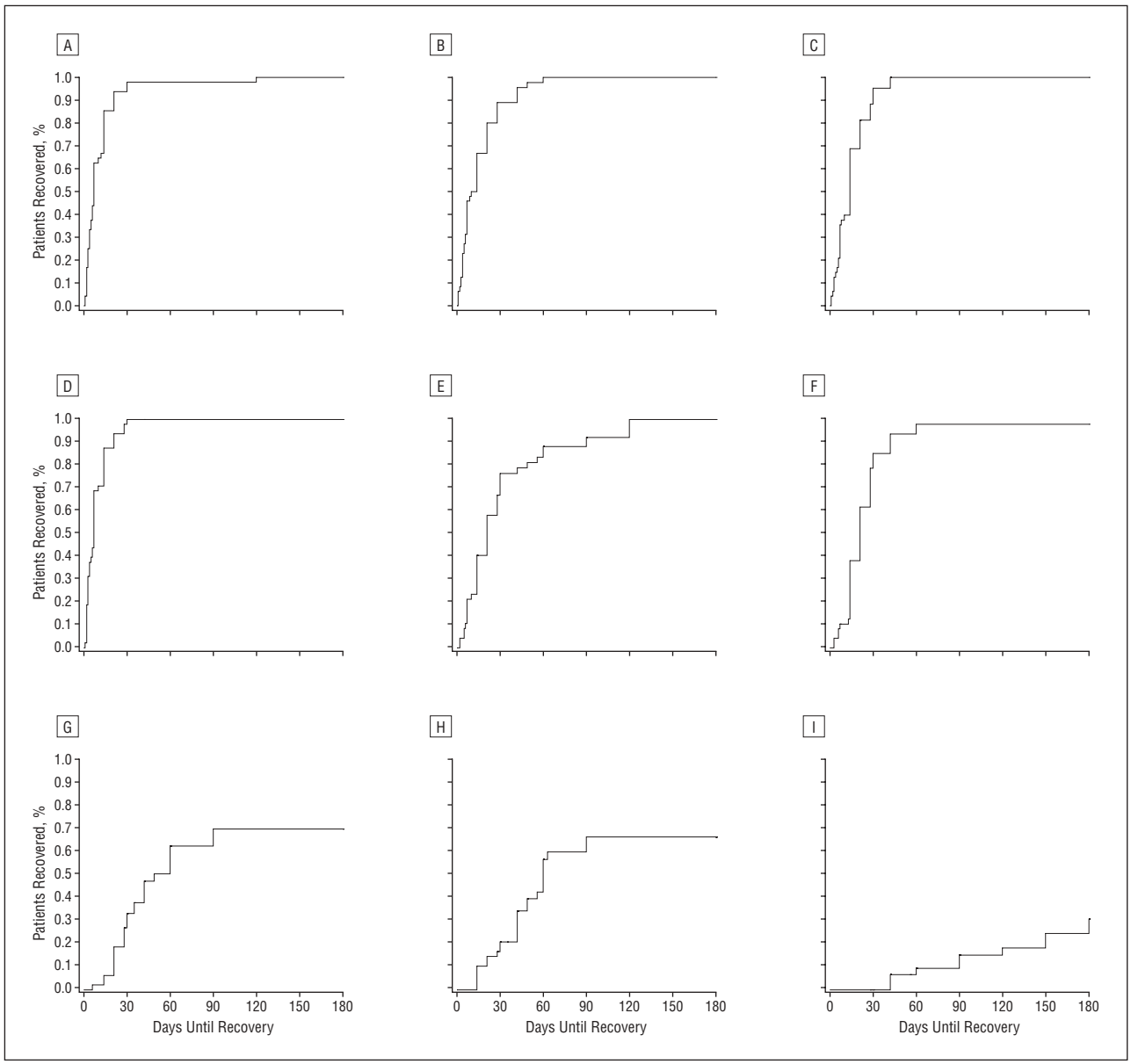

Figure 2. Time to functional recovery after joint replacement surgery. The y-axes show the percentage of patients who had recovered, and the x-axes show time in days, with time 0 indicating the day of surgery. The recovery in ability to get out of a chair or bed without assistance (A), walking without assistance (B), dressing without assistance (C), going to bathroom without assistance (D), bathing without assistance (E), cooking or preparing food without assistance (F), doing household chores such as cleaning without assistance (G), going shopping without assistance (H), and engaging in outside activities such as gardening without assistance (I).

and shopping (60 days) took longer. After 6 months, only about 30% were able to independently perform outside activities, such as gardening. Time to recovery was similar in patients aged 65 to 74 years and those 75 years or older, with the exception of bathing (median time to recovery, 14 days for patients 60-74 years and 28 days for those ≥75 years; $P=.01$).

12-MONTH CLINICAL OUTCOMES

Surgery was associated with better clinical outcomes (**Table 4** and **Figure 3**). Figure 3 shows large differences in the percentage of surgical and nonsurgical patients who achieved 50% improvement in WOMAC scores between baseline and the 12-month follow-up. Total WOMAC scores improved by a mean of 24 points in the surgical group and by only 0.5 point in the nonsurgical group ($P<.001$). Similar findings were observed across the WOMAC Pain, Stiffness, and Physical Function subscales (Table 4). The SF-12 Physical score improved by 10 points in surgical patients and remained the same in nonsurgical patients ($P<.001$). No difference between the groups was seen in the SF-12 Mental score. More patients in the surgical group improved and fewer worsened by 1 or more IADLs (Table 4). Surgery was associated with improvement in 2 of the 6 activities: house cleaning (adjusted odds ratio [OR], 3.6 [95% confidence interval [CI], 1.3-10.2) and shopping (OR, 6.8 [95% CI, 1.1-42.4]). In multivariate analyses, results were similar to the unadjusted results.

Table 4. Change in OA Symptoms and Functional Status From Baseline to 12-Month Follow-up for Patients Who Had Joint Replacement Surgery vs Those Who Did Not[a]

	All Patients (n=161)			65- to 74-Year-Old Group (n=82)			≥75-Year-Old Group (n=79)		
Mean (SD)	Surgery Group (n=48)	Nonsurgery Group (n=113)	*P* Value, Unadjusted (Adjusted)[a]	Surgery Group (n=30)	Nonsurgery Group (n=52)	*P* Value, Unadjusted (Adjusted)	Surgery Group (n=18)	Nonsurgery Group (n=61)	*P* Value, Unadjusted (Adjusted)
Total WOMAC, mean (SD)	−24.2 (15.1)	−0.5 (12.0)	<.001 (<.001)	−27.4 (16.2)	−0.8 (11.8)	<.001 (<.001)	−18.9 (11.8)	−0.3 (12.2)	<.001 (<.001)
Pain	−23.9 (16.4)	−1.4 (16.0)	<.001 (<.001)	−26.3 (15.7)	0.4 (16.1)	<.001 (<.001)	−20.0 (17.3)	−2.9 (15.8)	<.001 (.004)
Stiffness subscale	−20.8 (24.6)	0.2 (19.6)	<.001 (<.001)	−27.0 (21.4)	1.9 (18.5)	<.001 (<.001)	−10.6 (26.7)	−1.3 (20.5)	.12 (.34)
Physical function subscale	−24.8 (15.4)	−0.3 (13.0)	<.001 (<.001)	−27.8 (16.9)	−1.4 (12.6)	<.001 (<.001)	−19.7 (11.2)	0.6 (13.3)	<.001 (<.001)
SF-12, mean (SD)									
Physical subscale	9.6 (10.6)	0.1 (10.3)	<.001 (<.001)	11.2 (10.9)	−0.1 (10.5)	<.001 (.001)	6.9 (9.9)	0.2 (10.2)	.02 (.07)
Mental subscale	−2.2 (7.5)	−0.6 (8.1)	.25 (.30)	−2.5 (7.8)	−0.2 (7.6)	.19 (.31)	−1.6 (7.1)	−1.0 (8.6)	.76 (.70)
IADL Physical subscale, No. (%)[b]									
Improved by 1 dependency	20 (41.7)	27 (23.9)	.02 (.16)	15 (50.0)	15 (28.9)	.06 (.09)	5 (27.8)	12 (19.7)	.46 (.88)
No change	15 (31.3)	49 (43.4)		8 (26.7)	20 (38.5)		7 (38.9)	29 (47.5)	
Worsened by 1 dependency	13 (27.1)	37 (32.7)		7 (23.3)	17 (32.7)		6 (33.3)	20 (32.8)	

Abbreviations: IADL, instrumental activity of daily living; OA, osteoarthritis; SF-12, 12-Item Short-Form Health Survey; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Range of scales: WOMAC, 0-100 scale (higher scores indicate more severe symptoms); SF-12, 0-100 scale (higher scores indicate less severe symptoms); IADL, 0-6 scale (higher scores indicate more severe symptoms).

[a] Ten surgical patients did not complete baseline interviews, and for these 10 patients, the median values for the 151 patients with data available were imputed for the baseline variables required for the statistical analyses reported in this table. The results of analyses excluding these 10 patients were not different. Adjusted *P* values were derived from a multivariate model adjusting for a propensity score, which estimates probability of surgery based on knee vs hip OA, age, sex, income, Charlson comorbidity score, and WOMAC total score.

[b] The IADLs include cooking or preparing food, cleaning house or doing household chores, going shopping, doing laundry, engaging in outside activities (eg, gardening), driving or using public transportation.

The improvement for patients 75 years or older was less pronounced than in patients 65 to 74 years old; however, statistically significant differences in improvement were observed in this older subgroup on the total WOMAC score ($P<.001$), the WOMAC Pain subscale ($P=.01$), and WOMAC Physical Function subscale ($P<.001$), but not on the WOMAC Stiffness subscale ($P=.22$) and SF-12 Physical score ($P=.11$) (Table 4). An interaction term for age group and surgery did not indicate a statistically significant difference in the benefits of surgery in younger patients vs older patients for any of the outcomes ($P>.05$ for all comparisons).

DECISION MAKING ABOUT SURGERY

Among the 47 patients who had surgery and responded to our survey questions, 46 reported that they thought they had made the right choice about surgery (98%), and 1 reported being unsure.

Among the 113 who had not undergone joint replacement surgery by the end of the 12-month follow-up period, 51 reported surgery had not been offered as a potential treatment by any of their physicians (45%), and 62 reported that surgery had been offered (55%). Of the 62 who were offered surgery, 34 were considering surgery in the future (58%), and the remaining 25 were not considering surgery (42%). Of the 25 not considering surgery, 10 viewed surgery as too risky, 3 thought it would not help, 2 thought it was not needed, 2 were concerned about the discomfort of recovery, 3 responded "other," and 5 did not give a reason.

COMMENT

In this study of elderly patients who had severe OA of the hip or knee, joint replacement surgery resulted in substantial improvement in OA symptoms and in functional status. Most patients who had joint replacement surgery required assistance with activities such as household chores and shopping for more than a month after their surgery. Older age was not associated with worse clinical outcomes or longer recovery from surgery, with patients 75 years or older and those younger than 75 experiencing similar benefits and recovery.

Twenty-nine percent of patients had surgery during this 12-month study. Forty-five percent of patients who did not have surgery reported that surgery had not been offered as a potential treatment by any physician. Compared with patients who had surgery, patients who did not have surgery were older, had lower incomes, and were more worried about surgical complications and a long recovery.

Our findings of excellent outcomes from joint replacement surgery in elderly patients with severe hip or knee OA corroborate and extend the findings of previous studies. Research on hip and knee replacement for patients of all ages with severe OA has shown improvement in

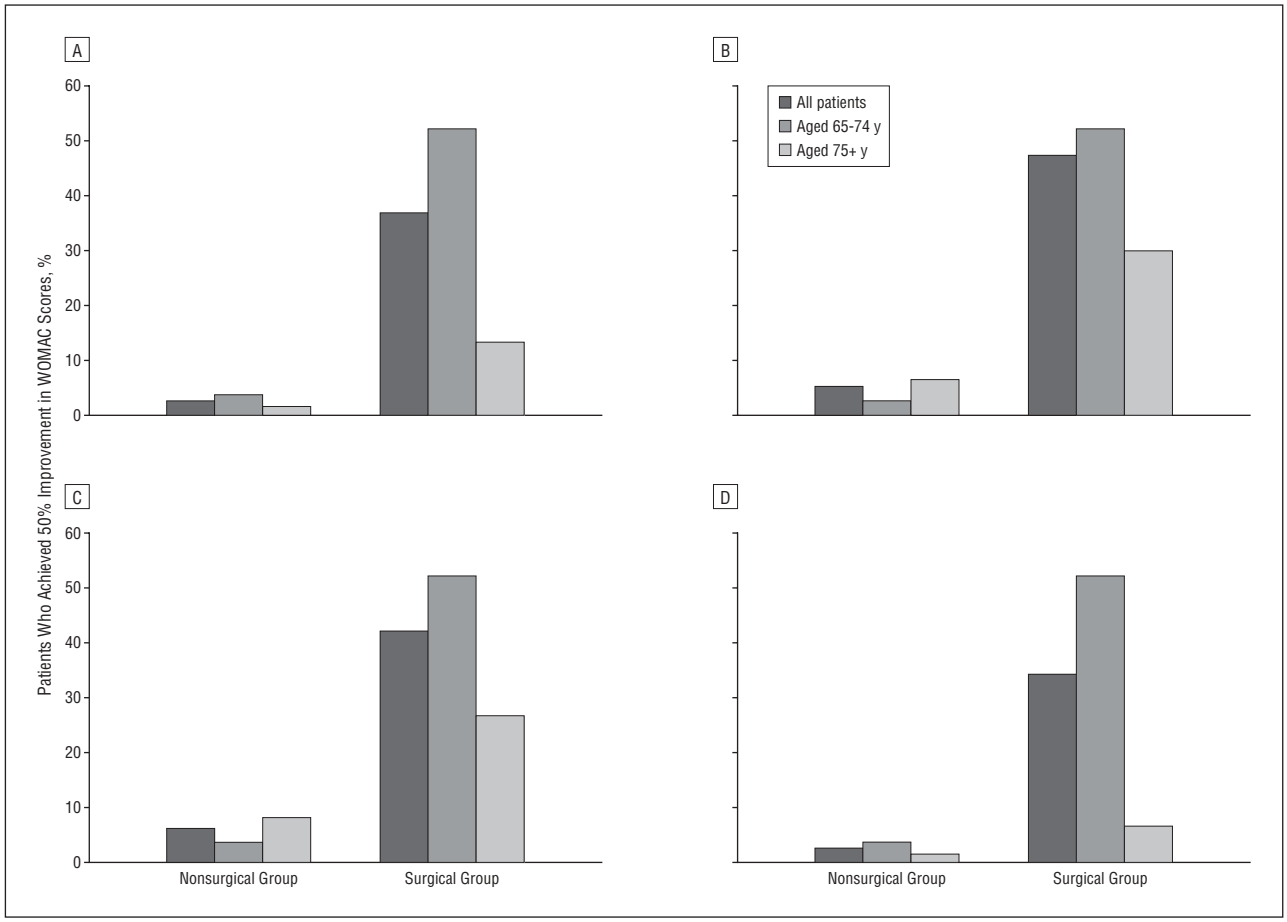

Figure 3. Patients who achieved a 50% improvement in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, comparing patients who had joint replacement surgery (surgical group) with those who did not (nonsurgical group). A, The proportion of patients who achieved 50% improvement of total WOMAC items from baseline in nonsurgical and surgical patients ($P<.001$ for comparisons between all surgical and nonsurgical patients; $P<.001$ for comparisons in patients aged 65-74 years; $P=.04$ for those aged ≥75 years). B, WOMAC Pain subscale ($P<.001$ for all patients; $P<.001$ for patients aged 65-74 years; $P=.002$ for those aged ≥75 years). C, WOMAC Stiffness subscale ($P<.001$ all patients; $P<.001$ for those aged 65-75 years; $P=.20$ for those aged ≥75 years). D, WOMAC Physical Function subscale ($P<.001$ all patients; $P<.001$ for those aged 65-74 years; $P=.04$ for those aged ≥75 years).

quality of life and functional outcomes.[2-12] Most studies focusing on elderly patients have documented good surgical outcomes. In a retrospective study[8] of 74 patients aged 75 years or older who underwent knee replacement, 83% reported their knee was "much better" after surgery, 79% were satisfied with their outcome, and 92% stated they had made the right decision about surgery. In a study[33] that included 50 patients aged 80 years or older and 50 patients aged 65 to 69 years, 2 years after surgery, pain and functional status were similar in the 2 age groups, but more patients in the older group relied on mobility aids. In a survey[11] of 487 Medicare beneficiaries at least 65 years old (including 160 who were ≥80 years old) who had knee replacement, patients reported improvement in their ability to walk and climb stairs and high satisfaction with surgery. Similar to our study, a number of studies[11,34,35] have found that older age was not associated with worse outcomes from joint replacement. A meta-analysis[15] of studies assessing functional outcomes after knee replacement surgery concluded that prior studies have not detected an association between age and outcomes but noted that most studies were limited by small sample size and inclusion of few very elderly patients. Our observation that recovery of ability to perform many ADLs was prolonged is consistent with a study[37] reporting decline in physical function 1 month after joint replacement. We observed benefits of surgery similar to those observed in cohorts that included younger patients, but it is possible that functional outcomes may have been better had surgery been performed at younger ages, when symptoms and functional limitations were less severe. Some research has shown that patients with more severe pain and functional limitations did not achieve physical function and pain outcomes that were as good as those achieved by patients with less severe baseline symptoms, and these findings suggest that earlier surgery may be beneficial.[37]

Our study extends prior research in several ways. Unlike many other studies, we did not focus on patients who were referred for evaluation for joint replacement surgery or scheduled to have surgery. We prospectively studied patients with severe OA, and, during longitudinal follow-up, some patients had undergone surgery and others had not. Our study design allowed us to compare outcomes after surgery with outcomes in a similar group who did not have surgery. Nearly half of the patients enrolled in our study were 75 years or older, allowing us to examine outcomes for patients at least 75 years old

and compare them with those of patients 65 to 74 years old. We longitudinally assessed symptoms and functional status after surgery, providing a detailed description of the recovery process.

Our findings should be interpreted in the context of the study's limitations. Patients in our cohort who had surgery were selected for surgery. Although most baseline characteristics of medically and surgically treated patients were similar, and we were able to adjust for the differences observed, this was not a randomized study, and unmeasured confounders may have affected our comparisons between the 2 groups. Similarly, our observation that outcomes and recovery were similar for patients younger than 75 years and those 75 years or older may have been influenced by unmeasured confounders because it is possible that in the oldest age group only the best candidates were selected for surgery. Furthermore, our study was not large enough to exclude modest differences in the 2 age groups. We cannot be certain that all patients included in our cohort had OA symptoms that would have improved with joint replacement surgery; however, we identified patients who were highly likely to be appropriate for surgery—patients who had radiographs showing severe OA and who had moderate to severe joint pain or stiffness and OA-related functional limitations, despite at least 6 months of conservative treatment. Finally, participation in the study involved interviews about OA symptoms and decision making about joint replacement surgery, which may have led to patients having more discussion with their physicians about these issues.

Our findings have several implications for patient care. We report detailed data about postoperative symptoms, functional recovery, and outcomes 12 months after surgery for elderly patients, including those in their late 70s and 80s. These data should help inform discussion about joint replacement surgery and allow patients to consider the risks and benefits of surgery as well as the expected postoperative recovery experience. Joint replacement surgery was not offered as a treatment option for many patients, suggesting that some physicians may not provide elderly patients with the opportunity to choose this effective treatment. Not surprisingly, patients who were more concerned about the risks of surgery and about a long surgical recovery were less likely to have joint replacement surgery. Some research suggests that elderly patients are reluctant to have joint replacement surgery, undervalue the benefits, and are concerned about recovery and the need for help after surgery.[38,39] Providing patients with more information about the experience of other elderly patients may affect patients' attitudes and preferences. Finally, our finding that patients with lower incomes were less likely to have surgery is concerning and mirrors many other research findings of diminished access to joint replacement surgery[40] and other effective treatments among patient with lower socioeconomic status. Of note, there are some data to suggest that these differences are not driven by differences in preferences or need for surgery; 1 study[41] found that lower education and income were associated with a greater need for joint replacement but were not associated with less willingness to have surgery.

In conclusion, elderly patients who had joint replacement surgery for severe OA of the hip or knee took several weeks to recover but experienced excellent long-term outcomes; recovery and outcomes were not substantially worse among patients 75 years or older. Many patients were not offered surgery or chose not to have surgery owing to concerns about postoperative complications or prolonged recovery. Improved communication between physicians and patients aged may allow more elderly patients to make informed choices and to thoughtfully weigh the risks and burdens of joint replacement surgery against its benefits in alleviating pain and improving function and quality of life.

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