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ORIGINAL ARTICLE

Patient Quality of Life During the 12 Months Following Joint Replacement Surgery

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Objective. **To determine whether preoperative characteristics influence quality of life outcomes 1, 6, and 12 months after joint replacement surgery.**
Methods. **Patients (n = 222) with osteoarthritis undergoing primary joint replacement surgery at a university hospital between November 1990 and March 1993 were prospectively studied. Bodily pain and physical function were assessed preoperatively and at the 3 postoperative time points using the Medical Outcomes Study 36 Item Short Form Health Survey.**
Results. **Bodily pain and physical function improved after joint replacement. At 1 month after surgery, despite improvements in bodily pain, physical function deteriorated. Preoperative bodily pain and physical function, demographic characteristics, and social support were significant correlates of improvement in bodily pain and physical function.**
Conclusions. **Patients experienced dramatic improvements in bodily pain and physical function after joint replacement. However, decline in physical function at 1 month implies significant need for prolonged informal or formal patient assistance with basic physical function after surgery. Greater preoperative social support was associated with improved bodily pain and physical function outcomes.**

KEY WORDS. Joint replacement surgery; Outcomes; Quality of life.

INTRODUCTION

Many studies have documented substantial improvement in health-related quality of life (QOL) after joint replacement surgery (1–15). When making a decision to undergo joint replacement, patients and their physicians need to consider the potential risks and benefits of the procedure. In addition to major medical concerns, patients express concern about pain, physical function, and associated dependence upon others during the rehabilitative phase after surgery (16). Although it has been reported that patients are able to achieve critical physical therapy milestones (walking with assistive device and climbing stairs) within 7–14 days after hip or knee replacement surgery (17), improvement in overall pain and physical function does not occur until sometime later in the recuperative period. By 6 weeks after surgery, patients undergoing total hip replacement report significant improvement in bodily pain (8). By 3 months after surgery, patients undergoing knee replacement surgery report significant improvement in bodily pain and physical function (6,15).

Because hospital stays and postacute care stays have been shortening during the last few years, patients are being discharged from structured therapy earlier in their recuperative process. Mean hospital length of stay has fallen to less than 5 days for joint replacement surgery (18). Since the implementation of the Balanced Budget Act of 1997, postacute services are also less utilized. At 30 days after surgery, less than 2% of patients remain in a facility (acute or transitional care setting) and less than 40% of patients continue to use home health services (FitzGerald JD, unpublished observations).

For these reasons, it would be helpful to have a clearer

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picture regarding patients' recuperative status after joint replacement at 1 month after surgery, when the majority of patients have been discharged from structured therapy. Furthermore, a clearer understanding regarding expected pain and function 1 month after surgery would also help physicians more accurately describe the expected postoperative recuperative course to patients who are considering joint replacement surgery. Finally, a clearer understanding regarding the patient preoperative characteristics associated with better outcomes after surgery would help physicians and their patients make better informed decisions regarding surgery, including the potential benefit and optimal timing of this major elective procedure.

Through the use of prospectively collected data, this study analyzes QOL outcomes before surgery and at 1, 6, and 12 months after surgery. This study also examines patient demographic, clinical, and surgical characteristics and their correlates with 2 dimensions of QOL (bodily pain and physical function).

PATIENTS AND METHODS

Patients undergoing hip or knee replacement were selected from a larger study designed to develop and validate a cardiac risk index for patients undergoing major noncardiac elective surgery (19) and to examine the longitudinal changes in QOL after elective surgery (7). The study was conducted at the Brigham and Women's Hospital (BWH), a 720-bed urban teaching hospital, and included patients undergoing major orthopedic (not limited to joint replacement), noncardiac thoracic, abdominal, and vascular surgeries. The BWH and University of California at Los Angeles institutional review boards approved the study protocol.

Patients. This report includes patients over the age of 50 years who underwent primary total hip or knee replacement for the treatment of osteoarthritis. All participants were prospectively enrolled between the dates of November 1, 1990 and March 30, 1993. To be eligible, patients also had to be English speaking and had to have adequate hearing and cognitive function to complete preoperative self-administered health status questionnaires and postoperative telephone interviews. Patients who had joint replacement for an indication other than osteoarthritis (e.g., rheumatoid arthritis or avascular necrosis) were excluded from these analyses.

Quality of life measurements. All subjects were evaluated a median of 1 day prior to surgery. Data were prospectively collected on demographic characteristics, social support, and medical history (including 26 underlying chronic medical conditions). QOL was measured by the Medical Outcomes Study 36 Item Short Form Health Survey (SF-36) (20). The SF-36 defines health-related QOL in terms of 4 physical and 4 mental health domains (20). The physical health domains include questions on general health, physical function, bodily pain, and role limitations due to physical function. The mental health domains include questions on general emotional well being, role limitations due to emotional problems, social function, and vitality (21). The scoring algorithm described by Ware and colleagues was used to develop raw scores (0–100 scales), where lower scores indicate poorer performance on that scale (22). Bodily pain and limitations with physical function have been cited as the 2 most important reasons to undergo joint replacement (1–3) and are most responsive to improvement after joint replacement (7,23). In following the practice of other authors (8), we selected these 2 domains for primary analyses.

At 1, 6, and 12 months postoperatively, SF-36 surveys were collected by telephone interview. The SF-36 questionnaire asks patients to recall their QOL over the last 1-month period. At the 1-month postoperative interview, patients were asked to recall their QOL during the previous week (SF-36, acute version) (22). For patients with partial followup QOL data, visits with missing data were deleted from analysis. At each of the time periods, there were no significant differences with respect to sex, age, obesity, number of comorbidities, surgical site, or marital status between patients with missing data and those with complete data. For all analyses described, P values <0.05 were considered statistically significant.

Correlate variables. Based on the findings observed in previous joint replacement studies, preoperative QOL and 7 additional characteristics were identified as important correlates of postoperative QOL (4,6,8,9,11–13,24,25). These characteristics included sex, age, obesity, surgical site (hip versus knee), bilateral replacement (versus unilateral replacement), social support, and number of comorbidities. In this analysis, age was categorized into 3 groups (<65 years, 65–74 years, and ≥ 75 years), which closely approximated the lowest quartile, 2 median quartiles, and the upper age quartile. Body mass index (BMI) was also categorized into 3 groups (<25 kg/m^2, 25–30 kg/m^2, and >30 kg/m^2), which closely approximated the lowest quartile, 2 median quartiles, and the upper quartile of BMI. Patients with BMI <25 kg/m^2 are at low risk for adverse medical events attributable to obesity, whereas patients with BMI ≥ 30 kg/m^2 are of moderate attributable risk for adverse medical events (26). BMI ≥ 30 kg/m^2 has been associated with potential negative joint replacement outcomes (27). The 26 medical comorbidities required to calculate the Charlson comorbidity index (28) were collected. Given the low frequency of comorbidity in this sample, the categories were simply summed and reported as 0, 1, and 2 or more comorbidities. Finally, social support was defined as a dichotomous variable based on patients' marital and living status. Patients who indicated during the preoperative interview that they were married or were living with someone were defined as having more social support than those stating they were not married and living alone.

Statistical methods. Means and proportions were calculated for the entire sample and separately for hip and knee replacement patients for each of the 7 characteristics and preoperative bodily pain and physical function. Hip replacement and knee replacement patients were compared in terms of their preoperative characteristics using chi-

Table 1. Missing followup response pattern for bodily pain and physical function for 222 study patients

	Missing data points			
	1 month	6 month	12 month	Total
Bodily pain	14*	16*	3	33 (from 31 patients)
Physical function	14†	15†	3	32 (from 31 patients)

* Two patients with missing bodily pain 1- and 6-month data.
† One patient with missing physical function 1- and 6-month data.

square and *t*-tests as appropriate. Few statistically significant preoperative differences were found between the groups, and both groups were combined for subsequent analyses to consolidate findings and increase the power of the analyses.

Unadjusted preoperative mean bodily pain and physical function scores were compared with an age- and sex-matched population-based US sample (22). Significance of differences between the study sample and the US sample means were analyzed using *t*-tests. The unadjusted preoperative bodily pain and physical function score means within each of the dichotomized characteristics and 3 levels of comorbidities were compared using *t*-tests or analyses of variance, as appropriate.

Differences of 3–5 SF-36 units have been described as clinically meaningful (29). Differences of 10 units on the bodily pain scale and 20 units on the physical function scale reflect mean differences between patients with minor medical conditions (hypertension) and patients with major medical conditions (e.g., congestive heart failure, chronic obstructive pulmonary disease, or advanced diabetes). Differences of 13 units on the bodily pain scale and 7 units on the physical function scale represent differences between patients with sciatica and patients with minor medical conditions (hypertension, no sciatica) (22).

Two separate multivariate models were constructed to assess the impact of selected covariates on bodily pain and physical function outcomes. Followup (1, 6, and 12 months) bodily pain and physical function scores were modeled as continuous variables using generalized linear models. To control for baseline status, preoperative bodily pain and physical function scores were stratified into tertiles and included in each respective model with the 7 previously identified characteristics. Repeated measures modeling was used to account for within-estimate variability across the 3 followup time periods. These regression models simultaneously evaluate the impact of covariates on the respective QOL scores across the 3 followup periods. Through this method, each postoperative period contributes equally to the regression function. Therefore, significant associations are attributable to either meaningful differences by covariate across each of the 3 followup periods, an isolated very large difference at 1 particular time point, or some intermediate pattern.

For significant covariates identified through the above models, further analyses were performed to describe the preoperative and postoperative differences. To accomplish this objective, QOL outcomes were stratified by the covariate of interest across the time periods. Tests of significance were performed using regression models that included the covariate of interest, either a 3-level time period variable (1, 6, and 12 months postoperative) or a 4-level time period variable (preoperative plus 3 postoperative periods) and an interaction term between the covariate of interest and the time period variable. The interaction term identifies divergent QOL outcomes across the respective time periods. The results from these secondary models are presented graphically. All statistical calculations were computed using SAS software application, version 8.0 (SAS Institute, Cary, NC).

RESULTS

Patients. Preoperative interviews were available for 225 patients. The preoperative participation rate for the study overall was 81.6% (7). Three patients lost to followup after the 1-month interview were dropped from this analysis. For the remaining 222 patients available for analysis, 191 patients (86%) had complete QOL followup data at all 3 time points. For the 31 patients with missing QOL data, 14 patients (6%) had missing 1-month pain and function data, 16 patients (7%) had missing 6-month pain data, 15 patients (7%) had missing 6-month function data, and 3 patients (1%) had missing 12-month pain and function data. Two patients had missing pain data and 1 patient had missing physical function data at both the 1-month and 6-month followup periods (counted in above totals). This accounted for the total 31 patients and respective 33 and 32 missing data points for pain and function (Table 1). Patients with missing data did not differ statistically from patients with complete data with respect to preoperative pain, functional status, or any of the aforementioned covariates.

For the 222 patients in the sample, 61% were female with a mean ± SD age of 68 ± 10 years (Table 2). The sample was predominantly white (96%). There were 131 (59%) knee replacements (10 bilateral) and 91 (41%) hip replacements (11 bilateral). Patients' mean ± SD BMI was 27.6 ± 4.4 kg/m^2. Twenty percent of patients had 2 or more comorbidities. Hypertension was the most prevalent comorbid condition (50.5% of patients) followed by hypercholesterolemia (20.3%) and peptic ulcer disease (15.2%). Nearly two-thirds of the patients (n = 141) were married. Of those not married, the majority were living alone (n = 56, 25% of total sample). Patients undergoing knee replacement had higher BMI than patients undergoing hip replacement (28.6 kg/m^2 versus 26.2 kg/m^2; $P <$

Table 2. Sample subject characteristics

	Entire sample (n = 222)	Hip (n = 91)	Knee (n = 131)
Age in years, mean ± SD	68.2 ± 9.6	67.5 ± 9.1	68.6 ± 9.9
Female, n (%)	135 (61)	55 (60)	80 (61)
Caucasian, n (%)	213 (96)	90 (99)	123 (94)
Bilateral, n (%)	21 (9)	11 (12)	10 (8)
Body mass index, mean kg/m² ± SD	27.6 ± 4.4	26.2 ± 4.4*	28.6 ± 4.2
Number of comorbidities, n (%)			
0	120 (54)	54 (59)	66 (50)
1	57 (26)	23 (25)	34 (26)
≥ 2	45 (20)	14 (15)	31 (24)
Not married and living alone, n (%)	56 (25)	17 (19)	39 (30)
Bodily pain, mean SF-36 score ± SD†	36.0 ± 18.3	32.7 ± 17.3‡	38.4 ± 18.7
Physical function, mean SF-36 score ± SD†	35.9 ± 23.1	33.3 ± 24.8	37.7 ± 21.6

* $P < 0.0001$ between hip replacement and knee replacement.
† Lower scores indicate worse pain or poorer physical function. SF-36 = Short Form 36.
‡ $P = 0.02$ between hip replacement and knee replacement.

0.0001) but had better preoperative bodily pain scores (38.4 versus 32.7; $P = 0.02$). Otherwise, patients undergoing hip replacement and knee replacement were similar.

Comparison with the US population. The sample mean preoperative bodily pain score (36.0 ± 18.3 units) and physical function score (35.9 ± 23.1 units) are significantly lower than the age- and sex-adjusted mean US sample bodily pain score (66.0 ± 26.2; $P < 0.0001$) and physical function score (67.0 ± 28.0; $P < 0.0001$; Figure 1). Lower scores reflect worse pain and poorer physical function.

Correlates with preoperative QOL. Women had significantly worse preoperative bodily pain scores (33.0 versus 40.8; $P = 0.002$) and physical function scores (30.1 versus 44.7; $P < 0.0001$) as compared with men (Table 3). Patients with BMI > 30 kg/m² had worse preoperative bodily pain than did each of the lighter groups (31.1 versus 38.2 and 37.4; $P < 0.05$ between heaviest group and each of the lighter groups). Heavier patients also had poorer preoperative physical function scores (29.2 versus 37.4 and 39.6; $P < 0.05$ between heaviest and each of the lighter groups). Not surprisingly, patients undergoing simultaneous bilat-

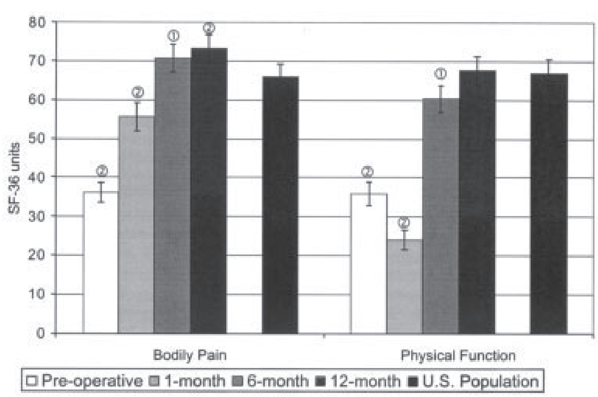


Figure 1. Preoperative and postoperative bodily pain and physical function scores. Data are unadjusted means ± 95% confidence intervals. Changes of 3–5 Short Form 36 (SF-36) units have been described as clinically meaningful (29). **(1)** $P < 0.05$ between referent period and age- and sex-adjusted US sample. **(2)** $P < 0.001$ between referent period and age- and sex-adjusted US sample.

Table 3. Unadjusted preoperative SF-36 bodily pain and physical function scores by preoperative characteristics*

	Bodily pain, mean SF-36 units ± SD	Physical function mean SF-36 units ± SD
Sex		
Male	40.8 ± 16.3†	44.7 ± 20.3‡
Female	33.0 ± 16.9	30.1 ± 23.0
Age, years		
< 65	36.4 ± 16.2	37.3 ± 21.2
65–74	35.9 ± 18.4	36.4 ± 23.5
≥ 75	35.8 ± 21.3	32.6 ± 24.8
Body mass index, kg/m²		
< 25	37.4 ± 18.3	39.6 ± 25.1
25–30	38.2 ± 18.1	37.4 ± 24.5
> 30	31.1 ± 18.1§	29.2 ± 16.0§
Site of joint replacement		
Hip	32.7 ± 17.3¶	33.3 ± 24.8
Knee	38.4 ± 18.7	37.7 ± 21.6
Unilateral vs bilateral replacement		
Unilateral	36.7 ± 18.2	36.9 ± 22.8¶
Bilateral	29.9 ± 18.9	26.0 ± 23.8
Number of comorbidities		
0	34.9 ± 16.5	35.9 ± 23.0
1	36.8 ± 20.8	33.5 ± 24.6
≥ 2	38.2 ± 19.5	38.8 ± 21.3
Social support		
Married or not living alone	36.2 ± 19.0	36.0 ± 23.4
Not married and living alone	35.7 ± 16.2	35.6 ± 22.0

* Lower scores indicate worse pain or poorer physical function. SF-36 = Short Form 36.
† $P < 0.005$.
‡ $P < 0.0001$.
§ $P < 0.05$ between body mass index > 30 kg/m² and other 2 groups.
¶ $P < 0.05$.

Table 4. Multivariate correlates of postoperative change in bodily pain and physical function*

	Bodily pain† (n = 222)			Physical function† (n = 222)		
	Δ	95% CI	P	Δ	95% CI	P
Male (vs. female)	4.4	−1.1, 9.8	0.12	8.7	3.4, 14.1	0.001
Age < 65 years‡						
65–74 years	1.2	−4.8, 7.3	0.69	−1.8	−7.4, 3.8	0.53
≥ 75 years	8.1	1.1, 15.2	0.02	−5.1	−11.6, 1.4	0.13
BMI ≤ 21 kg/m^2‡						
25–30 kg/m^2	−0.2	−6.4, 6.1	0.96	0.3	−5.5, 6.1	0.91
> 30 kg/m^2	3.9	−3.1, 11.0	0.28	−1.2	−7.9, 5.5	0.72
0 comorbidities‡						
1 comorbidity	−3.3	−9.3, 2.7	0.29	−2.6	−8.2, 3.1	0.37
≥ 2 comorbidities	−2.6	−9.3, 4.1	0.45	−3.1	−9.3, 3.1	0.33
Greater social support (vs. less social support)	9.0	3.0, 15.1	0.004	6.3	0.6, 11.9	0.03
Hip vs. knee replacement	8.9	3.4, 14.5	0.002	0.8	−4.4, 5.9	0.76
Unilateral vs. bilateral	7.7	−1.2, 16.5	0.09	9.4	1.2, 17.6	0.03
Lowest tertile of preoperative physical function (poorest function)‡						
Middle tertile of preoperative physical function	10.0	4.0, 16.1	0.001	4.0	−2.3, 10.4	0.21
Highest tertile of preoperative physical function (best function)	16.2	9.1, 23.3	<0.001	14.3	8.1, 20.6	<0.001

* Δ Represents difference in followup scores averaged across 1, 6, and 12 months versus peroperative respective scores. Changes of 3 to 5 Short Form-36 units have been described as clinically meaningful (29). 95% CI = 95% confidence interval. BMI = body mass index.
† For bodily pain, 33 data points missing out of 666 possible. For physical function 32 data points missing out of 666 possible.
‡ Reference group.

eral joint revisions had worse bodily pain scores (29.9 versus 36.7; $P = 0.10$) and physical function scores (26.0 versus 36.9; $P = 0.04$) than patients undergoing unilateral replacement surgery. There were no statistically significant differences in physical function or bodily pain scores across age, comorbidity, or social support categories.

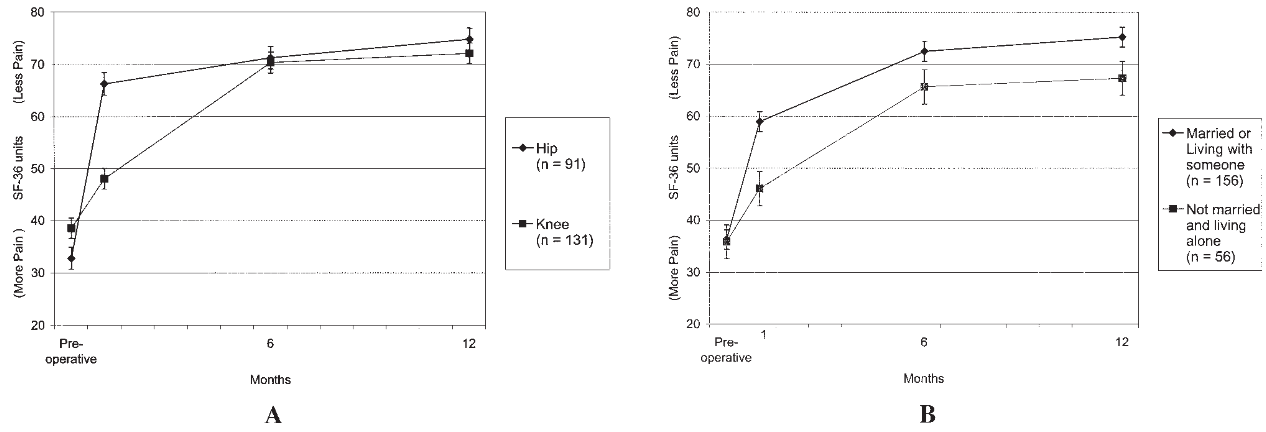
Changes in QOL over time. There were dramatic improvements in physical function and bodily pain after surgery. Patients improved from a mean ± SD preoperative bodily pain score of 36.0 ± 18.3 units to a mean ± SD 12-month postoperative score of 73.2 ± 26.3 units ($P < 0.0001$). The final observed 12-month bodily pain score was significantly better than the referent age- and sex-adjusted US sample bodily pain score (66.0 ± 26.2; $P < 0.005$; Figure 1). Similar gains were observed for physical function scores. Patients' mean ± SD physical function score improved from 35.9 ± 23.1 preoperatively to 67.8 ± 26.8 units ($P < 0.0001$) at 12 months after surgery. Figure 1 also demonstrates that although patients reported significantly improved perceptions of bodily pain (55.6 versus 36.0; $P < 0.0001$) 1 month after surgery, patients reported significantly poorer physical function (24.1 versus 35.9; $P < 0.0001$). Improvements in bodily pain plateau at 6 months, whereas physical function continues to improve between the 6-month and 12-month followup interviews (60.4 versus 67.8; $P = 0.001$). At 12 months after surgery, bodily pain and physical function scores were equivalent or superior to the age- and sex-adjusted mean US scores.

Correlates with QOL over time. *Bodily pain.* Multivariate analyses controlling for each of the 7 covariates and preoperative bodily pain demonstrated that age >75 years, greater social support, undergoing hip replacement rather than knee replacement, and less preoperative bodily pain were all significantly associated with better postoperative bodily pain outcome across the 3 followup periods (Table 4).

For the significant characteristics identified above, additional multivariate models describe the pattern of postoperative improvement at each of the time points. To determine whether the effect of a correlate varies over time, the significance of interaction terms between the correlate of interest and time were evaluated.

As noted in Table 4, patients undergoing hip replacement reported better outcomes across the 3 followup periods than patients undergoing knee replacement (8.9 units, 95% confidence interval [95% CI] 3.4–14.5). However, this difference is captured almost entirely by the 1-month postoperative period (Figure 2, panel A). The *P* value for the interaction term between type of surgery and time was < 0.0001, which confirms variation across the time periods. At 1 month after surgery, patients undergoing hip replacement reported a mean of 19.7 units less pain (higher score; 95% CI 4.5–12.2) than patients undergoing knee replacement.

Patients with more social support (married or living with someone) reported 9.0 (95% CI 3.0–15.1; Table 4) units of greater mean improvements in bodily pain over the 3 followup periods. There was little variation of the effect of social support during the various followup time periods ($P = 0.4$). Differences between the 2 groups' mean bodily pain scores were significant at 1 month and 12



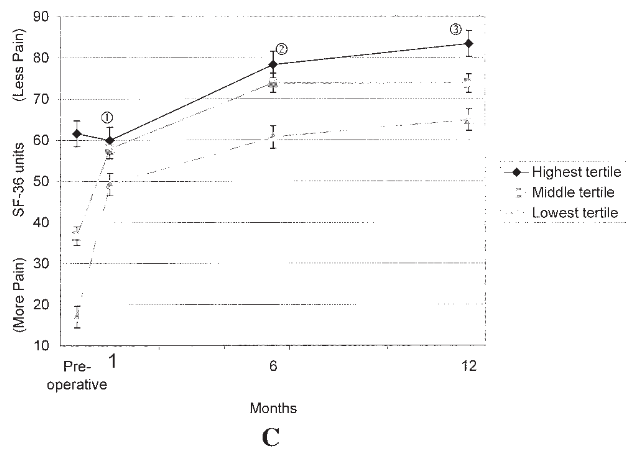


Figure 2. Preoperative and postoperative bodily pain scores. Data are adjusted mean ± standard error. Mean values are adjusted for covariate of interest and time period. Standard errors are adjusted to account for repeated measures. **A**: Surgical site. (1) $P < 0.0001$. **B**: Social support. (1) $P < 0.001$. (2) $P < 0.05$. **C**: Tertile of preoperative bodily pain. (1) $P < 0.05$ between top 2 tertiles and lowest tertile (not significant between middle and highest tertile). (2) $P < 0.005$ between top 2 tertiles and lowest tertile (not significant between middle and highest tertile). (3) $P < 0.05$ between each of the tertiles; $P < 0.0001$ between highest and lowest tertile. SF-36 = Short Form 36.

months after surgery: 12.9 (95% CI 5.7–20.4) and 7.9 units (95% CI 0.5–15.3), respectively (Figure 2, panel B).

Older patients (age ≥ 75 years) reported 8.1 units of greater mean improvements in bodily pain than did younger patients over the 3 followup periods (95% CI 1.1–15.2; Table 4). The influence of age was similar across time periods ($P = 0.6$). (Although not illustrated, these results would look similar to the pattern depicted in Figure 2, panel B.)

Less severe pain before surgery was a strong correlate of less severe pain after surgery. Patients with the least severe preoperative pain (highest bodily pain tertile) reported a mean of 16.2 units less postoperative pain than patients with the most severe postoperative pain (95% CI 9.1–23.3, Table 4). This relationship is best depicted graphically (Figure 2, panel C). By 1 month after surgery, the mean bodily pain differences between patients in the middle and highest tertiles (versus the lowest tertile) contracted to 8.6 (95% CI 0.7–16.5) and 11.3 (95% CI 1.9–20.7), respectively. This smaller mean difference persisted across the 6- and 12-month followups.

Physical function. A multivariate analysis was also performed to predict physical function across the 3 followup periods while controlling for covariates and preoperative physical function. Male sex, greater social support, unilateral replacement surgery, and better preoperative functional scores were all significantly associated with better postoperative functional outcomes (Table 4). Although, on average, women scored 8.7 units lower on the physical function scale than did men (95% CI 3.5–14.1; Table 4), the difference in postoperative physical function outcomes was largely attributable to preoperative differences in physical function (Figure 3, panel A). Women and men exhibited similar gains in physical function after surgery ($P = 0.4$ for time interaction term).

Greater social support was also noted to be associated with better physical function after joint replacement. Across the followup time periods, patients who were married or living with someone reported, on average, 6.3 units of greater improvement in physical function (95% CI 0.6–11.9; Table 4). Only slight differences in magnitude of the effect of social support across the followup time periods were detected with a maximum difference of 10.6 units (95% CI 3.5–17.8) noted at the 12-month time point.

Patients undergoing bilateral procedures reported an average of 9.4 lower physical function units on followup after controlling for preoperative physical function (95% CI 1.2–17.6; Table 4). The postoperative trend was very similar to the trend described for sex (Figure 3, panel A). The large preoperative physical function difference persisted across the 3 followup periods, but was statistically significant only at the 12-month followup period (12.8 units, 95% CI 2.4–23.2).

Better preoperative physical function was associated with better postoperative physical function (Table 4). Patients with the best preoperative physical function re-

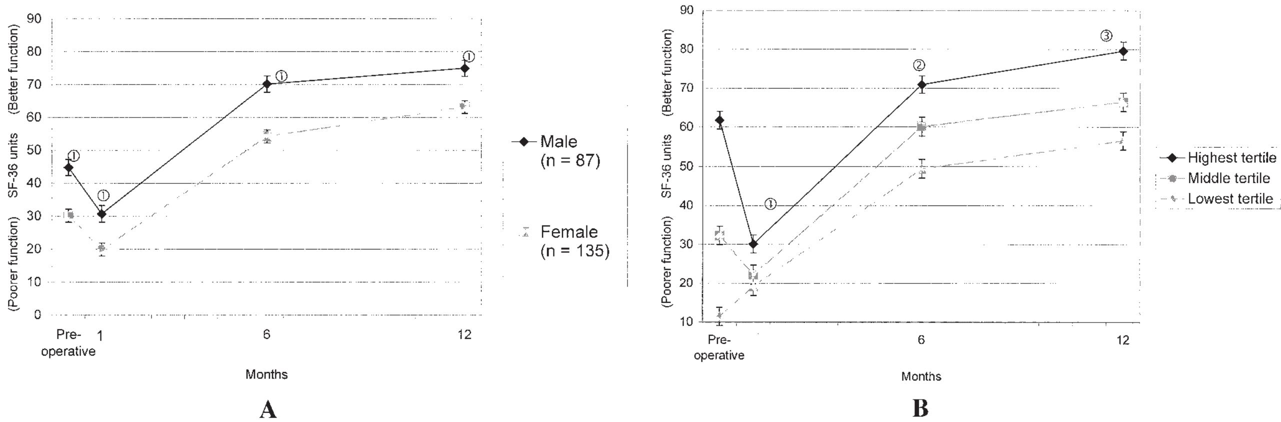


Figure 3. Preoperative and postoperative physical function scores. Data are adjusted mean ± standard error. Mean values are adjusted for covariate of interest and time period. Standard errors are adjusted to account for repeated measures. **A**: Sex. (1) $P < 0.005$. **B**: Tertile of preoperative physical function. (1) $P < 0.05$ between highest tertile and lower tertiles. (2) $P < 0.01$ between each of the groups; $P < 0.001$ between highest and lowest tertile. (3) $P < 0.001$ between top tertile and lower 2 tertiles; $P < 0.005$ between middle and lowest tertile. SF-36 = Short Form 36.

ported 14.3 higher units of postoperative physical function improvement across the 3 postoperative time periods than patients with the poorest preoperative physical function (95% CI 8.1–20.6). The large preoperative differences in physical function noted between the tertiles were markedly reduced 1 month after surgery. Patients in the best preoperative physical function tertile experienced a marked decline, whereas patients in the worst preoperative physical function tertile actually reported improvement 1 month after surgery. Thereafter, all 3 tertiles had similar significant gains in physical function scores (Figure 3, panel B).

DISCUSSION

This report confirms the findings from previous studies that patients have marked improvement in physical function and bodily pain after joint replacement. However, this report provides new insight regarding the initial recuperative phase after surgery. Despite significant improvements in bodily pain, patients experience marked decrease in physical function at 1 month after surgery. When one considers the already extremely reduced preoperative physical function, this finding of further decline has important implications for patients and their families regarding expected 1-month postoperative physical dependencies, particularly as patients are likely to be discharged from structured physical therapy at this time. This may well exacerbate patients' previously stated concern regarding postoperative dependency (16). These findings should stimulate discussions between physicians and their patients. These findings should also caution policymakers considering proposals that would further reduce postacute care services. Our finding of limited postoperative physical function is consistent with the findings from other studies that suggest this period of physical function decline abates 6 weeks after surgery (8) and patients are improved by 3 months after surgery (6,15).

Despite the surgical differences between hip replacement and knee replacement surgeries, physical function and bodily pain were remarkably similar prior to surgery and at 6 and 12 months postoperatively between these 2 groups of patients undergoing either hip or knee replacement surgery. The only significant difference between these patients was noted for the 1-month postoperative bodily pain scores. This observation confirms other authors' findings that patients undergoing knee replacement tend to recuperate more slowly than do patients undergoing hip replacement (17). Because patients had similar 1-month physical function scores, the recuperative difference is primarily due to more pain in the knee replacement patients at 1 month after surgery. By 6 months, the differences in pain between the 2 groups had fully resolved. Based on these findings, patients undergoing knee replacement should be counseled that despite a protracted recuperative period of at least 1 month, they should be able to expect excellent pain relief from surgery. To date, there has been no agreement in the literature regarding impact of surgical site on intermediate (12–24-month) outcomes. Some authors have noted more favorable outcomes for knee replacement (9,30), whereas other authors have noted better outcomes for hip replacement (25). Our analysis did not identify differences between patients undergoing hip replacement or knee replacement in bodily pain or physical function at either 6 or 12 months.

The 1-month data also provide interesting insight regarding the potential timing of joint replacement. This analysis stratified patients into tertiles based on preoperative bodily pain and physical function scores. Fortin and colleagues performed a similar analysis (4). Our results confirm their finding (and the findings of others) (8) that the single best predictor of postoperative QOL is patients' preoperative QOL. These interim 1-month data suggest that there may be a common recuperative pathway that patients pass through after joint replacement. As other authors have also addressed this issue indirectly (4), a randomized trial comparing early versus delayed joint replacement surgery would greatly assist clinical decision making regarding the optimal timing of surgery. Until that time, long-term studies examining the progression of pain and functional deterioration in patients with advanced hip and knee arthritis would help patients and their physicians better understand projected QOL outcomes between surgical and nonsurgical options.

This article also illustrates the important independent impact of social support on joint replacement QOL outcomes. Marital status has been previously associated with improved instrumental activities of daily living after hip replacement (31), and higher levels of social support have been associated with greater symptom relief after coronary artery bypass graft surgery (32). Furthermore, social support may be important to patients when considering the timing and whether or not to undergo joint replacement (16). In addition to providing assistance to the patient during the recuperative period, social support may provide patients with motivation to better rehabilitate their prosthetic joints. Furthermore, lack of social support may serve as a barrier to joint replacement surgery, particularly in light of our observed increased dependency at 1 month after surgery. Physicians ought to identify patients with weak social support and target postacute services for their increased need. The mechanism of better social support on the impact of improved joint replacement outcomes deserves further exploration.

This study also confirms the previously identified sex difference in preoperative joint replacement QOL (33). Although women had lower 12-month postoperative physical function than did men, they reported an equivalent amount of improvement in physical function after joint replacement. This postoperative trend suggests that the preoperative sex difference in physical function scores explains the majority of the observed postoperative sex difference in physical function outcome. To explain this observed preoperative sex difference, it has been suggested that women may delay surgery due to greater risk aversion regarding surgery and more concern about being a burden on their families (16). However, other authors have not noted a sex-associated risk aversion and cite referral bias as a potential barrier to access (34).

Regarding the observed sex differences in this study, it should be noted that in the referent US sample, there is a sex difference in self reported QOL as measured by the SF-36 (22). Women aged 65 years and older score 5.4 and 3.5 units worse than men of similar age on the bodily pain and physical function scales, respectively (22). It is not clear if this difference merely reflects a sex bias in subject response or truly poorer QOL due to a higher prevalence of osteoarthritis or other medical comorbid conditions among women. Nevertheless, the sex differences noted in this study were considerably larger than the described potential sex response bias in the US population sample.

In this report, patients aged 75 years and older reported significantly better pain relief after joint replacement than did younger patients (although reporting slightly poorer improvement in physical function). This difference is not likely attributable to other risk factors because older patients had similar preoperative pain status, weight, and proportion of women undergoing surgery compared with younger patients. Although there was a trend for older patients to have more comorbidities and less social support, these variables were controlled in the multivariate models. Rather, the observed greater pain reduction may reflect selection bias wherein referring physicians or surgeons may more stringently apply selection criteria based upon patient characteristics (not identified in this study) that would be associated with greater likelihood for improvement. Alternatively, because pain reduction and improved physical function are the goals of joint replacement surgery, optimizing pain reduction may be the emphasis for elderly patients whereas improved physical function may be the focus for younger patients. Questions raised by these caveats require further study.

It has been reported that generalists may be less likely to refer older patients for joint replacement (35); the findings of this study should give referring physicians further reason to consider joint replacement referral for their older patients. Although the literature is divided regarding the impact of advanced age on patient outcomes after joint replacement, this report confirms the findings of other authors who have noted that after adjusting for demographic, clinical, social support characteristics, and preoperative bodily pain, older age (≥65) was associated with slightly better improvement in bodily pain at 6 months, but had little impact on postoperative physical function (8). However, other authors have noted that older patients undergoing knee replacement benefited less from surgery in terms of improved pain, function, and mobility than did younger patients. In this same study, age had little impact on hip replacement outcomes (25). In a recent report, other authors have reported that age does not influence the outcome of joint replacement surgery (15).

Despite the general belief that obese patients have poorer joint replacement outcomes, we did not observe any significant correlation between patients' preoperative BMI and the QOL outcomes. Other authors have corroborated these findings (9). It has been previously shown that surgeons are less likely to operate on obese patients (36,37). The lack of association between obesity and intermediate outcomes should reassure physicians and their patients regarding the short-term benefits of joint replacement for obese patients. However, these findings cannot address longer-term concerns regarding potential premature joint failure (24).

There are several limitations to this study. All patients studied were from 1 tertiary referral center and hence, these findings may be unique to patients in such centers. Furthermore, the observed associations between the preoperative characteristics and the QOL outcomes noted were on a sample that had been selected for and underwent joint replacement surgery. Joint replacement surgery is an elective procedure and therefore patients are generally carefully screened prior to surgery. It is likely that there are multiple significant differences between patients who are selected for surgery and those with similar disabilities who are not selected for surgery. Findings from this study may not be generalizable to patients considering but not yet selected for joint replacement.

Furthermore, these data were drawn from a cohort of patients that underwent joint replacement prior to April 1993. Over the past 9 years, there have been changes in both prosthetics and techniques for joint replacement. Since the original study, the use of cement has declined for hip replacement. This decreased use of cement is associated with protracted rehabilitation after hip replacement. A greater use of cementless prosthetics for hip replacement would likely decrease the observed differences noted in this study between hip replacement and knee replacement surgeries. This study did not collect data regarding the use of cement. However, given the practice patterns at the time, most hip replacements were likely cemented.

The social support variable was created based upon the patients' self-reported preoperative living and marital status. This definition is a crude measure of social support. More importantly, the postulated benefits of greater social support are primarily dependent upon greater postoperative family assistance and motivation. However, it is likely that the preoperative definition of social support is highly correlated with a similar postoperative definition of social support. Nevertheless, more definitive comments regarding the mechanism of greater social support on joint replacement outcomes will have to await future studies designed to directly answer this question.

Finally, the SF-36 is a less sensitive instrument to change in physical function and pain than is a disease-specific instrument (such as the Western Ontario McMaster's University Osteoarthritis Index) (38). Therefore, the SF-36 may underestimate changes in pain and physical function.

In conclusion, this report finds that despite improvements in bodily pain, patients' physical function declines 1 month after joint replacement. Given the already poor preoperative physical function status, this finding implies that patients have significant need for assistance for a protracted period after surgery. The finding that there are similar recuperative pathways after joint replacement has implications for the timing and selection of patients for joint replacement. This common trajectory suggests that there may be threshold levels of disability and pain at which appropriate patients should be considered for joint replacement.

The finding that social support has a strong independent positive association with greater QOL improvement warrants further examination to understand what components of social support lead to better outcomes. Finally, because women presented with worse bodily pain and physical function scores yet reported comparable benefits, women may benefit from consideration of joint replacement surgery earlier in the course of their arthritis.

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