The Effect of Age on Pain, Function, and Quality of Life After Total Hip and Knee Arthroplasty

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Background: As utilization rates for total joint arthroplasty increase, there is a hesitancy to perform this surgery on very old patients. The objective of this prospective study was to compare pain, functional, and health-related quality-of-life outcomes after total hip and total knee arthroplasty in an older patient group (≥80 years) and a representative younger patient group (55-79 years).

Methods: In an inception community-based cohort within a Canadian health care system, 454 patients who received primary total hip arthroplasty (n=197) or total knee arthroplasty (n=257) were evaluated within a month prior to surgery and 6 months postoperatively. Pain, function, and health-related quality of life were evaluated with the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index and the 36-Item Short-Form Health Survey (SF-36).

Results: There were no age-related differences in joint pain, function, or quality-of-life measures preoperatively or 6 months postoperatively. Furthermore, after adjusting for potential confounding effects, age was not a significant determinant of pain or function. Although those in the older and younger groups had comparable numbers of comorbid conditions and complications, those in the older group were more likely to be transferred to a rehabilitation facility than younger patients. Regardless of age, patients did not achieve comparable overall physical health when matched with the general population for age and sex.

Conclusions: With increasing life expectancy and elective surgery improving quality of life, age alone is not a factor that affects the outcome of joint arthroplasty and should not be a limiting factor when considering who should receive this surgery.
PATIENTS AND METHODS

PATIENTS

A prospective community-based cohort study of patients recommended for either primary THA or TKA was conducted within a Canadian universal health care region (Edmonton, Alberta). This was an inception cohort that had been assembled for another study examining waiting-list times. Among the 197 participants who received THA, 163 (83%) were between 55 and 79 years of age and 34 (17%) were 80 years or older. Three deaths occurred in the older group 3 months after surgery and was unrelated to the operation. Demographic and baseline data were summarized in Table 1.

MEASURES

Joint-specific pain and functional outcomes were evaluated using the 36-Item Short-Form Health Survey (SF-36). This generic health measure is a self-administered 36-item questionnaire comprising 8 health dimensions: bodily pain, physical function, role limitations related to physical dysfunction, or stiffness. The WOMAC is a responsive, reliable, and valid instrument and has been extensively used to measure disability of the osteoarthritic hip and knee.

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highly selected patients, no study has prospectively compared these outcomes in a community-based study group of older and younger patients. Because utilization rates continue to increase and secondary factors affecting surgery are unclear, the effect of age needs to be evaluated in these patients. This is the first prospective community-based study comparing pain, function, and health-related quality-of-life outcomes after total joint arthroplasty in patients 80 years or older and a younger group.

The primary purpose of this study was to prospectively compare pain, functional, and health-related quality-of-life outcomes after THA and TKA in an older patient group (≥80 years) and a representative younger patient group (55-79 years) receiving joint arthroplasties.

RESULTS

Among the 197 participants who received THA, 163 (83%) were between 55 and 79 years of age and 34 (17%) were 80 years or older. Of the 257 participants who received TKA, 222 (86%) were between 55 and 79 years, and 35 (14%) were 80 years or older. Three deaths occurred within the TKA group during the 6-month follow-up. Two patients from the younger group died of pulmonary emboli within 1 month of discharge. The third death occurred in the older group 3 months after surgery and was unrelated to the operation. Demographic and baseline data are summarized in Table 1.

MEDICAL STATUS

Within both age groups, the majority of patients had at least one comorbid condition. The mean number of comorbid conditions was similar for both age groups regardless of the joint replaced (Table 1). The most frequently cited problem for patients with hip involvement was lower back pain, regardless of age (63 patients [39%] in the younger group and 15 patients [44%] in the older group). Hypertension was the most common comorbid condition in the TKA group, occurring in approximately 40% of the patients in each age group (90 of 222 in the younger group and 14 of 35 in the older
health (physical role function), mental health, role limitations related to emotional health (emotional role function), social functioning, vitality, and general health, as well as 2 summary measures: physical component summary and mental component summary. No global score exists for the SF-36. Scoring for the 8 dimensions ranges from 0 to 100 points, with higher scores representing better health. Reliability and validity have been extensively evaluated in a variety of patient populations, including patients undergoing THA and TKA and elderly persons both residing in the community and undergoing elective surgery.17,20,22,26

Sociodemographic and medical information, including age, sex, education, previous joint arthroplasty, and living arrangements, was collected at the baseline interview. The number of self-reported chronic conditions was recorded at the baseline interview using a list of 23 items27 and presented as a simple additive score.28 Data regarding the type of implant fixation (cemented, hybrid, or cementless), the number and type of in-hospital complications (wound infection, dislocation, manipulation under anesthesia, cardiorespiratory involvement, peripheral/central nervous system involvement, urinary tract infection, acute confusion, or blood loss requiring transfusion after surgery), and other medical information, such as diagnosis, were extracted from patients’ medical records by 2 health professionals. Health services utilization data were extracted from the regional database.

STATISTICAL ANALYSES

Because pain and functional outcomes are different for THA and TKA,29-31 the data were analyzed with respect to the type of joint replaced. Effect sizes were calculated for the WOMAC and SF-36 scores so that comparisons could be made between the age groups. This method standardizes scores for each age group, dividing the difference between the preoperative score and the score at the 6-month follow-up by the SD of the preoperative score. An effect size of 1.0 indicates a change of 1 baseline SD.

The preoperative and 6-month mean ± SD values of the SF-36 were compared with age- and sex-adjusted normative values (55-64 vs ≥65 years) using t tests. Because the SF-36 does not have a specific category for 80 years and above, the published normative values for age 65 years and above were weighted with respect to the sex distribution of the older study group. An overall age- and sex-adjusted normative value for each dimension and component summary score was then calculated based on the age and sex distribution of the 2 age groups for each joint. Only normative values for the SF-36 were used, since the WOMAC does not have normative values.

Bivariate analyses, such as the χ² statistic, were performed before multivariate analyses. Stepwise multiple linear regression analyses were used to evaluate the effect of age on pain and function while controlling for possible confounding effects of other variables. Models for changes in pain and function as measured by the WOMAC are presented for each joint. The selection of independent variables in the final models was based on their clinical significance or bivariate association with the dependent variables. Age, sex, waiting time, and length of stay in the acute care hospital were force-entered into the pain and functional models. Variables considered predictive of pain included preoperative bodily pain (SF-36), the number of comorbid conditions, and implant fixation. Preoperative joint pain (WOMAC), physical function (SF-36), body mass index, the number of comorbid conditions, preoperative living arrangements, and contralateral joint involvement were entered using forward selection as variables predictive of function. Age was treated as a continuous variable in the final model, but was also examined as a dichotomous variable. A subgroup analysis of patients 85 years or older did not show any deviations from outcomes of patients 80 years or older; therefore, and older age group included those patients 80 years or older.

Statistical analyses were performed using SPSS software version 8.0 (SPSS Inc, Chicago, Ill). All statistical testing was performed using 2-tailed tests, with significance at P ≤ .05.

HEALTH SERVICES UTILIZATION

The average waiting time for surgery ranged from 74 to 108 days and was not age dependent for TKA. There was a trend toward statistical significance for older patients with THA waiting less than younger patients (mean ± SD, 74 ± 61 vs 103 ± 85 days; P = .06). Using multiple regression and adjusting for covariates of age, sex, and length of stay within the hospital, waiting time did not affect pain or function at 6 months.

While no clinically significant differences were observed with the length of stay in the acute care setting, patients in the older age group were more likely to be transferred to rehabilitation facilities regardless of the type of joint replaced: 71% (n = 24) in the THA group and 83% (n = 29) in the TKA group. Only 40% of those in the younger group were transferred to other facilities for further rehabilitation. Those patients who were transferred to rehabilitation facilities had similar lengths of stay in the rehabilitation facilities regardless of age group (P > .05) (Table 1). At the 6-month follow-up interview, all patients had returned to the community. Within 6 months of discharge, 12 patients were admitted to the emergency department for prosthetic reasons, such as hip dislocations (n = 4), infections (n = 4), mechanical complications of prosthetic device (n = 3), and deep vein thrombosis (n = 1). Of these 12 patients, 2 who were 80 years or older were seen for hip dislocation; all other patients were from the younger groups (THA, n = 6; TKA, n = 4).

SURGICAL FACTORS

While the majority of patients had no in-hospital complications, the incidence of in-hospital complications was 0.39 complications per patient for the younger group regardless of the joint replaced (Table 1). Among the older patients in the THA and TKA groups, these rates were 0.55 and 0.41, respectively. These differences were not significant (P > .05).
OUTCOMES

WOMAC Outcomes

Patients, regardless of age, showed significant improvement in pain, function, and stiffness (Table 2). Moreover, the preoperative and 6-month postoperative scores were similar between the 2 age groups, although the older group reported less hip stiffness at 6 months. The magnitude of change as depicted by effect sizes typically showed greater gains in pain than function or stiffness for both age groups (Table 3).

Health-Related Quality of Life (SF-36)

Both age groups showed large effect sizes for bodily pain and physical function. Effect sizes were smaller for health, mental health, and role limitation due to emotional function dimensions (Table 3). Table 4 depicts improvements reported in all of the SF-36 dimensions for the younger group (P < .001). The older group did not im-
prove in health, mental health, and role limitation due to emotional function dimensions (P = .05); however, these values were comparable with age- and sex-adjusted values for the general population. Both age groups reached normative values in similar dimensions; that is, smaller changes were typically reported for the mental health dimensions, but these values were within the range of values for the general population. Changes were greater for physical health dimensions (bodily pain and physical function), but did not reach normative values.

**Multiple Linear Regression Analyses**

Age did not have a strong linear relationship with either pain or function. When age was entered into multiple linear regression models while controlling for the effect of other variables, it again was not a significant variable (Table 5 and Table 6). Age was examined both as a dichotomous and continuous variable. Inasmuch as age was not significant, the variables entered into the analyses accounted for 26% (THA) and 18% (TKA) of the explained variance in pain and 38% (THA) and 28% (TKA) of the explained variance in function.

**COMMENT**

In this prospective cohort study of THA and TKA, patients 80 years or older reported significant pain relief and functional improvement as well as positive gains in health-related quality of life that were comparable with those of patients aged 55 to 79 years. Our findings are consistent with previous improvements reported in younger cohorts.
from other studies.32-34 Patients with THA reported a 38% to 46% improvement in pain and function, while patients with TKA reported less of a change, a 28% to 34% improvement regardless of age. Although receiving a total joint arthroplasty is a function of age,1,2 this study found that the older patient group may be considered as a healthy cohort since these patients had numbers of comorbid conditions and complication rates similar to those of their younger counterparts. This may have been because of preferential bias in referral within the general practice for “suitable” candidates for this surgery; that is, frail elderly patients were not referred for surgery. This observation is supported by findings from studies that have recognized barriers to patients receiving arthroplasties1,4; however, it was unclear whether the bias for surgery occurred at the primary or orthopedic care level.3,35

Unlike other studies, this is the first prospective community-based study to compare pain, function, and health-related quality-of-life outcomes after total joint arthroplasties in patients 80 years or older and a younger group. These findings are presumed to be representative of general practice patterns since this cohort was not restricted to one center or surgeon and was conducted within a universal health care system. Although this cohort was community based, the older patient group may be considered as a healthy cohort since these patients had numbers of comorbid conditions and complication rates similar to those of their younger counterparts. This may have been because of preferential bias in referral within the general practice for “suitable” candidates for this surgery; that is, frail elderly patients were not referred for surgery. This observation is supported by findings from studies that have recognized barriers to patients receiving arthroplasties1,4; however, it was unclear whether the bias for surgery occurred at the primary or orthopedic care level.3,35

Others have questioned the wisdom of performing elective surgery in octogenarian patients because of their presumed susceptibility to major complications in the early postoperative phase.3,6 Our findings did not show a higher rate of complications in the older patients. Moreover, these results concur with other findings reported in a similar patient study group.11 While the complication rates were comparable in the older and younger groups, the most frequently cited complications, urinary tract infection rates were comparable in the older and younger groups.

Table 5. Multiple Linear Regression Model for Change in Pain†

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total Hip Arthroplasty† (n = 194)</th>
<th>Total Knee Arthroplasty‡ (n = 247)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>59.54 (29.61 to 89.46)</td>
<td>52.41 (26.07 to 78.75)</td>
</tr>
<tr>
<td>Age</td>
<td>−0.02 (−0.41 to 0.37)</td>
<td>0.01 (−0.24 to 0.42)</td>
</tr>
<tr>
<td>Female</td>
<td>6.49 (1.10 to 11.91)</td>
<td>0.03 (−0.42 to 0.80)</td>
</tr>
<tr>
<td>Waiting time</td>
<td>0.04 (−0.03 to 0.04)</td>
<td>0.01 (−0.02 to 0.04)</td>
</tr>
<tr>
<td>Length of stay</td>
<td>0.40 (−0.10 to 0.90)</td>
<td>−1.10 (−6.30 to 4.11)</td>
</tr>
<tr>
<td>Preoperative bodily pain (SF-36)</td>
<td>−0.59 (−0.77 to −0.41)</td>
<td>−0.42 (−0.56 to −0.27)</td>
</tr>
<tr>
<td>No. of comorbid conditions</td>
<td>−1.67 (−2.83 to −0.50)</td>
<td>−0.67 (−1.96 to 0.62)</td>
</tr>
<tr>
<td>Cementless prosthesis</td>
<td>−7.08 (−14.15 to −0.01)</td>
<td>−9.48 (−16.20 to −2.77)</td>
</tr>
</tbody>
</table>

Table 6. Multiple Linear Regression Model for Change in Function†

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total Hip Arthroplasty (n = 193)</th>
<th>Total Knee Arthroplasty (n = 247)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>87.25 (54.99 to 119.50)</td>
<td>74.42 (44.57 to 103.91)</td>
</tr>
<tr>
<td>Age</td>
<td>0.28 (−0.07 to 0.63)</td>
<td>0.06 (−0.25 to 0.38)</td>
</tr>
<tr>
<td>Female</td>
<td>3.12 (−2.42 to 8.67)</td>
<td>0.43 (−4.47 to 5.34)</td>
</tr>
<tr>
<td>Waiting time</td>
<td>−0.02 (−0.05 to 0.01)</td>
<td>−0.02 (−0.03 to 0.02)</td>
</tr>
<tr>
<td>Length of stay</td>
<td>−0.20 (−0.70 to 0.30)</td>
<td>−1.33 (−2.53 to −0.13)</td>
</tr>
<tr>
<td>Preoperative joint pain (WOMAC)</td>
<td>−0.59 (−0.76 to −0.41)</td>
<td>−0.43 (−0.57 to −0.28)</td>
</tr>
<tr>
<td>Body mass index</td>
<td>−0.68 (−1.20 to −0.17)</td>
<td>−0.31 (−0.71 to 0.10)</td>
</tr>
<tr>
<td>Contralateral joint involvement</td>
<td>−6.83 (−11.00 to −2.65)</td>
<td>−1.68 (−5.27 to −0.19)</td>
</tr>
<tr>
<td>Lives alone</td>
<td>−10.01 (−15.92 to −4.10)</td>
<td>−3.04 (−8.43 to 2.34)</td>
</tr>
<tr>
<td>No. of comorbid conditions</td>
<td>−2.06 (−3.28 to −0.84)</td>
<td>−1.56 (−2.74 to −0.37)</td>
</tr>
<tr>
<td>Preoperative bodily pain (SF-36)</td>
<td>−0.11 (−0.28 to 0.06)</td>
<td>−0.21 (−0.35 to 0.07)</td>
</tr>
</tbody>
</table>

*Dependent variables were calculated as the difference between preoperative and 6-month postoperative Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index pain score. The independent variable age was entered as a continuous variable. CI indicates confidence interval; SF-36, 36-Item Short-Form Health Survey.
†R² = 0.26.
‡R² = 0.16.
nary tract infection and deep vein thrombosis, were not considered major complications. Overall, the 6-month mortality rate was low in this study cohort; there were 2 fatal pulmonary embolisms in the younger group.

Although the older and younger patients had a similar number of comorbid conditions and comparable complication rates, a greater proportion of older patients were transferred to rehabilitation facilities rather than being discharged directly home. Other studies have reported that older age, living alone, and an increased number of comorbid conditions are determinants of receiving inpatient rehabilitation services before returning home. In this study cohort, a greater proportion of the older patients lived alone, yet all patients resided in the community at the 6-month follow-up. Although pain and functional gains were not age dependent, older patients were more likely to receive subsequent inpatient rehabilitation.

In conclusion, those patients 80 years or older attained pain, functional, and health-related quality-of-life outcomes expected for their age similar to those of a representative younger group (55-79 years) who received joint arthroplasties. Older patients were more likely to live alone and to be transferred to a rehabilitation facility; however, the number of comorbid conditions and in-hospital complication rates were comparable with those of the younger group. Furthermore, all older patients resided in the community at the 6-month follow-up. For the healthy person who is 80 years or older, joint arthroplasty provides pain relief and functional improvement, comparable with benefits in the younger patient population, and this is also reflected in similar health-related quality-of-life gains. With increasing life expectancy and elective surgery improving the quality of life, age alone is not a factor that affects the outcome of total joint arthroplasty and should not be a limiting factor when deciding who should receive this surgery.

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