Extent of Followup Care After Elective Total Hip Replacement

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ABSTRACT. ***Objective.*** To estimate the extent of radiographic and orthopedic followup among recipients of total hip replacement (THR), and to identify patients who are less likely to have consistent followup over 6 years postoperatively.

Methods. We studied a population-based sample of 622 patients who received THR in 1995. We developed a multivariate ordinal regression model with the extent of radiographic followup as the dependent variable (none, early, and consistent), adjusting for demographic and preoperative clinical characteristics, and hospital and surgeon volume.

Results. Ninety-four (15%) patients indicated that they had no followup radiographs, 269 (43%) had early followup only, and 259 (42%) had consistent followup radiographs over 6 years. Ninety percent of those with consistent followup orthopedic visits also had consistent followup radiographs over 6 years. Multivariate analyses revealed that older patients were less likely to have radiographic followup than younger patients (OR 0.76, 95% CI 0.65, 0.89) per each 5-year increase in age. Subjects with no college education were less likely to have radiographic followup than those with more education (OR 0.58, 95% CI 0.41, 0.83), and those with lower income were less likely to have radiographic followup than those with a higher income (OR 0.50, 95% CI 0.27, 0.92).

Conclusion. Only 42% of THR recipients reported consistent radiographic followup. Older patients, patients with lower income, and those with lower education level were less likely to have consistent radiographic followup over 6 years after THR. These population groups can serve as targets for interventions to improve followup after elective THR. (J Rheumatol 2006;33:1159–66)

Key Indexing Terms:
TOTAL HIP REPLACEMENT ORTHOPEDIC RADIOGRAPHIC FOLLOWUP

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Total hip replacement (THR) predictably relieves pain and improves function for patients with painful arthritic hips[1-6]. Joint replacement surgery remains one of the most effective treatments for severe arthritis affecting the hips, with excellent longterm results exceeding 20 years in many cases[7-12]. However, aseptic loosening due to osteolysis (inflammatory reaction to wear debris)[13] represents the largest threat to longterm survival of the implants. Other reasons for failure include dislocation, periprosthetic fracture, stem breakage, cup malposition, dissociated insert, dissociated femoral head, and infection[14].

The incidence of osteolysis increases progressively with time[15]. A recent study found osteolysis in 41% of hips at 7 years of followup[16]. While osteolysis may ultimately manifest as component loosening associated with pain, it may be silent, particularly in its early phases[17-24]. The evaluation and treatment of osteolytic defects identified in asymptomatic patients is controversial. However, osteolysis may cause enough bone loss to require revision THR[6]. Revision procedures are more costly and often more complicated than the index surgery[17,23,25-29]. Moreover, if unrecognized, osteolysis can lead to significant bone stock deficiency, making revision THR much more complex[30-33], often requiring bone allograft to restore adequate support[34,35]. Osteolysis can be detected as a progressive radiolucent line or cavity at the implant-bone or cement-bone interface on radiographs[24,36-39]. If osteolysis is

identified early, frequent monitoring strategies and, eventually, implementation of novel therapies may help delay or even prevent the need for more complex revision surgery if failures are detected sooner[40-46].

An essential feature of any surgical procedure is postoperative followup. Regular followup with an orthopedic surgeon, including radiographs, enables the surgeon to assess the result of surgery, recognize early signs of osteolysis, and identify the possible need for revision at an early stage[47,48]. Lack of effective followup may make any necessary surgery more difficult and potentially less successful, as conditions that may require a revision operation are not identified early.

Since bone loss may be asymptomatic, longterm followup is essential to determining outcomes and pathological processes related to THR[6,49]. However, there are no explicit guidelines for longterm followup care after THR following discharge.

The ideal extent of orthopedic and radiographic followup after THR has not been clearly defined. One published clinical pathway recommends visits to the orthopedic surgeon at 6 weeks postsurgery, 3 months, 6 months, and 1 year after THR, and then every 2 years[50]. In addition, evaluation with screening followup radiographs is typically performed in some settings in the immediate postoperative period and at followup every 2 years, with shorter intervals between visits if osteolysis becomes apparent[31]. Other guidelines suggest periodic longterm followup[49] or a longterm followup visit at a minimum after 5 years and every 5 years thereafter, with a minimum requirement of an anteroposterior and lateral radiograph[47,51].

Despite these recommendations, the frequency and duration of outpatient followup appointments after THR appear to vary greatly across orthopedic surgeons and hospitals[52]. In a recent survey of the American Association of Hip and Knee Surgeons, 80% of respondents recommended annual or biennial orthopedic clinical and radiographic examinations after THR, with more frequent followup times for clinical or radiographic signs of failure, previous revision arthroplasty, previous joint sepsis, and subnormal periprosthetic bone quality[53]. However, to our knowledge there has not been a population-based study examining the extent of clinical orthopedic and radiographic followup after THR.

The purpose of our study was to estimate the extent of radiographic and orthopedic followup among recipients of primary THR, and to identify patients who are less likely to have consistent followup over 6 years postoperatively. We hypothesized that longterm radiographic and orthopedic followup is not performed in all THR recipients consistently, and that the extent of followup varies according to patient characteristics.

MATERIALS AND METHODS

Patients. To select the study cohort, we used Medicare claims to identify a random sample of patients aged 65 years or older that were resident in 3 US states (Ohio, Pennsylvania, and Colorado) and had elective primary THR in calendar year 1995, as reported[54,55]. The analyses here are built upon surveys administered to this population-based cohort of patients 3 and 6 years after they received elective primary THR.

Data sources

Medical record. Medical record reviews were performed by trained personnel working in peer review organizations using a standardized data abstraction form. The medical record included data on patients' preoperative clinical characteristics such as age, sex, weight and height, the primary underlying joint disease (osteoarthritis, rheumatoid arthritis, or avascular necrosis), the surgical procedure performed (index vs revision), history of previous orthopedic surgery in other joints, and comorbid medical conditions. Comorbid medical conditions were extracted and aggregated using the Charlson Index[56]. Body mass index (BMI) was computed as weight (kg)/height (m)^2 and was dichotomized for obesity (overweight grade II: BMI > 30)[57].

Medicare claims. Medicare claims provided data on the volume of primary and revision THR performed in 1995 by the surgeon and the hospital.

Survey questionnaires. The 3-year followup questionnaire included questions about patients' recalled preoperative functional status (including use of supportive devices, limp, stair climbing, and walking distance)[58]. These items were adapted from the Harris Hip Score[4,5,59]. Weights were assigned as in the Harris Score, summed, and standardized to a 0–100 scale. This variable was dichotomized at the highest quartile. Patients also indicated their socioeconomic status, living arrangement, and number of years of formal education completed. Income consisted of the total household income in the past year (including all sources of income such as wages, social security, pensions, investments, etc.). The 3 and 6-year followup questionnaires assessed patients' pain and functional status with the Western Ontario and McMaster University Osteoarthritis Index (WOMAC)[60] and patients' mental health status with the 5-item Mental Health Inventory Questionnaire (MHI-5)[61]. The questionnaires asked whether patients had followup visits with an orthopedic surgeon and followup radiographs after primary THR.

Statistical methods. The primary outcome was the extent of radiographic followup visits in THR recipients. The dependent variable categories were defined as follows: None: no followup radiographs reported (3 or 6 years) after THR. Early: at least one followup radiograph reported at 0–3 years after THR, but no radiographs at 3–6 years after THR. Consistent: at least one followup radiograph reported at 0–3 years and one followup radiograph reported at 3–6 years after THR.

Definitions of none, early, and consistent orthopedic surgeon followup appointments were made analogously. Demographic data were summarized using descriptive statistics. The independent variables included patient sociodemographic characteristics (age, sex, race, living arrangement, level of income, level of education, type of residence, distance from home to hospital[62]), preoperative factors (obesity, comorbidities, underlying disease, mental health, and preoperative functional status), and hospital and surgeon characteristics (hospital and surgeon volume and surgeon's age). Analyses of the independent variable "income" included "missing" as a category.

We analyzed the bivariate relationship of each predictor variable to the outcome in order to select candidate predictors for inclusion in the multivariate model. A significance level of 0.10 was applied for selecting predictors. We developed ordinal regression models (also known as proportional odds models) using the 3-level dependent variable noted above, with those having consistent followup as the reference group. In these models, the odds ratio can be interpreted as the effect of an explanatory variable on the odds of having early followup versus no followup, and the odds of having consistent followup versus early followup[63]. These analyses were adjusted for all predictors that were retained in the model in a stepwise selection with a criterion of $p = 0.10$. These variables included age, sex, annual income, education level, and hospital volume. In addition, other relevant variables such as obesity, comorbidities, preoperative functional status, and distance from home to hospital were also included in the model.

We performed a sensitivity analysis in which the primary outcome measure was defined as a dichotomous indicator for the extent of followup in THR recipients (consistent vs early/none). For this outcome we built a multivariate logistic regression model that adjusted for all predictors that were retained in the model in a stepwise selection, with a selection criterion of $p = 0.10$. These variables included age, sex, income, education level, obesity, comorbidities,

preoperative functional status, distance from home to hospital, and hospital volume.

RESULTS

Patients. We selected a cohort of 1939 patients with primary THR, using the sampling procedures described above. The algorithms for case identification in this cohort are published[54,55]. Briefly, 956 patients of all those eligible to be involved in the sample returned questionnaires at 3 years of followup. Of these, 177 (19%) patients indicated that they had no followup visits with the orthopedic surgeon in the first 3 years following surgery, 382 (40%) had visits less than yearly, and 336 (35%) had yearly followup visits over this first 3-year period; 61 (6%) had missing values. On the other hand, 163 (17%) patients indicated that they had no followup radiographs in the first 3 years following surgery, 417 (44%) had followup radiographs less than yearly, and 317 (33%) had consistent followup radiographs over the first 3-year period; 59 (6%) had missing values.

At 6 years, we approached 907 patients (all those who agreed at 3 years except those who had died). A total of 792 (87%) returned completed questionnaires at 6 years of followup. Among these, 170 (21%) patients with missing values on the dependent variable were excluded from the analysis.

The 334 patients not included in the study sample at 6 years because they had died, did not respond, or had missing data on the dependent variable were similar to those included in the analyses except that they were 3 years older than those who were included (75 vs 72 yrs; $p = 0.0001$). Also, a lower proportion of subjects not included had incomes > $20,000 US than those who were included (36% vs 46%; $p = 0.005$). There was no difference in race.

The study sample included 622 patients who had a primary THR in 1995 and completed the survey at 3 and 6 years postoperatively. The demographic characteristics of the study sample are listed in Table 1, as are preoperative clinical factors and surgeon and hospital characteristics. The mean age was 72 years, 62% were female, 55% had an education level of a high school degree or less, 34% had an annual income < $20,000, less than 10% were employed, and 30% were living alone at the time of completing the 6-year survey.

Extent of radiographic and orthopedic followup. Ninety five (16%) patients indicated that they had no followup visits with the orthopedic surgeon, 256 (43%) had visits only in the first 3 years after surgery (early followup), and 247 (41%) had consistent followup visits over a 6-year period. Ninety-four (15%) patients indicated that they had no followup radiographs, 269 (43%) had followup radiographs only in the first 3 years after surgery (early followup), and 259 (42%) had consistent followup radiographs over 6 years. Ninety percent of those with consistent followup orthopedic visits also had consistent followup radiographs over 6 years after THR. We give results based on followup radiographs as the primary outcome measure.

Ordinal regression results are shown in Table 2. Multivariate ordinal regression analyses included age, sex, income, education level, distance from home to hospital, obesity, comorbidities, preoperative functional status, and hospital volume as potential predictors of radiographic followup. These analyses revealed that older patients were less likely to have radiographic followup than younger patients (OR 0.76, 95% CI 0.65, 0.89, per each 5-year increase in age). Subjects with no college were less likely to have radiographic followup than those with college or at least some college education (OR 0.58, 95% CI 0.41, 0.83). Finally, those with lower income were less likely to have radiographic followup than those with a higher income (OR 0.50, 95% CI 0.27, 0.92 for subjects with an income < $20,000; and OR 0.50, 95% CI 0.29, 0.88 for those with an income in the range of $20–50,000).

Other factors such as sex, race, living arrangement, distance from home to hospital, obesity, comorbidities, mental health, and functional status were not associated with radiographic followup (Table 2).

A sensitivity analysis using logistic regression showed similar results to those of the ordinal regression models. These logistic regression analyses confirmed that older patients were less likely to have radiographic followup than younger patients (OR per each 5-year increase in age 0.72, 95% CI 0.61, 0.87). Those with a lower level of education (OR 0.62, 95% CI 0.43, 0.91) compared with those with greater than high school education, and those with lower income were less likely to have radiographic followup than those with a higher income (OR 0.55, 95% CI 0.29, 1.05 for subjects with an income < $20,000; and OR 0.48, 95% CI 0.27, 0.86 for those with income in the range of $20–50,000).

DISCUSSION

We used patient survey data in a population-based sample of Medicare beneficiaries to describe practice patterns for radiographic and orthopedic followup after primary elective THR. Our results showed that among those who responded to the survey, 15% of THR recipients get no followup care and that only about 40% have consistent followup over 6 years, with the remainder having followup visits with an orthopedic surgeon as well as radiographic followup only in the first 3 years after THR. In addition, we identified factors related to reduced followup frequency. Older patients and patients with lower level of education and lower income were less likely to have consistent followup with radiographs over 6 years.

Other factors such as sex, race, living arrangement, distance from home to hospital, obesity, comorbidities, mental health, and functional status did not appear to influence the extent of followup. However, other factors may influence the patients' lack of understanding of why followup evaluation might be helpful, even if their orthopedic surgeon had suggested followup at the time of surgery.

Several authors have suggested that even asymptomatic patients should have followup care at least biennially follow-

Table 1. Study sample characteristics and radiographic followup.

Patient Characteristics	No Followup, N = 94 (%)	Early Followup, N = 269 (%)	Consistent Followup, N = 259 (%)	p
Sociodemographic factors				
Age, 5 yr categories				
65–70	26 (12)	86 (39)	106 (49)	0.005
70–75	36 (17)	90 (42)	89 (41)	
75–80	20 (16)	65 (51)	43 (34)	
≥ 80	12 (20)	28 (46)	21 (34)	
Female	57 (15)	163 (42)	166 (43)	0.44
Male	37 (16)	106 (45)	93 (39)	
Race				
White	92 (15)	262 (43)	251 (42)	0.27
Non-white	1 (7)	6 (40)	8 (53)	
Living arrangement				
Alone	28 (14)	88 (47)	73 (39)	0.52
Not alone	66 (15)	181 (42)	186 (43)	
Income, $US				0.01
High (≥ 50,000)	5 (7)	26 (37)	39 (56)	
Medium (20–50,000)	30 (14)	104 (49)	80 (37)	
Low (≤ 20,000)	42 (20)	91 (43)	79 (37)	
Missing data	17 (14)	48 (38)	61 (48)	
Education level				< 0.001
College and at least some college	28 (10)	113 (41)	132 (48)	
No college	65 (19)	149 (44)	123 (36)	
Distance to hospital, miles				0.27
Low (≤ 5)	25 (13)	80 (41)	88 (46)	
Medium (5–20)	40 (16)	117 (46)	99 (39)	
High (≥ 20)	29 (17)	72 (42)	72 (42)	
Preoperative clinical factors				
Obesity (BMI ≥ 30 kg/m^2)				0.57
Yes	17 (11)	79 (53)	52 (35)	
No	77 (16)	190 (40)	207 (44)	
Comorbidities (≥ 1)				0.22
Yes	41 (15)	130 (47)	103 (38)	
No	53 (15)	139 (40)	156 (45)	
Underlying disease				0.44
OA	78 (14)	240 (44)	227 (42)	
Other	16 (21)	29 (38)	32 (42)	
Functional status (highest quartile)				0.82
High	48 (15)	132 (42)	133 (42)	
Low	46 (15)	137 (44)	126 (41)	
Surgeon and hospital factors				
Surgeon's age, yrs				0.03
≥ 60	10 (8)	53 (45)	56 (47)	
< 60	84 (17)	216 (43)	203 (40)	
Surgeon volume				0.61
High (≥ 15)	30 (14)	100 (47)	85 (40)	
Medium (5–15)	25 (13)	81 (42)	88 (45)	
Low (≤ 5)	39 (18)	88 (41)	86 (40)	
Hospital volume				0.51
High (≥ 50)	37 (18)	91 (44)	77 (38)	
Medium (15–50)	23 (11)	91 (43)	99 (46)	
Low (≤ 15)	34 (17)	87 (43)	83 (41)	
Teaching hospital				0.64
Yes	57 (15)	166 (43)	163 (42)	
No	35 (16)	95 (43)	89 (41)	

BMI: body mass index, OA: osteoarthritis.

ing THR[53]. While most cases of clinically significant osteolysis are identified later than 6 years after the procedure, and followup would be expected to decrease with time from surgery, detection of clinically silent problems may be enhanced by early, regular, and consistent followup. This strategy permits identification of potential complications at an earlier stage and

Table 2. Radiographic followup after THR: ordinal regression results.

Patient Characteristics	N (%)	Crude OR	Adjusted OR*
Sociodemographic factors			
Age (ordinal, 5 yr categories)		0.80 (0.69, 0.93)	0.76 (0.65, 0.89)
Sex, female	386 (62)	1.13 (0.84, 1.54)	1.33 (0.95, 1.87)
Race, White	605 (97)	0.58 (0.21, 1.59)	
Living arrangement, alone	189 (30)	0.88 (0.63, 1.22)	
Income, $US			
High (≥ 50,000)	70 (11)	1	1
Medium (20–50,000)	214 (34)	0.43 (0.20, 0.73)	0.50 (0.29, 0.88)
Low (≤ 20,000)	212 (34)	0.49 (0.29, 0.83)	0.50 (0.27, 0.92)
Missing data	126 (20)	0.69 (0.39, 1.23)	0.80 (0.43, 1.48)
Education level			
College and some college	273 (45)	1	1
No college	337 (55)	0.57 (0.42, 0.78)	0.58 (0.41, 0.83)
Distance to hospital, miles			
Low (≤ 5)	193 (31)	1	1
Medium (5–20)	256 (41)	0.77 (0.54, 1.10)	0.74 (0.51, 1.07)
High (≥ 20)	173 (28)	0.82 (0.56, 1.21)	0.88 (0.58, 1.35)
Preoperative clinical factors			
Obesity (BMI ≥ 30 kg/m^2)	148 (24)	0.86 (0.61, 1.21)	0.91 (0.63, 1.31)
Comorbidities (≥ 1)	274 (44)	0.81 (0.60, 1.09)	0.82 (0.60, 1.13)
Underlying disease, OA	545 (88)	1.15 (0.74, 1.81)	
Functional status (highest quartile)			
High (≥ 21)	313 (50)	1	1
Low (< 21)	309 (50)	1.04 (0.78, 1.40)	1.03 (0.75, 1.41)
Surgeon and hospital factors			
Surgeon's age (≥ 60 yrs)	119 (19)	1.44 (0.98, 2.12)	
Surgeon volume			
High (≥ 15)	215 (35)	1	
Medium (5–15)	194 (31)	1.22 (0.84, 1.76)	
Low (≤ 5)	213 (34)	0.93 (0.65, 1.33)	
Hospital volume			
High (≥ 50)	205 (33)	1	
Medium (15–50)	213 (34)	1.52 (1.06, 2.19)	
Low (≤ 15)	204 (33)	1.13 (0.79, 1.63)	
Teaching hospital	386 (64)	1.08 (0.79, 1.47)	

* Adjusted for age, sex, race, income, education level, distance from home to hospital, obesity, comorbidities, preoperative functional status, and hospital volume.

hence may reduce the likelihood of complex revision procedures[16,21]. Our results indicate that these goals are not met in the majority of patients in a 6-year postoperative period.

Previous studies found that low income was associated with less favorable outcomes after total joint arthroplasty[64]. We found that older people and people with lower income and less education were less likely to receive regular followup. It is possible that healthcare providers offer these patients less information, and/or that the patients are less able to understand the information. Also, Medicare does not cover all medical costs, and these people may not have supplementary insurance or the ability to pay the uncovered amounts for followup appointments. In any case, our results suggest that intervention strategies are necessary to improve followup, specifically in patients who are older and have lower levels of education and income.

Major advantages of this study include the large sample size and population-based sampling strategy. Further, the study considered the level of function prior to surgery (albeit retrospectively)[58,65,66]. Also, the response rate is 87% of all those eligible to be involved in the sample at 6 years of followup. However, a major limitation of the study is the low response rate to the 3-year survey. Several authors have suggested that patients who do not respond to followup surveys have worse outcomes of total joint arthroplasty[67-69]. In contrast, a recent study found that patients who did not attend followup visits with the orthopedic surgeon after total knee replacement did not have significant differences in outcome variables or surgical procedures compared with patients who had complied with a followup protocol[70]. We can only speculate to what extent nonresponse influenced our results. It is impossible to tell from our study whether inconsistent followup is cause or effect of nonresponse. Future studies should attempt to disentangle these complex mechanisms.

In addition, we acknowledge that this cohort is older than 65 years and therefore we are uncertain what happens in younger patients. Orthopedic surgeons might be more aggressive in following younger, more active patients who are at higher risk of failure and hence more likely to need a revision procedure.

Data on followup orthopedic visits and radiographs were recalled and thus were subject to recall bias. We were unable to address this potential bias since we could not perform a medical record confirmation of followup visits. In general, immediate postoperative radiographs are obtained, since they serve as a baseline for identification of osteolysis on later studies, and comparison radiographs are important for decision-making. Also, most institutions follow a standard protocol for postoperative care following THR including a routine visit and radiographs. Our surveys collected information on whether patients had followup appointments with an orthopedic surgeon and followup radiographs after primary THR, but we were unable to distinguish whether they had no followup visits at all or if they had none after the routine postoperative visit. However, by potentially including early routine postoperative visits and radiographs in our definition of the dependent variable, we may overestimate the extent of followup care after primary elective hip replacement. Yet our data show a concerning lack of followup care. Thus the bias toward greater followup care is conservative. In addition, this ambiguity does not arise in the questionnaire at 6 years after the procedure, which is more important in assessing longterm followup care.

Our survey did not include questions on how orthopedic surgeons or health professionals communicate longterm followup care recommendations, nor on patient recall strategies that could facilitate compliance with followup visits. Indeed we do not know what percentage of patients actually comply with recommendations given at discharge from the acute care setting and subsequent followup visits, nor whether these recommendations follow a clinical pathway or not. However, 2 surveys of surgeons in the UK and the US suggested that consistent followup is recommended for all patients[52,53]. Further research is needed to correlate followup care type and frequency with outcomes and complications.

The principal finding of our survey is that a majority of patients in these series did not receive consistent followup care after total hip arthroplasty over a 6-year period. Healthcare providers may not be aware of the importance of longterm orthopedic and radiographic followup care in every recipient of THR. Our results may be useful in the development of practice guidelines for followup after total hip arthroplasty that may be used by healthcare providers involved in the care of THR recipients, such as orthopedic surgeons, rheumatologists, primary care physicians, radiologists, nurses, and physical therapists. Further, the results suggest that low income, low education, and older age may be independent predictors of inconsistent followup. Hence, specific efforts targeted to these patient groups may be necessary to improve followup and thus less complicated revision surgeries after THR.

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