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Patient Compliance with Clinical Follow-up After Total Joint Arthroplasty

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Background: Periodic clinical and radiographic evaluation is commonly recommended by orthopaedic surgeons to monitor patients following total joint arthroplasty, yet the compliance with and efficacy of patient follow-up protocols have not been well defined. The purpose of this study was to evaluate patient compliance with early clinical follow-up after total hip arthroplasty or total knee arthroplasty.

Methods: We performed a retrospective review of clinical follow-up compliance for 776 patients who had undergone a total joint arthroplasty in the lower extremity. This cohort included 505 total hip arthroplasties (372 primary and 133 revision procedures) and 271 total knee arthroplasties (195 primary and seventy-six revision procedures). The patients were given one-time verbal instructions by the treating surgeon at the three-month postoperative visit to return for the one-year follow-up evaluation. At the one-year follow-up evaluation, those who returned were once again verbally instructed to return a year later. Demographic factors, functional hip and knee scores, and follow-up compliance at one and two years after surgery were assessed.

Results: Patient compliance with clinical follow-up after all arthroplasties was 61% at one year and 36% at two years. With use of a multivariate model for patients who had total hip arthroplasty, the analyses showed that a revision hip procedure ($p = 0.006$), younger patient age ($p = 0.04$), and a higher preoperative Harris hip score for gait ($p = 0.04$) were associated with follow-up compliance at two years. Of the factors analyzed for patients who had total knee arthroplasty, only nonwhite race ($p = 0.03$) was found to be a positive predictor of follow-up compliance at the two-year follow-up interval.

Conclusions: Patient compliance with clinical follow-up after total joint arthroplasty in response to a verbal request made by the surgeon once at three months and once at one year postoperatively was poor in this series. These data indicate that this method (one-time verbal instruction) is insufficient to ensure compliance for follow-up after total joint arthroplasty.

More than 500,000 total hip and knee arthroplasties were performed in the United States in the year 2000, and the rate of total joint replacement is projected to increase 5% annually^{1,2}. On the basis of data collected through the United States Census Bureau, Kurtz et al. estimated that the demand for total hip arthroplasty will increase to 572,000 procedures annually by the year 2030, with the demand for primary total knee arthroplasty reaching approximately 3.5 million³. With an increasingly aging population, primary total joint arthroplasty of the hip and knee will become even more common and consequently the follow-up of these patients will be substantial.

The longevity of total joint arthroplasty can be limited by problems such as wear-debris-induced osteolysis and aseptic loosening⁴⁻⁷. Unfortunately, delayed diagnosis of these problems can result in the need for complex and costly revision surgery^{8,9}. Thus, periodic postoperative clinical and radiographic analysis to provide early detection of bearing surface wear, osteolysis, and implant loosening seems prudent. Follow-up visits for arthroplasty surveillance have traditionally been performed by the operating surgeon in the outpatient setting. To our knowledge, however, the extent to which patients comply with this recommendation and the efficacy of

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this type of patient surveillance have not been rigorously analyzed.

The purpose of this study was to determine the compliance with clinical follow-up in a consecutive series of patients who had hip or knee arthroplasty at our institution. In addition, we analyzed the positive and negative predictors for clinical follow-up compliance.

Materials and Methods

A total of 776 patients underwent total knee or total hip arthroplasty performed by one surgeon (J.C.C.) between September 1998 and January 2003. This cohort included 505 total hip arthroplasties (372 primary and 133 revision procedures) and 271 total knee arthroplasties (195 primary and seventy-six revision procedures). All patients consented to an institutional review board-approved protocol for prospective data collection. In the primary total hip arthroplasty group, there was a subgroup of twenty-nine patients who were part of a prospective, randomized clinical trial of a specific arthroplasty implant and served as a comparison group in this study. These patients were contacted by telephone to schedule their annual follow-up appointments and to remind them to attend. If these patients did not attend a scheduled visit, they were contacted by telephone to reschedule an appointment, and they were repeatedly contacted by telephone until they attended the annual visit. If a patient declined further follow-up evaluation, no more telephone contact was performed.

The remaining 747 patients constituted the study group, and they were analyzed collectively and by the type of procedure they underwent. Twelve patients (seven who had a primary total hip arthroplasty; three, a revision total hip arthroplasty; one, a primary total knee arthroplasty; and one, a revision total knee arthroplasty) died prior to one year of follow-up and were excluded from all analyses, leaving 735 patients for inclusion in the study group and available for the one-year follow-up visit. An additional five patients (one who had a primary total hip arthroplasty; three, a revision total hip arthroplasty; and one, a revision total knee arthroplasty) died prior to the two-year follow-up evaluation, leaving 730 patients available for the two-year analysis. At the time of hospital discharge, all patients in the study group were given appointments to be seen for follow-up at six weeks and three months postoperatively. At the three-month visit, they were given verbal instructions by the primary surgeon to return at one year postoperatively. At the one-year visit, the patients were again verbally instructed by the surgeon to return in one year for a two-year postoperative visit. For annual appointments, the patient was given the month and the year of the next appointment (verbally and in written form on the billing sheet). At checkout, the patient was given two options by the receptionist: (1) immediately schedule the future appointment through the receptionist or (2) contact the office by telephone at a later date to schedule the routine annual follow-up. We did not perform follow-up telephone calls or mail notifications to remind these patients of their appointments.

We retrospectively queried our registry to determine the follow-up compliance of patients who had undergone either total

hip arthroplasty or total knee arthroplasty. The 735 patients were subdivided into four groups: (1) primary total hip arthroplasty, (2) revision total hip arthroplasty, (3) primary total knee arthroplasty, and (4) revision total knee arthroplasty.

Data for all patient visits were recorded prospectively. For patients who received bilateral joint arthroplasty, only data from the first procedure were utilized. If both procedures occurred on the same day, only one set of preoperative joint scores was utilized. If a patient received a primary hip or knee arthroplasty and subsequently required a revision procedure, they were excluded from the hip and knee revision data set analyses to guarantee that no single patient was counted twice in this study. The Social Security numbers for all patients analyzed were cross-referenced with the Social Security Death Index to exclude any patients from the study who had died within the two-year follow-up period.

The preoperative information included first and last name, Social Security number, age, date of surgery, date of follow-up appointments, procedure performed (arthroplasty type), preoperative diagnosis, surgeon, race, sex, history of joint infection, height, weight (both body mass index as a continuous variable, and overweight status [body mass index of >25] as a dichotomous variable), proximity to the medical center, Harris hip scores¹⁰ (pain, gait, function, activity, and total score for the evaluated hip) for the patients receiving a hip arthroplasty, and Knee Society function and clinical scores¹¹ for the patients receiving a knee arthroplasty. Because of its skewed and abnormal distribution, proximity to the medical center was dichotomized according to the distribution of distances the patients lived from the medical center. Proximity was categorized on the basis of the 75th percentile distance from the medical center of fifty miles. This categorization allows comparison between patients who lived within fifty miles of the medical center and patients who lived more than fifty miles away. Patient compliance with follow-up was the primary outcome variable analyzed. A ninety-day window of eligibility was chosen for each annual follow-up visit. For example, a patient could successfully return for the one-year follow-up visit as long as he or she returned to the office within the period from ninety days before to ninety days after the one-year postoperative date.

All 735 patients were analyzed collectively, and each arthroplasty type was also analyzed separately (hip arthroplasty and knee arthroplasty) to assess the association of procedure-specific measures with compliance. The data on the return of patients for one-year and two-year follow-up were analyzed separately, creating a total of six individual analyses.

Demographic and clinical variables for patients who did and did not return for follow-up were compared with use of logistic regression. Variables that were significant ($p \leq 0.05$) in univariate logistic regression analyses were analyzed in a multivariate logistic regression analysis predicting compliance. Adjusted odds ratios and corresponding 95% confidence intervals are reported for variables in the multivariate model, adjusted for all other variables in the model. For categorical predictors, the reference category for the adjusted odds ratio is indicated with an adjusted odds ratio of 1.0. For continuous predictors and unless otherwise noted, adjusted odds ratios

TABLE I Summary of Total Hip Arthroplasty and Total Knee Arthroplasty Follow-up Compliance

| Variable | Total Hip Arthroplasty | | | Total Knee Arthroplasty | | |
|---|------------------------|-----------------------|------------------|-------------------------|----------------------|------------------|
| | Primary (N = 336) | Revision (N = 130) | All (N = 466) | Primary (N = 194) | Revision (N = 75) | All (N = 269) |
| Female sex* | 195 (58) | 80 (62) | 275 (59) | 140 (72) | 42 (56) | 182 (68) |
| White race* | 254 (76) | 111 (85) | 365 (78) | 132 (68) | 63 (84) | 195 (72) |
| Age† (yr) | 57 ± 17 | 64 ± 15 | 59 ± 17 | 67 ± 12 | 67 ± 12 | 67 ± 12 |
| Body mass index† (kg/m ²) | 29.1 ± 7 | 27.2 ± 6 | 28.5 ± 6 | 31.7 ± 8 | 31.5 ± 7 | 31.6 ± 8 |
| Harris hip scores† | | | | NA | NA | NA |
| Pain | 12.6 ± 6 | 13.9 ± 9 | 13.0 ± 7 | | | |
| Gait | 14.7 ± 9 | 10.6 ± 9 | 13.6 ± 9 | | | |
| Activity | 8.0 ± 3 | 7.0 ± 3 | 7.7 ± 3 | | | |
| Function (gait and activity) | 22.7 ± 10 | 17.6 ± 11 | 21.3 ± 11 | | | |
| Total | 43.2 ± 15 | 40.1 ± 19 | 42.4 ± 16 | | | |
| Knee Society scores‡ | NA | NA | NA | | | |
| Function | | | | 44.4 ± 16 | 46.3 ± 22 | 44.9 ± 18 |
| Knee score | | | | 29.1 ± 13 | 37.7 ± 18 | 31.4 ± 15 |
| Proximity to medical center* | | | | | | |
| ≤50 miles | 246 (73) | 87 (67) | 333 (71) | 152 (78) | 56 (75) | 208 (77) |
| >50 miles | 90 (27) | 43 (33) | 133 (29) | 42 (22) | 19 (25) | 61 (23) |
| Death* | | | | | | |
| Patients who died between 1 and 2 yr of follow-up | 1 (0.3) | 3 (2) | 4 (1) | 0 | 1 (1) | 1 (0.4) |
| Patients who survived at 2 yr postop. | 335 (99) | 127 (98) | 462 (99) | 194 (100) | 74 (99) | 268 (99) |
| Attended 1-yr follow-up visit* | 201 (60) | 76 (58) | 277 (59) | 129 (66) | 40 (53) | 169 (63) |
| Attended 2-yr follow-up visit*§ | 107 (32) | 54 (43) | 161 (35) | 79 (41) | 22 (30) | 101 (38) |

*The values are given as the number of patients, with the percentage in parentheses. †The values are given as the mean and the standard deviation. According to the Harris hip-scoring system, pain was rated on a scale of 0 to 44 points; gait, from 0 to 33 points; activity, from 0 to 14 points; and function (which included gait and activity), from 0 to 47 points. The remaining 9 points are allocated to range of motion (5 points) and absence of deformity (4 points), which were not included in this analysis. ‡The values are given as the mean and the standard deviation. The function score ranges from 0 to 100 points, and the knee score ranges from 0 to 50 points. §The data are reported after excluding patients who died between the one and two-year follow-up visit. NA = not applicable.

reflect the increase in the odds of returning for follow-up per a one-unit increase in the variable. Adjusted odds ratios for age are expressed in units of ten years. Data are reported as the mean and the standard deviation or as the number of patients (and the percentage of the group).

Results

Of the study cohort of 735 patients, 466 patients were treated with a total hip arthroplasty (336 primary and 130 revision procedures), and 269 patients with a total knee arthroplasty (194 primary and seventy-five revision procedures). Follow-up compliance data according to procedure for all patients managed with total hip or total knee arthroplasty are presented in Table I.

All Arthroplasty Procedures (Table I)

Clinical follow-up compliance for all patients combined was 61% (446 of 735 patients) at the one-year visit and 36% (262 of

730 patients) at the two-year follow-up visit. For the one-year follow-up evaluation, we found that a lower body mass index was associated positively with compliance. The mean body mass index of patients returning for follow-up was 29.2 ± 7 . In comparison, the mean body mass index for patients who did not return was 30.4 ± 7 . This difference was significant ($p = 0.03$). In contrast to this finding, however, the dichotomous overweight variable was not found to have a significant association with follow-up. Patients who lived within fifty miles of our center were significantly more likely to return for follow-up ($p = 0.005$). However, at the two-year follow-up, none of the potential predictors we analyzed were significantly associated with compliance (see Appendix).

The comparison group of twenty-nine patients who were specifically contacted to secure follow-up appointments had a compliance rate of 97% (twenty-eight patients) at both one and two years, which was significantly better than the rate

TABLE II Variables Associated with Patient Compliance with Follow-up at Two Years After Total Hip Arthroplasty

| Variable | Attended Two-Year Follow-up Visit | | Univariate Logistic Regression Results (P Value) | Multivariate Logistic Regression Results | |
|---------------------------------------|-----------------------------------|---------------|--|--|--|
| | No (N = 301) | Yes (N = 161) | | P Value | Adjusted Odds Ratio (95% Confidence Interval)* |
| Revision or primary procedure† | | | 0.03 | | |
| Revision | 73 (24) | 54 (34) | | 0.006 | 1.00 |
| Primary | 228 (76) | 107 (66) | | | 0.52 (0.33, 0.83) |
| Sex† | | | 0.48 | | |
| Male | 128 (43) | 63 (39) | | | |
| Female | 173 (57) | 98 (61) | | | |
| Race† | | | 0.07 | | |
| Nonwhite | 70 (23) | 26 (16) | | | |
| White | 228 (77) | 134 (84) | | | |
| Overweight† | | | 0.33 | | |
| No | 85 (29) | 52 (34) | | | |
| Yes | 207 (71) | 103 (66) | | | |
| Age‡ (yr) | 60 ± 17 | 56 ± 17 | 0.03 | 0.04 | 0.88 (0.78, 0.99) |
| Body mass index‡ (kg/m ²) | 28.8 ± 6 | 28.1 ± 6 | 0.26 | | |
| Proximity to medical center† | | | 0.67 | | |
| ≤50 miles | 213 (71) | 117 (73) | | | |
| >50 miles | 88 (29) | 44 (27) | | | |
| Harris hip score‡ | | | | | |
| Pain | 12.6 ± 7 | 14.0 ± 8 | 0.05 | 0.79 | 1.00 (0.97, 1.04) |
| Gait | 12.9 ± 9 | 15.1 ± 9 | 0.01 | 0.04 | 1.03 (1.00, 1.06) |
| Activity | 7.6 ± 3 | 8.0 ± 3 | 0.12 | | |
| Function (gait and activity) | 20.5 ± 11 | 23.2 ± 11 | 0.01 | | |
| Total | 41.0 ± 16 | 45.0 ± 16 | 0.01 | | |

*Unless otherwise noted, adjusted odds ratios reflect the increased odds of attending the two-year follow-up visit for a one-unit increase in the variable, after adjusting for all other variables in the model. For categorical variables, the first category listed is the reference category for the adjusted odds ratio. The adjusted odds ratios for age are expressed in units of ten years. †The values are given as the number of patients, with the percentage in parentheses. Data on weight were unavailable for fifteen patients, and data on race were unavailable for four patients. ‡The values are given as the mean and the standard deviation.

of 61% at one year and 36% at two years in the study group ($p < 0.0001$).

Hip Arthroplasty (Tables I and II)

Of the 466 patients who received a total hip arthroplasty, 277 (59%) returned for the recommended one-year follow-up, and 161 (35%) of the 462 who were still alive returned for the two-year evaluation (Table I). After multivariate regression analysis of the one-year follow-up information (data not shown), positive predictors for returning for follow-up were found to be white race ($p = 0.009$), the preoperative Harris hip score for gait ($p = 0.04$), and a proximity to the medical center of less than fifty miles ($p = 0.006$). A com-

parison of follow-up compliance after revision and primary arthroplasty procedures did not reveal any significant difference.

Analysis of the data at the two-year follow-up visit showed that the type of arthroplasty (revision or primary) was a significant independent predictor of follow-up ($p = 0.006$, Table II), as patients who had a revision were more likely to return. Younger age ($p = 0.04$) and a better preoperative Harris hip score for gait ($p = 0.04$) were also found to be positive predictors of patient compliance with follow-up at two years, implying that patients who were younger and more mobile preoperatively were more likely to return for follow-up appointments. In the comparison group of twenty-nine patients, the rate

TABLE III Variables Associated with Patient Compliance with Follow-up at Two Years After Total Knee Arthroplasty

| Variable | Attended Two-Year Follow-up Visit | | Univariate Logistic Regression Results | |
|---------------------------------------|-----------------------------------|---------------|--|--|
| | No (N = 167) | Yes (N = 101) | P Value | Unadjusted Odds Ratio (95% Confidence Interval)* |
| Revision or primary† | | | 0.10 | |
| Revision | 52 (31) | 22 (22) | | |
| Primary | 115 (69) | 79 (78) | | |
| Sex† | | | 0.74 | |
| Male | 53 (32) | 34 (34) | | |
| Female | 114 (68) | 67 (66) | | |
| Race† | | | 0.03 | 1.00 0.56 (0.32, 0.96) |
| Nonwhite | 38 (23) | 35 (35) | | |
| White | 129 (77) | 66 (65) | | |
| Overweight† | | | 0.52 | |
| No | 28 (17) | 14 (14) | | |
| Yes | 137 (83) | 86 (86) | | |
| Age‡ (yr) | 66 ± 12 | 67 ± 12 | 0.58 | |
| Body mass index‡ (kg/m ²) | 32.0 ± 9 | 30.9 ± 6 | 0.24 | |
| Proximity to medical center† | | | 0.07 | |
| ≤50 miles | 123 (74) | 84 (83) | | |
| >50 miles | 44 (26) | 17 (17) | | |
| Knee Society function score‡ | 44.4 ± 18 | 45.7 ± 18 | 0.54 | |
| Knee Society total score‡ | 31.2 ± 14 | 31.4 ± 16 | 0.93 | |

*Unadjusted odds ratios reflect the increased odds of attending the two-year follow-up visit for a one-unit increase in the variable. The first category listed is the reference category for the odds ratio. †The values are given as the number of patients, with the percentage in parentheses. Data on weight were unavailable for three patients. ‡The values are given as the mean and the standard deviation.

of follow-up compliance for the two-year follow-up appointment was 97% (twenty-eight patients), which was significantly better than the rate of 35% (161) of 462 patients in the study group ($p < 0.0001$).

Knee Arthroplasty (Tables I and III)

The overall rate of follow-up compliance after total knee arthroplasty was 63% (169) of 269 patients at the one-year visit and 38% (101) of the 268 patients who were still alive at the time of the two-year follow-up (Table I). After multivariate analysis of the one-year data (not shown), the only factor that was found to be positively associated with compliance was female sex ($p = 0.03$). Being overweight (a body mass index of >25) was identified as a negative predictor of follow-up compliance ($p = 0.04$). The Knee Society score and type of procedure (primary or revision) did not appear to significantly impact follow-up compliance.

At the two-year interval (Table III), nonwhite race was a positive predictor of follow-up compliance ($p = 0.03$). The other variables, including revision or primary procedure, sex, and weight, did not appear to alter the likelihood for follow-up at the two-year interval. Only univariate analysis

was performed for the two-year data because there was only one predictor and/or factor for compliance (nonwhite race).

Discussion

As the demand for hip and knee arthroplasties continues to increase with time, there is a corresponding need to define practical methods of postoperative surveillance. The cost-effectiveness of surveillance protocols must also be analyzed and justified. Recommendations for patient follow-up should aim, at least in part, to identify problems in a timely way so that, if necessary, a less complicated revision procedure may be performed. The reasons for revision hip arthroplasty have recently been analyzed. Specifically, Clohisy et al.¹² found that, of 439 revision hip procedures performed, 55% were performed for aseptic loosening and an additional 13% were performed for osteolysis around well-fixed components. Paprosky et al.¹³ also reported on failure modes requiring revision hip arthroplasty. They noted that, of the 270 consecutive revisions on the acetabular side, 71% were performed for osteolysis or loosening of the cup. Malchau¹⁴ examined the Swedish arthroplasty registry and reported that 74% of the 8878 first-time revisions were performed for aseptic loosening.

Maloney et al.¹⁵ reported that acetabular osteolysis was detected in twenty-five (2.3%) of 1081 hips at the five to ten-year follow-up evaluation. For the 168 patients followed for a minimum of ten years, 12.2% had pelvic osteolysis. Similarly, O'Rourke et al.¹⁶ reported that seventeen (16%) of 105 modular total knees (all with radiographic follow-up) had osteolysis of five to eight years after surgery. Thus, with conventional hip and knee implants, the five to ten-year postoperative period is a timely interval for surveillance. This calls into question the clinical value and cost-effectiveness of early (one to five-year) follow-up visits. Perhaps the major benefit of early follow-up is to have the patient establish a pattern of compliance with follow-up.

Changing patient demographics may also impact surveillance protocols after arthroplasty. For example, the number of young active patients undergoing hip and knee arthroplasty procedures continues to increase. Combined with an emphasis on maintaining an active lifestyle, these factors increase the number of patients at risk for wear-induced osteolysis. Crowther and Lachiewicz¹⁷ examined fifty-six young patients who had a hip arthroplasty, with young defined as an age of less than fifty years, and found that the incidence of pelvic osteolysis was 23% at a minimum of nine years of follow-up. They also observed a high rate of polyethylene wear of 0.15 mm/yr. Additionally, Maloney et al.¹⁵ found a similar rate of osteolysis after hip arthroplasty in patients younger than fifty years (22%; fifteen hips), a much lower rate of osteolysis in patients older than fifty years (7.8%; eight hips), and no osteolysis in those patients older than seventy years. Thus, younger patients undergoing hip arthroplasty are at an increased risk of wear and lysis problems. We recommend that young patients (less than fifty years old) be monitored at five and ten years after arthroplasty. If wear and lysis problems are identified, the patient should be monitored more frequently.

Currently, there are no definitive recommendations for the frequency of patient follow-up after total joint arthroplasty. In a recent survey of active members of the American Association of Hip and Knee Surgeons conducted by Teeny et al.¹, there was great discrepancy among surgeons regarding their recommendations for follow-up after total joint arthroplasty. In the one to five-year follow-up period after total hip arthroplasty, 46% of the surgeons thought that annual appointments were necessary and 40% believed that biennial visits were sufficient. There were similar results regarding follow-up of total knee arthroplasty, with 45% of the surgeons advocating annual follow-up visits and 40% preferring biennial follow-up appointments. Given the time range for the development of problems related to wear and lysis^{12,15}, and the known increased risk in young active patients, we suggest that an ideal follow-up protocol should incorporate these factors.

Regardless of frequency, the compliance in almost all studies has been reported to be extremely low. Joshi et al.¹⁸ conducted a study designed to assess outcome in patients lost to follow-up. They attempted to contact all patients who had a total knee arthroplasty performed between 1976 and 1988 at their institution for a minimum ten-year follow-up evaluation.

Despite surgeon-initiated contact efforts, 123 (23%) of 563 patients did not comply; however, with the use of private detectives and research assistants, their group was able to obtain postoperative functional scores and clinical outcomes for all patients.

Many reasons are cited for high rates of patients lost to follow-up, including a change of residence, difficulty with traveling, scheduling conflicts, and doctor's office delays^{18,19}. Sethuraman et al.¹⁹ questioned 100 asymptomatic patients at routine follow-up evaluations after total knee arthroplasty and found that forty-five patients would have preferred not to return to the doctor's office because of the inconvenience and a perceived lack of benefit. Moreover, they found that those patients would be content to mail questionnaires back to the physician's office regarding functional status along with routine radiographs. No patient felt that quality of care would be compromised with such a treatment algorithm.

Despite demonstrating a clear deficiency in patient compliance with our protocol of short-term follow-up, our study has certain limitations that must be acknowledged. First, registry data from only one surgeon's practice in a limited geographic area were included. The practice analyzed in this study drew patients from a large demographic area, including both urban and rural populations in the Midwest. These factors may result in bias because of the demographic makeup of the study cohort and the practice style of the individual surgeon. Second, certain patient-specific factors such as comorbidities may have impacted patient compliance with follow-up, yet were not analyzed in this study. Third, with patient compliance with the two-year follow-up evaluation of <40% for all joints combined, this study may lack the statistical power to identify certain predictors of compliance with postoperative follow-up visits. Furthermore, a large number of statistical tests were conducted. As the number of tests increases, the likelihood increases that any one of these tests is significant but not clinically important. For example, we do not believe that knowledge of a patient's body mass index is really of clinical prognostic importance relative to follow-up compliance. Therefore, caution must be used in evaluating the importance of any individual test. Finally, our comparison group consisted of a subset of patients willing to participate in a prospective randomized study, and therefore these patients may have been more likely to return for follow-up because they were a more motivated patient cohort.

The most important finding from our study is that a large percentage of our patients did not return for follow-up beyond the first year after total joint arthroplasty on the basis of a protocol that was limited to a one-time verbal instruction from the treating surgeon. Looking at the results from our comparison group (repeated communications to return for follow-up), as well as work by Joshi et al.¹⁸, a more intensive surgeon-directed attempt to contact patients can result in a higher rate of follow-up. Nevertheless, successful follow-up protocols are expensive and personnel-dependent, and they may not be covered by insurance carriers.

In an asymptomatic patient, the orthopaedic surgeon's primary concern is to detect bearing surface wear and clinically

silent osteolysis. The peak prevalence of osteolysis-related problems is at ten years or more after the primary arthroplasty; therefore, the optimal screening time is in the five to ten-year interval^{12,15}. Since radiographic screening is the critical evaluation component for these problems, alternative radiographic surveillance programs carried out at sites convenient for the patient may provide a more effective screening mechanism to detect early implant failure.

Appendix

eA A table showing variables associated with two-year follow-up compliance of all patients after arthroplasty is available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD/DVD (call our subscription department, at 781-449-9780, to order the CD or DVD). ■

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