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Patellar Resurfacing Compared with Nonresurfacing in Total Knee Arthroplasty

A Concise Follow-up of a Randomized Trial*

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Investigation performed at the Department of Orthopaedic Surgery, Tulane University, New Orleans, Louisiana, and the Department of Orthopaedic Surgery, Washington University School of Medicine and Barnes-Jewish Hospital, St. Louis, Missouri

Abstract: Patellar resurfacing in total knee arthroplasty remains controversial. This study compared the long-term clinical outcomes of total knee arthroplasties performed with and without the patella resurfaced and is an update of a previous report. Eighty-six patients (118 knees) underwent primary total knee replacement and were randomized into two groups: those treated with and those treated without resurfacing of the patella. Outcomes included the scores according to the Knee Society clinical rating system, the scores according to a forty-one-question patellofemoral-specific patient questionnaire, patient satisfaction, global and anterior knee pain scores, radiographic findings, and complications and revisions. Fifty-seven patients (seventy-eight knees) were followed for a minimum of ten years. No significant differences were identified between the two groups in terms of the range of motion, Knee Society scores, satisfaction, global knee pain, or anterior knee pain. The overall revision rates in the original series of 118 knees were 12% in the nonresurfacing group and 9% in the resurfacing group. Seven patients (12%) in the nonresurfacing group and two patients (3%) in the resurfacing group underwent revision for a reason related to a patellofemoral problem. On the basis of these findings, we concluded that, with the type of total knee arthroplasty used in our patients, similar results may be achieved with and without patellar resurfacing.

Level of Evidence: Therapeutic Level II. See Instructions to Authors for a complete description of levels of evidence.

Background

While there have been several randomized clinical trials¹⁻¹¹ comparing resurfacing with nonresurfacing of the patella in total knee arthroplasty, few investigators^{2,3} have reported long-term results. The purpose of this study was to report the results, after a minimum of ten years of follow-up, of a prospective, randomized clinical trial comparing resurfacing with nonresurfacing of the patella in total knee arthroplasty; our emphasis was on anterior knee pain, patellofemoral revisions, and clinical and functional outcomes. The current report is an update of a prospective randomized clinical trial¹ initiated in 1992 and for which the early (three-

year)¹ and mid-term (five to seven-year)¹² results have been previously reported.

Methods

All patients who were to have a total knee arthroplasty at Tulane University Hospital, Veterans Affairs Medical Center (VAMC), New Orleans, and VAMC, Alexandria, Louisiana, between January 1992 and December 1993 were considered for inclusion in the study. The indications for surgery, inclusion criteria, and demographic data have been reported previously¹. When a patient was to undergo bilateral total knee arthroplasty, the first knee was randomized to the patellar

*Original Publications

Barrack RL, Wolfe MW, Waldman DA, Milicic M, Bertot AJ, Myers L. Resurfacing of the patella in total knee arthroplasty. A prospective, randomized, double-blind study. *J Bone Joint Surg Am.* 1997;79:1121-31.

Barrack RL, Bertot AJ, Wolfe MW, Waldman DA, Milicic M, Myers L. Patellar resurfacing in total knee arthroplasty. A prospective, randomized, double-blind study with five to seven years of follow-up. *J Bone Joint Surg Am.* 2001;83:1376-81.

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treatment and the second knee then received the other patellar treatment. One hundred and eighteen knees (sixty without and fifty-eight with patellar resurfacing) in eighty-six patients were originally reported on¹. The numbers of patients, randomi-

zation, loss to follow-up, and numbers of knees included in the analysis for this ten-year report are outlined in a Consolidated Standards of Reporting Trials (CONSORT)^{13,14} diagram (Fig. 1). The next of kin of all patients who had died were contacted

Patella Resurfacing/Nonresurfacing: Consort -Flowchart

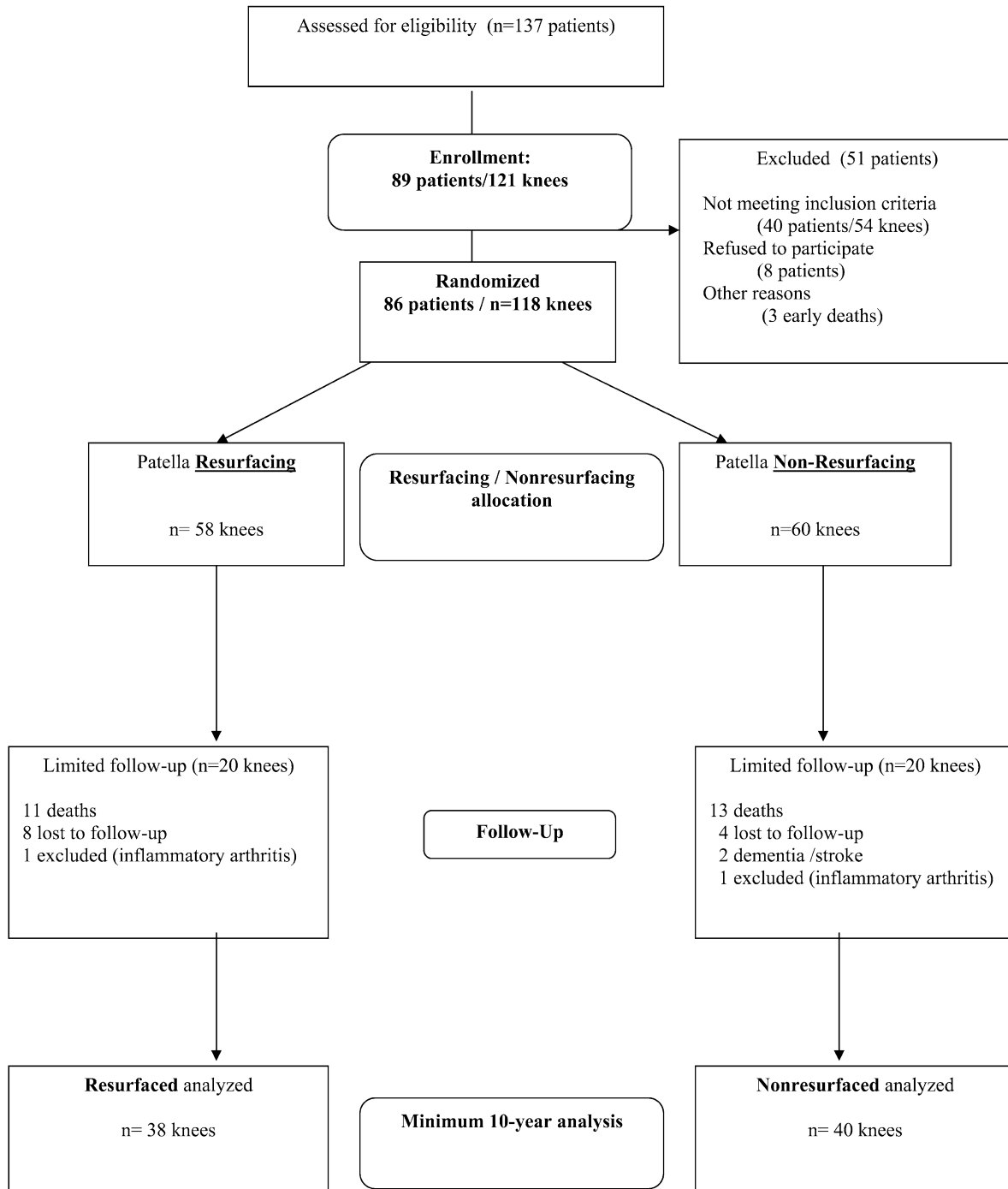


Fig. 1

CONSORT (Consolidated Standards of Reporting Trials) flow diagram^{13,14} depicting patient enrollment and treatment allocation and indicating the patients lost to follow-up at ten years.

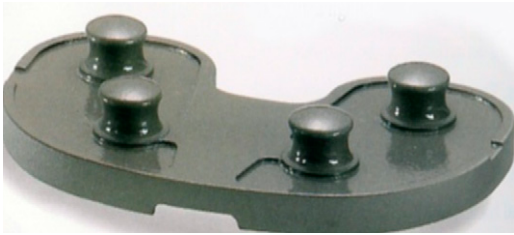


Fig. 2
The total knee arthroplasty tibial component, which has a precoat, four-peg cemented design.

by a research coordinator in order to complete a patellofemoral questionnaire regarding the results up to the time of death. The mean age of the patients at the time of the most recent follow-up was seventy-eight years (range, forty to ninety-four years).

The study was approved by the institutional review board at the Tulane University School of Medicine. Patients were not registered in a formal clinical trials registry, as none existed in 1992. All patients received the same cemented posterior cruciate-sparing prosthesis (Miller-Galante II; Zimmer, Warsaw, Indiana) (Figs. 2, 3, and 4).

The randomization, grading of patellar chondromalacia, patellar treatment, and total knee arthroplasty procedures were performed with uniform approaches and techniques as described in the original report¹. At the time of the ten-year follow-up, thirty-nine knees (50%) were evaluated clinically by a researcher blinded to the type of patellar treatment. Home visits were required to evaluate another thirty-nine knees because of patient insurance, medical, or other issues preventing a routine clinic visit at ten years. The data collection, radiographic follow-up, and attempts at patient contact were halted in August of 2005 because of Hurricane Katrina, which devastated the Tulane Medical Center and the region where the study participants lived. At all preoperative and postoperative visits, the Knee Society clinical rating score¹⁵, which ranges from 0 to 200 points, was ascertained for each knee in a double-blind fashion—that is, neither the patient nor the examiner was aware of whether the patella had been resurfaced.

Patient satisfaction was assessed with use of detailed questionnaires that all patients completed preoperatively and at each follow-up visit. At the ten-year evaluation, all living patients completed a forty-one-question evaluation form (see Appendix) developed by the senior author (R.L.B.) and administered by a blinded researcher.

Radiographs were available for thirty-eight knees (49%) at the time of the ten-year follow-up. The radiographs were analyzed by an investigator other than the treating surgeon for the same variables as reported previously^{1,12,16,17}.

Statistical Analysis

Continuous variables were analyzed with analysis of covariance, with adjustment for the preoperative status. Because the data were skewed and not amenable to transformations, the results of the analysis of covariance were confirmed with Kruskal-Wallis tests. Categorical variables were analyzed with chi-square tests. Significance was set at $p \leq 0.05$. Between-group comparisons were performed with use of generalized estimating equations to account for the correlation of knees in patients treated with bilateral arthroplasty¹⁸. Because of generalized estimating equation model-fit violations, several binary variables were analyzed with the Fisher exact test.

Source of Funding

The original study was supported by a grant from Zimmer (Warsaw, Indiana), which included funding for the study development and for the two-year and five to seven-year follow-up studies. However, Zimmer was not involved with the collection of data, its analysis, or the preparation or editing of any of the publications. In addition, no funding was received from any source for the current (ten-year) follow-up study.

Results

At a minimum of ten years (range, 120 to 150 months) postoperatively, the Patellofemoral Patient Questionnaire (see Appendix) was completed by all surviving patients and by the next of kin of the patients who had died. We identified no significant differences between the resurfacing and nonre-

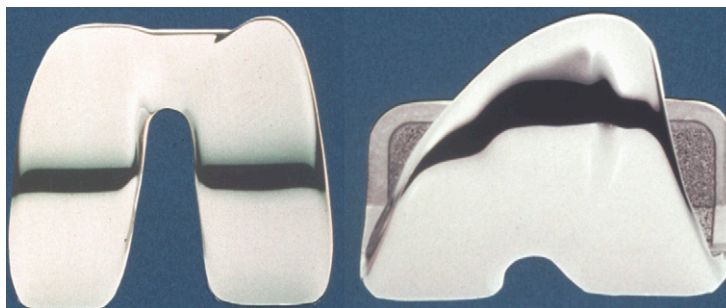


Fig. 3
The total knee arthroplasty femoral component, which is anatomic with a deepened trochlear groove and a widened proximal flange designed to accept both a nonresurfaced and a resurfaced patella.

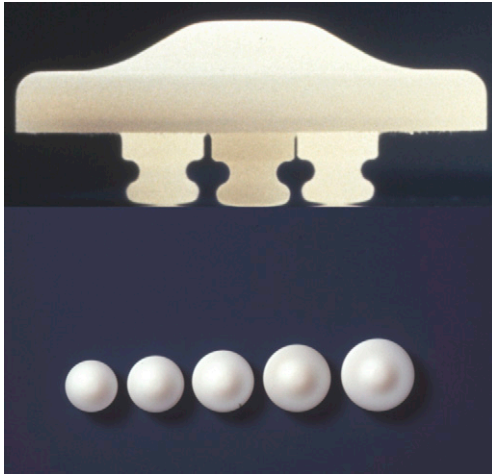


Fig. 4
The total knee arthroplasty patellar component, which is an all-polyethylene domed three-peg cemented implant with multiple sizing options.

surfacing groups with regard to the scores for forty of the forty-one questions.

Complications and Revisions

Revisions for a Reason Related to a Patellofemoral Problem

There was no difference in the rates of revision for a reason related to a patellofemoral problem between the two study groups (Fisher exact test, $p = 0.15$; chi-square = 2.83). Since the five to seven-year report, no additional nonresurfaced patellae had required revision to a resurfacing. Seven (12%) of the original sixty nonresurfaced patellae had been subsequently resurfaced in the first five to seven years after the index procedure. Six of these resurfacings had been done by the time of the two to four-year follow-up examination, and one had been done by the five to seven-year follow-up examination. The seven revisions were accomplished without operative complications, and there was an initial decrease in anterior pain in six of the seven knees. Prior to the patellar resurfacing, the anterior pain score for these seven knees was a mean of 8 points (range, 6 to 10 points) on a scale of 1 to 10 points. The average pain rating after the resurfacing was 2.3 points at the two to four-year follow-up examination, but in four of the five patients who were re-evaluated at five to seven years following the original total knee arthroplasty the rating was found to have deteriorated (to a mean of 7.4 points); no further change was noted at the ten-year visit. The average duration of follow-up after the subsequent patellar resurfacing procedures was 72.8 months (range, twelve to ninety-six months). All patients who underwent a revision total knee arthroplasty remained satisfied with the result of the revision, despite a recurrence of anterior knee pain in all of them.

In contrast, since the five to seven-year report, two (3%) of the fifty-eight resurfaced patellae required a revision for a patella-related complication. One patient had aseptic loosening of the patellar component at 6.5 years, and the arthroplasty was

revised with re-resurfacing of the patella. This patient had anterior knee pain that developed insidiously four years following the index total knee arthroplasty. The patient continued to have the anterior knee pain, with a pain score of 7 points, at the time of the ten-year follow-up and was unsatisfied with the outcome of the total knee arthroplasty. Patellar osteonecrosis developed in a second patient, who subsequently had a transverse periprosthetic patellar fracture at eight years postoperatively and underwent a patellectomy. An extensor lag developed, and the patient underwent an extensor mechanism allograft procedure, which also failed. She was unsatisfied with the outcome.

Revisions for a Reason Not Related to a Patellofemoral Problem

No patients in the nonresurfacing group required revision for a reason not related to a patellofemoral problem. Three (5%) of the original fifty-eight knees in the resurfacing group had a revision for a reason not related to a patellofemoral problem (infection, tibial liner exchange, and open reduction and internal fixation of a periprosthetic femoral fracture).

Overall Revision Rates

The overall rate of reoperations, including those for reasons related and not related to a patellofemoral problem, was 9% (five of fifty-eight) for the patients with a resurfaced patella. There was no significant difference in the overall revision rates

TABLE I Knee Society Scores and Range of Motion

	Group		P Value†
	Nonresurfaced (N = 40)*	Resurfaced (N = 38)*	
Clinical knee score			
Preop.	49 ± 17	45 ± 17	0.23
Postop.	85 ± 17	83 ± 16	0.96
Change‡	36 ± 20	38 ± 23	
Functional score			
Preop.	43 ± 18	42 ± 14	0.18
Postop.	69 ± 25	63 ± 25	0.15
Change‡	26 ± 25	21 ± 27	
Total score			
Preop.	93 ± 30	88 ± 21	0.14
Postop.	155 ± 41	146 ± 37	0.28
Change‡	62 ± 39	59 ± 40	
Postop. flexion (deg)	111 ± 10	108 ± 13	0.58

*The values are given as the mean and standard deviation. †The first p value was derived by comparing the preoperative values between groups with use of a generalized estimating equation model and rank-transformed data. The second p value was derived by comparing postoperative values between groups after adjusting for the preoperative values with use of a generalized estimating equation with rank-transformed data (to account for clustering). ‡Change = postoperative – preoperative.

between the knees with a nonresurfaced patella (12%) and those with a resurfaced patella (9%) ($p = 1.0$; chi square = 0.30).

Knee Society Clinical Rating Scores and Range of Motion

We could identify no differences in the Knee Society clinical rating scores or the range of motion between the two groups ($p > 0.5$ for all comparisons) (Table I). With the numbers studied, there was also no significant difference in the Knee Society scores or subscores between obese and nonobese patients or among patients with different grades of chondromalacia.

Radiographic Analysis

Radiographic assessments were performed up to the date of the most recent follow-up visit, with all patients having radiographs at a minimum of ninety-six months (range, ninety-six to 146 months). Radiographs made at a minimum of ten years postoperatively were available for thirty-eight (49%) of the seventy-eight knees. No components appeared to be loose radiographically in any patient at the most recent follow-up evaluation.

Anterior Knee Pain

Pain in *any* part of the knee was prevalent at ten years, with equal rates in the nonresurfacing (50%) and resurfacing (49%) groups ($p = 0.91$). On the basis of the question "How often does your knee hurt?", it was found that global pain occurred with equal frequency (23%) in the two groups ($p = 0.78$). While nearly 50% of the patients reported the presence of any knee pain, *anterior* knee pain was reported less often (in 16% of those with a nonresurfaced patella and 21% of those with a resurfaced patella; $p = 0.35$). The recorded severity of the anterior knee pain was also similar between the nonresurfacing (1.5 of 10 points) and resurfacing (1.7 of 10 points) groups ($p = 0.23$). No difference in other types of knee pain (pain at night, at rest, during movement, and during weight-bearing) could be identified between the groups.

Patient Satisfaction and Questions Regarding Patellofemoral Function

We detected no difference in patient satisfaction or patellofemoral function between the nonresurfacing and resurfacing groups at ten years. Overall satisfaction with the result of the total knee arthroplasty, including that of patients who had undergone revision for any reason, did not differ between the resurfacing (94% satisfied) and nonresurfacing (98%) groups. The patients who had undergone bilateral total knee arthroplasty showed no significant change, at ten years, in their preference for or against the resurfaced knee as compared with their responses at five to seven years. However, the nonresurfacing and resurfacing groups differed significantly with regard to the patients' report of the overall change in the status of the knee since the prior (five to seven-year) visit (Question 33; see Appendix), with the data favoring the nonresurfaced knees ($p = 0.03$). Eighty percent of those without resurfacing and 70% of those with resurfacing reported that the involved knee was "about the same"; 5% and 11%, respectively, reported

that it was "a lot worse"; 2% and 11%, that it was "a little worse"; 11% and 4%, that it was "a little better"; and 2% and 4%, that it was "a lot better." With the numbers studied, this was the only category on the forty-one-item questionnaire that showed a significant difference, favoring nonresurfacing of the patella.

Discussion

In this study, the seven revisions of nonresurfaced patellae for the treatment of anterior knee pain were all performed within the initial five to seven years after the primary total knee arthroplasty, and six of the seven were performed in the two to four-year postoperative period. In contrast, the two revisions related to a patellofemoral problem in the resurfacing group were performed after the five to seven-year follow-up interval. While these numbers are small and difficult to base generalizations on, they may reflect the practice pattern that we think is typical when physicians follow patients clinically for anterior knee pain and problems that are often attributed to "the patella" following total knee arthroplasty. A few years of observing a patient with a nonresurfaced patella and persistent anterior knee pain following a total knee arthroplasty may lead the patient and surgeon to consider a resurfacing because it is a surgical option. In contrast, there is little to offer a patient who has substantial anterior knee pain despite resurfacing of the patella if the radiographic and clinical findings are unremarkable. Thus, there may be a tendency to observe these patients for longer periods of time. These patients may then present with late complications such as osteonecrosis of the patella, aseptic loosening, patellar fragmentation, periprosthetic fracture, and complications involving the extensor mechanism, which are seen infrequently when the patella is left unresurfaced. In addition, as little as 5° of combined tibial and femoral internal malrotation of a knee arthroplasty component^{19,20} may be a factor associated with anterior knee pain and may occur without radiographic changes¹⁹ such as patellar tilt or subluxation.

The results of this study are limited by a number of factors. There were too few patients for the study to have enough power to detect all differences between the groups, and we did not perform a power calculation prior to commencing the study. Also, a number of patients did not return for clinical follow-up, and we acknowledge that there is no substitute for such a visit, but these patients were evaluated with a detailed questionnaire, which has been a useful tool in other reports of patellar resurfacing^{2,3}. Routine clinical follow-up examinations of patients at ten years or more after an operation are often impractical for social, medical, and geographic reasons.

The recurrence of anterior knee pain following all seven revisions to resurface previously nonresurfaced patellae and following re-resurfacing of a knee with a loosened patellar component, combined with the equal prevalence of residual anterior knee pain in the two groups, suggests that underlying patient, implant, or surgical factors substantially impact the presence of anterior knee pain regardless of whether the patella is resurfaced or not at the time of total knee arthroplasty.

On the basis of our results, we conclude that, with the type of total knee arthroplasty used in our patients, similar

results may be achieved with and without resurfacing of the patella. We continue to resurface the patella when the patient has an inflammatory condition of the knee. However, it is our routine practice to otherwise leave the patella unresurfaced.

Appendix

eA The Patellofemoral Patient Questionnaire 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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