A Comparison of the PCL-Retaining AGC and Posterior Stabilizing Legacy Prostheses for Total Knee Arthroplasty

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Introduction

Excellent clinical results have been reported for both posterior-stabilized and posterior cruciate ligament retaining prosthesis for total knee arthroplasty [1–6]. Several studies have directly compared these devices. The studies have utilized a variety of knee scoring systems, questionnaires, and radiographic analysis to evaluate the results. Many of these studies have concluded that there is no difference between the posterior-stabilizing and PCL retaining prostheses [7–12]. However, a report by Conditt et al [11] suggested that posterior-stabilized prostheses inhibit deep flexion in some movements, whereas reports by Maruyama et al [9] and Hirsch et al [10] have determined that these prostheses provide a greater range of motion.

The purpose of this study is to compare two devices used in the authors' facility: the PCL retaining AGC (Biomet, Warsaw, IN, USA) and the posterior-stabilizing Legacy (Zimmer Warsaw, IN, USA).

Materials and methods

Ninety-nine Legacy Posterior-Stabilizing (LPS) prostheses and 96 Anatomic Graduated Components (AGC) prostheses were implanted in 69 patients each. All patients had a pre-operative diagnosis of medial osteoarthritis. All operations were performed at the Center for Hip and Knee Surgery in Mooresville, IN. All surgeries utilizing LPS implants were performed by a senior author (P.M.F.) and all of the AGC operations by another senior author (M.A.R.). The procedures were performed from 1997 through 2000, a breakdown of which is presented in Table 1.

Age, body mass index (BMI), overall limb alignment, Knee Society knee and function scores, and range of motion (ROM) were recorded preoperatively and at 2 months, 6

months, 1, 3, 5, and 7 years postoperatively. Radiographic analyses were performed to detect radiolucencies.

The average follow-up for the LPS group was 2.7 years (± 1.8) [0.5, 7.6]. The average follow-up for the AGC group was 3.5 years (± 1.8) [0.4, 6.9]. There were five deaths and 17 total patients lost to follow-up in the LPS group. There were three deaths and eight total patients lost to follow-up in the AGC group. There were no recorded reoperations in either group.

The average age for the entire population was 68.4 years (± 9.8) [40, 92], with an average BMI of 30.5 (± 5.5) [20.0, 47.3]. A two-sample *t*-test revealed a significantly higher BMI in the LPS cohort, with the AGC group averaging 27.9 and the LPS group averaging 33.3 ($p < 0.0001$).

Categorization of radiolucencies by zone was performed as described by F.C. Ewald on behalf of The Knee Society. Chi-square tests were used to compare the amount of radiolucency in each group. Two-sample *t*-tests were performed to compare the BMI of the two groups. ANOVA analysis was performed to compare range of motion. Wilk's lambda, multivariate ANOVA was performed to test for differences between clinical outcomes from the prostheses considered. All statistical operations were performed using SAS 9.02 (Cary, NC, USA).

Results

Radiographic analysis

All radiographs were evaluated by a single investigator and radiolucencies of at least 1 mm were recorded. Analysis of the radiographs using chi square test revealed no statistically significant differences between the AGC and LPS cohort with regards to tibial radiolucencies ($p = 0.5593$). Fisher's exact test was used to evaluate femoral radiolucencies, and again showed no statistically significant difference between the two groups ($p = 1.000$). Two of the tibial AGC radiolucencies were 2 mm, one in zone 3 and one in zone 4. In both groups, no knee was considered to be radiographically loose at the time of the final follow-up.

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Table 1. Quantity of prosthesis implanted per year

	1997	1998	1999	2000
LPS	7	26	26	40
AGC	0	46	28	22

Table 2. Incidence of tibial radiolucency

	N at last follow-up x-ray	Any radiolucency	No radiolucency
LPS	88	13 (14.8%)	75 (85.2%)
AGC	93	11 (11.8%)	82 (88.2%)

Table 3. Location of tibial radiolucencies by zone

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
LPS	9	3	0	7	0	0	0
AGC	7	3	4	7	2	0	0

Table 4. Incidence of femoral radiolucencies

	N at last follow-up x-ray	Any radiolucency	No radiolucency
LPS	88	1 (1.1%)	87 (98.9%)
AGC	93	1 (1.1%)	92 (98.9%)

Table 5. Location of femoral radiolucencies by zone

	Zone1	Zone2	Zone3	Zone4	Zone5	Zone6
LPS	0	0	0	1	0	0
AGC	1	1	0	0	0	0

Tables 2, 3, 4 and 5 give a detailed description of the radiolucencies.

Preoperative analysis

Preoperatively, the mean knee and function scores for the LPS implanted knees were 48 (± 13) [5, 80] and 43 (± 14) [-10 , 80], respectively. The mean knee and function scores for the joints to be implanted with the AGC were 40 (± 11) [12, 56] and 47 (± 5) [25, 60], respectively. This revealed a higher knee score for LPS ($p < 0.0001$), but a lower function score ($p = 0.0384$) (Fig. 1).

The average preoperative flexion and extension for the LPS group was 102° ($\pm 14^\circ$) [45° , 130°] and -1° ($\pm 9^\circ$) [-24° , 22°], respectively. The mean flexion and extension for the AGC cohort was 112° ($\pm 11^\circ$) [80° , 130°] and -3°

($\pm 8^\circ$) [-30° , 15°], respectively. ANOVA analysis revealed a significantly lower flexion for LPS patients ($p < 0.0001$).

The mean preoperative alignment for the LPS group was 3° valgus ($\pm 10^\circ$) [23° varus, 24° valgus]. The mean alignment for the AGC group was 1° varus ($\pm 7^\circ$) [20° varus, 22° valgus]. The joints to be implanted with the LPS were found to be significantly better aligned than the joints to be implanted with the AGC ($p < 0.0001$).

Postoperative analysis

Postoperatively, the mean knee and function scores for the LPS group were 93 (± 7) [64, 101] and 90 (± 14) [50, 100], respectively. The average knee and function scores for the AGC group were 94 (± 9) [55, 101] and 93 (± 14) [30, 100], respectively. Although there was a broad range of knee and function scores within the groups, there were no reoperations or revisions performed at the time of the final follow-up.

The mean postoperative flexion in the LPS group was 108° ($\pm 10^\circ$) [90° , 130°], and the mean extension was 0° ($\pm 2^\circ$) [-10° , 0°]. The mean postoperative flexion for the AGC implanted joints was 112° ($\pm 10^\circ$) [75° , 130°], and the mean extension was -1° ($\pm 2^\circ$) [-10° , 5°].

The cohort with LPS prostheses had an average postoperative alignment of 5° valgus ($\pm 3^\circ$) [6° varus, 12° valgus]. The AGC implanted joints had an average alignment of 4° valgus ($\pm 2^\circ$) [6° varus, 10° valgus].

No postoperative outcome was found to be statistically significantly different between the two groups ($p = 0.0995$ Wilk's lambda, multivariate ANOVA). The apparent difference in postoperative flexion is attributable to the unbalanced preoperative flexion and BMI representation of the AGC group.

Discussion

This study found no significant differences between the LPS and AGC PCL-retaining prosthesis for use in total knee replacement. However, based on the retrospective, non-randomized design of this study, there are some inherent limitations. In particular, the two groups were noted to have different preoperative characteristics. The LPS group was

Fig 1. Knee/function scores

noted to have less flexion, higher knee scores and BMIs, lower functional scores, and better overall alignment. The lower preoperative flexion and the higher BMIs in the LPS cohort should have had a negative influence on postoperative flexion. However, this study found no significant difference between the LPS and AGC PCL-retaining prosthesis with regard to postoperative ROM. In addition, all LPS and AGC knees were implanted by two different surgeons and there was discrepancy in the number of patients lost to follow-up, with more lost in the LPS group.

Because of the study design and the dissimilar characteristics in the AGC and LPS groups, it is difficult to demonstrate a difference between the groups in regard to the outcomes measured. However, we have demonstrated that good clinical results can be achieved with either the LPS or AGC knee systems. This series supports what has previously been reported in the literature—that a successful total knee replacement can be achieved with either a PCL-retaining or substituting prosthesis when appropriate patient selection and precise surgical technique are utilized.

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