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Mid-Term Survivorship of Minimally Invasive Unicompartmental Arthroplasty With a Fixed-Bearing Implant: Revision Rate and Mechanisms of Failure

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ABSTRACT

Minimally invasive unicondylar arthroplasty (UKA) continues to gain popularity for the management of patients with degenerative arthritis limited to one compartment of the knee. In this study, we examine a series of 517 fixed-bearing, cemented unicompartmental knee components implanted in patients to manage degenerative arthritis in the medial compartment of their knee. All UKAs were performed at a single institution using the same fixed-bearing design. In this study we sought to examine the survivorship of the UKA components and the mechanisms of failure for the knees that were revised. The survivorship and revision rate with this implant were similar to those found in other published reports of fixed-bearing unicompartmental arthroplasties performed through minimally invasive surgical techniques.

Minimally invasive (MI) techniques for performing unicompartmental knee arthroplasty have continued to gain popularity since first described by Repicci and Eberle [1] in 1999. Since that time, the implants and surgical technique for minimally invasive surgery continued to evolve. An arthroplasty with a smaller incision and less damage to the muscle and nerves around the knee is appealing to both the surgeon and the patient. Patients desire a shorter recovery period [2], fewer complications [3–5 (p.14)] and a quicker return to work and recreational activities. The latest reports from the National Joint Registry for England and Wales [6 (p.169)] and from the Swedish Knee Arthroplasty Register [5 (p.18)] indicate that at least half of the UKA procedures were performed through minimally invasive incisions (59% and 52%–53%, respectively). Early reports with this technique showed failure rates that appeared to exceed expectations [7]; however, 10-year follow-up data from The Swedish Knee Arthroplasty Register did not find higher revision rates with minimally invasive UKA [5 (p.18)]. In this study, we sought to answer three questions with this retrospective case series. First, were the early failures in this MI UKA series followed by a period of good survivorship? Second, did the failure rate remain constant throughout the study? Third, did the mechanism of failure that required revision of the unicompartmental arthroplasty to a total knee arthroplasty change over the course of the study?

Approval was obtained from the institutional review board for this retrospective study on the survival of minimally invasive unicompartmental arthroplasties performed at our institution.

Materials and Methods

From June 2001 to October 2004, 517 consecutive unicompartmental knee arthroplasties (UKA) were performed at a single institution. For all 517 knees, the procedure was performed through a minimally invasive surgical incision involving the medial compartment of the knee.

Surgical Technique for Minimally Invasive UKA

A medial parapatellar arthrotomy is made in line with the incision, and if necessary, the arthrotomy can be extended 1 cm into the vastus medialis obliquus for improved exposure. The knee can then be fully visualized to confirm the appropriateness of a UKA. A small amount of medial tibial sleeve is elevated for exposure, although care is taken not to elevate fibers of the deep MCL. The proximal tibial cut is made with an extramedullary alignment guide, but the cutting block is rarely pinned into place to avoid causing stress risers from the pinholes. The femoral cuts are then made using ligament tension off the cut surface of the tibia, with the primary goal to align the tibial and femoral prostheses parallel to avoid component to component malalignment and subsequent edge loading.

The final components are then cemented into place, starting with the tibia, taking care to remove any excess cement from the borders of the component. Specialized instruments have been designed to remove cement from the posterior margin of the tibial component.

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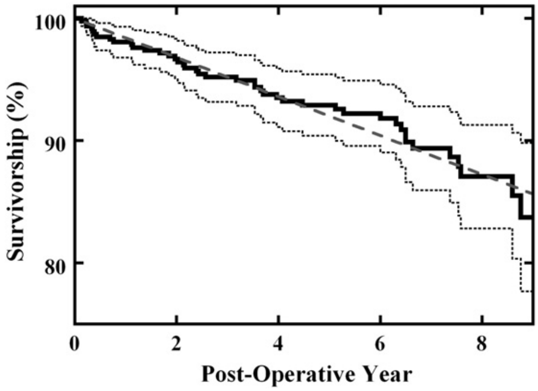

Fig. 1. Survivorship of 517 medial preservation (DePuy, A Johnson & Johnson Company) unicondylar implants (heavy black line). The small dashed lines represent the upper and lower bounds of the 95% confidence interval. The heavy dashed line (gray) represents the rate of decrease in survivorship over the course of the study (1.6%).

Minimizing the amount of cement placed on the component and packing a gauze sponge into the posterior recess of the knee may reduce retained cement fragments. Despite these instruments and technical considerations, it remains difficult to visualize cement behind an all-polyethylene component when using a minimally invasive technique.

The femoral component is then cemented, and once appropriately positioned allowed to dry with the leg in a figure-four position. Final inspection is performed to insure proper component tracking and inspect for any retained cement fragments. This technique has been described previously [7].

A single implant design, the fixed-bearing Preservation (DePuy, A Johnson & Johnson Company, Warsaw, IN) unicompartmental knee was used in all arthroplasties. The femoral component was made of cobalt–chromium alloy. An ultra-high-molecular-weight (UHMWPE) all-polyethylene tibial component was used in 500 knees and a metal-backed tibial component was used in 17 knees. Cement fixation was used for both the femoral and tibial components. The UKAs were performed in 416 patients (517 knees) for the following reasons: degenerative arthritis (512 knees), avascular necrosis (2 knees), osteonecrosis (2 knees) and post-traumatic arthritis (1 knee).

Bilateral UKAs were performed in 101 patients (202 knees). The study group consisted of 161 men (199 knees) and 255 women (318 knees). The mean age of the patients at the time of surgery was 66 ± 9.9 years (range, 37–95). The mean height of the patients was 67 ± 4.1 inches (range, 52–79), their mean weight was 183 ± 37.0 lbs (range, 113–325) and their mean body mass index (BMI) was 29.1 ± 5.7 kg/m^2 (range, 17–58).

For patients undergoing knee arthroplasty at our institution, the preoperative evaluation includes a Knee Society Score [8], an Oxford Survey [9] and preoperative radiographs of the affected joint. After arthroplasty, the annual postoperative evaluation includes the Knee Society Score with evaluation of postoperative radiographs, the Oxford Survey and a patient satisfaction questionnaire. Revision procedures were recorded in our institutional database as per-routine protocol for all knee arthroplasties performed at our institution. Revisions performed outside our institution were recorded when the patient and/or outside surgeon provided that information.

Statistical Methods

The Kaplan–Meier technique was used to determine survivorship using failure for any reason as the endpoint in the analysis (including failures pending revision). For the knees pending revision operations, the failure date used in the survivorship analysis were the date on which the need for a revision operation was established.

Non-parametric Mann–Whitney tests were used to examine any differences between the UKAs revised or pending revision and the UKAs unrevised without pending revision in terms of age, height, weight, BMI and gender.

Results

The mean follow-up for the minimally invasive UKAs in this study was 4.9 ± 3.0 years. Using a Kaplan–Meier survivorship analysis, the survival rate for this implant was 97% (95% CI: 95%–98%) at 2 years, 93% (95% CI: 91%–96%) at 4 years, 92% (95% CI: 90%–95%) at 6 years. Fig. 1 shows the Kaplan–Meier survivorship with revision/pending revision for any reason as the endpoint in the analysis. The rate of decrease in the survivorship (1.6%) remained fairly constant over time (Fig. 1). Fifteen knees were revised within 2 years of the UKA and, an additional 16 knees were revised by 6 years (Table 1). The revisions for infection and tibial collapse/fracture occurred early. Knees that failed for infection occurred within 6 months of UKA implantation and the two knees that failed for tibial collapse/fracture occurred at 5 months and at 2 years after UKA. Revisions for other reasons tended to occur over the entire follow-up interval we examined (Table 1).

Forty-three knees failed and required a revision procedure. Forty-four percent of the failures (19/43) were caused by aseptic loosening (Table 1). Twenty-five of the UKAs were revised at the author's institution and 18 were revised at an outside facility. Of the 18 knees revised at an outside institution, 6 knees failed by progression of disease in the lateral compartment, 4 knees failed for aseptic loosening, 2 failed because of “unexplained pain” that did not resolve after UKA despite no clinical or radiographic evidence for the failure and 6 were revised for reasons unknown to us.

Of the 25 UKAs from our institution that required/require revision, 19 were converted to a primary-style total knee implant. Three knees required the use of a stemmed tibial component in the conversion to a total knee arthroplasty. The remaining three knees failed because of aseptic loosening but have yet to be revised due to personal circumstances of the patient.

Table 1
Mechanism of UKA Failures.

	Interval to Revision (y)					
Reason Revised	0–2	>2–4	>4–6	>6–8	>8	Total Revisions
Aseptic Loosening	8 (3[a])	4		7 (1[a])		19
Infection	3					3
Progressive arthritis	3 (2[a])	3 (2[a])	1[a]	2 (1[a])	2	11
Unexplained pain		1[a]	1[a]			2[a]
Tibial fracture/Collapse	1	1				2
Revised elsewhere (unknown to us)		3[a]	2[a]		1[a]	6[a]
Total revisions (per year)	15	12	4	9	3	43

[a] Revised elsewhere.