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CLINICAL RESEARCH

The Repicci II® Unicondylar Knee Arthroplasty

9-year Survivorship and Function

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Abstract

Background Unicompartmental knee arthroplasty (UKA) is a recognized procedure for treatment of medial compartment osteoarthritis. UKA using minimally invasive surgery (MIS) has the theoretical advantage of less bone resection and quicker rehabilitation. Whether the function of patients with UKA compares with that of patients with conventional TKA is unclear.

Questions/purposes We determined (1) the length of stay and complications associated with a short-stay MIS protocol; (2) whether MIS techniques allow for accurate positioning of the implant and alignment of the limb; (3) the change in functional scores; (4) the revision rate, reasons for revision, and survival of this implant.

Patients and Methods We prospectively followed 100 patients who had 114 UKAs. All completed an International Knee Society (IKS) score preoperatively, at 1 year, and at last followup. We determined survivorship. Minimum followup was 5.2 years (mean, 7.4 years; range, 5.2–9 years).

Results Mean length of stay was 1.2 days, with 41% discharged the same day. The perioperative complication rate was 6%. The mean IKS score improved from 77 to 93 and was 86 at last followup. The mean hip-knee-ankle axis changed from 6° varus to 1.7° varus. Twenty-two patients underwent a revision procedure at a mean 6.2 years after the index procedure. Survivorship of the prosthesis was 78% at 9 years.

Conclusions The short-stay protocol was not associated with a high perioperative complication rate. This technique is associated with improvement in function and restoration of limb alignment, allowing accurate positioning of the implant. Compared with other reports of survival of UKA, this implant had a lower survivorship and increased revision rate.

Level of Evidence Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.
Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.
This work was performed at St Vincent's Clinic.

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Introduction

UKA is an increasingly performed operation for osteoarthritis (OA) of the knee [9]. Reported advantages of UKA over TKA include preservation of normal knee kinematics [16], lower perioperative morbidity [33], minimal blood loss [30], accelerated recovery [24, 29, 30], and improved ROM [29, 30, 34]. Proprioception with a UKA is reportedly superior in that patients believe that after UKA, the knee behaves more like the native knee [26]. Patients who have UKAs generally have shorter hospital stays [7, 30, 39], and the procedure appears cost-effective when measured in units of quality-adjusted years [38, 39]. Some studies of the survivorship of prostheses used in UKA, regardless of type, have reported poor survivorship rates, when compared with prostheses used in TKA [17, 23, 25], whereas others report 10- and 15-year survivorship rates of 85% to 95% for UKA comparable to those for TKA [14, 34, 36]. One report suggests the higher reported survival of UKA in some studies relates to patient selection, improved surgical technique, and better prosthetic design [34].

We began performing minimally invasive resurfacing UKA using an inlay prosthesis in 1999. This technique allows for limited resection of bone and enables the use of less invasive surgical techniques than is possible with other types of prostheses used for UKA. The inlay prosthesis and technique also have allowed us to develop a short-stay protocol, which we believe may not be possible with other implants or techniques. However, some authors have reported that MIS techniques do not allow for more accurate re-creation of anatomy after UKA, particularly in relation to AP tibial placement or postoperative limb alignment [15, 33].

Our aims were to determine (1) the length of stay and complications associated with a short-stay MIS protocol; (2) whether MIS techniques allow for accurate positioning of the implant and alignment of the limb; (3) the change in functional scores; (4) the revision rate, reasons for revision, and survival of this implant.

Patients and Methods

We reviewed the first 100 prospectively followed patients who had 114 selected UKAs for medial compartment OA from July 1999 to September 2000. From the beginning, we used a short-stay protocol whereby the patients are admitted on the day of their surgery and discharged either later that day or the following day. Our indications for unicompartmental knee replacement were those described previously [22, 35]: patients with noninflammatory arthritis, pain and tenderness localized to the medial joint line, flexion greater than 90°, a correctable varus deformity (confirmed under anesthesia), an intact ACL, and radiographically an Ahlback grade [1] less than 4. We did not exclude patients with Grade 2 or 3 changes [3] provided they could localize their symptoms to the medial compartment. The ultimate decision to proceed with a UKA was made at the time of surgery. Age, weight, and level of activity were not determining factors in the decision to proceed. Contraindications for the procedure were inflammatory arthritis, anterior cruciate ligament deficiency, and symptoms that could not be localized to one compartment. Two patients had bilateral procedures performed under the same anesthesia and five had staged bilateral procedures, giving a total of 114 procedures for review. The average age of the patients at the time of surgery was 67 years (range, 48–87 years). At the time of followup, seven patients had died, all of whom had unilateral procedures, leaving a total of 93 patients (107 knees). None of the patients who died had revision of their prosthesis, nor were any on a waiting list for revision surgery, however, as these seven patients had completed IKS scores preoperatively and at 1 year followup, their results were included in the calculation of the mean preoperative and 1-year followup IKS scores. No patient was lost to followup. The average body mass index (BMI) was 28.9 (range, 19.9–47.7). There were 52 men and 41 women, with 61 right and 46 left UKAs performed. Minimum followup was 5.2 years (mean, 7.4 years; range, 5.2–9 years).

All patients were educated as a group the day before surgery by the senior nurse educators, the physiotherapists, and an occupational therapist. In addition to being given general information regarding the surgery and procedure, patients are instructed in how to change the wound dressing on the third postoperative day and given a program for ROM and isometric muscle rehabilitation.

All patients were admitted on the same day as their surgery. For the purposes of calculating the amount of time spent in the hospital, 1 day was considered to be the 24 hours after surgery. In other words, if a patient was discharged 6 hours after surgery, this would be recorded as 0.25 (being ¼ of 24). Surgery was performed with the patient under general anesthesia and with tourniquet control with antibiotic prophylaxis using a third-generation cephalosporin. Patients were administered chemical thromboprophylaxis preoperatively.

All patients were admitted on the day of surgery and all surgery was performed by the senior author (MJN). Surgery was performed in the hanging-leg position, with the thigh supported with a bolster. A MIS technique was used with an incision approximately 8 to 9 cm long extending longitudinally from the medial edge of the patella to the edge of the tibial tuberosity. A parapatellar subvastus arthrotomy was used, sparing the quadriceps. The patella was displaced laterally, but not everted, and an approximately 2-mm edge of the medial facet was excised to prevent impingement. The medial meniscus was excised. The tibia and femur were prepared by burring the remaining articular cartilage to a smooth surface, with minimal resection of bone. The tibia was prepared freehand in the anatomic position of a 3° posterior slope and 2° to 3° varus. Using a template and methylene blue dye, the outline of the area on the tibia to be prepared was marked (Fig. 1). It is important not to overcorrect the deformity but to re-create the anatomic position for each patient, ie, to correct only the deformity produced by joint-space loss. We used a routing guide to enable us to get the plane correct and flat. The landmark was the normal joint line, which is 1 to 2 mm above the tibial bony surface.

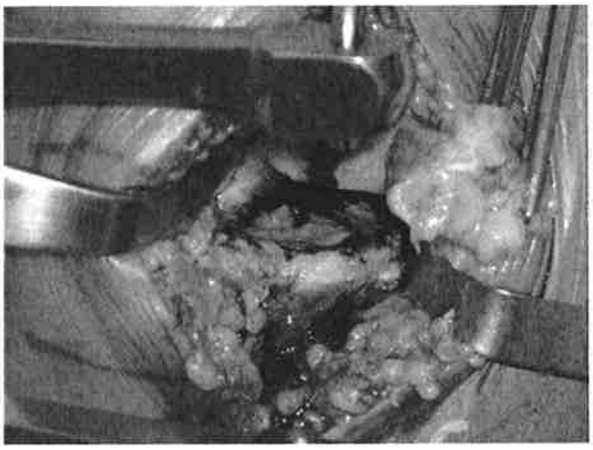

Fig. 1 Methylene blue outlines the tibial cut to be made.

Fig. 2 An all-polyethylene tibial component is cemented in situ with a rim of bone surrounding.

We aimed for maximum coverage, while retaining a rim of bone, which captured the implant and helped pressurize the cement (Fig. 2). The Repicci II® (Biomet, Inc, Warsaw, IN, USA) cobalt-chromium femur/all-polyethylene tibia fixed-bearing prosthesis was implanted in all cases (Fig. 3). All components were cemented with one 20-g mix of CMW cement (DePuy Orthopaedics Inc, Warsaw, IN, USA). The implant was pressurized with the knee in varus and mid-flexion, so as not to tilt the tibia if there was any toggle. Individual 10-mL fractions of ropivacaine hydrochloride 0.75% were injected intraoperatively into four different sites, namely, the posterior capsule, the medial ligament structure, the infrapatellar fat pad, and the pes anserinus. Wounds were closed over a suction drain and the wound infiltrated with 10 mL ropivacaine hydrochloride 0.75%. In addition, we used an intraarticular analgesic infusion device, the On-Q Painbuster® (I-Flow Corp, Lake Forest, CA, USA) containing ropivacaine hydrochloride 0.75% and 160 mg gentamicin, which the patient removed after 3 days. The wound was dressed with a compression bandage, and the suction drain was removed in the recovery bay 2 hours after surgery.

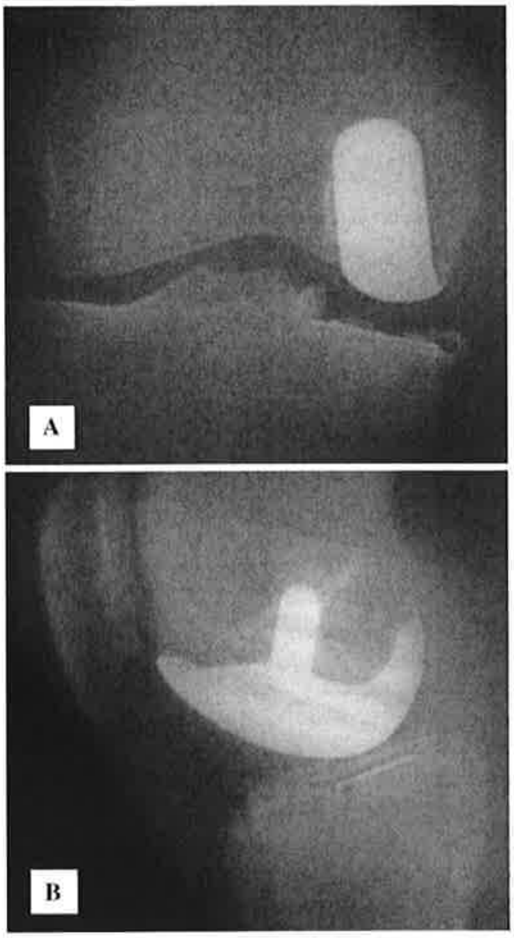

Fig. 3A–B (**A**) AP and (**B**) lateral radiographs taken 9 years after surgery show a Repicci II® prosthesis for medial compartment OA.

All patients were mobilized wearing a long-knee hinged brace as rapidly as their comfort allowed, many within hours of their surgery, under the direct supervision of one of the physiotherapists. The patients initially began static quadriceps rehabilitation and ROM exercises as tolerated. They initially used a walker and then crutches, being fully weightbearing before discharge. The hinged brace was used only for weightbearing, and not at rest. The brace was removed at 2 weeks and the patients were allowed to begin swimming at that stage. They also were allowed to walk using only one crutch. They were encouraged to use an exercise bicycle at 4 weeks, and wean off any walking aid between 4 and 6 weeks.

Patients were seen for first followup at 2 weeks, at which point, radiographs comprising weightbearing long-leg AP, flexion lateral, and Merchant views, were taken. Measurements recorded included the HKA angle, femorotibial angle, and position of the tibial tray relative to the long axis of the tibia as seen on AP and lateral views. The long-knee brace was removed at this stage and ROM documented using a standard goniometer. Patients were given instructions regarding mobilizing fully weightbearing without crutches. Patients were seen again for followups at 6 months and 1 year postoperatively, at which stage repeat radiographs were performed. Clinical examination comprised ROM testing and assessment for any laxity/instability of the knee in either the coronal or sagittal plane. All patients completed an IKS score [18] preoperatively, at 1 year, and at last followup. Age, gender, BMI, length of hospital stay, and all perioperative complications were recorded.

We recorded all subsequent surgery, including revision of the prosthesis, and survivorship at 10 years. We defined any prosthesis that had been revised, or was awaiting revision, as having failed. We recorded an IKS score on all revisions postoperatively and compared these scores with those of patients who had not undergone revision surgery.

Two of us (TOD, MJN) independently assessed preoperative and postoperative radiographs on three separate occasions (taking the average as the actual value) for the HKA axis on standing views and the AP and posterior positions of the tibial implant to reduce the risk of interobserver and intraobserver variability (kappa value: 0.81).

Information was obtained from the Central Financial Department of our institution regarding costs, in terms of the cost of the implant, and costs incurred as a result of inpatient treatment, which essentially comprises the cost of providing accommodation and personnel involved with postoperative care of the patient.

Changes in IKS scores were analyzed using Student's t test. The Mann-Whitney test was used to compare preoperative and postoperative differences in radiographic values and IKS scores between patients who eventually underwent revision surgery and those who did not. The Pearson correlation coefficient was used to analyze data for correlation between factors such as BMI and age with failure. The D'Agostino-Pearson test was used to test for normal distribution, to accept or reject normality. A p value greater than 0.05 indicates that the data can be assumed to have normal distribution. Kaplan-Meier analysis [2] was used to assess survivorship, defined as revision of the prosthesis or decision to revise. Statistical analysis was performed using SPSS® for Windows® (SPSS Inc, Chicago, IL, USA).

Results

The average length of surgery was 91 minutes (range, 74–120 minutes). Eight patients had perioperative complications (Table 1). No patient required surgery that necessitated general anesthesia. The average length of stay was 1.2 days (range, 0.2–3.2 days). Forty-one percent of patients were discharged on the day of surgery. We observed an association with age and length of stay: patients younger than 65 years were more likely ($p < 0.001$) to be discharged the same day of surgery. Patients with a BMI greater than 35 were more likely ($p < 0.001$) to be discharged more than 24 hours after their surgery. TKA in our institution is associated with an average length of stay of 5.4 days. Compared with this, UKA using our short-stay protocol would be 57% less expensive overall taking into account operating theater costs, accommodation costs, and cost of implant (Table 2).

Table 1. Perioperative complications

Complication	Number of patients	Time postoperatively (days)
Superficial wound infection	1	3
Hemarthrosis	1	5
Deep venous thrombosis	2	10, 11
Pes anserinus pain	3	32, 69, 132
Excessive pain	1	10

Table 2. Costs associated with TKA and UKA in our institution*

Cost	TKA	UKA
Prosthesis	8863	4107
Operating room (including personnel)	4120	3062
Accommodation	4825†	524‡
Total	17,808	7693

*As of 06/16/2009; values are in Australian dollars; †based on a 5-night inpatient stay; ‡based on a day-case procedure; UKA = unicompartmental knee arthroplasty.

The HKA axis corrected ($p = 0.002$) from a preoperative mean of −6° varus (range, −10°–0°) to −1.7° varus (range, −5°–100°). The mean tibial tray angle observed on the postoperative AP radiograph was 2.7° valgus (range, 0°–5°). Ninety-four percent of the radiographs showed re-creation of the tibial slope to within 2° of the preoperative value (range, 0°–4°). The patients who had revision surgery for progressive disease were similar to all other patients, with the exception of a difference in postoperative limb alignment: patients who had progressive disease had a mean HKA axis of 0.4° valgus (range, 0°–10°), compared with −2° varus (range, −8°–0°) for those who had no progression and no revision surgery.

The IKS score improved ($p = 0.023$) from a preoperative mean of 77 (range, 72–79) to a mean of 93 (range, 88–95) at 1 year followup. At last followup, the mean score was 86 (range, 82–93). When excluding scores for

Table 3. ROM before and after surgery

Extension (°)		p Value	Flexion (°)		p Value
Preoperative	Postoperative		Preoperative	Postoperative	
−3.95 (−10–0)	−1.58 (−10–0)	0.013	130.4 (90–150)	133.3 (100–150)	0.009

Values are expressed as means, with ranges in parentheses.

Table 4. Revisions with time to revision and reason for failure

Case	Time from index procedure (years)	Reason for revision*	Procedure
1	8	A	TKA
2	8.2	A	TKA
3	3.2	A	TKA
4	6.5	A	TKA
5	8.4	A	TKA
6	4.2	B	TKA
7	7.2	B	TKA
8	7.6	B	TKA
9	8.2	B	TKA
10	9.1	B	TKA
11	6.3	B	TKA
12	7.3	B	TKA
13	6.3	B	TKA
14	5.4	B	TKA
15	3.7	B	TKA
16	2.3	C	TKA
17	2.5	C	TKA
18	6.3	C	TKA
19	1.1	C	TKA
20	8.5	D	TKA
21	8.8	E	Exchange tray
22	9.5	E	TKA

*A = progression of disease to lateral compartment; B = progression of disease to lateral and patellofemoral compartments; C = subsidence of tibial tray attributable to stress fracture; D = malalignment; E = aseptic loosening.

the patients who had died from the preoperative and 1-year followup IKS scores, the mean scores were similar ($p = 0.438$). Postoperative ROM was better than preoperative ROM (Table 3).

During the time before last followup, there were 21 revision procedures to a TKA (Table 4). One additional patient had revision of the tibial tray for aseptic loosening at 8.8 years after the index procedure, giving a revision rate of 19% at a mean of 6.2 years (range, 1.1–9.5 years) after the index procedure. The survivorship was 78% at 9 years (Fig. 4). We found no difference in the IKS scores preoperatively ($p = 0.219$) and at 1 year ($p = 0.288$) between patients who had undergone revision surgery and those who had not (Table 5). However, the mean last IKS score of patients who underwent revision surgery was 82 (range, 74–88) at last followup, which was lower ($p = 0.013$) than the mean score for patients who did not undergo revision surgery (88). There was no correlation between revision and BMI ($p = 0.233$) or age ($p = 0.30$).

Discussion

Surgical management of unicompartmental OA of the knee using a UKA continues to generate debate and controversy [9], partly owing to the paucity of literature available concerning prospective randomized trials comparing UKA with TKA or high tibial osteotomy for treating unicompartmental disease. Several retrospective studies suggest the survivorship of UKA, performed for certain indications approaches that of TKA [14, 19, 34, 36]. There are purported advantages of a UKA over a TKA [16, 30, 39]. More recently developed MIS techniques offer other potential advantages related to quicker rehabilitation and cost, but when UKA is performed using these techniques there is a risk the limited exposure does not allow for accurate restoration of alignment after UKA. The questions we wished to answer with this study were whether UKA with MIS techniques (1) reduced the length of stay and complications; (2) allowed for accurate positioning of the implant and alignment of the limb; (3) provided high functional scores at followup; (4) was associated with revision and survival rates compared with those reported in the literature.

There are several limitations of this study. First, our data represent those from the first 100 patients (114 knees) of one surgeon. The data, therefore, do not take into account the learning curve associated with the procedure, although the majority of the failures were late and associated with progression of disease, suggesting they were not attributable to a learning curve. Second, we did not compare our data with those of patients who had TKA for medial compartment OA. However, it is not our practice to perform TKA for patients with medial compartment OA and an Ahlback grade less than 4. Third, we did not document the grade of degenerative disease in the patellofemoral or lateral compartments. However, one study suggests asymptomatic patellofemoral disease does not adversely affect functional improvement in patients undergoing UKA [6].

Fourth, we did not factor into account the added cost of revisions of UKA when comparing the cost with TKA, bearing in mind that, in the majority of circumstances a TKA will have longer survivorship than a UKA. To accurately compare costs, those for any additional revisions owing to the use of UKA should be considered.

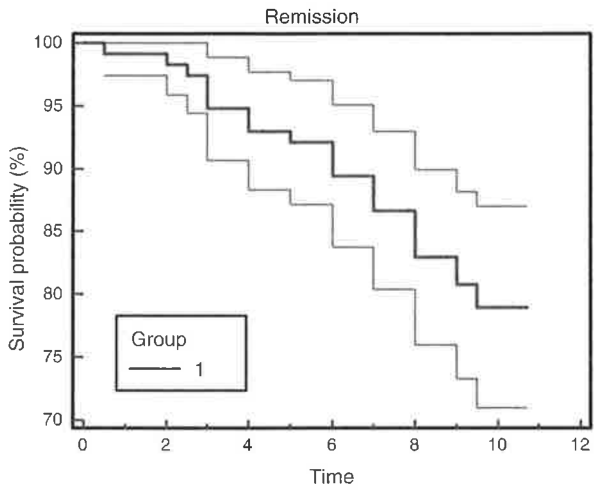

Fig. 4 A Kaplan-Meier survivorship graph shows the survival rate with 95% confidence intervals. The 9-year survivorship is 78%.

Koskinen et al. [20] concluded UKA was less cost-effective than TKA. However, the average length of hospital stay for patients who had UKAs in their series was more than 15 days when data were first collected in 1988 and was still more than 5 days in 2003. Willis-Owen et al. [39] reported a savings of £1761 (UK pounds) when a UKA was used for an equivalent patient in preference to TKA. When taking into account implant and personnel costs, and the average length of stay for a patient having TKA in our practice, UKA is cost-efficient, resulting in a savings of 57%, or approximately $7030 (US dollars). Although we do not have a comparative cohort, our data suggest an aggressive short-stay protocol is not associated with any increase in perioperative complications. We achieved a 41% rate of same-day discharge with our protocol, and a mean length of hospital stay of 1.2 days. Younger patients and those with a BMI less than 35 have a better chance of being discharged the same day of their surgery.

Although there are some concerns that MIS techniques are not as accurate as open UKA in creating the optimal AP tibial placement or postoperative alignment [13, 33], other

Table 5. Revisions with hip-knee-ankle alignment, ROM, and clinical scores

Case	Preoperative alignment (°)	Postoperative alignment (°)	Preoperative ROM (°)	Postoperative ROM (°)	Preoperative IKS score	Postoperative IKS score	Final IKS score	Pain/ADL score
1	−10	0	0/130	0/130	77	94	81	64
2	−10	0	0/130	0/130	79	67	70	70
3	−10	−5	0/145	0/135	89	93	75	64
4	−5	1	−10/130	−5/140	79	83	82	66
5	0	2	0/130	0/130	64	90	79	64
6	−4	0	−10/120	−10/120	79	86	72	64
7	−15	−5	−10/140	0/135	86	96	88	74
8	−4	0	−10/140	0/140	86	97	89	73
9	0	10	0/150	0/150	86	96	85	62
10	0	10	−5/135	0/135	72	97	83	71
11	−5	0	0/140	0/140	86	97	66	45
12	−10	3	0/130	0/135	83	91	84	76
13	−5	0	0/130	0/145	72	97	90	77
14	−5	−5	−10/125	−10/135	67	87	80	63
15	−5	5	−5/140	0/140	85	98	96	84
16	−15	−8	0/125	0/130	66	86	84	70
17	−5	1	−10/140	−5/140	77	89	72	55
18	−8	0	0/130	0/125	84	96	89	75
19	−5	−2	−10/105	−5/100	69	90	69	55
20	−10	5	−5/115	0/115	70	94	92	83
21	−10	−4	−10/100	−10/130	51	81	91	79
22	−10	0	0/125	0/130	79	94	90	80

IKS = International Knee Society; ADL = activities of daily living.

Table 6. Key clinical findings in published series

Study	Key findings	
Newman et al. [33]	Reduced perioperative morbidity Improved ROM Improved Bristol knee score	with UKA
Laurencin et al. [26]	Enhanced proprioception of UKA	
Emerson and Higgins [13]	Improved IKS scores	
	Restoration of soft tissue balance	
	Accurate restoration of alignment	
Price et al. [36]	Good functional outcome Good pain relief Improved HSS scores	with UKA
Macaulay and Yoon [28]	Early improvement in function and ROM	
Koskinen et al. [21]	Improved IKS scores	
	5/46 knees revised owing to excessive early polyethylene wear	
Cartier et al. [12]	Undercorrection of varus Adequate polyethylene	key to success
Romanowski and Repicci [37]	Lower morbidity than alternative treatments	
Current study	Improved IKS scores	
	Low morbidity with short-stay protocol	
	41% done as day case	
	Cost effective	

HSS = Hospital for Special Surgery.

Table 7. Comparison of survivorship rates for UKA

Study	Implant	Survivorship (years)	Revision (number)
Newman et al. [33]	St Georg Sled (n = 52)	89.8% (15)	4
Ansari et al. [4]	St Georg Sled (n = 461)	87% (10)	–
Knutson et al. [19]	St Georg Sled (n = 1345)	89% (10)	–
Emerson and Higgins [14]	Oxford (n = 55)	85% (10)	6
Koskinen et al. [21]	Oxford (n = 1145)	81% (10)	–
	Duracon (n = 196)	78% (10)	–
	Miller-Galante II (n = 330)	79% (10)	–
	PCA (n = 146)	53% (10)	
Koskinen et al. [20]	Miller-Galante (n = 46)	86.6% (7)	8
Price et al. [36]	Oxford (n = 439)	93% (15)	23
Macaulay and Yoon [28]	Miller-Galante (n = 33)	97% (3.2)	1
Carr et al. [11]	Oxford (n = 121)	99% (8)	–
Murray et al. [32]	Oxford (n = 143)	98% (10)	–
Kumar and Fiddian [23]	Oxford (n = 100)	85% (11)	–
Bert [8]	MBUKA (n = 100)	87% (10)	–
Lidgren [27]	Oxford (n = 749)	86% (10)	–
Argenson et al. [5]	Miller-Galante (n = 160)	94% (10)	–
Cartier et al. [12]	Marmor (n = 60)	93% (10)	2
Romanowski and Repicci [37]	Repicci (n = 136)	96% (8)	6
Current study	Repicci II (n = 114)	78% (10)	21

studies suggest implant position is similar whether UKA is performed using MIS or the open techniques [10, 31, 36]. In our series, the average HKA alignment postoperatively was less than 2° varus, which we believe ideal, with consistent positioning of the tibial tray on the AP view at less than 3° valgus to the anatomic axis of the tibia. In addition, the tibial slope was within 2° of the preoperative slope in greater than 94% of patients.

Functional improvement from previous UKA series has been consistent (Table 6). This pattern was mirrored in our series. The IKS score improved from a preoperative mean of 77 to 93 at 1 year followup. At last followup, it had decreased to a mean of 86.

We had a revision rate less than 20% at a mean of more than 6 years, which was higher than rates reported in other series (Table 7). The most common reason for revision was progression of disease. We could find no other midterm to long-term independent review in the literature reporting the results of minimally invasive resurfacing UKA using an inlay prosthesis. The developer of the Repicci II® prosthesis reported an 8-year followup study with a revision rate of 4% [37], considerably lower than our revision rate. Survival rates from the early series of UKA were lower compared with rates for TKA: revision rates of 22% at 2 years [25] and 28% at 6 years [17] were reported. However, more recent studies have reported improved survivorship for the implants to as much as 95% at 10 years (Table 7). This is attributable to a combination of better implant design, more rigid patient selection, and improved surgical technique. In our series, the survival rate at 9 years was 78%, not as high as the survivorship rates reported with other implants (Table 7).

UKA using a minimal resection MIS technique is a technically demanding procedure. Our results show the survivorship and rate of revision are not as good as those reported for other UKA techniques using fixed mobile-bearing prostheses. However, patients had reasonable functional scores, and the UKA we performed can be revised to a TKA without the need for stems or wedges. It is possible to consistently implant the prosthesis in an anatomic position. Finally, the MIS technique was cost-efficient and associated with relatively few postoperative complications comparable to other types of UKA and TKA for treatment of medial compartment OA of the knee.

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