

5- to 16-Year Follow-Up of 54 Consecutive Lateral Unicondylar Knee Arthroplasties With a Fixed-All Polyethylene Bearing

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Abstract: The clinical and radiographic results of 54 knees (52 patients) with a unicondylar knee arthroplasty (UKA) with fixed-all polyethylene bearing implanted for lateral osteoarthritis were studied at 5- to 16-year follow-up (mean, 100.9 months). Four underwent second surgery: 1 conversion to total knee arthroplasty and 3 received UKA in the medial compartment. The mean International Knee Society knee score was 94.9 points, with a mean range of motion of 132.6° and a mean International Knee Society function score totaling 81.8 points. Implant survival was 98.08% at 10 years. These excellent results suggest that UKA with fixed-all polyethylene bearing is a reliable option for management of isolated lateral knee osteoarthritis. **Keywords:** knee, unicompartmental arthroplasty, lateral osteoarthritis.

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Degenerative joint disease can affect any or all of the compartments of the knee joint. The etiology of lateral compartment arthritis include degenerative changes secondary to trauma, complication of spontaneous osteonecrosis of the lateral femoral condyle [1], and complication from a dysplastic lateral femoral condyle causing a valgus deformity that contributes to pathologic loading of the lateral compartment of the knee and subsequent bone and cartilage destruction [2] and less commonly in the process of treatment of lateral meniscus tear [3,4]. The available options for operative treatment of isolated lateral femoral arthritis include osteotomy [5,6], unicompartmental (UKA) or total knee arthroplasty (TKA) [7-9].

Recent midterm and long-term studies suggest reasonable outcome at 10 years with survivorship greater

than 95% for medial UKA [10,11]; however, only limited long-term follow-up data are available for lateral UKA [7,8,12]. Often, these studies were contradictory. Some [13,14] demonstrated worse results for lateral UKA than for the medial side, whereas others [15,16] demonstrated a good outcome for lateral UKA. A recent study by Argenson et al [17] concluded that lateral UKA is a reasonable option for treatment of isolated lateral compartment knee arthritis, but his series included 4 different designs of UKA.

We intended to study the outcomes of lateral unicondylar prosthesis, with an all-polyethylene tibial component, as an option in the treatment of isolated lateral knee arthritis. We present our experience with a follow-up period ranging from 5 to 16 years and a median follow-up of more than 8 years.

Materials and Methods

We present a retrospective study conducted in our center on patients operated on between January 1990 and October 2003. During this period, we performed more than 1600 TKAs and 150 UKAs. Of the latter group, we selected all patients who received a lateral UKA.

The patients selected to receive a lateral UKA had to have the following criteria: lateral compartment osteoarthritis (OA) stage C or D (without severe cupula) according to the International Knee Documentation Committee [18] radiologic criteria. The patellofemoral and medial compartments should show no sign of incipient radiologic and/or clinical OA. Asymptomatic

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patellofemoral OA was accepted in selected cases of patients older than 70 years with high comorbidity and low activity. Stress x-rays of the knee had to show correction of the deformity when a varus stress was applied. Full correction was not necessary because the aim was to check the correctability of the deformity caused by wear of the articular cartilage, not the whole valgus deformity.

The exclusion criteria included clinical and radiologic signs of OA in the medial tibiofemoral and patellofemoral joints and nonfunctional cruciate ligaments as evidenced clinically and radiographically on a single-leg stance lateral view of the knee. If the anterior tibial translation was more than 10 mm, there was a nonfunctional anterior cruciate ligament. Limited range of motion was considered a contraindication to UKA if the patient had more than 10° flexion contracture. Inflammatory arthritis such as rheumatoid arthritis was an absolute contraindication to UKA. There is no consensus within the literature for an upper age limit with this prosthesis. Therefore, we did not exclude the older, less active patients. The lower age limit traditionally was set at 65 years old. If a patient was younger than 65 years and not suitable for a tibial varus osteotomy, our alternative surgical option to UKA, they would be offered a lateral UKA. The most common cause for this was OA secondary to trauma in patients with normal alignment. General health issues could influence our decision because UKA was considered safer with less blood loss and a more rapid recovery than TKA. Weight has been shown to greatly influence the wear pattern [19,20], and Berend et al [20] reported that body mass index greater than 32 kg/m² predicted failure and was associated with a reduction in survivorship. We therefore did not perform UKA in patients weighing more than 85 kg.

There were 54 lateral UKAs (36%) performed in 52 patients. Bilateral UKA was performed in a single setting for 2 patients.

Follow-up of the patients was recorded prospectively. The patients were seen at 3, 6, and 12 months postoperative and at yearly intervals after that with x-rays and a recorded clinical examination. A questionnaire on patients' satisfaction was also completed.

At the time of the final follow-up, 3 patients had died with more than 5 years of follow-up and a complete file with radiographs and satisfaction surveys but were not included in this study. Two patients (2 knees) had been lost to follow-up. Therefore, 49 knees in 47 patients were available after a minimum follow-up duration of 5 years (90.7%). Thirty-nine patients had a clinical and radiographic examination at the time of the final evaluation. Eight patients were contacted by telephone because they were unable to come to the hospital for clinical examination, and they sent their new x-rays and completed a questionnaire.

The mean duration of follow-up was 100.9 months (range, 64-189 months). The mean age of the patients at the time of the index procedure was 72.2 ± 3.0 years (range, 25-88 years), and the mean weight of the patients was 66.7 ± 15.8 kg (range, 40-85 kg; Table 1). Etiologically, all (100%) of the lateral UKAs were implanted for lateral OA, of which 3 were posttraumatic OA. Thirty-eight knees had not undergone previous surgery; 11 had previous surgery (5 open meniscectomies, 3 arthroscopies, and 3 osteosynthesis for lateral tibial plateau fracture).

All patients received the same prosthesis (HLS evolution Uni; Tornier Company, Saint-Ismier, France) with a fixed-all poly tibial component. An important feature of this prosthesis design was the resurfacing of the distal femoral condyle. The thickness of the cemented tibial polyethylene liner in this type of implant ranged from 8 to 14 mm.

Operative Procedure

All the patients were operated on by the senior author following the same surgical principles established since 1990, with a lateral approach [21] for the lateral UKAs. A tourniquet was used in all cases. Since 1996, we started to limit exposure, and since 1998, we no longer osteotomize the tibial tuberosity for the lateral approach [22]. Tibial tuberosity osteotomy was performed in the lateral approach for 6 patients (6 knees). The anterior cruciate ligament was normal in 44 knees and alternated in 5 knees (evaluation noted during the surgical procedure). All implants were cemented. The polyethylene tray was 9 mm thick in 87.7% of the cases (n = 43), 10 mm thick in 4.1% of the cases (n = 2), 11 mm thick in 4.1% of the cases (n = 2), 12 mm thick in 2.05% of the cases (n = 1), and 13 mm thick in 2.05% of the cases (n = 1). Thicknesses 8 and 14 mm were not used.

Patient Evaluation

The clinical results were studied using the International Knee Society [23] score. The radiologic results were evaluated based on standardized images taken at the last follow-up: standing frontal and lateral images (Fig. 1A and B), an axial view of the patellae at 30° and the lower limb alignment was assessed on long-leg radiographs performed using a standardized technique in which the

Table 1. The Series

	Mean	SD	Minimum	Maximum
Age (y)	72.2	3s.0	25	88
Weight (kg)	66.7	15.8	40	85
Height (cm)	162.73	18.24	148	185
Body mass index (kg/m ²)	25.08	2.96	19.1	32.8
Side (n = 49)			Right: n = 29; left: n = 20	
Sex (n = 47)			Female: n = 39; male: n = 8	

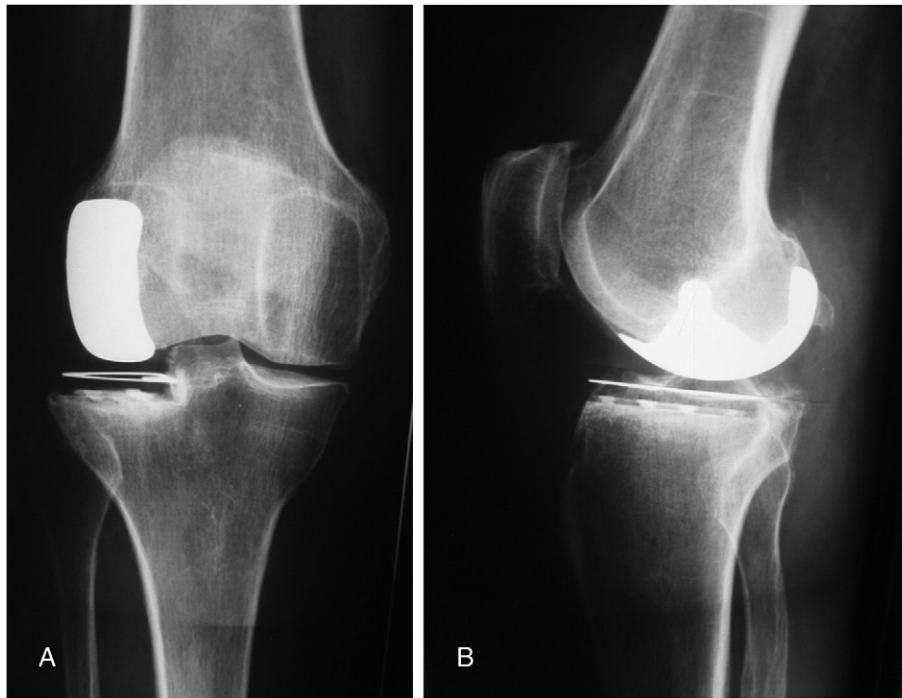


Fig. 1. Seventy-two-year-old lady. Lateral UKA with 8-year follow-up. (A) Anteroposterior x-ray. (B) Lateral x-ray.

patient stood with the patellae facing anteriorly, then the hip-knee-ankle angle was measured, and valgus deformation was expressed in positive value [24,25].

Therefore, we were able to measure the postoperative femoral, tibial, and femorotibial mechanical angle and the tibial slope at the last follow-up. We searched for radiolucencies (noting any progression if necessary) in accordance with the IKS criteria [23] or deterioration of other compartments in the joint. Finally, detectable wear of the polyethylene was sought on the standard x-rays using a metallic landmark on the tibial base plate.

Surgical intervention secondary to the implantation of the prosthesis was considered a failure. This included either implant removal and change to a TKA in case of infection, loosening, and so on, or the development of medial OA and implantation of an ipsilateral medial UKA.

The statistical analysis was done using Minitab software (Minitab SARL, Paris, France). A χ^2 test was used to compare the quantitative variables, with significance set at $P < .05$. The survival curves were calculated using the Kaplan-Meier method with a 95% confidence interval based on the following end points: implant removal and/or a second UKA performed for OA progression in the other compartments.

Results

Mean Follow-Up

The 49 implants had a clinical or radiologic follow-up equal to or greater than 5 years; maximal follow-up was

16 years. The mean follow-up at the last review was 100.9 months (64-189 months).

Functional Results

Forty-five UKAs were evaluated (the 4 cases revised were excluded for functional results analysis). The mean IKS knee score was 94.9 points (range, 70-100 points), with mean range of flexion of 132.6° (range, 115°-150°) and a mean IKS function score totaling 81.8 points (range, 25-100 points; Table 2). The gain was 26.7 points for the IKS knee score and 12.8 points for the IKS function score (statistically significant gain; $P < .05$). Therefore, 97.9% of the patients were very satisfied or satisfied (very satisfied, 76.7%; satisfied, 19.2%).

No pain or occasional pain was reported by 85.1% of the patients. Patients were able to walk either unlimited distances or greater than 1 km in 80.9%. Limping was found in only 17% of the patients, and the use of a cane remained necessary for 10.6% (in all cases related to multiple joint involvement or general health status).

The 3 patients who passed away before final evaluation were not included in these results because we decided to have a prospective collection of data. However, they had complete files at a minimum of 5-year follow-up. The functional result was good at the last visit, with a mean IKS knee score was 91.7 points and a mean IKS function score totaling 83.3 points.

Radiologic Results

All the measurements were performed at the latest visit (Table 2). The average femorotibial alignment was 181.8° (range, 174°-192°). The posterior tibial component slope

Table 2. Clinical and Radiologic Data

		Before Surgery				At Last Follow-Up			
		Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum
Clinical results	Function score	68.9	6.1	0	100	81.81	5.84	25	100
	Knee score	68.2	4.2	35	92	94.93	2.50	70	100
	Flexion maximum	129.8	3.2	90	150	132.6	2.3	115	150
Radiologic results	ATm	90.2	0.8	83	98	89.84	0.8	85	95
	AFm	93.0	0.7	87	98	89.69	1.19	87	96
	AFTm	185.2	1.0	178	192	181.78	1.12	174	192
	Tibial slope	90.1	1.6	80	99	84	0.82	78	90

ATm indicates tibial mechanical angle; AFm, femoral mechanical angle; AFTm, femorotibial mechanical angle.

averaged 84° (range, 78°-90°). Radiolucent lines related to the tibial component were appreciated in 6 knees at the bone-cement interface. All were less than 2 mm and did not progress. Radiolucencies were observed at bone-cement interface in relation to one femoral component; it was less than 2 mm and nonprogressive.

The final radiographic assessment of the progression of arthritis in the medial compartment revealed grade 1 change in 5 patients. In 3 patients, total loss of joint space required revision surgery to UKA of the medial compartment.

To date, we have not observed arthritic progression of the patellofemoral joint that would warrant additional surgery in this series of 49 UKAs. The 3 patients with lateral patellofemoral OA remained clinically asymptomatic with no radiologic progression at 91-month follow-up.

Complications

Early (1-3 months). General complications were rare. We noted 2 cases with deep venous thrombosis, which were managed with appropriate anticoagulation therapy.

Late. Of the 49 UKAs, 4 underwent a second surgery: 1 conversion to TKA (1 case of tibial tray loosening at 2 years) and 3 revisions for UKA in the medial compartment (Fig. 2). These 4 patients were alive at the time of final assessment of the study, with good functional result and no reintervention at 69-month follow-up of the second surgery. Their mean IKS knee score was 88.8 points, and their mean IKS function score totaled 96.2 points.

No revision surgery was necessary either for wear of the femoral or tibial components or for infection.

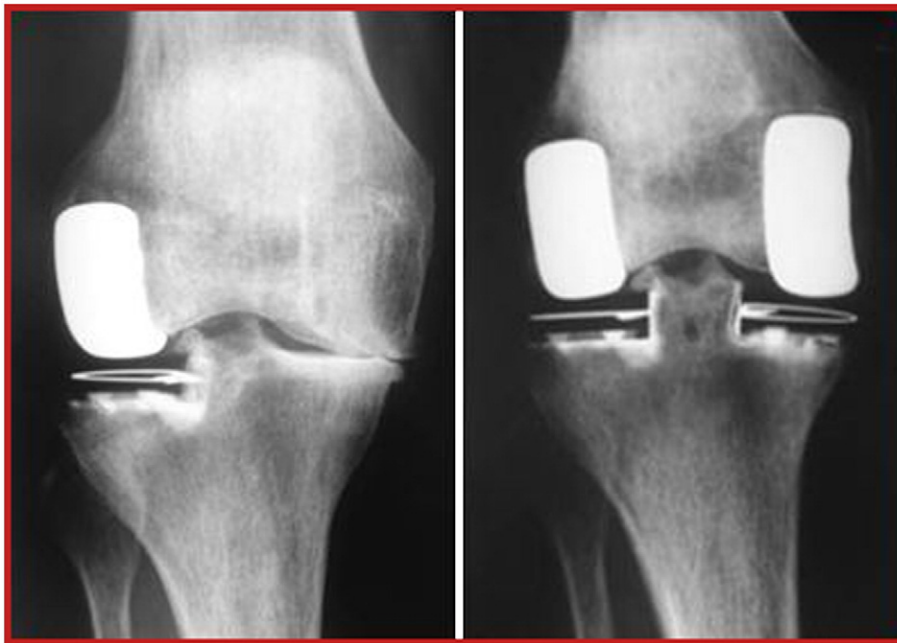


Fig. 2. Seventy-four-year-old lady. Consecutive medial OA 6 years after lateral UKA. Three-year follow-up x-ray after medial UKA (9-year follow-up for lateral UKA).

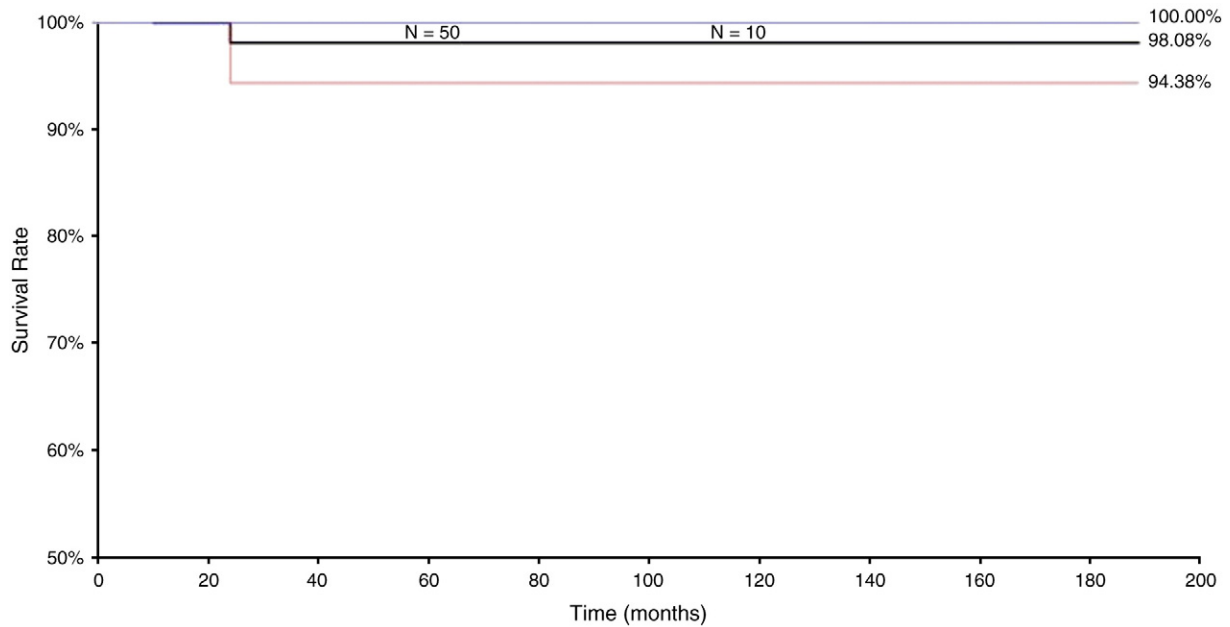


Fig. 3. Kaplan-Meier survivorship curve (failure: UKAs revision).

Survival Curves

Implant survival was 98.08% (94.38%-100%) at 10 years, taking as the end-point removal of the prosthesis (Fig. 3). If we also define development of contralateral compartment arthritis (total loss of joint space) as failure, implant survival will be 91.12% (82.79%-99.45%) at 10 years (Fig. 4).

Discussion

Lateral unicompartmental knee OA is a difficult condition for the orthopedic surgeon to manage.

Options for surgical treatment include osteotomy and arthroplasty whether total or unicompartmental [9]. We have previously published criteria to determine the appropriate procedure for the appropriate patient as discussed in “Materials and Methods” [26]. We present our experience in patients satisfying these criteria for lateral UKA with a 5- to 16-year follow-up period.

The medial UKA is well documented for the treatment of medial OA with survival rates between 90% and 95% at 10 years [10,27]. The lateral UKA is less well described in the literature, and often, reports may be contradicting.

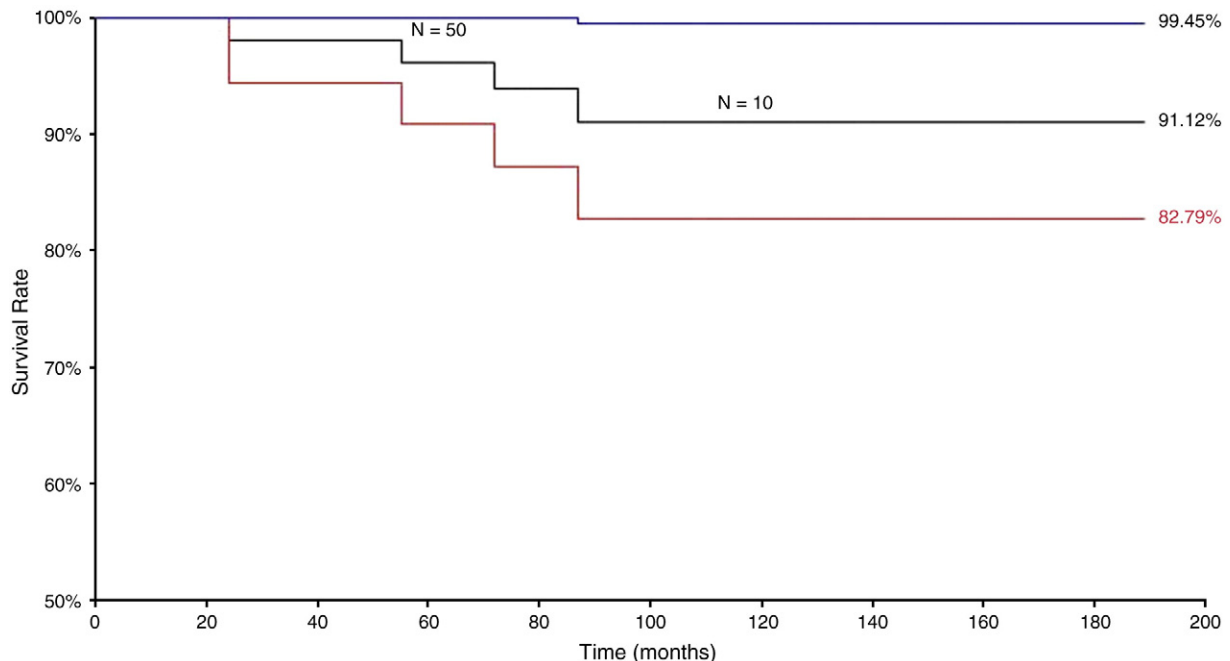


Fig. 4. Kaplan-Meier survivorship curve (failure: UKAs revision or degenerative changes in the opposite compartment).

Scott [28] found a ratio of 1 lateral UKA for 10 medial UKAs. This is probably related to the relative scarcity in the incidence of lateral isolated OA compared with that of medial OA [29], as well as to the differences concerning biomechanics of these 2 compartments. The use of the Oxford mobile-bearing UKA (Biomet, Bridgend, Great Britain) gave excellent results for medial compartment; however, for lateral compartment, it was associated with 10% of dislocation of the mobile-bearing component and showed a failure rate of 21% at 5 years [8]. A preceding study with fluoroscopy [30] had indeed shown that the femoral rolling-gliding mechanism during knee flexion is much more important in lateral compartment. This could explain certain early failures with mobile-bearing lateral UKAs.

Few studies evaluated the long-term results of the isolated lateral UKA, and it is necessary to separate the recent series from the older ones. The older series are often contradictory. On a global series of UKAs, Scott and Santore [13] found more failure with lateral (6 failures of 12) than with medial (1 failure on 88) at only 3.5 years of follow-up, the same as for Cameron et al [14], who reported the lateral failure of 9 of 20 prostheses. In their opinion, they attributed this failure to osteopenia of the lateral tibial plateau and the difficulty of correcting excessive valgus. On the contrary, Insall and Aglietti [15], as well as Laskin [16], had improved results for lateral UKAs but on a selected patient population. In the recent literature, the results are very satisfactory. Sah and Scott [31] found an excellent result for all their knees (49 knees), without any cases of revision and 5-year follow-up. Pennington et al [32] showed comparable results with long-term follow-up on 29 knees, which, at 12 years of follow-up, had not required revision and all with excellent function. Ohdera et al [33] reported on 18 knees with a minimum of 5-year follow-up. Sixteen knees (89%) were rated as excellent or good using the Hospital for Special Surgery (HSS) scoring system, and 2 knees were revised. Argenson et al [17] showed 84% survivorship at 16 years on a series of 38 knees operated with 4 different prosthesis designs.

Our results are better compared with studies that used a similar prosthesis: a cemented all-polyethylene tibial component. Ashraf et al [7] presented their result on a series of 88 prostheses, with a mean follow-up period of 8 years. They had a 74% survivorship at 10 years taking revision for any cause as the end point for the study. This series was operated by 4 surgeons and had used a new design for the femoral component along the course of the study. O'Rourke et al [34] report the longest follow-up for lateral UKA, with a mean follow-up of 24 years and 14 knees and a 72% survivorship at 25 years.

We report a 98% survivorship at 10 years with our series composed of 49 knees and a mean follow-up of

8.4 years. Our results conform to the other series and show an excellent long-term survivorship. The clinical results of our series are encouraging, with an IKS passing from 102 points (knee, 58; function, 44) to 165 points (knee, 85; function, 80). Meanwhile, all the recently reported series seem to agree that patient selection greatly influences the UKA survival rate [10,26]. Limited degenerative involvement of a single compartment, moderate axial deformation, and joint range of motion that is not highly restricted are the classic indications. In our opinion, a moderate body mass index is also an important factor.

Surgical technique must be followed rigorously to avoid an early failure. The early failure at 2 years in our series requiring revision to a TKA with tibial stem is considered due more to a technical problem than the implant.

Walton et al [35] reported significant progression of arthritis in the opposite femorotibial compartment at 5-year follow-up, but they did not study the influence of postoperative femorotibial axis on the gravity of these pathologic changes. They reported 6 revisions to TKA in a series of 32 lateral UKA and concluded that progression of arthritis in the opposite compartment was more for lateral than medial UKA. It was indeed shown that a medial UKA has to be placed in slight undercorrection, to preserve the contralateral compartment [27]. We think like Ohdera et al [33] that it is the same for lateral side. The residual deformation must be a real undercorrection; the prosthesis makes it possible to correct only articular wear by respecting the extra-articular constitutional osseous deformity. The 3 cases of medial compartment wear in our series, which required medial UKA, all had a postoperative varus femorotibial axis. This contributes to the degenerative change of the medial compartment. Such medial wear was also observed in the series of O'Rourke et al [34], who revised 2 cases: one was in neutral alignment and the other was in varus from a preoperative valgus deformity. Meanwhile, the hypocorrection did not involve wear of polyethylene as the origin of revision or of bad clinical results.

The progression of OA in the patellofemoral compartment has been reported at the medium term with medial UKA by Berger et al [36] and Weale et al [37]. Hernigou and Deschamps [27] found a greater tendency toward patellofemoral OA in medial UKAs than in lateral UKAs. None of the patients in our series were reoperated for this complication.

Loosening of the tibial component in all poly designs has been recently emphasized by Saenz et al [38], who showed 8 cases of tibial component loosening in their cohort of 113 knees; they found no statistical correlation between body weight and failure, although they noted that 75% of their failed cases were considered as obese with a body mass index equal to or exceeding 30 kg/m².

Table 3. Comparison Between Our Series and Other Studies

Authors	Year	No. of UKAs	Type of Implant	Mean Follow-Up (y)	Survivors hip (No. of Revision)	Mean Age (y)	Cause of Revisions (No. of Cases)
Marmor [39]	1983	14	Cemented all-poly tibia	7.4 (2.5-9.83)	NA	–	
Günter et al [8]	1996	53	Cemented, metal backed, mobile bearing	5 (2.5-9.83)	82% at 5 y (11)	68 (40-88)	Bearing dislocation (6); loosening (1); late infection (3); tibial fracture (1)
Ohdera et al [33]	2001	18	4 designs	8.25 (5-15.8)	NA (2)	64.5 (52-77)	Femoral loosening (1); medial OA (1)
Ashraf et al [7]	2002	83	Cemented all-poly tibia	9 (2-21)	74% at 15 y (15)	69 (35-81)	Fractured femoral component (4); medial OA (9); tibial loosening (5); femoral loosening (1)
O'Rourke et al [34]	2005	14	Cemented all-poly tibia	24 (17-28)	72% at 25 y (2)	No specific to lateral UKA	Arthritis progression in other compartment (2)
Pennington et al [32]	2006	29	Cemented metal backed (72%) and all-poly tibia (28%)	12.4 (3.1-15.6)	100% at 12.4 y (0)	68 (52-86)	No revision
Sah and Scott [31]	2007	49	3 different designs	5.2 (2-14)	100% at 5.4 y (0)	–	No revision
Forster et al [40]	2007	30	Metal backed with mobile bearing (43%) and fixed-all poly tibia (57%)	2 (2-3.4)	NA (3)	67(36-93)	Tibial loosening (3)
Volpi et al [41]	2007	25	Cemented metal backed with mobile bearing	2.35 (1-5)	NA (0)	73.5 (65-82)	No revision
Argenson et al [17]	2008	38	4 different designs	12.6 (3-23)	84% at 16 y (5)	61 (34-79)	Medial OA (3); patellofemoral OA (1); tibial loosening (1)
Our series	–	49	Cemented all-poly tibia	8.4 (5.3-15.8)	98.08% at 10 y (4)	72.2 (25-90)	Medial OA (3); tibial loosening (1)

We strictly limit UKA for patients weighing less than 85 kg, and in our series, we had only 1 tibial loosening early at 2 years.

The limitation of this study could be the mean follow-up, which is less than 10 years. However, the advantage of our series is that it is of consecutive patients, with standard criteria, an identical prosthesis, the same surgeon, and mainly (tibial tuberosity osteotomy initially for access) the same technique. In comparison with other series published (Table 3), our results confirm that lateral UKA with full poly is a reasonable option for lateral femorotibial OA.

Conclusion

Osteoarthritis confined to the lateral compartment of the knee is less common than medial or patellofemoral. We believe that, with appropriate patient selection and rigorous surgical technique, lateral UKA is a reliable option. Furthermore, the excellent survivorship of our younger age group is similar to previously published long-term series. We believe that the inclusion criteria

can be expanded to include suitable patients younger than 65 years.

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