Acta Orthop. Belg., 2012, **78**, 203-209

ORIGINAL STUDY

The Oxford II medial unicompartmental knee arthroplasty An independent 10-year survival study

Philippe ZERMATTEN, Urs MUNZINGER

From the Schulthess Clinic, Zurich, Switzerland

Unicompartmental knee arthroplasty (UKA) is being used increasingly. We report the outcome of a series of 48 Oxford II meniscal bearing UKAs carried out for osteoarthritis of the medial compartment (38 knees in 32 patients) and for spontaneous avascular necrosis of the medial femoral condyle (10 knees in 10 patients). Using the endpoint of revision for any cause, the outcome for every knee was established. Ten knees have been revised (20.8%). At ten years there were 21.5 knees still at risk and the cumulative survival rate was 77.7% (95% CI : 56.8 to 90.2). Our study reveals a higher failure rate than previous reports on this prosthesis. The technique of implantation of the Oxford knee is demanding ; the learning curve is thus long and could explain, at least partially, our moderate results.

Keywords : Oxford unicompartmental knee arthroplasty ; osteoarthritis ; osteonecrosis ; knee prosthesis ; mobile bearing.

INTRODUCTION

The Oxford meniscal-bearing knee prosthesis was introduced in 1978 by Goodfellow and O'Connor (*7*). Initially it was used as a bicompartmental implant. Since 1982 the designers of the prosthesis have used the prosthesis for unicompartmental arthroplasty. They reported in 1988 the outcome of the first 103 consecutive cases (*8*). The absence of the anterior cruciate ligament was associated with a significantly greater incidence of failure. The criteria for selection of patients were subsequently better defined, and the designers of the prosthesis could demonstrate very good long-term results (*15*). We report an independent 10-year survival analysis of the Oxford II meniscal-bearing knee prosthesis.

PATIENTS AND METHODS

Between July 1992 and February 1999 fifty-two Oxford meniscal knee prostheses were consecutively implanted in 46 patients at our institution. Forty-eight knees (42 patients) were included in the study : 38 knees (32 patients) with primary medial osteoarthritis and 10 knees (10 patients) with spontaneous avascular necrosis (AVN) of the medial femoral condyle. The study group consisted of 33 women (37 knees) and 9 men (11 knees). The average age of the patients at the time of operation was 69.2 years (range : 57-82). All prostheses were implanted on the medial side. Six patients had a one-stage bilateral UKA.

■ Philippe Zermatten, MD, Orthopaedic Surgeon.
■ Urs Munzinger, MD, Orthopaedic Surgeon.
Correspondence : P. Zermatten, Department of Surgery, Division of Orthopaedic Surgery and Traumatology, Centre Hospitalier du Centre du Valais, Av. Gd Champsec 80, 1950 Sion, Switzerland.
E-mail : philippe.zermatten@hopitalvs.ch

No benefits or funds were received in support of this study

Thirty-eight knees included in the study had primary osteoarthritis of the medial compartment of the knee (Ahlbäck's radiological grades 2 or 3 (*1*)) with full-thickness preservation of articular cartilage in the lateral compartment as seen on preoperative radiographs. Fibrillation of the cartilage of the lateral compartment, observed at operation, and even focal erosions, if limited to the medial margin of the lateral femoral condyle, were not considered to be contraindications. The state of the patellofemoral compartment was not used as a criterion for selection and no patients was rejected because of patellofemoral degeneration. All knees had a functionally intact anterior cruciate ligament. Patients with fixed flexion of more than 15° were excluded. Varus deformity was not a contraindication unless it did not correct passively. Age and weight did not influence selection. Four knees (4 patients) were excluded from the study : three because an Oxford phase III prosthesis had been implanted and one because of the location of the osteoarthritis (lateral compartment). Although osteonecrosis of the medial femoral condyle was not considered as an indication at that time by the designers of the Oxford hemiprosthesis, 10 such cases were included in the study.

All operations were carried out by three experienced surgeons, most of them by one (UM). For all knees included in the study, the medial compartment was replaced by the Oxford II meniscal knee prosthesis (Biomet Ltd, Bridgend, UK). Perioperatively a single dose of cefuroxime (Zinacef®) was given. In all cases the surgery was performed with a tourniquet either under general or regional anaesthesia. A midline or medial skin incision was used. A medial parapatellar arthrotomy with division of the vastus medialis muscle and eversion of the patella was used. All three compartments were inspected. According to intraoperative findings the opportunity to convert to a total knee arthroplasty (TKA) was discussed. We could however perform a UKA in all knees. During insertion care was taken to closely match the flexion and extension gap, as prescribed by the designers of the implant. The femoral and tibial components were both cemented. The thickest meniscal bearing providing a mechanical axis as close as possible to the clinically evaluated neutral alignment was used. Partial synovectomy was performed in 5 knees. No notch plasty was performed. Continuous passive motion was started on the first postoperative day. Partial weightbearing was prescribed for 6 weeks. Perioperatively and during this period low molecular-weight heparin (Fraxiparine®) was administered.

The patients were reviewed as a rule at 1, 3, 5 and 10 years postoperatively ; those who had not reached the 10 years at the time of the review were contacted and questioned about the status of their operated knee. At review, 6 patients had died (7 knees), 9 patients (10 knees) had been revised, one patient (2 knees) who reached the 10-years at the review time was lost to follow-up after 8 years.

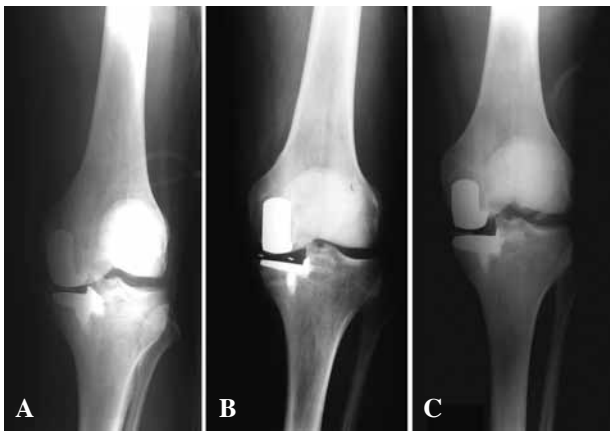

Fig. 1. — Radiographs of a left Oxford II UKA. A : Postoperative anteroposterior (AP) view, B : AP view showing a meniscal bearing (size 1) dislocation at 2 weeks postoperative, C : Post revision AP view showing a correct position of the inlay (size 4).

Using revision of the prosthesis for any cause as the endpoint, a life table was constructed according to Rothman's method and the 1-year to 11-year survival rates were determined ; 95% confidence intervals (CI) were calculated by means of the equation of Rothman (*20*).

RESULTS

By the time the study was performed, revision surgery had been performed on 10 knees (9 patients) because of painful osteoarthritis of the lateral compartment in three (Fig. 1), dislocation of the bearing in one (Fig. 2), anteromedial impingement in one, aseptic loosening in one (Fig. 3), infection in one, recurrent haemarthrosis in one, arthrofibrosis in one and secondary instability in one (Table I). The ten-year cumulative survival, when there were still 21.5 knees at risk, was 78% (95% CI : 56.8 to 90.2) (Table II). The Kaplan-Meier survival curve shows a flat segment between years 3 and 8 ; the survival rate then remained unchanged (78%) up to the

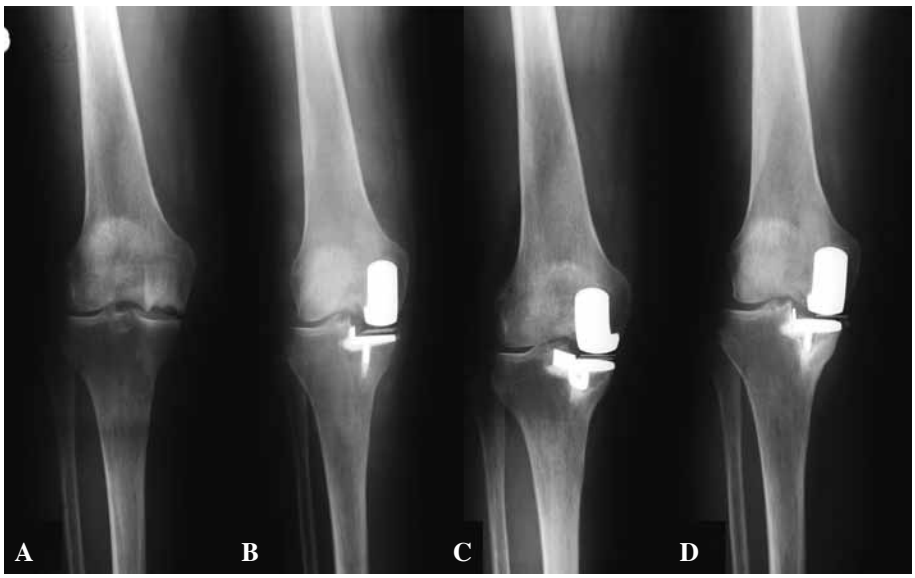

Fig. 2. — Radiographs of a right knee. A : Preoperative anteroposterior (AP) view showing osteonecrosis of the medial femoral condyle, B : Postoperative AP view following Oxford II UKA, C : AP view at 6 months postoperative, D : AP view at one year postoperative showing signs of osteolysis below the tibial plateau (aseptic loosening).

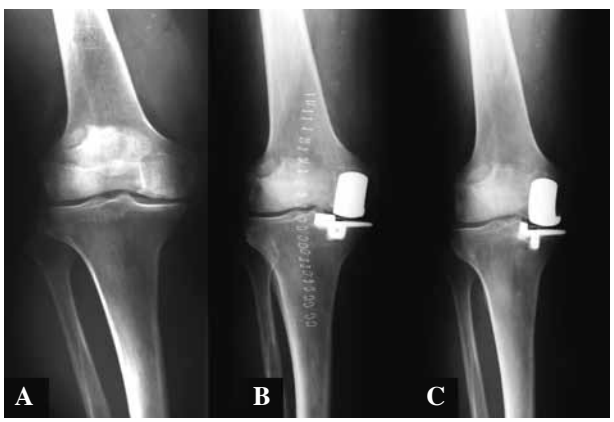

Fig. 3. — Radiographs of a right knee. A : Preoperative anteroposterior (AP) view showing signs of medial osteoarthritis and a patella bipartita, B : Postoperative AP view immediately following Oxford II unicompartmental knee arthroplasty, C : AP view showing signs of lateral osteoarthritis at 10 years follow-up.

11th year, but the confidence intervals have widened as the number at risk has decreased (Fig. 4). Comparison between the survival curves for the two subgroups showed no statistically significant difference (Fig. 5). There were three late failures attributed to lateral arthritis, with two of these in the AVN group.

DISCUSSION

The survival rate of 77.7% of our series at ten years (CI 56.8 to 90.2) is markedly different from the 97.7% (CI 92.7 to 100) reported by Murray *et al* (*15*). Our findings can be compared to the results of the designer's series because our selection criteria were identical, except that we included some cases of AVN. In fact, our results were achieved in knees with primary medial OA in 38 knees (79.2%) and spontaneous AVN of the medial femoral condyle in 10 knees (20.8%). The survival analysis showed no significant difference between the two subgroups (log-rank test, $p = 0.16$). Langdown *et al* (*11*) reported in a small series that the use of the Oxford medial UKA for spontaneous focal AVN of the knee was reliable in the short to medium term and gave results similar to those achieved in patients with primary OA.

In our series, the principal cause of failure was the progression of arthritis in the lateral compartment which occurred in 3 knees at an average of

Table I. — Details of revised Oxford II UKAs

Time to revision (yrs)	Indication for revision	Operative findings	Procedure	Outcome
0.04	Bearing dislocation	Components firmly fixed	Bearing exchange	Poor, revised to TKA*
0.6	Low grade infection	Components firmly fixed	AS, lavage, synovectomy	Poor, revised to TKA**
1.1	Aseptic loosening	Tibial plateau not firmly fixed	Revised to TKA	Good
1.25	Pain	Arthrofibrosis	Revised to TKA	Good
2.4	Instability	ACL/MCL laxity	Revised to TKA	Good
2.5	Pain	Impingement	Revised to TKA	Poor, bearing exchange*
3.5	Pain	Recurent haemarthrosis	Revised to TKA	Moderate
6	Pain	Lateral osteoarthritis	Revised to TKA*	Good
9	Pain	Lateral osteoarthritis	Revised to TKA	Good
10	Pain	Lateral osteoarthritis	Revised to TKA	Good

*performed extra muros, **in 2 stages (low grade infection), ACL = anterior cruciate ligament, AS = arthroscopy, MCL = medial collateral ligament, TKA = total knee arthroplasty.

Table II. — Survival table for 48 medial Oxford II UKAs

Year since op	Number at start	Failure*	Withdrawn°	Lost to follow-up	Number at risk **	Annual failure rate (%)	Annual success rate (%)	Survival rate (%)	95% confidence level †
1	48	2	0	0	48	4.17	95.83	95.83	86.0 to 98.8
2	46	2	0	0	46	4.35	95.65	91.67	80.1 to 96.8
3	44	2	0	0	44	4.55	95.45	87.50	74.6 to 94.3
4	42	1	1	0	41.5	2.38	97.62	85.42	71.7 to 93.1
5	40	0	0	0	40	0.00	100.00	85.42	71.4 to 93.2
6	40	0	1	0	39.5	0.00	100.00	85.42	71.3 to 93.2
7	39	1	3	0	37.5	2.56	97.44	83.23	68.3 to 91.9
8	35	0	2	2	34	0.00	100.00	83.23	67.5 to 92.2
9	33	1	5	0	30.5	3.03	96.97	80.70	63.6 to 90.9
10	**27**	**1**	**11**	**0**	**21.5**	**3.70**	**96.30**	**77.72**	**56.8 to 90.2**
11	15	0	13	0	8.5	0.00	100.00	77.72	44.3 to 93.8

*revision of the prosthesis for any cause ; °sum of patients who died or were lost to follow-up or reached the end of the trial ; **number at start minus half of the withdrawn patients ; †calculated according to Rothman's equation.

8.2 years postoperatively. These three knees had not been overcorrected into excessive valgus at the time of the original surgery, and we found no correlation, with the numbers studied, between alignment and bearing thickness. Interestingly, two of these knees belong to the AVN group. Development of arthritis in the lateral compartment after medial knee arthroplasty is usually attributed to surgical overcorrection of the original varus deformity. Cartier *et al* (*5*) reported that a slight undercorrection of varus alignment and adequate polyethylene thickness of the tibial component in UKA appear to be important contributors to a successful outcome. Weale *et al* (*24*) demonstrated that the retained articular cartilage continued to function for ten or more years after unicompartmental replacements for anteromedial OA of the knee suggesting that anteromedial OA may be considered as a focal disorder of the

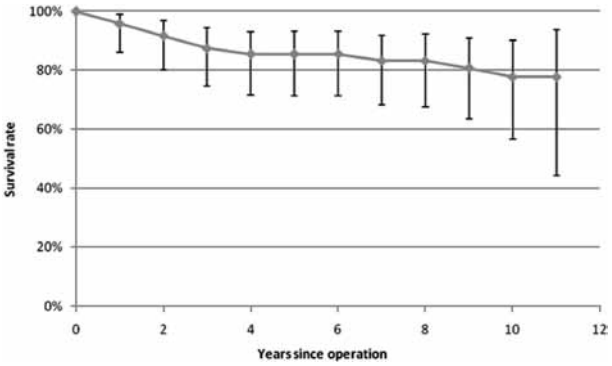

Fig. 4. — Kaplan-Meier survival curve of Oxford II UKAs

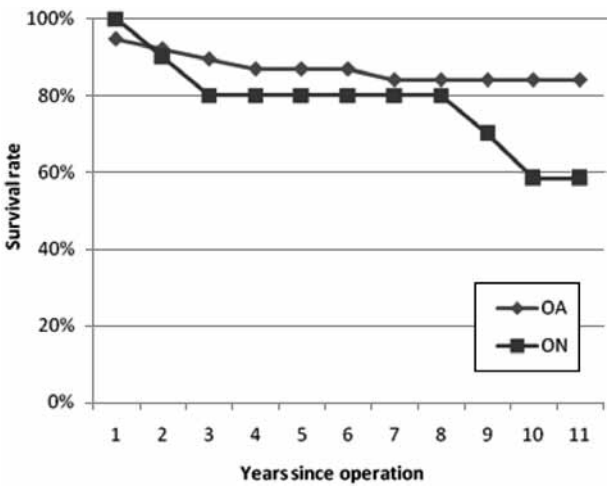

Fig. 5. — Kaplan-Meier curves of the 2 subgroups (OA : osteoarthritis, ON : osteonecrosis). Statistically there is no significant difference between the curves (log-rank test, p = 0.16).

knee. Emerson and Higgins (*6*) reported recently in a small series that progression of arthritis in the lateral compartment was the most common reason for late failure and was not related to the initial postoperative alignment. The mechanisms of failure for UKA are still poorly understood. In addition to overcorrection into valgus alignment, long term ligament degeneration, particularly of the anterior cruciate ligament (ACL), and polyethylene particulate wear debris have been mentioned as possible causes of failure for UKA. Hollinghurst *et al* (*9*) assessed the cruciate mechanism at long term after medial UKA (St Georg) using an established fluoroscopic technique and showed that the cruciate mechanism remained intact over time and the ligaments continued to function similarly to those of the normal knee. In our series, one knee failed because of ligament degeneration (ACL/MCL) 2.4 years postoperatively. With the numbers studied, we found no correlation between ligament degeneration and alignment or bearing thickness. Although the long-term failure rates of fixed-bearing UKA are generally described in the literature as high (*2,3,13,16,19*), especially because of polyethylene wear, Li *et al* (*12*) showed in a randomized study that mobile-bearing UKA had better kinematics, a lower incidence of radiolucency but not a better knee function than fixed-bearing UKA at 2 years. Polyethylene particulate wear debris continues to be implicated in the aetiology of aseptic loosening following UKA or TKA. Price *et al* (*16*) measured the *in vivo* ten-year linear wear of the Oxford UKA using a roentgenstereophotogrammetric technique and found that the mean linear wear rate was 0.02 mm/year. This may offer the device a survival advantage in the long term. In our study one knee failed because of aseptic tibial loosening about 1 year after surgery. Here, as well, we found no correlation, with the numbers studied, between loosening and bearing thickness. Moreover, Price *et al* (*17*) reported in a long-term clinical study that the survival of the medial Oxford UKA was not negatively affected by the use of thin polyethylene bearings. In our series thin meniscal bearings (size 0 in 18 knees, size 1 in 25 knees) were used in 43 knees (89.6%). Although this apparently had no consequence on the outcome of our prostheses, this could however explain the need to mobilize postoperatively five knees under anaesthesia because of an insufficient range of motion. All five knees subsequently demonstrated a good function. The other causes of failure were miscellaneous : one recurrent haemarthrosis, one antero-medial impingement, one arthrofibrosis, one bearing dislocation and one infection.

The technique of implantation of the Oxford Knee is demanding and very different from that of

other unicompartmental implants. In comparison with TKA, this technique is less forgiving. However, revision of failed Oxford UKA is easier than revision of a failed TKA. Weale *et al* (*25*) recommend UKA for younger patients in whom one could expect a TKA to fail within their lifetime. Price *et al* (*18*) showed that the Oxford UKA can achieve ten-year results comparable to TKA in patients younger than 60 years of age. Berend *et al* (*4*) even reported in a large series that obesity, young age, patellofemoral disease and anterior knee pain had no influence on the successful outcome of medial UKA using the Oxford (phase III) device. Moreover, Saldanha *et al* (*21*) reported that the complexity of operation and complications encountered in revision of a medial Oxford UKA and its early outcome compare favorably with those of TKA revision.

The number of prostheses remaining in the follow-up is an important variable determining the reliability of the data. With numbers as low as ten the possible error is in the order of 20%. The statistical comparison between the subgroups OA and AVN could be in this way distorted. In fact the number at start in the AVN group at ten years was less than 10 and the 95% confidence limits (24 to 85) demonstrate the poor reliability of the survival curve at that time. If we consider the OA group separately we obtain a survival rate of 84% (CI 61 to 94) at ten years. This result is comparable to those of other independent studies (*14,22,23*) or register data (*10*). The Kaplan-Meier curves suggest a bimodal failure pattern in the AVN group and early failures in the OA group.

Our study can not confirm the good to excellent long-term results, as usually described in the literature, of the Oxford II meniscal knee prosthesis for medial OA and spontaneous ON of the knee. The technique of implantation of the Oxford knee is demanding ; the learning curve is thus long and could explain, at least partially, our moderate results.

Acknowledgments

The authors gratefully acknowledge Mrs Eva Cantoni, Department of Econometry of the University of Geneva, for her assistance in the statistical analysis of the data.

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