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Technical aspects of revision and functional outcome after revision of the Oxford unicompartmental knee arthroplasty

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ABSTRACT

Background: This study analysed the technical aspects of revision of the Oxford unicompartmental knee arthroplasty (OUKA) and functional results after revision.
Methods: In a historic cohort study we analysed all revised OUKAs that were primarily implanted at our clinic over a 10-year period (1998–2009). The primary aim was to investigate surgical difficulties encountered during revision surgery of the OUKA. Outcomes were the knee society score (KSS), WOMAC (Western Ontario and McMaster Universities), SF-36, VAS pain and VAS satisfaction after revision.
Results: During the study period, 331 OUKAs were inserted. With an average follow-up of six years and five months (range one month to nine years and eight months), there were 44 (13.3%) OUKAs that needed one or more revision surgery procedures. The average time to revision was three years and eight months (range one month to nine years and five months). The main reasons for revision surgery were bearing dislocation, malpositioning or loosening of a component and progression of osteoarthritis. Most revisions, mainly conversion to primary total knee arthroplasty (TKA), gave few surgical problems. Minor bone loss that needed no augmentation was seen most frequently. The functional outcomes after revision surgery were moderate.
Conclusion: A limited amount of surgical difficulty during revision of OUKA was found; in all total revision cases a primary TKA was implanted. However, in most patients there were moderate functional results as well as disappointing pain and satisfaction scores after revision.

1. Introduction

Selected patients with unicompartmental osteoarthritis (OA) of the knee can be treated with the Oxford unilateral knee arthroplasty (OUKA; Biomet, Warsaw Ind.) [1]. The OUKA is a unicompartmental knee arthroplasty with a mobile bearing [2]. The potential positive aspects of this type of arthroplasty are less bone resection than a total knee arthroplasty (TKA) and preservation of knee kinematics by retaining the cruciate ligaments; these result in faster recovery and better function [2].

The literature presents contradictory results, varying from a 10-year survival rate of 74.7% reported by Mercier et al., to a 10-year survival of 98% in the inventor group of Murray et al. [2–17]. There is a discrepancy in survival rates between studies published at high-volume centres and studies published by general orthopaedic clinics [18,19]. It is important to realise that the implantation of an OUKA is a technically demanding procedure with strict indications, and this might be the primary cause for the high failure rate described in the literature. According to the inventor group, the main reasons for revision are loosening of the prosthesis seen on radiographic imaging and pain [2]. In addition, it is generally assumed that revision of an OUKA is relatively easy, which results in a lower threshold to perform revision surgery [18]. In the literature, the most common causes for revision are progressive OA, aseptic loosening and bearing dislocation [11,12,14,15]. Recently there has been an enhanced interest in problems during OUKA revision surgery [20–22].

The goal of this historic cohort study of patients with medial OA for which an OUKA was implanted is to conduct an analysis of the technical aspects of OUKA revision surgery. This includes the type of revision and functional results after revision expressed in patient-related outcome measures (PROMs).

2. Materials and methods

We reviewed the operation notes of all patients ($N = 331$) who received an OUKA at our teaching hospital between November 1998 and December 2009. During primary surgery, the lateral compartment was routinely checked for OA and, when present, a conversion to a total knee prosthesis was performed. Patients who had a revision after the primary surgery were selected. A revision was defined as any surgical

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procedure that resulted in the exchange or removal of any of the prosthetic components. The average follow-up of the primary OUKA group was six years (range one to 12 years).

The primary outcome was the technical aspect of the revision with possible technical difficulties. Bony defects encountered during revision surgery were graded as large or small; defects needing partial bone or cement augmentation were graded as large. The anterior cruciate ligament (ACL) was not routinely tested during revision surgery and its function could therefore not be analysed at the time of surgery. Secondary outcomes were patient-reported outcome measurements. During review in the outpatient clinic, the knee society score (KSS), which consists of outcome and functional score, Western Ontario and McMaster Universities (WOMAC), Short Form (SF-36), Visual Analogue Scale (VAS) pain and VAS satisfaction were obtained for a minimum of one year follow-up. The study was approved by the medical ethics committee of our hospital.

All statistical analyses were performed using SPSS version 21 (IBM Corp., Armonk, NY, USA). Median and averages of outcomes were calculated as well as confidence intervals and standard deviations. For secondary outcomes, the KSS was analysed for KSS function only. The Spearman rho coefficient was used to correlate between secondary outcomes such as KSS, KSS function, WOMAC, SF-36 mental health and physical health, VAS satisfaction and pain. The correlation was calculated for revision from an OUKA to a TKA after excluding revisions from an OUKA to another OUKA.

3. Results

In our clinic, a large teaching hospital, 331 OUKAs were implanted between 1998 and 2008 by seven different orthopaedic surgeons. Patient age at the time of primary surgery was 64 years ± 8.34 (mean ± standard deviation (SD)). Female–male ratio was 2:1. One or more revisions were seen in 44 OUKAs (44 patients). Average time to revision was three years and eight months (range one month to nine years five months). The 10-year survival was 86.7%. The causes for revision are listed in Table 1. The major causes for revision in our cohort were bearing dislocation (22%), progressive OA (22%) and loosening of one of the components (tibia 20%, femur two percent). In 12% of the revisions, pain was the only reason for revision. No cases were revised because of infection. There were 47 revisions performed in 44 knees (Table 2). Most revisions consisted of conversion to a TKA (77%). Only primary TKAs with no augmentation or stems were used. Eight bearing revisions (16%) and three tibial or femoral component revisions (six percent) were performed. One patient underwent a bearing revision three times and one patient was revised to a TKA after an earlier bearing revision. Several perioperative findings were noted (Table 3). The majority of problems noticed were small bone defects without a need for augmentation (25%). Another regular finding was insufficiency of the posterior cruciate ligament, needing a posterior stabilised (PS) TKA (19%).

There were 34 patients available for assessment of secondary outcome measures. Five patients had died, two patients were excluded because they had a revision at another hospital, one patient refused to participate and two patients could not be located. Mean follow-up time in months after revision was 69 ± 34.14 (mean ± SD) with a range of 20–140. The outcomes of the PROMs are stated in Table 4. Correction for revision to a TKA and excluding revision from OUKA to OUKA resulted in a mild negatively significant correlation between VAS pain and age at revision ($r = -0.395$, $P = 0.031$). No correlation exists between gender or SF-36 mental health or any of the other mentioned scores.

Table 1
Reason for revision (50 problems in 47 revisions).

Bearing dislocation	11 (22%)
Progressive osteoarthritis	11 (22%)
Loosening of tibial component	10 (20%)
Pain without identifiable cause	6 (12%)
Malpositioning of tibial component	5 (10%)
Malpositioning of femoral component	2 (4%)
Recurrent haemarthrosis	2 (4%)
Loosening of femoral component	1 (2%)
Tibial fracture	1 (2%)
Overcorrection of knee alignment	1 (2%)

Table 2
Type of revision.

Revision to TKA	36 (77%)
Bearing change	8 (17%)
Revision of tibial component	2 (4%)
Revision of femoral component	1 (2%)

TKA, total knee arthroplasty.

Table 3
Perioperative findings during revision surgery.

Small bony defect of tibia/femur	12
Rupture of PCL	9
Large bony defect of tibia	3
Tibial plateau fracture	1
Metallosis	1
Impingement	1
Non-described	20

PCL, posterior cruciate ligament.

4. Discussion

According to the inventor group, the main reason for revision of the OUKA is supposed to be loosening seen on radiographic imaging and pain. As a primary outcome, we analysed the number of surgical difficulties encountered during revision surgery. There is no clear definition or classification of what constitutes a technical difficulty. We considered the need for augmentation or a revision prosthesis to be correlated with technical difficulty. The need for a constrained type of prosthesis and preoperative fracture are indicators for perioperative difficulty.

There was a 78% revision rate to primary TKA, 17% bearing change and six percent component revision. Partial revision has been described as an option if one component has loosened and another is well-affixed [11,23].

Because there were no large bone defects, all the revisions were to a primary TKA. No augmentation or stems were needed. This was probably due to the OUKA design, which allowed bone-sparing resection during primary implantation. During implantation of the OUKA we attempted to perform the bone resection as conservatively as the knee and prosthesis allowed, possibly resulting in no need for augmentation. Another possible explanation is the follow-up of the knee replacements. In case of suspected tibial loosening, the knees were followed radiologically to prevent extensive bone loss from developing. There were no cases of infection either, which could have resulted in bone loss. We

Table 4
Patient-related outcome measures after revision.

	Range (worst to best)	Mean (SD)	Median
Combined KSS	0–200	129 (42.7)	125
WOMAC	0–100	34 (20.8)	37
SF-36 (ph)	0–100	37 (10.5)	38
SF-36 (mh)	0–100	49 (10.4)	49
VAS (s)	10–0	4.2 (2.51)	5
VAS (p)	10–0	4.0 (2.59)	5

SF-36 (ph) = physical health, SF-36 (mh) = mental health, VAS (s) = satisfaction, VAS (p) = pain. KSS, knee society score; SF-36, Short Form; VAS, Visual Analogue Scale; WOMAC, Western Ontario and McMaster Universities.

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