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Original Article

Survival analysis and functional outcome of the Oxford unicompartmental knee replacement up to 11 years follow up at a District General Hospital

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ABSTRACT

Background: There have been several large originator studies reporting excellent results with this prosthesis but far fewer large independent studies. We present, to our knowledge, the largest independent series documenting excellent survivorship rates and good functional outcomes at a mean follow up of 5.5 years post implantation of the Oxford unicompartmental knee replacement.

Methods: Our prospective study looks at the survivorship and the functional outcome of 364 Oxford UKRs performed in a district general hospital at a mean follow up of 5.5 years (range 5–11 years).

Post operatively knees were assessed in a research clinic using the Oxford knees score (as well as the American Knee Society Score and the Hospital for Special Surgery Score). Maximal flexion was also measured.

Results: There were 26 revisions of 364 knees giving a survivorship, with revision as the end point, of 93% at a mean of 5.5 years post op (range 5–11 years).

We achieved an Oxford score of 37.5, a mean AKSS of 161 (divided as American knee functional score 75.75/American knee objective score 85.4 (excellent)). The mean HSS score was 84.5. We achieved 'Excellent' Oxford knee scores in 137 knees (48%), 'Good' in 75 (26%), 'Moderate' in 51 (17%) and 'Poor' in only 27 (9%) of knees.

Mean improvement in functional scores were: Oxford score (14.4), AKSS (71) and HSS (26.3). Mean maximal flexion was 123° range (110–140).

Conclusions: We have confirmed that good medium to long-term function and survival can be obtained following Oxford medial knee replacement for treating anteromedial osteoarthritis, in our large independent series.

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1. Introduction

The congruent mobile bearing Oxford partial knee replacement was designed for the treatment of anteromedial osteoarthritis with fully correctable varus deformity and fixed flexion of less than 15°. ¹ Since its introduction in 1982 there have been impressive survivorship studies both from originator and non originator data, with rates of 94–100% at 10 years, and 95% at 14 years and 90% at 15 years. ^{2–7} There are fewer studies describing the functional outcomes of this prosthesis. ^{8–10}

Improved range of motion is a factor considered to relate to better functional scores in unicompartmental knee replacement when compared to Total knee replacements, this is supported by work from Laurencin ¹¹ and Amin. ¹² The American Knee Society Score has been used to assess outcome in knees post operatively, this score takes into account limb alignment and down scores those with varus malalignment. This is important in total knee arthroplasty as it has been shown that those with varus malalignment post operatively do poorly, ^{13–16} however this has not been demonstrated to be the case with unicompartmental knees. ¹⁷

The Oxford knee score has been more recently used to measure the functional outcomes in knees, however there are few studies publishing these scores post unicompartmental arthroplasty.

The aim of our study was to determine the medium term functional outcomes and survivorship of the Oxford unicompartmental knee replacement performed in a district general hospital. We have studied 364 knees, over a period of 5–11 years post implantation, looking at their functional scores, their range of motion, and survivorship.

2. Patients and methods

This was a prospective study in which the period of data collection and patient recruitment was from November 1999 to November 2011. All patients were scored preoperatively using the Oxford knee score. We analysed data from patients who's knees had been implanted for at least 5 years. Using this

criteria we identified 364 Oxford partial knee replacements that had been implanted at a mean of 5.5 years previously (range 5–11 years), in our District General Hospital.

The Arthroplasties were performed over an 11-year period by the three senior authors, a staff grade surgeon and several training registrars. Each knee was assessed in a research clinic by an independent assessor (research physiotherapist).

2.1. Pt selection (inclusion/exclusion criteria)

All patients requiring arthroplasty for painful knee arthritis were considered for our study. Only those with isolated anteromedial osteoarthritis, fixed flexion deformities $\leq 10^\circ$, an intact ACL, and fully correctable varus deformities were included in our study group. Those with symptomatic patellofemoral joint osteoarthritis were excluded (and underwent TKR). Those included in the study were consecutive patients.

Patients were followed up at yearly intervals post surgery and at each visit were scored using the American Knee Society (AKSS), Oxford Knee (OKS) and Hospital for Special Surgery (HSS) scores to assess functional outcomes. Range of motion was assessed using a goniometer and recorded for each knee. Results were collated on an excel spread sheet. The data from the patients' most recent follow up is used (i.e. the longest time since surgery); average scores were calculated for each group of patients at their latest follow up. A summary of our results are displayed in [Table 1](#).

3. Results

During the study period there were 51 patients lost to follow up (14%) and 55 patients had died (15%). In these patients we determined the state of the implant from hospital and general practitioner records and established that no further surgical procedure had been carried out. Scores from their latest follow up were included.

Mean age at implantation was 69 years (46–90 years). 196 were female (54%) and 168 were male (44%)

The majority were implanted via a minimally invasive approach – 297 (81.5%) and the remaining 67 (19.5%) through a medial parapatellar approach with patella eversion.

Table 1 – Summary of data recorded from 364 knees at upto 11 years post op.

Mean age – 69 Total knees 364 Mean Fu – 5.5 years LTF 51/364 = 14% RIP – 55/364 = 15% Revisions 26/364 = 7%									
Years	No of patient	Fixed flexion	Free flexion	Range	AKSS knee	AKSS func	AKSS total	HSS	OKS (new)
11	5	0	132	0–132	86	87	153	87	37
10	34	1	120	1–120	87	73	159	84	37
9	20	3	123	3–123	84	72	156	84	37
8	14	1	126	1–126	85	78	163	87	39
7	54	2	127	2–127	86	81	167	87	39
6	49	1	125	1–125	82	75	157	85	34
5	62	2	122	2–122	90	83	173	86	38
Mean	364	1.407738095	120.75		85.41666667	75.75	159.3333333	84.5	37.41666667

There were 26 revisions overall performed during the study giving a revision rate of 7% and thus, using revision as an end point, a survivorship rate of 93% at a mean of 5.5 years. There was one revision from the standard approach group (5/67, 7.5%), and twenty one from the minimally invasive group (21/297, 7.1%).

We achieved a mean Oxford score of 37.5, a mean AKSS of 161 (divided as American knee functional score 75.75/American knee objective score 85.4 (excellent)). The mean HSS score was 84.5. These results are displayed in Table 1.

According to the criteria in the 'Oxford Knee Scoring' system. We achieved 'Excellent' Oxford knee scores in 182 knees (50%), 'Good' in 91 (25%), 'Moderate' in 53 (15%) and 'Poor' in only 37 (10%) of knees (see Fig. 1).

We separated out the 'Oxford knee scores' for minimally invasive and standard approaches, scores. Average Oxford knee score for the minimally invasive group was 36, and 37.5 for the standard approach. Minimally invasive knee scores were as follows: excellent 153 (51%), good 74 (23%), moderate 53 (17%), poor 31 (9%) see Fig. 2. Standard approach knee scores were as follows: excellent 29 (45%), good 17 (27%), moderate 12 (18.5%), poor 6 (9.5%) see Fig. 3. We found no statistically significant difference in Oxford scores when comparing minimally invasive and medial parapatellar approaches ($p = 0.645$, General Linear Model, Univariate analysis) and no significant difference between approach and OKS over the follow up period ($p = 0.142$, General Linear Model, Univariate analysis).

We found statistically significant differences between pre op and post op Oxford scores at every stage post op ($p < 0.001$; mean difference range: -13.8 to -16.84 ; ANOVA, Games-Howell Post-Hoc Test). Fig. 4 demonstrates this.

Kaplan–Meier survivorship (Fig. 5) demonstrates 87.9% survivorship at 11 years (CI 82.53–93.27%).

Mean maximal flexion was 123° range (110–140) (Table 1).

We had four major complications in our series (which did not require revision of the knees): one patient sustained a pulmonary embolism; one knee was washed out for suspected infection however no organisms were grown; and two underwent manipulations under anaesthesia for post operative stiffness.

3.1. Revisions

There were twenty-six revisions in our cohort. No revisions required any augmentation or increased constraint—a

Fig. 2 – Oxford scores in 'minimally invasive' group.

primary 'AGC Cruciate retaining Arthroplasty' was the revision implant utilised in eight cases and a primary 'Stryker Cruciate retaining Scorpio' in the remaining one.

Revision to AGC Cruciate retaining TKR was performed for a number of reasons. Fourteen knees were revised because of progression of symptomatic arthritis, lateral compartmental in nine cases and a combination of lateral and patellofemoral in the remaining five. Six knees were revised for aseptic loosening – four with a loose tibial component and two with loose femoral component. Four knees were revised for dislocated bearings: two were undersized and one was following trauma, and the other for which no obvious cause could be ascertained. Two were revised for unexplained medial pain.

4. Discussion

4.1. Survivorship

We found that our overall survival rate (93% at a mean of 5.5 years follow up of 364 knees) was comparable with other studies. Using Kaplan–Meier survivorship our data reveals 87.9% survivorship at 11 years (CI 82.53–93.27%) see Fig. 5.

Originator data gives excellent survivorship for this prosthesis: Pandit et al described survival rates of 97.3% at 7 year follow up in 688 knees.¹⁸ Carr et al showed a 99% survivorship in 121 knees at a slightly shorter follow up of 3.8 years.¹⁹ Goodfellow, the design surgeon, reported survivorship rates of 91% at a maximum of 5 years in the 103 knees that they

Fig. 1 – Oxford scores in all knees regardless of approach.

Fig. 3 – Oxford scores in the standard approach group.

Fig. 4 – Mean Oxford knee score for the knees pre op and post op. $P < 0.01$ at every stage post op.

implanted, although it is worth noting that 27 of those implanted were lateral unicompartmental knees.²⁰ Murray et al reported 98% survival at mean 7.6 years follow up in 143 knees.² Price et al reported 91% survival at maximum 10 years in 52 patients under the age of 60, and 96% survivorship in those over 60 ($n = 512$).²¹ Price also quoted rates of 93.1% 15 year survival in 439 knees with mean age at implantation of 70 years.²² Pandit et al recently reported the largest study of

Oxford partial knee outcomes over mean period of 5.6 years (range 1–11 years) implanted via a minimally invasive approach – they demonstrated survivorship rates of 96% (CI: 92.5–97.5) with a mean Oxford score of 41.3.²³

Independent series have also published good results, although these were either based on much smaller samples or followed up for shorter periods than in our study. Luscombe et al reported survival of 95% in 78 knees at 2 years.²⁴

Fig. 5 – Kaplan–Meier survivorship graph for the knees.

Unfortunately, as the length of follow up increases the sample sizes are much smaller: Vorlat et al documented 93% survival of 41 knees at 5 years post op.²⁵ Kort et al reported 96% survivorship in 46 knees at max follow up of 6 years.²⁶ Emerson et al published survival rates of 93% at 10 years in 50 knees.²⁷ Keys et al reported an impressive 100% survival rate at 10 years in 40 knees,³ unfortunately there was no information on the functional outcome in these patients. Langdown et al also showed 100% survival of the Oxford partial knee replacement at 10 years in 29 knees when implanted for osteonecrosis.²⁸ Verdonk et al published survivorship rates lower than ours (86%) in 97 knees at a mean follow up of 6.8 years. There is one outstanding independent study, Svard et al⁵ publishing survival rates of 95% at 10 years in 121 knees, although unfortunately these knees were not assessed functionally.

4.2. Functional outcomes

We also found that our functional outcomes, in the form of Oxford knee scores (average OKS 36.4), were comparable with other studies.^{18,19,24,28} Carr et al achieved excellent Oxford scores of 40.1 on average, in 121 patients – however this was in a smaller cohort after mean follow up of 3.8 years.¹⁹ Langdown et al reported good average OKS of 38 at a mean follow up of 5 years, this was in a total of 29 patients.²⁸ Luscombe et al reported good average Oxford scores of 38.3 in 78 patients with a 2 year follow up.²⁴ Although these studies had slightly higher Oxford scores on average at follow up they were either followed up for shorter periods or consisted of smaller sample sizes than ours. Pandit et al reported mean Oxford scores of 39 and 41.3,^{18,23} other than the fact that these results are from a specialist centre, it is noteworthy that all were performed through a minimally invasive approach.

Based on level 1 evidence (RCTs) it has been shown that minimally invasive approaches used for TKR yield better short term results (<1 year post op) than standard approaches however after 1 year the results are comparable.^{29,30} However, several authors support the use of minimally invasive techniques for implantation of UKR, with low revision rates and good functional outcomes in the short term^{31,32} – only one study warned of poor outcomes unless proper instrumentation and training was utilised for such approaches.³³

The majority of our knees (81.5%) were implanted via minimally invasive techniques and produced excellent results comparable to, although not statistically significantly better than, those implanted with standard approaches.

Analysing all knees implanted over a period of 11 years, regardless of approach, we achieved 'Excellent' or 'Good' Oxford knee scores in 273 (75%) of knees, 'Moderate' in 53 (15%) and 'Poor' in only 37 (10%) of knees. These figures are comparable with other authors.^{9,10} With regards to the AKSS our scores, although excellent, were slightly lower than the current published data. Our mean AKSS of 161 (functional 75.5/knee 85.4) this compares well with Rajasekhar's study in which 135 knees were followed up for a mean of 5.8 years achieving AKSS of 168.4 (function 76.2/knee 92.2).⁴ Kort and Emerson reported AKSS of 90.5 and 92 (knee only) respectively however their studies included less than 50 patients each.^{26,27} The small numbers in these studies may have some bearing on their results.

Our study, as far as we are aware, is the largest independent series documenting excellent survivorship rates and good functional outcomes at a mean follow up of 5.5 years post implantation of the Oxford unicompartmental knee replacement. The main limitation to our study was there were almost 7% lost to follow up. The study demonstrated no significant difference between the Oxford scores of minimally invasive knees versus standard approaches. However, we found better early rehabilitation, time to discharge and patient satisfaction with the minimally invasive approach therefore this became the default technique hence the higher proportion of minimally invasive approaches in our study.

We have confirmed that good, medium to long-term results can be obtained following the Oxford partial knee replacement in a district general hospital setting, where the surgery has been performed by surgeons of various experience. The Oxford meniscal bearing arthroplasty offers long term relief from pain with good knee function in the treatment of anteromedial osteoarthritis of the knee with appropriate selection of patients and good surgical technique. We also confirm that using a minimally invasive approach to perform Oxford partial knee replacement produces equally as good functional outcomes and survivorship as compared to a medial parapatellar approach with patella eversion. Our results justify the use of unicompartmental surgery for isolated medial compartmental osteoarthritis of the knee.

Conflicts of interest

All authors have none to declare.

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