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Does activity affect the outcome of the Oxford unicompartmental knee replacement?

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ABSTRACT

Background: High levels of activity are considered to be a contraindication to unicompartmental knee replacement (UKR) and are not recommended after UKR. To determine if these recommendations should apply to the mobile-bearing Oxford UKR, this study assessed the effect of post-operative activity level on the outcome of this device.
Methods: The outcome of the first 1000 Phase 3 cemented Oxford UKRs implanted between 1998 and 2010 was assessed using survival analysis, the Oxford Knee Score (OKS) and the American Knee Society Objective (KSS-O) and Functional (KSS-F) Scores. Patients were grouped according to the maximum post-operative Tegner Activity Score.
Results: The mean follow-up was 6.1 years (range 1 to 14). Overall, increasing activity was associated with superior survival ($p = 0.025$). In the high activity group, with Tegner ≥ 5 ($n = 115$) 2.6% were revised and the 12-year survival was 97.3% (confidence interval (CI): 92.0% to 99.1%). In the low activity group, with Tegner ≤ 4, ($n = 885$) 4.3% were revised and the 12-year survival was 94.0% (CI: 91.4 to 95.8). The difference between the two groups was not significant ($p = 0.44$). Although the final OKS and KSS-F were significantly better in the high activity group compared to the low activity group (OKS 45v40, KSS-F 95v78), there was no difference in the change in OKS or KSS-O.
Conclusions: High activity does not compromise the outcome of the Oxford UKR and may improve it. Activity should not be restricted nor considered to be a contraindication.

1. Introduction

Unicompartmental Knee Replacement (UKR) is a less invasive alternative to total knee replacement in patients with appropriate indications [1,2]. As it tends to provide more normal kinematics and better function it is often favoured in more active patients [3,4]. However, the use of UKR in patients with high activity levels remains controversial. High activity has traditionally been regarded as a contraindication to UKR and following UKR patients are generally advised to avoid high levels of activity. The main reason for this is the high revision rates due to wear and loosening that would be expected [5–10].

The Oxford UKR (Biomet, Bridgend, UK) was designed to minimise wear and loosening by having a fully congruent mobile bearing. A 20-year wear study of the Phase 2 Oxford using Radio-Stereophotogrammetric Analysis (RSA) found extremely low wear (mean 0.4 mm, max 0.6 mm), therefore activity may not be a major issue with this device [11]. The outcome of the first 1000 Phase 3 Oxford UKRs implanted using a minimally invasive surgical approach has been previously reported, with a 10-year survival rate of 96% [12]. The aim of this study was to determine the relationship between post-operative activity level and outcome in this cohort of 1000 UKRs. Greater clarity on this issue would allow improvements in patient selection for UKR, and a greater understanding of the level of post-operative activity that is safe and achievable following UKR.

2. Materials and methods

Between June 1998 and March 2010, a consecutive series of 1000 Phase 3 Oxford UKRs were implanted using a minimally invasive surgical approach by two surgeons (DWM, CAFD) for anteromedial osteoarthritis (OA) or spontaneous osteonecrosis of the knee with indications as recommended by the Oxford group [13,14]. Baseline demographic and intra-operative details were recorded including intra-operative findings and component sizes. Patients were clinically assessed before surgery and at one, five, seven, 10, and 12 years following surgery

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Table 1
Patients grouped according to maximum Tegner score achieved post-operatively. For each group, the number of knees in that group, mean patient age, mean patient BMI and median bearing thickness used at the time of initial procedure are displayed.

Maximum Tegner Score	Number of knees	Age/years (mean, SD)	BMI (mean, SD)	Bearing thickness (median)
0 to 1	40	70.7 (11.8)	27.7 (4.9)	4
2	164	71.4 (10.0)	28.9 (6.1)	4
3	518	67.0 (9.0)	28.8 (5.3)	4
4	163	62.8 (8.6)	29.0 (4.5)	4
5	49	61.2 (6.6)	28.3 (3.3)	4
>6	66	61.3 (9.3)	27.1 (3.8)	4

using the Tegner Activity Scale (TAS), the objective and functional subscales of the Knee Society Score (KSS-O and KSS-F) and the Oxford Knee Score (OKS) [15–18]. The clinical assessment measures which included examination findings were completed by an independent physiotherapist at the time of patient follow-up. If patients did not attend the follow-up assessments for social or geographical reasons they were sent postal questionnaires (TAS, KSS-F, OKS). If the patients did not return the questionnaires, they were contacted by telephone and the relevant clinical information was obtained. For patients who had died, information was gathered from hospital notes, general practitioners' records and relatives to establish whether the patient had undergone any further surgery on the knee.

Activity level was measured using the TAS. Patients were compared on the basis of TAS (patients with TAS of 0 or 1 were grouped together, as were those with a TAS ≥ 6, as few patients recorded these scores), and by groupings corresponding to low (TAS ≤ 4) and high activity levels (TAS ≥ 5). The post-operative groupings were made on the basis of the highest TAS achieved at any time point after surgery. The outcomes used in the analysis (OKS, KSS-O and KSS-F) were those recorded at the time of last follow-up and are expressed as absolute and change (i.e., post minus pre) scores.

Outcomes of interest were patient-reported outcome and implant survival. For normally distributed data, one way analysis of variance (one way ANOVA) and ANOVA for a trend were performed to determine if the outcome changed with Tegner score. A significance level of $p < 0.05$ was used throughout. Survival was calculated where a failure was defined as any operation in which a component was changed, a new component was added or a bearing dislocation had occurred. Survival analysis was undertaken using life tables and Kaplan–Meier analysis, with survival rates being compared using Cox regression. Survival rates were quoted when there were at least 20 knees at risk in both high and low activity cohorts. Statistical analyses were performed using Stata IC (v.12.1, Stata corp., College Station, TX).

3. Results

A total of 1000 medial UKRs were performed in 818 patients. There were 636 unilateral and 182 bilateral procedures, of which 22 were simultaneous and 160 were staged. The mean age at the time of operation was 66 years (range: 32 to 88 years). 425 (52%) were women and 393 (48%) were men. The procedure was undertaken in 977 knees for primary anteromedial OA and for medial spontaneous osteonecrosis in 23 (20 femoral, 3 tibial). Four knees were lost to follow-up in the first year. The outcome of the remaining 996 (99.6%) was known. The mean follow-up time was 6.1 years (range 1 to 14) with 620 knees having been followed-up for at least five years.

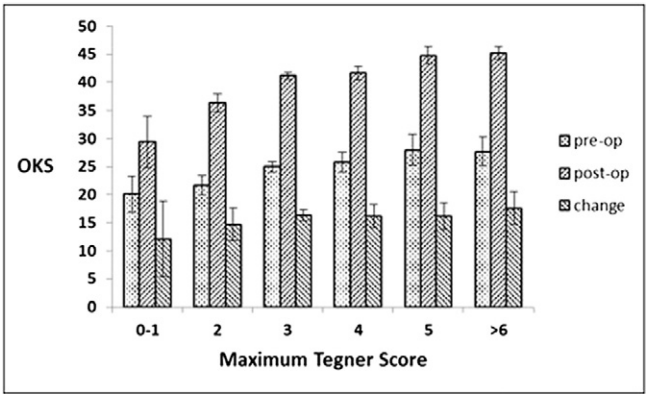

Fig. 1. Bar chart showing pre-operative OKS, OKS at the time of last review and change in OKS for various Tegner groups. Error bars represent 95% confidence intervals.

Overall UKR survival at 12 years was 94.4% (95% CI: 92.1 to 96.0%, 157 at risk). There were 41 revisions: 17 for progression of osteoarthritis in the lateral compartment, seven for infection, six for bearing dislocation, six for pain, three for component loosening and one for avascular necrosis of the lateral femoral condyle. In one case the reason for revision was unknown as the revision was performed outside the UK.

Pre-operative demographic and operative details are given in Table 1. The mean outcome scores (pre-operative OKS and OKS, KSS-O and KSS-F achieved at last follow-up) for each group are summarised in Table 2 and displayed graphically in Fig. 1 (OKS) and Fig. 2 (KSS). There were 885 knees in the low activity group (Tegner ≤ 4) and 115 (11.5%) in the high activity group (Tegner ≥ 5). The mean scores in these groups are shown in Table 3.

Increasing TAS was associated with increased survival, with an increase in one point on the Tegner score being associated with around 30% fewer revisions compared to the previous group (hazard ratio (HR) for revision was 0.71 per one unit increase in Tegner score, 95% CI 0.52 to 0.96, $p = 0.025$, Table 2). The final post-operative OKS showed a significant trend ($p < 0.01$) with increasing activity being associated with increasing OKS. However, patients with higher activity also had higher pre-operative OKS and change scores demonstrated no significant difference between groups ($p = 0.34$). There was no significant difference between groups in the KSS-O ($p = 0.72$) but a significant trend was found in the post-operative KSS-F ($p < 0.01$), with increasing activity being associated with increasing score.

There were 38 revisions (4.3%) in the low activity group (Tegner ≤ 4) compared to 3 revisions (2.6%) in the high activity group (Tegner ≥ 5).

Table 2
Clinical outcome (mean, SD) pre-operatively and at the time of last review according to maximum Tegner score achieved (OKS = Oxford Knee Score, KSS-O = American Knee Society Score-Objective, KSS-F = American Knee Society Score-Functional).

Maximum post-operative Tegner Score	Mean increase in Tegner score (max postop–preop score)	Number of revisions	Pre-operative OKS	Post-operative scores (at last follow-up)			12-year survival [95% confidence interval]
				OKS	KSS-O	KSS-F	
0 to 1	0 (0.0)	5	20.1 (7.5)	29.4 (13.2)	78.0 (29.6)	47.6 (28.5)	86.4 [65.9 to 95.0]
2	0.4 (0.05)	8	21.7 (8.5)	36.3 (9.5)	84.6 (15.5)	64.2 (26.4)	90.1 [78.8 to 95.6]
3	0.83 (0.04)	20	25.0 (8.6)	41.1 (7.1)	83.2 (13.6)	80.3 (19.0)	94.9 [91.7 to 96.9]
4	1.31 (0.10)	5	25.8 (8.9)	41.6 (7.9)	82.5 (15.3)	88.2 (15.7)	96.0 [90.4 to 98.3]
5	1.88 (0.14)	1	28.0 (7.6)	44.8 (5.5)	78.4 (22.0)	93.2 (12.9)	98.0 [86.4 to 99.7]
≥6	2.80 (0.18)	2	27.7 (9.1)	45.1 (4.7)	85.0 (9.1)	95.7 (8.1)	96.9 [88.2 to 99.2]