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Unicompartmental knee replacement: Does the macroscopic status of the anterior cruciate ligament affect outcome?

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ABSTRACT

Purpose: ACL damage is associated with progression of arthritis and whilst in the population undergoing joint replacement in the majority of cases the ACL is intact there is a wide spectrum of ACL disease. This study investigated whether the macroscopic status of the ACL affected functional outcome or survival following UKR.
Methods: The macroscopic status of the ACL was recorded in 820 cemented Oxford UKRs implanted by two surgeons for the recommended indications. The ACL was considered functionally normal in the setting of anteromedial tibial wear and macroscopically the ACL visually appeared normal or had synovial damage or longitudinal splits. The patients were followed up independently with a mean follow-up of 10.3 years (range 5.3 to 16.6).
Results: More marked ACL macroscopic damage was significantly associated with increasing age, male gender and a more extensive anteromedial tibial defect. Patients with more ACL damage had a significantly lower preoperative AKSS Objective Score, however no difference in AKSS-Functional or OKS was detected between groups. At 10 years no difference in functional outcome or activity level was found between groups. Compared to those with a macroscopically normal ACL at 10 years a significantly greater improvement from baseline OKS score was seen in patients with macroscopic ACL abnormalities. At 15 years no difference in implant survival, or failure mechanism, was detected between groups.
Conclusion: The macroscopic status of the ACL does not affect long term functional outcomes or implant survival and in the setting of an intact ACL macroscopic status is not a contraindication to mobile bearing UKR.
Level of evidence: Level IV.

1. Introduction

In patients with moderate to severe osteoarthritis who fail non-operative management unicompartmental knee replacement (UKR) is a clinical and cost effective treatment [11,30]. UKR provides significant functional benefits over total knee replacement (TKR), including increased range of movement, preserved knee kinematics and preserved proprioception [9,22,21]. These benefits have, in part, been attributed to the fact that UKR is minimally invasive retaining the native structures of the joint, including the knee ligaments, in particular the anterior cruciate ligament (ACL).

In the native knee the intact ACL plays a pivotal role in knee kinematics and is important for femoral rollback, the screw-home mechanism and normal gait [14]. In addition the mechanoreceptors within the ACL play a key role in proprioception, loss of which is associated with poor knee function [23]. ACL degeneration is strongly associated with osteoarthritis and a correlation exists between radiological grade of osteoarthritis and degree of degeneration of the ACL [15].

The ACL has been reported to be intact in up to two thirds of patients undergoing TKR (range 25% to 68%) and it is known that the macroscopic status of the ACL is associated with the pathoanatomy of knee arthritis within the joint, with progressive ACL damage associated with an increasing size of anteromedial tibial defect [7,25].

A functional ACL is a requirement for mobile bearing UKR. When mobile bearing UKR is used in ACL deficient knees a significantly higher failure rate, predominantly due to tibial loosening, is observed compared to ACL intact knees or ACL deficient knees treated with simultaneous or sequential ACL reconstruction and UKR [12]. In addition where mobile bearing UKR is performed in ACL deficient knees this is associated with abnormal knee kinematics and bearing movement [19].

Whilst a functionally intact ACL is a requirement for mobile bearing UKR, not all patients have a macroscopically normal ACL. Furthermore it is known that even in a macroscopically normal ACL high levels of histological abnormalities exist. The outcome of UKR in these patients who have macroscopic abnormalities in the ACL is unknown. As a significant number of patients presenting with anteromedial arthritis have an abnormal, yet intact, ACL it is important to establish whether it is safe to perform a UKR in these cases. This study investigated the relationship between the macroscopic status of the ACL and the

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pathoanatomy of arthritis within the knee and the effect of the macroscopic ACL status on the 10 year functional outcomes and 15 year implant survival in a consecutive series of patients treated with medial mobile bearing UKR.

2. Patients and methods

The macroscopic status of the ACL was recorded in the first 1000 consecutive cemented Phase 3 Oxford medial UKRs performed via a minimally invasive approach by two designer surgeons (DWM & CAFD). UKR were performed for the recommended indications as described by Goodfellow et al. [5]. Details of the cohort have been published previously [17,18]. The ACL was considered functionally normal if it was present and not friable and fragmented. If there was doubt about its integrity it was assessed at the time of operation with a ligament hook. The ligament hook, held between the surgeon's thumb and index finger, was passed posterior to the ACL and drawn in the anterior direction with a firm force applied. The ACL was considered intact where it resisted the anterior force provided by the ligament hook [4].

Patients were assessed and followed up independently. Assessments were performed pre-operatively and at one, five, seven, 10, 12 and 15 years post operatively by a senior physiotherapist. At the time of surgery a detailed intra-operative record of the status of each of the compartments within the knee was made. The macroscopic status of the ACL was classified as, normal, or having synovial damage or longitudinal splits [4]. Data on the ACL status was available in 820 knees. The size and depth of anteromedial tibial defect as defined previously was measured and classified as focal (≤2 cm^2) full thickness cartilage loss (FTCL), extensive (>2 cm^2) FTCL, bone loss ≤5 mm or bone loss >5 mm [24]. Functional outcomes were assessed using the Oxford Knee Score (OKS), American Knee Society Score Objective (AKSS-O), and Functional (AKSS-F), and the Tegner Activity Score [8,16,27]. As, unlike TKR, the Oxford UKR aims to restore native alignment and not achieve neutral alignment. The AKSS-O was also calculated without performing deductions for alignment [6].

All patients were contacted in the previous 18 months to ascertain the current functional status of their knee and incidence of re-operations. Where patients had died information about the status of their knee, and the presence of further operations was obtained via primary and secondary care records as well as via patient's relatives where appropriate. Data was extracted from our prospective database on 1st September 2014.

3. Statistical methods

A power calculation was performed using the minimally clinically important difference reported for OKS [3]. Using the Altman nomogram for a power of 80% at a significance level of 0.05 and using a standard deviation of 8, a sample size of 80 patients is required to detect a clinically important difference between groups [29].

To detect differences in survival between groups a Mantel–Cox test was performed for implant-related re-operations, which included any re-operations in which components were changed, in which the meniscal bearings were replaced for dislocation, and any re-operations in which new components were inserted. Life-table analysis was performed and confidence intervals (CI) were calculated using the method described by Peto et al. [20]. All analyses were performed using SPSS Version 20 (IBM Corporation, Armonk, New York). Statistical significance was set at $p < 0.05$.

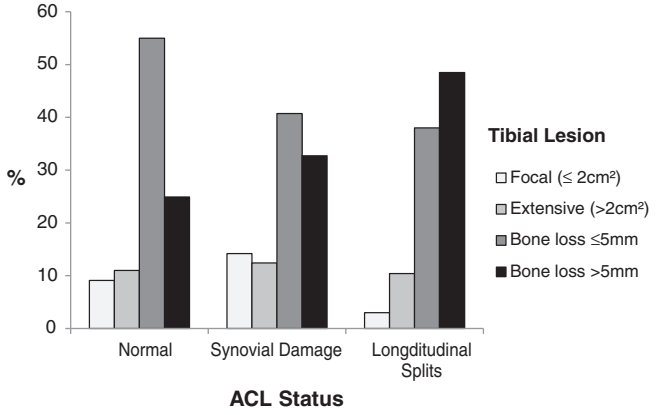

Fig. 1. Anteromedial tibial lesion size by macroscopic status of ACL.

4. Results

Of the 820 cases where the status of the ACL was recorded, 540 were unilateral procedures and 140 bilateral. In 565 cases the ACL was normal, in 116 cases it had synovial damage and in 139 cases it had longitudinal splits. Baseline demographics are outlined in Table 1. Those patients with longitudinal splits were significantly older and had lower pre-operative AKSS-O scores than those patients with normal ACL.

The size of the anteromedial tibia medial defect increased as the degree of macroscopic damage to the ACL increased ($p < 0.01$). In patients with a macroscopically normal ACL a tibial defect involving bone loss of >5 mm was observed in 25% of cases compared to in almost 50% of cases in those patients with longitudinal splits to the ACL (Fig. 1).

All patients were followed up for a minimum of five years with the exception of those who were lost to follow-up (four), died (31), underwent revision (15) or withdrew from the study due to poor health (five). Of those patients who withdrew from the study at any time point, all due to medical co-morbidities not associated with their knee, we are not aware of any revisions. The mean follow-up was 10.4 years (range 5.3 to 16.6) with 460 knees having a minimum 10 year follow-up and 54 knees a minimum 15 year follow-up.

The mean OKS by year following UKR for each of the three groups is displayed in Fig. 2. At 10 years there was no significant difference in OKS scores between groups ($p = 0.94$) with an overall mean score of 40 (SD9) and 79% of knees having good or excellent outcomes [10].

Table 1
Baseline demographics.

	Normal (565)	Synovial damage (116)	Longitudinal splits (139)	$p=$
Age (SD)	66.1 (9.7)	67.1 (9.3)	69.1 (9.2)	0.004[a]
% Male	48.0 ($n = 271$)	54.3 ($n = 63$)	62.6 ($n = 87$)	0.007
OKS (SD)	24.5 (8.8)	23.3 (9.0)	26.5 (8.6)	0.053
AKSS-Objective (SD)	51.3 (19.2)	48.5 (17.8)	45.0 (16.2)	0.025
AKSS-Functional (SD)	69.6 (18.3)	66.3 (14.7)	69.0 (18.4)	0.192
Tegner Score (SD)	2.3 (1.1)	2.3 (1.5)	2.4 (1.2)	0.487

[a] Bonferroni post hoc test revealing that there are significant differences in age between those patients with a normal ACL and those with longitudinal splits.

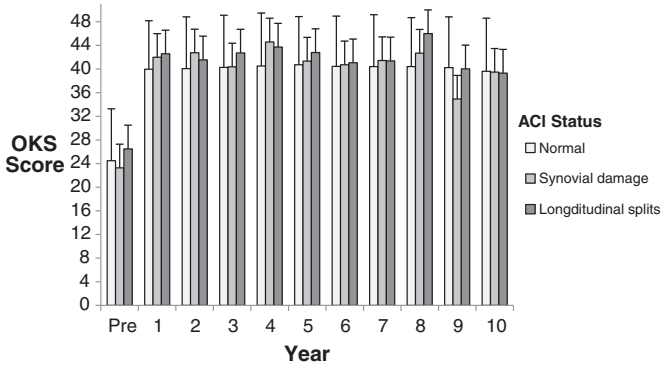

Fig. 2. Mean Oxford Knee Score by year following surgery (SD).