Does Anterior Cruciate Ligament Deficiency Preclude Unicompartmental Knee Replacement?

1Boissonneault, A; 2Pandit, H; 3Pegg, E; 4Jenkins, C; 5Dodd, CA; 6Gibbons, CLMH; 7Gill, HS; 8Murray, DW
hemant.pandit@ndoms.ox.ac.uk

INTRODUCTION:
The Oxford Knee is a unicompartmental knee replacement (UKR) that mimics the natural mechanics of the native knee by use of a 3-component design: a fully congruent, unconstrained mobile bearing, a spherical femoral component, and a flat tibial component. The design relies on the integrity of soft tissues, muscles, and ligaments for constraints. An absent or damaged anterior cruciate ligament (ACL) has been shown to upset this dynamic stability, and studies have reported a significantly higher incidence of failure for Oxford UKRs implanted in ACL-deficient (ACLD) knees. In the only published series of medial Oxford UKRs in ACLD knees there were 28 cases, of which six failed before two years. The most common cause of failure was aseptic tibial component loosening. Since this original series, the designer surgeons have traditionally used the implant in treatment of end-stage medial compartment osteoarthritis (OA) for knees with a functionally intact ACL.

Anteromedial osteoarthritis is a pathological condition specific to ACL-intact knees where the site of cartilage and bone erosion remains centred anteriorly on the tibial plateau. This confined lesion spares the cartilage on the posterior tibial plateau, and allows for correction of the varus angular deformity during flexion of the knee. This contrasts with the pattern of wear seen in patients presenting with primary OA and secondary rupture of the ACL. When the ACL becomes severely damaged or ruptures, posterior subluxation of the femur on the tibia extends the erosion posteriorly. Current literature suggests the destruction of this posterior cartilage produces a fixed varus deformity, leading to shortening of the medial collateral ligament and degeneration of the lateral compartment.

ACL deficiency is considered to be a contraindication for UKR because of the reported incidence of high failure rate (21.4% at two years). Subsequent studies outlining the progression of OA in ACLD knees have proposed additional evidence for why ACL deficient patients should not be considered for UKR. However, due to the perceived advantages of UKR over total knee replacement (TKR) – increased mobility, better restoration of natural biomechanics, reduced morbidity and shorter hospital stay – we have performed UKR in ACLD knees in selected cases over the past ten years, mostly at the request of the patient. The primary aim of this study was to establish the implant survival and clinical outcome of this cohort; the secondary aim was to compare this data with a matched cohort of ACL intact patients who have undergone Oxford UKR for anteromedial OA.

METHODS:
This study reports on 42 consecutive patients with ACL deficiency and concomitant symptomatic medial compartment osteoarthritis that were treated with Oxford UKR under the care of two surgeons between January 2001 and June 2011. Patients were categorized as ACL deficient and included in this study only if intra-operative examination determined the ACL was not functionally intact – either friable/fragmented or completely absent (ACLD group). All patients were followed prospectively by independent physiotherapists in a dedicated research clinic.

Each patient in the ACLD group was matched for age, gender and follow-up time with a patient who had undergone Oxford UKR for end-stage osteoarthritis with an intact ACL (ACLI group). This provided a baseline against which clinical scores and radiological assessment could be compared. The instruments for clinical assessment were the Oxford Knee Score (OKS), a validated patient questionnaire (0 = worst outcome, 48 = best outcome), the American Knee Society Score (both objective and functional), and the Tegner Activity Score.

Pre-operative lateral radiographs were analyzed to determine the site and extent of tibial cartilage and bone erosions. Post-operative radiographs at the time of last follow-up were assessed for progression of osteoarthritis into the lateral compartment and for evidence of implant loosening (subsidence and/or presence of radiolucency). If a radiolucency was identified, it was assessed to confirm whether it was physiological or pathological.

PASW statistical software (version 18) was used to analyse survivorship via KMPLOT: Kaplan-Meier estimation of the survival function.

RESULTS SECTION:
There were 46 medial Oxford UKRs implanted in 42 consecutive ACLD patients (4 bilateral, 32 men and 10 women). The mean age at operation was 65 years (45 to 81). There were 33 knees classified as friable/fragmented and 13 knees as absent. The mean follow-up time was 4.5 years (0.4 to 10.6) for the ACLD group and 4.4 years (2.2 to 7.5) for the ACLI group.

Clinical assessment: The ACLD group had a significantly lower pre-operative objective American Knee Society Score than the ACLI group (p = 0.001); there was no significant difference in other pre-operative clinical scores. There was no significant difference in any of the clinical scores at 1- or 5-year follow-up between the two groups. At 5-year follow-up, the ACLD group had a mean OKS of 43 (29 to 48, SD = 5) and the ACLI group had a mean OKS of 40 (20 to 48, SD = 10).

Patients with an absent ACL had an average pre-operative OKS of 25 (18 to 33, SD = 6) and 1-year follow-up OKS of 41 (25 to 48, SD = 6). Whether patients had friable/fragmented, absent or normal ACLs, there was no significant difference between pre-operative OKS scores, 1-year follow-up OKS scores, or 5-year follow-up OKS scores.

Radiological assessment: Analysis of pre-operative lateral radiographs revealed the tibial plateau defects in ACLD knees were all central and posterior. This confirms the patients in the ACLD group had typical clinical presentations associated with ACL deficiency, and were not special cases with anteriorly contained lesions.

No patient in either group had evidence of component subsidence or pathological loosening and there was no significant difference (p = 0.371) in the presence of physiological radiolucencies.

Complications: There was one patient in the ACLD group (friable/fragmented) who developed lateral compartment arthritis and subsequently underwent revision to a TKR. The failure rate of 2.2% for the ACLD group in this study is significantly less (p = 0.003) than the 21.4% reported in the original series of medial Oxford UKRs.

No patient in the ACLI group had a significant complication.

DISCUSSION:
The 10-year survival rate for medial Oxford UKRs in ACLD knees was 96% (95% CI 89 to 100) and there was no significant difference (p = 0.269) between survival rates for the two groups in this study. Where the most common method of failure in the original series was aseptic tibial loosening, the only revision in this study was due to lateral compartment arthritis. In this case, the tibial component was found to be soundly fixed at the time of revision surgery. The successful outcome among ACLD patients is not limited to implant survival, but extends to patient satisfaction, as shown by clinical assessments.

It is difficult to explain why the results from this current series differ significantly from previously published work. It might be that evolution of surgical instruments and technique have made the Phase 3 Oxford procedure more forgiving than the Phase 1 procedure performed in the original series. The procedure for the Phase 3 Oxford implant differs from the Phase 1 in that it allows ligament tensions in flexion and extension to be balanced intra-operatively. A more accurate restoration of native muscle-tendon length may allow the hamstrings to function more optimally in stabilizing the tibia from subluxing anteriorly during heel strike.

This study is limited in that it only provides short and mid-term data for ACL deficient patients. Future data will be necessary to assess longer-term survival rates.

SIGNIFICANCE:
As life expectancy continues to improve, there is a growing middle-aged and elderly population that are diagnosed with end-stage osteoarthritis but want to remain active. This study suggests Oxford UKR may present a new surgical treatment option for those among this population with concomitant ACL deficiency.