Mid-term Outcomes of the Fixed Bearing Lateral Oxford Unicompartmental Knee Replacement

Lachlan W. Arthur[1], Cathy Jenkins[2], Christopher A.F. Dodd[2], Andrew J Price[1,2], William F.M. Jackson[2], Nicholas Bottomley[2], Abtin Alvand[1,2], and David W. Murray[1, 2]

[1] Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences (NDORMS), University of Oxford, Oxford, UK
[2] Nuffield Orthopaedic Centre, Oxford University Hospitals NHS Foundation Trust, Oxford, UK

Corresponding author

Name: Lachlan Arthur

Institutional Address: Oxford Orthopaedic Engineering Centre, Botnar Institute for Musculoskeletal Sciences, Old Rd, Headington, Oxford OX3 7LD, United Kingdom

Phone: +44 7479422877

Email: Lachlan.arthur@ndorms.ox.ac.uk

Declarations:

Conflict of interest

The author or one or more of the authors have received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this article. In addition, benefits have been or will be directed to a research fund, foundation, educational institution, or other non-profit organisation with which one or more of the authors are associated.

Funding

This work was supported by funding from Zimmer Biomet via the University of Oxford (ORTHO.CR.GK10.12).

Ethical approval

Ethical approval was sought from the local research ethics committee chair (Oxfordshire Ethics Committee C) with formal approval deemed unnecessary under the National Health Service research governance arrangements.

Acknowledgements

The authors would like to thank Jo Brown and Barbara Marks for their assistance with the study. Lachlan Arthur would like to thank the Rhodes Trust for funding his research work.

Authors' contributions

LWA – Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing
CJ – Conceptualization, Data curation, Project administration, Writing – review & editing
CAFD – Data curation, Investigation, Writing – review & editing
AJP – Data curation, Investigation, Writing – review & editing
WFMJ – Data curation, Investigation, Writing – review & editing
NB – Data curation, Investigation, Writing – review & editing
AA – Data curation, Investigation, Writing – review & editing
DWM – Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – review & editing

Mid-term Outcomes of the Fixed Bearing Lateral Oxford Unicompartmental Knee Replacement

Abstract:

Aims: Lateral unicompartmental knee replacement (UKR) accounts for about 1% of all knee replacements and has had mixed clinical results. The aim was to determine the medium-term results for the Fixed Lateral Oxford UKR (FLO).

Methods: This study reports the clinical results and survival for 305 consecutive FLOs implanted between 2015 and 2022, with minimum 1-year follow-up. 93% of knees satisfied the recommended indications. The mean follow-up was 4.3 years (SD 1.9), and maximum was 8 years. The mean age was 70.8 (SD 11) and mean BMI was 28.4 (SD 5.4). The right side was operated on in 65% of cases and 72% of patients were female. Isolated lateral compartment osteoarthritis was the indication for 98% of operations. The Oxford Knee Score (OKS) was recorded pre- and post-operatively to assess the FLOs clinical effectiveness. The revision status of all knees was known.

Results: 2 FLOs were converted to primary TKRs, 2 had the addition of a medial UKR for medial compartment disease, and there were 3 other reoperations**.** At last clinical follow-up the mean OKS was 41, a mean increase of 20 points from pre-operative OKS. At 7 years the survival rate for any re-operation (including revision) was 96% (95%CI 91-100), for revision was 98% (95%CI 94-100) and for revision to primary TKR was 99% (95%CI 96-100). No revisions required revision TKR components. When knees outside the recommended indications were excluded, there was only 1 revision, an addition of a medial UKR for osteoarthritis progression, resulting in a 7-year survival for revision was 99.2% (95%CI 94-100).

Conclusions: This study presents the largest published cohort of fixed bearing lateral UKR. The good clinical outcomes and medium-term survival of the FLO, particularly if the recommended indications are used, suggest it is an excellent alternative to TKR for the treatment of isolated lateral compartment disease.

Abbreviations:

Body Mass Index (BMI) 95% Confidence Interval (CI), Fixed Lateral Oxford (FLO), Oxford Domed Lateral (ODL), Oxford Knee Score (OKS) Total Knee Replacement (TKR), Unicompartmental Knee Replacement (UKR)

Keywords:

Unicompartmental Knee Replacement, Unicompartmental Knee Arthroplasty, Fixed Bearing, Lateral, Fixed Lateral Oxford Unicompartmental Knee Replacement

Introduction:

Approximately 10% of patients with severe knee osteoarthritis have disease isolated to the lateral compartment of the knee, compared to up to 50% of patients who have disease isolated to the medial compartment[1-4]. When joint-preserving treatments for isolated lateral compartment osteoarthritis fail, surgical treatment options include total knee replacement (TKR) or lateral unicompartmental knee replacement (UKR). UKR has several benefits over TKR including a lower risk of post-operative complications, faster recovery, a smaller incision, less pain, less blood loss, and being more cost-effective[5-7]. Despite these benefits, overall UKR usage remains at approximately 10% of all knee replacements globally[8,9] and lateral UKR usage is about 1%. Underuse of UKRs is attributed to higher revision rates than TKR in registries and the technical difficulty of the procedure[3,6,8].

The Oxford UKR, with spherical femoral components, flat tibial components and fully congruent mobile bearings, was introduced to minimise polyethylene wear and to allow thin bearings to be used with minimal bone resection[10]. The device has achieved excellent results when used in the medial compartment[11,12]. However, on the lateral side bearing dislocation has been a problem as in flexion the ligaments are lax allowing the joint to distract[13-16]. The Oxford Domed Lateral (ODL) tibial implant was designed to reduced bearing dislocation rates by using a more anatomically shaped domed tibial component with a biconcave mobile bearing that increased entrapment. Although the ODL did reduce dislocation rate, the dislocation rate remains high (2-6%)[14,16-18]. The domed tibia was found to restore more normal kinematics and roll back than a flat tibial component.

In 2014 the Fixed Lateral Oxford UKR (FLO) was approved[19]. The ODL and FLO tibial components can be used interchangeably so if during trialling of an ODL there is concern about bearing instability a FLO can be implanted. The same surgical technique is used for both procedures. The components are implanted anatomically, and the normal ligament tension and leg alignment is restored in full extension which restores the normal ligament laxity in flexion. The short-term results of the FLO are good with 100% survival at 4-years and a mean Oxford Knee Scores (OKS) of 41 reported in a cohort of 130 FLOs[20]. As a result, the FLO is being used more commonly than the ODL. However, due to potential concerns related to wear, with the incongruent articulation and extensive roll back, it is important for the FLO to have longer follow up. The aim of this study was to determine the medium-term survival and clinical effectiveness of the FLO.

Methods:

This study prospectively collected data on consecutive patients who underwent a primary FLO (Biomet Orthopedics, Warsaw, USA, Bridgend, UK) at 2 centres between 2015 and 2022. The data was retrospectively reviewed for patients with a minimum 1 year follow up. Primary bi-compartmental UKRs were excluded. 1 patient was lost to clinical follow-up, but we could confirm the implant had not been revised from the National Joint Registry, so they were included in survival analysis. In total, 305 FLOs in 279 patients were included (Table 1).

The operations were performed by 6 experienced consultant surgeons who routinely perform UKR procedures. The recommended indications for the procedure are primary osteoarthritis or avascular necrosis in the lateral compartment of the knee. With osteoarthritis there should be bone-on-bone laterally, full thickness cartilage in the medial compartment, functionally intact anterior cruciate (ACL) and collateral ligaments, and a correctable intra-articular valgus deformity[21]. Severe wear of the patellofemoral joint with bone loss and grooving was considered a contra-indication. In some cases, the indications were extended to include knees with a non-functional ACL or previous lateral tibial plateau fracture.

All procedures were performed according to the manufacturer's surgical technique[19]. In almost all cases a torniquet was used. A minimally invasive approach with a lateral para-patellar incision was used. No ligament releases were undertaken. In most patients, a trans-patellar tendon vertical tibial cut was used to orientate the vertical cut directed towards the Anterior Superior Iliac Spine to internally rotate the tibial component. In some patients the vertical resection was made without incising the patellar tendon. The femoral components were positioned anatomically. The appropriate bearing thickness was selected to ensure that the lateral collateral ligament was just tight in extension. All tibial components were fixed with bone cement. Cemented twin-peg femoral components were used in 42% of patients while all other patients had cementless femoral components. Patients were allowed to fully weight bear post-operatively.

Patient records were reviewed for demographics, operative report details (indications, intraoperative complications, component sizes), body mass index (BMI), pre-operative clinical scores. Patients were contacted to determine if they had had a complication or revision and to determine their final Oxford Knee Score (OKS).

Statistical Analysis

Statistical analysis was performed using GraphPad Prism (version 10.0.2 for Windows, GraphPad Software, Boston, Massachusetts USA). Mann Whitney U tests were used to compare non-

parametric pre- and post-operative scores and Chi-squared tests were used to compare categorial scores. A p-value <0.05 was considered statistically significant.

Survival analysis was performed using the life table method with the endpoints being “reoperation”, “revision”, “revision to TKR” and “revision to revision TKR”. The Peto method was used to calculate 95% confidence intervals (CI) for cumulative survival[22]. Cumulative survival was calculated for all knees and only those knees operated on within the recommended indications. “Revision” was defined as any reoperation where a new component was added, or any component was removed or changed. “Re-operation” included revisions. The clinical outcome was assessed with the latest Oxford Knee Score (OKS). The Kalairajah classification of OKS was used to classify scores into excellent (> 41), good (34–41), fair (27–33), and poor (< 27) categories[23].

Ethical approval

Ethical approval was sought from the local research ethics committee chair (Oxfordshire Ethics Committee C) with formal approval deemed unnecessary under the National Health Service research governance arrangements.

Results:

305 knees in 279 patients were followed up for a minimum of 1 year with a mean follow-up of 4.3 years (SD 1.9, range 1.0-8.0), including 110 patients with a minimum of 5 years follow-up. The mean age at operation was 70.8 (SD 11) and mean BMI was 28.4 (SD 5.4). The right side was operated on in 65% of cases and 72% of patients were female (Table 1). Isolated lateral compartment knee osteoarthritis was the indication for 98% (n=298) of patients, with avascular necrosis (n=4), and post-traumatic osteoarthritis (n=3) accounting for the indications of the remaining operations. 23 knees (8%) were operated on outside the recommended indications: 18 with non-functional ACLs, 3 with previous lateral tibial plateau fractures, 1 with a previous distal femoral osteotomy, and 1 with full thickness cartilage loss in the medial compartment. 17 patients died following the surgery at a mean time of 3.3 years post operation. 1 patient died 13 days after the operation from an unknown cause.

No intraoperative complications were recorded and no patients required a blood transfusion. There were 3 knees with post-operative complications not requiring further surgery. A patient had a superficial wound infection that was successfully treated with oral antibiotics. Another had ongoing pain had a steroid injection 1 year post-operatively. 1 patient had recurrent pain and swelling which was successfully treated with ultrasound-guided injection of corticosteroid and local anaesthetic 1.5 years post-operatively.

There were 3 reoperations that were not classified as revision (Table 3). 1 patient had a post-operative deep wound infection that was successfully treated with washout, debridement, and antibiotics with retention of implants 18 days after the initial operation. There were 2 knee arthroscopies with medial meniscectomies at 1.3 and 3 years postoperatively.

There were 4 revisions, but 2 did not require conversion to TKR (Table 3)9. They were both for medial compartment osteoarthritis. Both were successfully treated by addition of a medial UKR at 0.8 and 4.9 years postoperatively. The 2 revisions that required a TKR were straight forward conversions to a primary TKR. The first was revised 7 months postoperatively due to intermittent posterior subluxation of the femoral component off the tibial component. The other revision was performed at another centre 5.5 years after the initial operation for progressive arthritis in an ACL deficient patient.

The mean pre-operative OKS was 21.0 (SD 8.7, n=106), which improved significantly ($p<0.0001$) to 40.9 (SD 7.8, n=270) postoperatively, at a mean follow-up of 4.3 years (SD 1.9). Of the 270 knees with post-operative OKS recorded, 59% were categorised as an excellent outcome, 26% a good outcome, 9% a fair outcome, and 6% a poor outcome. This was significantly better ($p<0.0001$) than the pre-operative OKS for which 73% of knees were categorised as poor (Table 2).

At 7 years the cumulative survival when the endpoint was re-operation (including revision) was 96.4% (CI 91.3-100), when the endpoint was revision it was 97.5% (CI 94.2-100), when the endpoint was revision with a primary TKR was 98.6% (CI 95.3-100) and when the endpoint was revision with revision TKR components it was 100% (Tables 4, Figure 1).

Out of the 23 knees that did not satisfy the recommended indications there were 3 (13%) revisions, 2 for medial osteoarthritis and 1 for instability. Therefore, following the 283 knees (93%) implanted for the recommended indications there were 3 re-operations and only 1 revision. In this group the 7-year cumulative survival was 98.5% (CI 91.7-100) for the endpoint of re-operation, 99.2% (CI 94.2-100) when the endpoint was revision, and 100% when the endpoint was revision to TKR (Table 5, Figure 1).

Discussion:

The series of patients presented in this study is largest cohort of fixed bearing lateral UKRs published to date that we are aware of. The finding that 85% of patients had an excellent or good OKS and that the 7-year cumulative revision rate was 2% demonstrates that the FLO is a good treatment option for patients with isolated lateral compartment knee osteoarthritis.

The mean post-operative OKS recorded at last clinical review, a mean of 4.3 years after the operation, was 41. An OKS of 41 is considered a very good outcome, bordering on excellent, and corresponded to a mean increase of 20 points from the pre-operative OKS. This is a slightly larger increase in OKS than what has been achieved with the Oxford UKR for treatment of medial disease at 5 years (mean ΔOKS 17)[12]. This was primarily because the pre-operative OKS was higher prior to medial OUKR (pre-operative OKS=25.1), suggesting that the FLO was used for more severe disease. The clinical outcome of lateral UKR in this study is superior to TKR, which has a mean OKS of 33 at 5 years[24]. This benefit of UKR compared to TKR for treatment of lateral compartment knee osteoarthritis is also supported by a small matched study which found lateral UKR to have a significantly higher post-operative OKS than TKR when used to treat lateral compartment disease[25].

The 7-year survival of 98% using revision as the endpoint compares well to other reports of lateral fixed bearing UKR. Given that lateral UKR accounts for less than 10% of UKR procedures, and less than 1% of all knee replacements, there are few large studies of fixed bearing lateral UKR for comparison[26]. The largest comparable study reported a 5-year survival of 99% and 10-year survival of 94% for 103 fixed bearing lateral UKRs consisting of FLO and Vanguard-M (Biomet) implants[27]. Similarly, a cohort of 101 AMC Uniglide lateral UKRs had a 5-year survival of 95.5%[28]. FLO survival also appears to be better than mobile bearing lateral UKRs, like the ODL, which has a 5-year survival of 92%[14], with the difference being primarily due to dislocation[5,13,14]. The FLO also has better survival than the lateral UKRs in the registry data, with lateral UKRs in the National Joint Registry found to have a 5-year survival of 93% with 376 implants at risk, and 87% in the Dutch Arthroplasty Register[29,30].

The 7-year survival rate for revision of 98% is similar to what would be expected following a TKR. However following TKR revisions tend to be complex requiring revision TKR components and the outcomes may be compromised, particularly if done for an established infection[31,32]. Following the FLO there were no revisions that required revision components and none for infection. 2 of the 4 revisions were straight forward conversions to primary TKR. The other 2 were insertions of medial UKR, which although technically revisions, were not a failure of the original implant. Furthermore there is good evidence that the results of bicompartmental UKRs are better than those of primary TKRs[33]. TKR often require non-revision reoperations for example for possible infection or manipulation under anaesthetic for the treatment of stiffness. As a result, the survival rate for all re-operations following the FLO is better than would be expected following TKR[34].

3 of the 4 revisions occurred in the 7% of cases that were outside the recommended indications. The knee treated with a medial UKR for medial compartment arthritis 9 months postoperatively was known to have some medial compartment arthritis at the time of the lateral UKR. The patient,

despite knowing there was an increased chance of requiring further surgery, requested a lateral UKR rather than a TKR, as they had a successful lateral UKR in their other knee. The knee that was converted to a TKR 7 months postoperatively due to intermittent painful posterior subluxation of the femoral component off the tibial component, was ACL deficient pre-operatively and had marked bone loss posteriorly on the tibiaindicative of posterior femoral subluxation. The other revision to TKR, for medial osteoarthritis 5.5 years postoperatively, was also ACL deficient. The overall revision survival for patients satisfying the recommended indications at 7 years was 99.2%, with the only revision being an addition of a medial UKR at 5 years.

The main disadvantage of a fixed bearing UKR is that the rate of linear polyethylene wear is higher than that of a fully congruent mobile bearing device[10,35,36]. Wear of the FLO has not been assessed in a clinical study, but it may be appreciable as there is a large amount of AP movement within the articulation. This wear may compromise the kinematics and in the long term may wear through the polyethylene, particularly if the polyethylene is thin. Excessive wear can also lead to osteolysis [37]. There is also evidence that the more anatomic surface shape the ODL than the flat surface of the FLO, results in more normal kinematics in high flexion with. The main disadvantage of the ODL is the risk of dislocation. However, as the FLO and ODL tibial components are implanted with the same technique and can be used interchangeably, surgeons can plan to use a mobile bearing in young, active patients, and change to a fixed if the mobile bearing can be dislocated at a trial reduction.

This study does have some limitations, notably that there is no control or comparison group. Another limitation is that pre-operative OKS scores were missing for 65% of patients. However, a sub analysis of patients that had both pre- and post-operative OKS (n=85) found that the differences between pre- and post-operative scores in this subgroup were of a similar magnitude and remained statistically significant.

Conclusion:

This large study demonstrates that the FLO achieves very good clinical outcomes with a low failure rate: At 7 years the cumulative rate for all re-operations was 3% and the cumulative revision rate was 2%. The revisions were either additions of medial UKR or primary TKR and none were complex requiring revision TKR components. In the 282 (92%) knees that satisfied the recommend indications the cumulative revision rate at 7 years was 0.8%. This study therefore suggests that the FLO is an excellent treatment for lateral compartment osteoarthritis and has seems to have better results than TKR in patients satisfying the recommended indications.

References:

1 Scott, C. E. H., Nutton, R. W. & Biant, L. C. Lateral compartment osteoarthritis of the knee. *The Bone & Joint Journal* **95-B**, 436-444 (2013). https://doi.org:doi:10.1302/0301-620X.95B4.30536

2 Stoddart, J. C., Dandridge, O., Garner, A., Cobb, J. & van Arkel, R. J. The compartmental distribution of knee osteoarthritis – a systematic review and meta-analysis. *Osteoarthritis and Cartilage* **29**, 445-455 (2021). https://doi.org:10.1016/j.joca.2020.10.011

3 Campi, S., Tibrewal, S., Cuthbert, R. & Tibrewal, S. B. Unicompartmental knee replacement - Current perspectives. *Journal of clinical orthopaedics and trauma* **9**, 17-23 (2018). https://doi.org:10.1016/j.jcot.2017.11.013

4 Buzin, S. D., Geller, J. A., Yoon, R. S. & Macaulay, W. Lateral unicompartmental knee arthroplasty: A review. *World journal of orthopedics* **12**, 197-206 (2021). https://doi.org:10.5312/wjo.v12.i4.197

5 Deng, M. *et al.* Unicondylar knee replacement versus total knee replacement for the treatment of medial knee osteoarthritis: a systematic review and meta-analysis. *Archives of orthopaedic and trauma surgery* **141**, 1361-1372 (2021). https://doi.org:10.1007/s00402-021-03790-7

6 Wilson, H. A. *et al.* Patient relevant outcomes of unicompartmental versus total knee replacement: systematic review and meta-analysis. *The British Medical Journal* **364**, l352 (2019). https://doi.org:10.1136/bmj.l352 %J BMJ

7 Willis-Owen, C. A., Brust, K., Alsop, H., Miraldo, M. & Cobb, J. P. Unicondylar knee arthroplasty in the UK National Health Service: An analysis of candidacy, outcome and cost efficacy. *The Knee* **16**, 473-478 (2009). https://doi.org:10.1016/j.knee.2009.04.006

8 Klasan, A., Parker, D. A., Lewis, P. L. & Young, S. W. Low percentage of surgeons meet the minimum recommended unicompartmental knee arthroplasty usage thresholds: Analysis of 3037 Surgeons from Three National Joint Registries. *Knee Surgery, Sports Traumatology, Arthroscopy* **30**, 958-964 (2022). https://doi.org:10.1007/s00167-021-06437-7

9 Kleeblad, L. J., Zuiderbaan, H. A., Hooper, G. J. & Pearle, A. D. Unicompartmental knee arthroplasty: state of the art. *Journal of ISAKOS* **2**, 97-107 (2017). https://doi.org:https://doi.org/10.1136/jisakos-2016-000102

10 Ghosh, P. *et al.* Low polyethylene creep and wear following mobile-bearing unicompartmental knee replacement. *Knee Surg Sports Traumatol Arthrosc* **29**, 3433-3442 (2021). https://doi.org:10.1007/s00167-020-06243-7

11 Mohammad, H. R., Strickland, L., Hamilton, T. W. & Murray, D. W. Long-term outcomes of over 8,000 medial Oxford Phase 3 Unicompartmental Knees-a systematic review. *Acta orthopaedica* **89**, 101-107 (2018). https://doi.org:10.1080/17453674.2017.1367577

12 Mohammad, H. R. *et al.* Ten-year clinical and radiographic results of 1000 cementless Oxford unicompartmental knee replacements. *Knee Surg Sports Traumatol Arthrosc* **28**, 1479-1487 (2020). https://doi.org:10.1007/s00167-019-05544-w

13 Mohammad, H. R., Matharu, G. S., Judge, A. & Murray, D. W. The Mid- to Long-Term Outcomes of the Lateral Domed Oxford Unicompartmental Knee Replacement: An Analysis From the National Joint Registry for England, Wales, Northern Ireland, and the Isle of Man. *The Journal of Arthroplasty* **36**, 107-111 (2021). https://doi.org:https://doi.org/10.1016/j.arth.2020.07.031

14 Kennedy, J. A. *et al.* Oxford domed lateral unicompartmental knee arthroplasty. *The Bone & Joint Journal* **102-B**, 1033-1040 (2020). https://doi.org:10.1302/0301-620x.102b8.Bjj-2019-1330.R2

15 Weston-Simons, J. S. *et al.* The mid-term outcomes of the Oxford Domed Lateral unicompartmental knee replacement. *The Bone & Joint Journal* **96-B**, 59-64 (2014). https://doi.org:10.1302/0301-620x.96b1.31630

16 Gunther, T. *et al.* Lateral unicompartmental arthroplasty with the Oxford meniscal knee. *Knee* **3**, 33-39 (1996).

17 Newman, S. D., Altuntas, A., Alsop, H. & Cobb, J. P. J. T. K. Up to 10 year follow-up of the Oxford Domed Lateral Partial Knee Replacement from an independent centre. *Knee* **24**, 1414-1421 (2017).

18 Walker, T. *et al.* Mid-term results of lateral unicondylar mobile bearing knee arthroplasty: a multicentre study of 363 cases. *The Bone & Joint Journal* **100**, 42-49 (2018).

19 Berend, K., Berend, M., Mauerhan, D., Dodd, C. A. F. & Murray, D. W. Oxford® Fixed Lateral Partial Knee: Biomet UK Limited. (Zimmer Biomet, 2015).

20 Asadollahi, S. *et al.* Early results of fixed-bearing unicompartmental knee replacement designed for the lateral compartment. *Journal of orthopaedic surgery and research* **17**, 146 (2022). https://doi.org:10.1186/s13018-021-02896-3

21 Goodfellow, J., O'Connor, J., Pandit, H., Dodd, C. & Murray, D. *Unicompartmental Arthroplasty with the Oxford Knee*. 2nd edn, (Goodfellow Publishers, 2015).

22 Peto, R. *et al.* Design and analysis of randomized clinical trials requiring prolonged observation of each patient. II. analysis and examples. *British journal of cancer* **35**, 1-39 (1977). https://doi.org:10.1038/bjc.1977.1

23 Kalairajah, Y., Azurza, K., Hulme, C., Molloy, S. & Drabu, K. J. Health outcome measures in the evaluation of total hip arthroplasties--a comparison between the Harris hip score and the Oxford hip score. *The Journal of Arthroplasty* **20**, 1037-1041 (2005). https://doi.org:10.1016/j.arth.2005.04.017

24 Williams, D. P. *et al.* Long-term trends in the Oxford knee score following total knee replacement. *The Bone & Joint Journal* **95-B**, 45-51 (2013). https://doi.org:doi:10.1302/0301-620X.95B1.28573

25 Tu, Y. *et al.* Does Unicompartmental Knee Replacement Offer Improved Clinical Advantages Over Total Knee Replacement in the Treatment of Isolated Lateral Osteoarthritis? A Matched Cohort Analysis From an Independent Center. *The Journal of Arthroplasty* **35**, 2016-2021 (2020). https://doi.org:https://doi.org/10.1016/j.arth.2020.03.021

26 Heyse, T. J. & Tibesku, C. O. Lateral unicompartmental knee arthroplasty: a review. *Archives of orthopaedic and trauma surgery* **130**, 1539-1548 (2010). https://doi.org:10.1007/s00402-010-1137-9

27 Hefny, M. H., Smith, N. A. & Waite, J. Cemented Lateral Unicompartmental Knee Replacement: A retrospective single centre independent series. *Journal of Orthopaedics, Trauma and Rehabilitation* **29**, 22104917221075822 (2022). https://doi.org:10.1177/22104917221075822

28 Smith, J. R. A. *et al.* Fixed bearing lateral unicompartmental knee arthroplasty—Short to midterm survivorship and knee scores for 101 prostheses. *The Knee* **21**, 843-847 (2014). https://doi.org:https://doi.org/10.1016/j.knee.2014.04.003

29 Baker, P. N. *et al.* Mid-term equivalent survival of medial and lateral unicondylar knee replacement. *The Journal of Bone and Joint Surgery. British Volume* **94-B**, 1641-1648 (2012). https://doi.org:10.1302/0301-620x.94b12.29416

30 Burger, J. A. *et al.* A Comprehensive Evaluation of Lateral Unicompartmental Knee Arthroplasty Short to Mid-Term Survivorship, and the Effect of Patient and Implant Characteristics: An Analysis of Data From the Dutch Arthroplasty Register. *The Journal of Arthroplasty* **35**, 1813-1818 (2020). https://doi.org:https://doi.org/10.1016/j.arth.2020.02.027

31 Greidanus, N. V., Peterson, R. C., Masri, B. A. & Garbuz, D. S. Quality of Life Outcomes in Revision Versus Primary Total Knee Arthroplasty. *The Journal of Arthroplasty* **26**, 615-620 (2011). https://doi.org:https://doi.org/10.1016/j.arth.2010.04.026

32 Stirling, P., Middleton, S. D., Brenkel, I. J. & Walmsley, P. J. Revision total knee arthroplasty versus primary total knee arthroplasty. *Bone & Joint Open* **1**, 29-34 (2020). https://doi.org:doi:10.1302/2633-1462.13.BJO-2019-0001.R1

33 Lazzara, J. T. *et al.* Fixed lateral unicompartmental knee replacement is a reliable treatment for lateral compartment osteoarthritis after mobile-bearing medial unicompartmental replacement. *Knee Surgery, Sports Traumatology, Arthroscopy* (2023). https://doi.org:10.1007/s00167-023-07573-y

34 Murray, D. W. *et al.* A randomised controlled trial of the clinical effectiveness and cost-effectiveness of different knee prostheses: the Knee Arthroplasty Trial (KAT). *Health Technol Assess* **18**, 1-235, vii-viii (2014). https://doi.org:10.3310/hta18190

35 Ashraf, T., Newman, J. H., Desai, V. V., Beard, D. & Nevelos, J. E. Polyethylene wear in a non-congruous unicompartmental knee replacement: a retrieval analysis. *Knee* **11**, 177-181 (2004). https://doi.org:https://doi.org/10.1016/j.knee.2004.03.004

36 Horsager, K. *et al.* Similar polyethylene wear between cemented and cementless Oxford medial UKA: a 5-year follow-up randomized controlled trial on 79 patients using radiostereometry. *Acta orthopaedica* **90**, 67-73 (2019). https://doi.org:10.1080/17453674.2018.1543757

37 Janssen, S. J., van Oost, I., Breugem, S. J. M. & van Geenen, R. C. I. A structured evaluation of the symptomatic medial Oxford unicompartmental knee arthroplasty (UKA). *EFORT Open Reviews* ***6***, 850-860 (2021). https://doi.org:10.1302/2058-5241.6.200105

Tables:

Table 1: Demographics of patients included in the study

Demographics	
Patients (knees)	279 (305)
Right:Left	197:108
Male:Female	86:219
Mean Age (years) [range]	70.9 [37.3 – 93.4]
Body Mass Index (kg/m^2) [range]	28.4 [19.6 – 45.2]
Indication for Fixed Lateral Oxford UKR	
Lateral Compartment Osteoarthritis	298
Avascular Necrosis	4
Post-Traumatic Osteoarthritis	3
Component Sizes	
Femoral Component Type (n=288) Twin Peg Cemented:Cementless	128:160
Femur Size (n= 302)	
Extra Small	9
Small	199
Medium	80
Large	13
Extra Large	1
Tibia Size (n=303)	
A	1
B	23
C	91
D	95
E	59
F	34
Bearing Thickness (n=303)	
Size 3	89
Size 4	157
Size 5	44
Size 6	11
Size 7	2

Table 2: Comparison of Pre-operative and Post-operative Oxford Knee Score (OKS)

	Pre-operation (SD) [range]	Post-operation (SD) [range]	p-value
OKS (0-worst to 48-best)	21.0 (8.7) [3 – 45] n=106	40.9 (7.8) [4 – 48] n=270	p<0.0001
OKS Category			
Excellent (>41)	1	160	p<0.0001
Good (34 – 41)	7	70	
Fair (27 – 33)	20	24	
Poor (<27)	78	16	
OKS – Pain (0-worst to 28-best)	10.8 (5.4) [0-26]	24.7 (4.9) [1 – 28]	p<0.001
OKS – Function (0-worst to 20-best)	10.1 (3.9) [2 – 20]	16.2 (3.6) [3 – 20]	p<0.001

Table 3: Summary of Re-operations and Revisions

Follow-up Time to Revision / Re-operation (Years)	**Type of Revision / Re-operation**	**Operated on within recommended FLO indications?**
0.1	Re-operation: Debridement, antibiotics, and implant retention for wound infection	Yes
0.6	***Revised:*** Primary total knee replacement due to posterior subluxation of the femur off the tibial component in extremes of flexion and extension	**No** – friable and fragmented ACL with pre-operative instability
0.8	***Revised:*** Addition of medial unicompartmental knee replacement for medial osteoarthritis progression	**No** – full thickness cartilage loss in the medial compartment pre-operatively
1.3	Re-operation: Knee arthroscopy and partial medial meniscectomy	Yes
3.0	Re-operation: Knee arthroscopy and medial meniscectomy	Yes
4.9	***Revised:*** Addition of medial unicompartmental knee replacement for medial osteoarthritis progression	Yes
5.5	***Revised:*** Primary total knee replacement for medial osteoarthritis progression	**No** – absent ACL

Table 4: Life Table for Survival Analysis

Years Since Operation	Number at Start	Withdrawn (Success or Death)	Revised to Primary TKR	Revised with medial UKR	Re-operation	Cumulative Survival % - **Revision to Primary TKR** (95% Confidence Interval)	Cumulative Survival % **- All Revisions** (95% Confidence Interval)	Cumulative Survival % **- All Re-operations** (95% Confidence Interval)
0 – 1	305	3	1	1	1	99.7 (100 – 99.1)	99.3 (100 – 98.4)	99.0 (100 – 97.9)
1 – 2	299	41	0	0	1	99.7 (100 – 99.1)	99.3 (100 – 98.3)	98.6 (100 – 97.2)
2 – 3	257	52	0	0	0	99.7 (100 – 99.0)	99.3 (100 – 98.2)	98.6 (100 – 97.1)
3 – 4	205	43	0	0	1	99.7 (100 – 98.9)	99.3 (100 – 98.1)	98.2 (100 – 96.3)
4 – 5	161	47	0	1	0	99.7 (100 – 98.8)	98.6 (100 – 96.6)	97.5 (100 – 94.1)
5 – 6	113	37	1	0	0	98.6 (100 – 96.2)	97.5 (100 – 94.4)	96.4 (100 – 92.7)
6 – 7	75	50	0	0	0	98.6 (100 – 95.3)	97.5 (100 – 94.2)	96.4 (100 – 91.3)
7 – 8	25	23	0	0	0	98.6 (100 – 92.4)	97.5 (100 – 89.3)	96.4 (100 – 86.6)

Table 5: Life Table for Survival Analysis for Knees That Met the Recommended Indications for the Fixed Lateral Oxford Unicompartmental Knee Replacement

Years Since Operation	Number at Start	Withdrawn (Success or Death)	Revised to Primary TKR	Revised with medial UKR	Re-operation	Cumulative Survival % - **Revision to Primary TKR** (95% Confidence Interval)	Cumulative Survival % - **All Revisions** (95% Confidence Interval)	Cumulative Survival % - **All Re-operations** (95% Confidence Interval)
0 – 1	282	3	0	0	1	100	100	99.6 (100 – 98.9)
1 – 2	278	38	0	0	1	100	100	99.3 (100 – 98.3)
2 – 3	239	49	0	0	0	100	100	99.3 (100 – 98.2)
3 – 4	190	42	0	0	0	100	100	99.3 (100 – 98.0)
4 – 5	148	44	0	1	0	100	99.2 (100 – 98.3)	98.5 (100 – 96.4)
5 – 6	103	35	0	0	0	100	99.2 (100 – 97.4)	98.5 (100 – 95.9)
6 – 7	68	45	0	0	0	100	99.2 (100 – 96.6)	98.5 (100 – 95.0)
7 – 8	23	22	0	0	0	100	99.2 (100 – 94.2)	98.5 (100 – 91.7)

Figures:

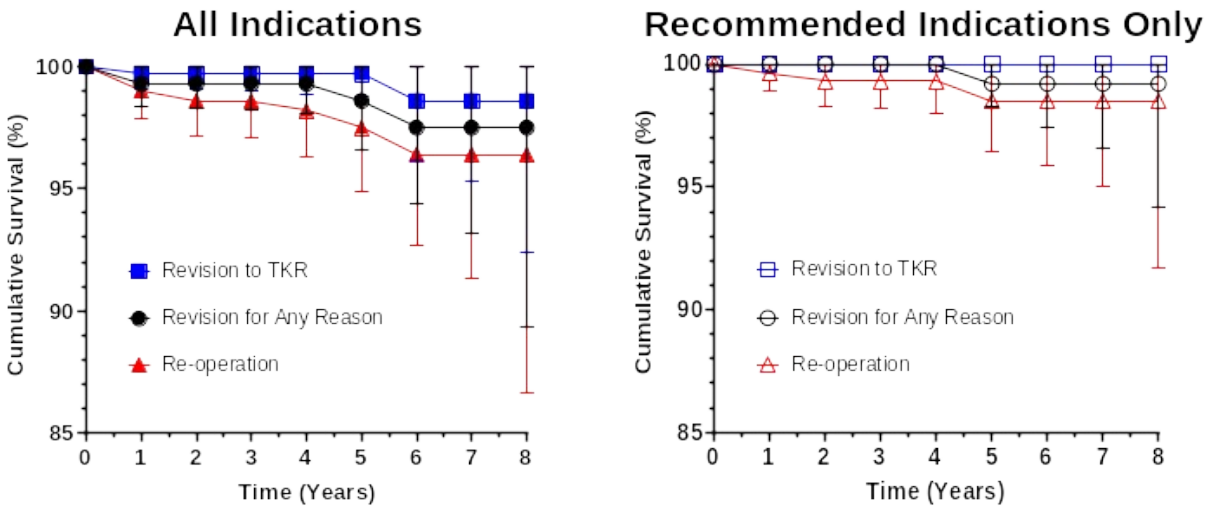

Fig 1 Survival curve**s** for Fixed Lateral Oxford implants implanted in all knees (n=305) and those that met the recommended indications (n=283). Survival curves for endpoints of “Revision to TKR” (blue square), “Revision for Any Reason” (black circle), and Re-operation” (red triangle) as endpoints. Data points indicate cumulative survival +/- 95% confidence intervals.