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Oxford Domed Lateral Unicompartmental Knee Replacement: 10 year survival and 7 year clinical outcome

Abstract

Aim: To describe mid-to-long term results of Oxford mobile bearing domed lateral unicompartmental knee replacement (UKR), and determine the effect of potential contraindications on outcome.

Methods: 325 consecutive domed lateral UKR undertaken for the recommended indications were identified, and functional and survival outcomes were assessed. The effect of age, weight, activity and presence of full thickness erosions of cartilage in the patellofemoral joint on outcome were evaluated.

Results: Median follow up was 7 years (range 3 to 14), and mean age at surgery was 65 (range 39 to 90). Median Oxford Knee Score (OKS) was 43 (range 37 to 47), with 81% achieving a good or excellent score (OKS >34). Revisions occurred in 34 (10%). 14 (4%) were for dislocation, of which 12 had no recurrence following insertion of a new bearing. 12 (4%) were for medial OA. Ten-year survival was 85% (CI 79-90). Age, weight, activity and patellofemoral erosions did not have a significant effect on the clinical outcome or survival.

Conclusion: Domed lateral UKR provides a good alternative to TKR in the management of lateral compartment osteoarthritis. Although dislocation is relatively easy to treat successfully, the dislocation rate of 4% is high. It is therefore recommended that intra-operatively bearing stability is assessed and if the bearing can easily be displaced a compatible fixed bearing lateral tibial component should be inserted instead of the domed tibia. Younger age, heavier weight, high activity and patellofemoral erosions did not detrimentally affect outcome, so should not be considered contraindications.

Take home message:

- The Domed lateral mobile bearing UKR provides good outcomes in the treatment of lateral compartment osteoarthritis.
- The risk of dislocation in this study is 4%. To prevent dislocation, intraoperative trialling to assess the stability of the bearing is recommended. If unstable, a lateral Oxford fixed bearing tibial component should be inserted.

Manuscript

Background:

Lateral unicompartmental knee replacement (UKR) can be used as an alternative to total knee replacement (TKR) in the management of isolated lateral compartment osteoarthritis of the knee. UKR, when compared to TKR, has been shown to have many advantages, including quicker recovery, more normal joint function, and better patient reported outcomes, though with a higher revision rate[1]. However, lateral compartment osteoarthritis appropriate for lateral UKR is much rarer than medial compartment osteoarthritis appropriate for medial UKR. Therefore the published series for lateral UKR are much smaller than those informing the outcomes of medial UKR.

The anatomy and kinematics of the lateral compartment of the knee are very different to the medial, so ideally, different designs and surgical techniques should be used for medial and lateral UKR. The lateral tibial plateau is convex, and during flexion there is a large amount of movement of the lateral femoral condyle on the tibia[2, 3]. In high flexion the femoral condyle drops down and articulates with the back of the tibial plateau[4]. In order to more closely restore normal anatomy and kinematics the Oxford domed lateral UKR (Zimmer Biomet, Warsaw, United States of America), which has a convex tibial plateau and biconcave bearing[5, 6], was introduced. The lateral ligaments are lax in flexion so, on average, the lateral side can be distracted by 7 mm, compared to 2 mm on the medial side[7]. This laxity has historically led to a high dislocation rate of mobile bearing devices[8]. Over the years improvements in surgical technique and implant design has seen an incremental decrease in the dislocation rate for mobile bearing lateral UKR[9-12]. Weston-Simons[13] previously evaluated 265 domed lateral UKR with a mean follow up of four years and found a mean Oxford Knee Score of 40, a reoperation rate of 4.5%, of which 1.5% were due to dislocation, and a survival at 8 years of 92%. However, more recently other centres have published higher dislocation rates up to 6% over five years[14].

The indications for the medial UKR are now well-defined and evidence-based[15, 16]. The indications for Oxford domed lateral UKR have reflected the medial side, and require bone-on-bone disease in the lateral compartment, full thickness cartilage in the medial compartment, and functionally intact ligaments. A rarer indication is spontaneous osteonecrosis of the knee. Historical contraindications, proposed by others, such as age, weight, activity level and patellofemoral joint (PFJ) damage have not been considered to be contraindications for the Oxford[17, 18]. However, the effect these factors have on outcome have not been examined in detail, so we do not know whether they should be contraindications.

The aims of this paper were firstly to describe the function and implant survival following Oxford domed lateral UKR out to ten years, and secondly to examine the effect of previously described contraindications to UKR on outcomes.

Patients and Methods

Between September 2004 and December 2015, 325 consecutive domed lateral UKRs were implanted in 308 patients for the recommended indications by two designer surgeons. Indications for lateral UKR were similar to those used for medial Oxford UKR: all cases had significant symptoms with bone on bone osteoarthritis or spontaneous osteonecrosis of the knee in the lateral compartment and a functionally intact anterior cruciate ligament (ACL) with full-thickness cartilage in the weight bearing portion of the medial compartment. Any intra-articular valgus deformity was correctable. The state of the patellofemoral joint, patient's age, activity level and weight were not considered contraindications.

All procedures were carried out using the modified minimally invasive surgical (MIS) technique for the Phase 3 Domed OUKR[19]. This involved a lateral parapatellar skin incision with trans-patellar tendon incision for vertical tibial cut, internal rotation of the tibial component, anatomical positioning of the femoral component, and selection of the bearing thickness in full extension. This resulted in the ligaments just being tight in full extension and being loose in flexion. All components were fixed with polymethylmethacrylate cement.

Patients were prospectively followed by research physiotherapists independent of the surgical and clinical teams. Patients were assessed routinely at one, five, seven, ten, and 12 years post operatively, and at other times if there was a problem. Patients are contacted by mail for a hospital clinic appointment. If they failed to respond, they were contacted by telephone. Scores recorded were the Oxford Knee Score (OKS)[20], the American Knee Society score functional (AKSS-F) and objective (AKSS-O)[21] and the Tegner activity score[22]. OKS was categorised as per Kalairajah et al[23] into excellent (>41), good (34 to 41), fair (27 to 33), and poor (<27). AKSS was categorised into excellent (85 to 100), good (70 to 84), fair (60 to 69) and poor (<60). Revision was defined as the addition, removal or exchange of any component, including bearing exchange for dislocation (or for any other indication), addition of medial UKR to the medial compartment, or conversion to total knee replacement. We undertook a series of sub-analyses based on all cause revision, all cause excluding dislocation, revision due to arthritis progression, conversion to TKR and conversion to revision TKR. In addition, we examined the effect on outcome of age, weight, activity level and PFJ damage.

Statistical analysis. We used Stata v14.0 (STATA Corp, Texas, USA) and R statistical programming software (R Core Team, Vienna, Austria) for statistical analysis. For normally distributed variables, mean and standard deviation were tested with student's t test. For non-parametric data, median and interquartile range are reported, with a Wilcoxon's signed rank test performed for paired data, and Mann Whitney U test for independent observations. Survival, with failure was assessed using Kaplan-Meier survival analysis, with significance tested with a log rank test. A p-value <0.05 was considered significant.

Results

Baseline characteristics: The mean age at surgery was 65 years (SD 11, range 39 to 90), and mean body mass index 28 (SD 5, range 17 to 48; Table 1). Full thickness defects in the patellofemoral joint were present in 46 knees (44 patients). Three knees in three patients had spontaneous osteonecrosis of the knee, the remaining knees had osteoarthritis. Median follow up was 7 years (range 3 to 14 years), and the mean pre-operative OKS was 24 (SD 7, range 2 to 46). 26 (8%) died due to reasons unrelated to the knee replacement operation and without any further intervention to the knee, and a further 13 (4%) withdrew from follow up (age related high-level care requirements n=9, no longer wished to be part of study n=3, moved abroad n=1), none of these reported problems with their knee at time of withdrawal. One patient (one knee) was lost to follow up.

Functional scores: There was a significant improvement in OKS, AKSS-O, AKSS-F and the Tegner Activity Score (all $p<0.001$). Median OKS was 43 (IQR 37-47), AKSSO was 95 (IQR 85-99), AKSSF 80 (IQR 60-100), and Tegner activity score 3 (IQR 2-3). OKS was available in 98% (317 knees) of the cohort, and by OKS criteria 60% (189 knees) achieved an excellent outcome (score > 41), 22% (71 knees) a good outcome (34 to 41), 9% (27 knees) a fair outcome (27 to 33) and 9% (30 knees) a poor outcome (<27; Figure 1).

The AKSS-O was available in 79% (255 knees) of the cohort. According to AKSS-O criteria, 74% (189 knees) achieved an excellent outcome (85 to 100), 9% (24 knees) a good outcome (70 to 84), 9% (23 knees) a fair outcome (60 to 69) and 7% (19 knees) a poor outcome (<60).

Survival: There were 34 (10%) revisions occurring at a mean 3.7 years (range 2 weeks to 10 years; Table 2; Figure 2 and Figure 3). Bearing dislocation occurred 14 times (4% of cohort); in ten of these the dislocation occurred medially, with two anterior and two unknown. Two of these dislocations were secondary to trauma. Twelve knees had progression of osteoarthritis within the knee (4%). More rarely revisions occurred for aseptic femoral loosening (n=1), deep infection (n=1), and recurrent haemarthrosis (n=2). Three of the knees had a bearing exchanged as part of explorations indicated for a locking knee (n=1), unexplained pain (n=1), and an early superficial infection (n=1). Finally, one knee sustained an unrelated patella fracture which was tension band wired. This wire subsequently became infected necessitating revision.

Five and ten year Kaplan-Meier survival estimates are 92.1% (95% CI 89-95, at risk 204), and 84.6% (95% CI 79-90, at risk 72). With failure as any indication excluding dislocation, survival estimates were 96.7% (95-99, at risk 209) and 89.5% (85-95, at risk 74). With failure as progression of arthritis, survival estimates were 99.6% (99-100, at risk 212), and 92.3% (88-97, at risk 76). Considering failure as conversion to TKR, five and ten year survival estimates are 98.0% (95% CI 96-100, at risk 204) and 93.7% (95% CI 90-98, at risk 72). Considering failure as conversion to TKR requiring revision TKR components, five and ten year survival were 99.7% (95% CI 99-100, at risk 204), and 99.7% (95% CI 99-100, at risk 72).

The most common primary revision procedure was a bearing exchange. This occurred alone (n=7), or was combined with screw augmentation (n=7; Figure 4), debridement (n=1), exploration for pain (n=1), or femoral component revision (n=1). Single stage TKR was the next most common (n=11; 7 primary TKR components; 4 unknown - performed elsewhere; Figure 5), followed by addition of medial UKR (n=5; Figure 6), conversion to a fixed bearing tibial component (n=1), and a two-stage TKR (n=1; required revision components). Of the dislocations (n=14), 12 (86%) were successfully managed with a single procedure with a mean follow up of 4.2 years post revision (range 1-10 years; bearing exchange (n=5), bearing exchange and screw augmentation (n=5), fixed bearing (n=2)); the remaining cases (n=2) suffered a repeat dislocation and were converted to a fixed bearing tibial component at 1 month and 3 months after a bearing exchange and a bearing exchange with screw augmentation respectively.

Impact of historical UKR contraindications on outcome

Age: 107 lateral UKRs (33%) were implanted in patients less than 60 years old at time of surgery. The average age for each group was 52 and 71, and older patients were more likely to be female (48% vs 69%, p<0.001; Table 3). There was no difference in OKS, but younger patients had slightly better AKSS and Tegner scores (Table 4). There was no differences in implant survival.

Weight: There were 131 knees (43%) over 82 kg in weight. The mean weight was 67 kg (48 to 82) and 95 kg (82 to 121). There were big differences in age and percentage of females in the groups, with the heavier group being younger (mean age 67 vs 61, p<0.001) and having a lower percentage of females (36% vs 83%, p<0.001; Table 3). There were no differences in outcome (Table 4).

Tegner: There were 35 knees (11%) that had a Tegner score equal to or greater than five (participates in heavy labour, competitive cycling or cross-country skiing). The median Tegner scores were 3 (IQR 2-3) and 6 (IQR 5-6). Those with high scores were younger (mean age 60 vs 65, p=0.009) and had a lower percentage of females (42% vs 64%, p=0.01; Table 3). They also had a higher prevalence of full thickness PFJ lesions (23% vs 12%, p=0.03). Median OKS was 43 (IQR 36-46) vs 47 (IQR 43-48; p<0.001), and median AKSS-F was 75 (IQR 60-90) vs 100 (IQR 85-100; p<0.001). There was no difference in implant survival (p=0.67).

State of patellofemoral joint: There were 46 knees (16%) with full thickness cartilage loss in the patellofemoral joint. This included any of the medial facet, lateral facet, or trochlea. There were no differences in baseline characteristics between groups (Table 3), or outcome (Table 4).

Discussion

This is the largest series of lateral UKR with ten year survival data. It demonstrates that the mobile domed lateral provides good results with high level of function particularly in young patients. The survival rates, although satisfactory, are not as good as those achieved with medial UKR primarily because of higher rates of bearing dislocation and arthritis progression. However, like mobile bearing medial UKR, the historical UKR contraindications of age, weight, activity and patellofemoral OA did not negatively affect patient reported outcome measures (PROMs) or implant survival, so should not be considered to be contraindications.

Bearing dislocation has always been a problem with the mobile bearing OUKR in the lateral compartment due to the lax lateral ligaments in flexion, which allow on average 7 mm distraction compared with 2 mm on the medial side[7]. The Domed Lateral OUKR (Zimmer Biomet, Bridgend UK) was introduced to restore normal knee kinematics, particularly in high flexion, and to reduce the risk of dislocation seen in earlier flat designs[12]. It has a spherically convex, domed tibial plateau, and a fully congruent biconcave bearing. This more closely mimics the normal anatomy than any other knee replacement[5] and allows the lateral femoral condyle to sublux posteriorly and inferiorly, articulating with the back of the convex lateral tibial plateau in high knee flexion, as it does in the normal knee. As a result it provides better flexion and more normal roll back than the traditional flat design[6, 24]. The biconcave bearing also has more entrapment than the flat bearing so it is less likely to dislocate[11]. For example for an anterior or posterior dislocation the amount of distraction necessary for dislocation to occur increases from 4.5mm to 7.6mm, and for a medial dislocation onto the wall it increases from 4.1mm to 5.9mm[11]. This explains why, with the domed lateral medial dislocation onto the wall (entrapment 5.9mm) is more likely to occur than anterior or posterior (entrapment 7.6mm). It also explains why inserting screws so their heads sit above the wall and increase the apparent height of the wall and thus the entrapment prevents recurrent dislocation (Figure 4).

Despite the increased entrapment of the biconcave bearing decreasing the dislocation rate, at 4% in the designer's series, it is still unacceptably high. Other independent series report dislocation rates of 2%, 2%, 4% and 6%[14, 25-27]. The Fixed bearing Lateral Oxford (FLO; Zimmer Biomet, Warsaw, United States of America) tibial component was introduced, in part, to address this problem. The FLO was designed to be used interchangeably with the domed lateral tibial component. (The sizing nomenclature is however different with the equivalent FLO being 2 sizes larger than the domed). The FLO does not have the advantages of minimal wear and improved kinematics of the domed but cannot dislocate. In view of the high dislocation rate, shown in this study, and the availability of the FLO we have changed our practice, and recommend that surgeons implanting the domed lateral should, during the trialling phase, assess the stability of the bearing. The knee should be placed in the figure of four position and, holding the trial bearing in the bearing removal instrument, the surgeon should see if it can easily be dislocated medially onto the wall. Under these circumstances it would be sensible to implant the Fixed Lateral Oxford tibial component. Similarly if a dislocation of the Domed lateral does occur this can be treated with conversion to a FLO. Hopefully with further improvements to the domed lateral the incidence of dislocation will decrease further so it can safely be used in all patients. Until this is achieved, for surgeons implanting few lateral UKR, or for elderly patients who will have limited benefit from the low wear or improved kinematics of the Domed lateral, the FLO may be a better option.

The ten year survival of the domed lateral is 85%. This is similar to that reported by the three other studies reporting the 10 year survival of lateral UKR, two of which were fixed bearing and one mobile (Table 5). However if the risk of dislocation could be decreased the ten year survival would improve up to 90%. This is still worse than that achieved by medial OUKR (94% to 99%[28-30]). The main reason for the difference is progression of disease medially, as with this as an endpoint the ten year survival was 92.3% (CI 88-97). It would seem therefore that disease progression may be more common after lateral UKR than medial, as it is after PFR. Disease progression is most common after Patellofemoral Replacement (PFR). With the Avon PFR, Metcalfe et al[31] reported a 10 year survival of 77%, with 56% of revisions occurring due to disease progression. Further study is needed to understand the risk factors for medial disease progression.

Another option would be TKR. Whilst this would no doubt reduce the dislocation revision rate, it would negate many advantages provided by UKR. UKR in general has fewer perioperative complications, and a lower mortality rate than TKR[32]. Following domed lateral UKR knee movement is similar to the normal knee[24], unlike following TKR[33]. The mean OKS in this series of domed lateral UKR was 40 (SD 9, range 6 to 48), which is higher than the OKS that tends to be achieved by TKR[34, 35]. Further, valgus knees undergoing TKR have double the revision rate of those in varus[36, 37], making lateral UKR an attractive alternative.

The indications for medial UKR are now established and evidence based[15, 16, 38]. These are bone-on-bone arthritis of the affected compartment, intact remaining compartment, and functionally intact ligaments. Evidence for lateral UKR has lagged behind the medial side as it is a rarer procedure - fewer than 5% of patients with knee arthritis have isolated lateral osteoarthritis, compared to 30-50% for isolated medial compartment osteoarthritis[39]. Consequently, indications for the procedure have reflected the medial side. On the medial side, historical contraindications such as young age, heavy weight, high activity or co-existent patellofemoral osteoarthritis are not related to outcome[16-18]. In this study we have tested these specific criteria on the lateral side, and have found that patient function and implant survival in groups considered contraindicated were similar to those who weren't. These findings therefore support the current view that the contraindications should not apply to the dome lateral UKR.

Our study has limitations. These results were obtained by the designer surgeons, and may limit the generalisability of the results. However, other centres have reported similar results with similar dislocation rates[14, 25-27]. It is a single centre, single arm series with no comparator groups. Both surgeons are experienced UKR surgeons performing a high proportion of their knee replacement practice as UKR. Furthermore we did not undertake a radiographic review. However, it is patient function that is the most important outcome following intervention, and we have reported this in detail.

In conclusion, the Oxford domed lateral UKR provides a good treatment option for isolated lateral compartment osteoarthritis. Young age, heavy weight, high activity and co-existent patellofemoral osteoarthritis should not be considered contraindications. However there is an appreciable risk of bearing dislocation and if the bearing is found to be unstable at surgery it may be sensible to implant that fixed lateral Oxford instead.

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Tables

Table 1: Cohort demographics	
N of knees	325
N of patients	303
Mean age at surgery (sd, range)	64.9 (11, 39-90)
Percentage Female (N)	63% (204)
Mean BMI (sd, range)	27.7 (5, 17-48)
Mean preop OKS (sd, range)	24.5 (9, 2-46)
Median preop tegner activity score (IQR, range)	2 (2-3, 0-7)
Percentage full thickness PFJ lesion (N)	14% (46)

Table 2: List of revisions

Number	Time to revision (years)	Age/Gender	Indication	Revision
1	0.05	39F	Dislocation	Bearing exchange
2	0.06	68M	Early infection	Debridement and bearing exchange
3	0.10	76M	Dislocation	Bearing exchange + screws
4	0.15	78M	Dislocation	Revision to fixed bearing
5	0.18	74M	Dislocation	Bearing exchange
6	0.31	84F	Dislocation	Bearing exchange + screws
7	0.35	69F	Dislocation	Bearing exchange + screws
8	0.35	67F	Dislocation	Bearing exchange
9	0.39	56M	Dislocation	Bearing exchange + screws
10	0.53	51F	Dislocation	Bearing exchange
11	0.54	59F	Dislocation	Bearing exchange + screws
12	1.0	65F	Infection	Revision to TKR (with stems)
13	1.4	59M	Recurrent haemarthrosis	Revision to TKR
14	1.6	68F	Traumatic bearing dislocation	Bearing exchange
15	1.8	42F	Dislocation	Bearing exchange + screws
16	2.2	75M	Recurrent haemarthrosis	Revision to TKR
17	2.6	60M*	Disease progression	Addition of medial UKR
18	2.9	54M	Pain	Bearing exchange
19	4.0	40M*	Dislocation	Bearing exchange + screws
20	4.0	44M	'Locking knee' (revised elsewhere)	TKR at other centre
21	4.3	74F	Infection post trauma (infected cerclage wire)	Revision to TKR
22	4.3	48F	Pain (femoral component found to be loose)	Femoral component revision + bearing exchange
23	5.0	66F	Progression of OA	Addition of medial UKR
24	5.5	53F	Progression of OA	Revision to TKR
25	6.5	58F	Progression of OA	Revision to TKR
26	7.0	53M*	Progression of OA	Addition of medial UKR
27	7.2	60F	Progression of OA	Revision to TKR
28	7.2	73F*	Progression of OA	Revision to TKR
29	7.6	43M	Progression of OA	Revision to TKR
30	8.7	43F	Progression of OA	Revision to TKR
31	8.7	44M*	Dislocation[#]	Bearing exchange
32	9.1	75F	Progression of OA	Addition of medial UKR
33	9.3	63F	Progression of OA	Addition of medial UKR
34	10.5	42F	Progression of OA	Revision to TKR (elsewhere)

*Tegner score ≥ 5
[#]Bearing dislocated whilst working under the sink
OA osteoarthritis; TKR total knee replacement; UKR unicompartmental knee replacement.
Screw procedure involved addition of screws above the medial wall (Figure 4)

Table 3: Demographics of subgroups								
Historical contraindication	**N**	**Mean Age in years (sd)**	**Mean body mass index (sd)**	**% female (N)**	**Median preop Tegner (IQR)**	**% full thickness PFJ at operation (N)**	**Median preop OKS (IQR)**	**Median follow up in years (range)**
Age < 60 years	107	52.0 (6)	28.2 (5)	48% (52)	3 (3-4)	14% (15)	22 (17-29)	7 (1 to 13)
Age ≥ 60 years	218	71.2 (7)	27.4 (5)	69% (152)	3 (2-3)	14% (31)	25 (19-31)	6 (1 to 14)
P value		NA	0.22	<0.001	0.34	0.74	0.05	0.03
Weight < 82 kg	173	67.4 (11)	24.9 (3)	83% (144)	3 (2-3)	14% (24)	26 (19-32)	7 (1 to 13)
Weight ≥ 82 kg	131	61.2 (10)	31.3 (4)	36% (47)	3 (3-3)	15% (20)	24 (18-29)	7 (1 to 14)
P value		<0.001	NA	<0.001	0.23	0.77	0.06	0.66
Tegner score < 5	276	65.1 (11)	27.7 (5)	64% (178)	3 (2-3)	12% (32)	24 (18-31)	7 (1 to 14)
Tegner score ≥ 5	35	59.8 (11)	26.6 (3)	42% (15)	6 (5-6)	23% (8)	25 (23-32)	7 (1 to 12)
P value		0.009	0.07	0.01	NA	0.03	0.10	0.40
PFJ no bone exposed	239	64.4 (12)	27.6 (5)	64% (152)	3 (2-3)	0% (0)	24 (18-31)	7 (1 to 13)
PFJ bone exposed	46	66.4 (11)	28.1 (5)	57% (26)	3 (2-4)	100% (46)	25 (17-29)	7 (1 to 12)
P value		0.30	0.54	0.36	0.28	NA	0.60	0.43

Table 4: Outcomes by subgroup

Group	N	Median OKS (IQR)	Median AKSS-O (IQR)	Median AKSS-F (IQR)	Median Tegner Score (IQR)	Percentage revised (N)	Five year Kaplan-Meier survival (95% CI)
Age							
<60	107	42 (34-47)	95 (84-100)	90 (70-100)	3 (3-4)	16% (17)	89.8 (84-96)
>60	218	43 (37-47)	90 (83-99)	75 (64-90)	3 (2-3)	8% (17)	93.3 (90-97)
P value	NA	0.21	0.03	<0.001	<0.001	0.03	0.10
Weight							
<82	173	43 (38-47)	95 (89-100)	80 (65-100)	3 (2-3)	9% (16)	93.5 (90-98)
>82	131	43 (36-47)	95 (84-98)	80 (60-100)	3 (3-3)	12% (16)	91.0 (86-96)
P value	NA	0.27	0.11	0.97	0.10	0.52	0.43
Tegner Activity score							
<5	276	43 (36-46)	95 (85-98)	75 (60-90)	3 (2-3)	10% (27)	92.4 (89-96)
>5	35	47 (43-48)	97 (92-100)	100 (85-100)	6 (5-6)	14% (5)	93.8 (86-100)
P Value	NA	<0.001	0.04	<0.001	NA	0.60	0.56
PFJ							
No bone exposed	239	43 (37-46)	95 (87-98)	80 (60-100)	3 (2-3)	8% (20)	94.0 (91-97)
Bone exposed	46	43 (36-47)	95 (70-97)	75 (65-90)	3 (2-4)	11% (5)	92.7 (85-100)
P value	NA	0.85	0.50	0.61	0.28	0.80	0.67

AKSSO and AKSSF American Knee Society Score Objective and Functional; CI confidence interval; IQR interquartile range; N number; OKS Oxford Knee Score; PFJ patellofemoral joint

Table 5: Comparison of lateral UKR series with greater than 50 patients											
Study	Region	N	Mean follow up (years)	Patient-time	N revisions (%)	CTIR (revision)	N dislocation (%)	CTIR (dislocation)	N not dislocation (%)	CTIR (not dislocation)	10 year survival
Fixed bearing											
Ashraf 2002[40]	UK	83	9	747	15 (18%)	2.01	0	0	15 (18%)	2.0	83%
Berend 2012[41]	USA	100	3	204	1 (1%)	0.49	0	0	1 (1%)	0.3	NR
Smith 2014[42]	UK	101	3	303	4 (4%)	1.32	0	0	4 (4%)	1.3	NR
Edmiston 2018[43]	USA	65	7	455	4 (6%)	0.88	0	0	4 (6%)	0.9	80-85%*
Oxford domed											
Newman 2017[25]	UK	61	7	427	7 (11%)	1.64	1 (2%)	0.23	6 (10%)	1.41	80%
Walker 2018[14]	Germany	363	3	1089	36 (10%)	3.31	20 (6%)	1.84	16 (4%)	1.47	NR
This study	UK	325	7	2324	34 (10%)	1.46	14 (4%)	0.60	20 (6%)	0.86	85%

N Number; NR not reported. CTIR component time incidence rate (calculated as event/patient-years * 100)
Studies with less than 50 patients, or earlier series from the same centre are excluded.
*This study did not report their exact figure but displayed a survival curve.

Figure Legends

Figure 1: OKS Oxford Knee Score, grouped as per Kalairajah et al[23]

Figure 2: The majority of bearing dislocations occurred within the first year; contrasted with 80% of disease progressions occurring after five years.

Figure 3: Domed lateral unicompartmental knee replacement implant survival; TKR total knee replacement

Figure 4: The bearing has dislocated medially onto the wall. The insertion of two screws will prevent this happening.

Figure 5: The majority of patients required no more than a primary total knee replacement at the time of their revision surgery.

Figure 6: Medial disease progression can be managed with the addition of a medial unicompartmental knee replacement.