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Title: Unsatisfactory outcomes following unicompartmental knee replacement for partial thickness cartilage loss: A medium term follow up.

Abstract

Purpose Whilst medial UKR is indicated for full-thickness cartilage loss (FTCL) on occasion it has been used to treat partial-thickness cartilage loss (PTCL). This matched case-control study investigates the five-year outcomes in a consecutive series of UKR implanted for PTCL.

Methods Between 2002 and 2014, 94consecutive UKR (90patients) were implanted by two surgeons for PTCL and followed up independently for a mean 6years (range 1-13). These cases were matched 1:2 based on age, gender and preoperative OKS with knees with FTCL anteromedial osteoarthritis managed with UKR. Functional outcomes, implant survival and incidence of reoperations was assessed at one, two and five years. A sub-study of 36knees (36patients) with PTCL who had had pre-operative MRI was performed to identify whether there were any MRI factors that predicted outcomes.

Results Knees with PTCL had significantly worse functional outcomes (OKS and AKSS-O) at one, two and five years postoperatively. A quarter of knees with PTCL reported fair or poor results and a fifth failed to achieve a clinically significant improvement from baseline of four points or more on the OKS, double that seen in knees with FTCL. Whilst no difference in implant survival was detected between groups, knees with PTCL had a triple the reoperation rate with the majority, three-quarters, being arthroscopies for persistent pain.

Patients with PTCL who achieved fair or poor outcomes were younger with worse preoperative functional scores, compared to those who achieve good or excellent outcomes however no other differences in baseline demographics were seen. MRI findings (FTCL, subchondral oedema, synovitis or effusion) did not provide additional prognostic information.

Conclusion Medial UKR should be reserved for patients with FTCL, whilst some patients with PTCL do achieve good results, at present, we cannot identify which these will be and in this situation MRI is not only unhelpful but also misleading.

Level of Evidence: Level III

Keywords: unicompartmental knee replacement, implant survival, functional outcome, patient selection, partial thickness cartilage loss

Introduction

Patients with early knee arthritis have been reported to represent over a quarter of secondary care consultations for osteoarthritis [1]. Having failed non-operative treatment modalities, in three-quarters of cases their pain and functional scores are the same, if not worse than patients with more advanced structural changes [2]. In randomised studies arthroscopy has been shown not to help this group of patients and there is uncertainty over the role of non-operative treatments including the use of corticosteroids, hyaluronic acid and platelet rich plasma [3-6]. As such these patients represent a significant clinical challenge and the optimum treatment of this group, including the role of expectant management, is unclear.

Unicompartmental knee replacement (UKR) is a definitive treatment for patients with anteromedial osteoarthritis (AMOA) or spontaneous osteonecrosis of the knee [7]. However, in cases of AMOA the patient should have full-thickness cartilage loss (FTCL) with bone-on-bone arthritis in the medial compartment, as it has been reported that with partial-thickness cartilage loss (PTCL) in the medial compartment more variable outcomes are seen with a higher proportion of cases not benefiting from the operation in the short term (mean 2 years (range 1 to 6)) [8].

Suitability for UKR can reliably be determined using radiographic assessment using anteroposterior (AP), lateral, skyline and stress radiographs, in combination with a radiographic Decision Aid [9]. In patients suitable for UKR in the majority of cases bone-on bone FTCL is demonstrated by complete obliteration of the joint space on a standing AP radiograph. In early AMOA, due to the location of the lesion, FTCL may not be seen on a standing AP radiograph and varus stress radiographs, performed at 20° flexion or postero- anterior flexion radiographs (Rosenberg) may be required to demonstrate this finding [9]. If bone-on-bone is not seen radiographically an arthroscopy can be undertaken to assess the joint. If there is exposed bone on both femoral and tibial articular surfaces it can be assumed that there is bone-on-bone arthritis and UKR is indicated.

Whilst it is not routine practice in our unit to implant UKR in the absence of bone-on-bone FTCL in the medial compartment, a number of cases have been performed in this situation, primarily due to patient request as the other treatment options have failed. This case-control study compared the five-year functional outcome and implant survival of a consecutive series of knees with medial compartment PTCL (femur, tibia or both femur and tibia) treated with Phase 3 Oxford UKR and a matched subgroup of knees with medial FTCL bone-on-bone arthritis taken from our consecutive series of 1000 Phase 3 Oxford UKRs [7].

Patients and Methods

Our prospective database of consecutive patients undergoing medial Phase 3 Oxford UKR via a minimally invasive approach by [redacted] was examined to identify knees that were found to have PTCL in the medial compartment at the time of operation. UKR implanted for spontaneous osteonecrosis of the knee, based on radiological or histological diagnosis, or that did not fulfil other criteria for UKR: i) retained full thickness cartilage in the lateral compartment, ii) functionally normal medial collateral ligament (MCL), iii) functionally normal anterior cruciate ligament (ACL), iv) absence of bone loss with grooving to the lateral facet of the patella were excluded from the analysis [10]. Between November 2002 and November 2014 94 UKRs (90 patients) were identified with PTCL on the femur (18 knees), tibia (63 knees) or both femur and tibia (13 knees) in the medial compartment at the time of operation.

This cohort of patients was matched, 2:1, using propensity score matching based on age, gender and preoperative Oxford Knee Score (OKS) to knees with FTCL AMOA identified from a consecutive series of 1000 UKR (818 patients) implanted by the designer surgeons, between June 1998 and March 2009, for recommended indications [7].

Patients were independently followed up using a standard protocol of clinical review with functional assessment. Outcome assessment was performed by research physiotherapists independent of the surgical and clinical teams involved in the patients care. Patients were assessed pre-operatively and at one, two and five years post-operatively. Functional

outcomes were assessed using the: OKS, American Knee Society Score Objective (AKSS-O), and Functional (AKSS-F), and the Tegner Activity Score[11-13].

All patients were contacted in the previous 24 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 further operations on their knee was obtained from primary and secondary care records as well as from patient's relatives where appropriate.

A sub-study was performed on 36 knees (36 patients) with medial compartment PTCL who had undergone MRI prior to UKR. MRI were assessed for evidence of FTCL in the medial compartment, the presence of subchondral bone-marrow oedema in the medial compartment, which has been associated with FTCL, in the medial compartment, evidence of synovitis and the presence of a moderate to large suprapatellar effusion using the methodology and criteria outlined by Hunter et al. (2008)[14,15]. MRI were assessed by an experienced musculoskeletal radiology consultant ([redacted]) who was blinded and given no clinical information about the patients.

Statistical methods

A power calculation was performed using the minimally clinically important difference reported for OKS [16]. 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 [17].

To assess for differences in functional outcome between knees with PTCL in the medial compartment (femur, tibia or femur and tibia) and those knees with FTCL, non-parametric tests (Mann–Whitney U) were performed. Subgroup analysis, based on the location of the partial thickness disease was performed and assessed statistically using non-parametric tests (Kruscal Wallis). Categorical data was assessed using a Chi Squared Test.

To assess for the impact of time on functional outcome scores following UKR, a Friedman Test was performed. In the MRI sub-study to assess for differences in functional outcomes between different groups based on MRI findings non-parametric tests (Mann–Whitney U) were performed.

For the OKS a difference of four points or more was considered clinically relevant for differences between groups (minimal important difference (MID)) and individual improvements over time (minimal detectable change (MDC)) [18].

To assess for differences in implant survival and re-operation rate between knees with PTCL in the medial compartment (femur, tibia or femur and tibia) and those knees with FTCL a log-rank test was performed. Implant failure included any re-operations in which components were removed, in which the meniscal bearings were replaced for dislocation, and any re-operations in which new components were inserted.

A p-value of <0.05 was deemed statistically significant with no adjustment made for multiple testing due to a priori hypothesised associations between PTCL and outcomes following UKR[19].

Results

Patients with medial compartment PTCL (94 knees, 90 patients) were younger than patients from our consecutive 1000 patient series with FTCL (64.1 (SD11) v 67 (SD10) years; p=0.02). No difference in gender (p=0.11), body mass index (BMI) (p=0.23), macroscopic ACL status (normal, synovial damage or longitudinal splits) (p=0.09) or preoperative function assessed by OKS (p=0.43), AKSS-O (p=0.16), AKSS-F (p=0.69) or Tegner Activity Score (p=0.28) was seen between groups.

Following 2:1 matching based on age, gender and preoperative OKS no differences in baseline characteristics were seen between groups. Table 1. With the exception of preoperative Tegner Activity Score, which was higher in knees with partial thickness lesions of the tibia compared to knees with partial thickness lesions on both the femur and tibia (p=0.02), no differences in preoperative demographics were seen based on the location of the PTCL (femur, tibia or femur and tibia). Follow up data for the primary outcome measure (OKS) was available for 86% of knees at year one, 65% of knees at year two and 94% of knees at year five.

Year 1

At year one knees with PTCL in the medial compartment had significantly lower OKS (mean 37 (SD9) v 41 (SD8), p<0.001) and AKSS-O (mean 80 (SD20) v 89 (SD11), p=0.007) scores compared to those with medial compartment FTCL. Table 2. No difference in AKSS-F (p=0.08) or Tegner Activity Score (p=0.38) was seen between groups. No difference in outcomes was detected based on the location of the PTCL. Table 2. When knees that underwent revision or reoperation knees were excluded knees with PTCL still had significantly worse OKS (mean 38.3 (SD8) v 40.9 (SD8), p=0.002) and AKSS-O (82.2 (SD17) v 88.8 (SD11), p=0.03) at one year compared to knees with FTCL, highlighting that in knees that were not revised UKR performed for PTCL had overall worse outcomes assessed using these measures. No difference in AKSS-F (87.1 (SD16) v 88.9 (SD15), p=0.36) or Tegner Activity Score (3.0 (SD1) v 2.9 (SD1), p=0.81) was seen between groups.

Compared to knees with FTCL the outcomes of knees with PTCL was more variable. Figure 1. Using OKS criteria at year one 25% (19 of 77 knees) of knees with PTCL reported poor or fair outcomes, almost double that of knees with FTCL (14%; 22 of 156 knees; p=0.049). Figure 2.

Compared to baseline score, 22% (11 of 50 knees) of knees with PTCL failed to achieve clinically meaningful improvements in OKS of four points at one year compared to knees with FTCL in which 10% (12 of 115 knees; p=0.049) failed to achieve clinically meaningful improvements in OKS.

Compared to patients with PTCL in the medial compartment who achieved good or excellent outcomes in the first year postoperatively, patients with PTCL who reported poor or fair outcomes were significantly younger (mean 59.2 years (SD14) v 65.9 years (SD10), p=0.04) and had significantly worse pre-operative knee function, as assessed by a lower pre-operative OKS (mean 18.8 (SD8) v 25.2 (SD8), p=0.04) and AKSS – F score (mean 60.0 (SD19) v 72.0 (SD16), p=0.05). No difference in gender (p=0.87), BMI (p=0.74), ACL status (p=0.45), location of PTCL (p=0.73), AKSS-O (p=0.99) or Tegner Activity Score (p=0.45) was seen between groups.

Year 2

At year two post-operatively knees with PTCL in the medial compartment had significantly lower OKS (mean 37 (SD11) v 41 (SD8), p=0.02) and AKSS-O (mean 77 (SD23) v 88 (SD15), p=0.002) scores compared to those with medial compartment FTCL. Table 2. Figure 1. No difference in AKSS-F (p=0.09) or Tegner Activity Score (p=0.69) was seen between groups. No difference in outcomes was detected based on the location of the PTCL. Table 2.

Using OKS criteria at year two 29% (15 of 52 knees) of knees with PTCL reported poor or fair outcomes, double that of knees with FTCL (12%; 9 of 74 knees; p=0.02). Figure 2.

Year 5

At year five post-operatively knees with PTCL in the medial compartment had significantly lower OKS (mean 39 (SD8) v 42 (SD6), p=0.049), AKSS-O (mean 78 (SD13) v 84 (SD13), p=0.02) and AKSS-F (mean 81 (SD16) v 87 (SD16), p=0.01) scores compared to those with medial compartment FTCL. Table 2. Figure 1. No difference in Tegner Activity Score (p=0.81) was seen between groups. No difference in outcomes was detected based on the location of the PTCL. Table 2.

Using OKS criteria at year five 25% (13 of 51 knees) of knees with PTCL reported poor or fair outcomes, double that of knees with FTCL (12%; 17 of 139 knees; p=0.04). Figure 2

A Friedman test, non-parametric repeated measures test, performed to see whether there was any change in functional scores between years one, two and five post-UKR in the setting of PTCL, demonstrated no change in OKS (p=0.10), AKSS-O (p=0.68) or Tegner Activity Score (p=0.78) during this period indicating that the outcome achieved at year one was likely to be maintained until year five. A significant worsening of AKSS-F (p=0.004) was recorded between years one, two and five.

Implant survival and reoperations

In knees with PTCL in the medial compartment there were four revisions cases at a mean of 5.9 years (range 0.9 to 10.3 years). There were two cases of disease progression, one treated with lateral UKR (6.3 years) and one treated with TKR (10.3 years), one case of femoral component loosening secondary to bearing impingement (7.2 years) and one revision for persistent pain (0.9 years). Two cases occurred in knees with partial thickness femoral cartilage loss and two case in partial thickness tibial cartilage loss. No difference in implant survival was seen between knees with PTCL compared to those with FTCL in the medial compartment (p=0.06).

In addition to the four revision cases, in knees with PTCL in the medial compartment there were 9 reoperations at a mean of 3.4 years (range 3 days to 9.9 years). There were seven arthroscopies performed for pain at a mean of 4.1 years (range 1.2 to 9.9 years) and two

arthroscopic debridement's performed for suspected infection at a mean of 1 year (3 days and 2 years). One case occurred in a knee with partial thickness femoral cartilage loss, six cases in knees with partial thickness tibial cartilage loss and two cases in knees with both PTCL of the femur and tibia. At five years the reoperation rate of knees with PTCL was 10.9% (95% CI 1.4 to 20.4%), triple that of knees with FTCL (3.9% (95% CI 1.1 to 6.7%); p<0.001). Figure 3.

MRI Sub-study

MRI were available for 36 knees (36 patients) who had been identified as having PTCL at operation. In this cohort of patients with medial compartment PTCL on the femur, tibia or femur and tibia, the sensitivity and specificity of MRI at detecting FTCL was 68% and 80% for the medial femoral condyle plateau and 67% and 55% for the medial tibial plateau.

In knees with PTCL no difference in functional outcomes (OKS, AKSS-O and AKSS-F) at one year were seen between knees with MRI evidence of: FTCL on both the femur and tibia within the medial compartment, bone marrow oedema on both the femur and tibia within the medial compartment, suprapatellar effusion or evidence or synovitis and those without these findings. Table 3. Knees with MRI evidence of bone marrow oedema of both the femur and tibia within the medial compartment were found to have a higher year 1 Tegner Activity Score (p=0.003) than knees without bone marrow oedema. No difference in Tegner Activity Score was seen between other groups.

Discussion

Following medial UKR, knees with PTCL in the medial compartment at operation had significantly worse functional outcomes than knees with FTCL bone-on-bone arthritis with no evidence of improvement seen over time and this difference maintained to at least five years post-operatively. A quarter of knees with PTCL reported fair or poor results and a fifth failed to achieve a clinically significant improvement from baseline of four points or more on the OKS, double that seen in knees with FTCL bone-on-bone arthritis. Whilst no difference in implant survival was detected between groups, knees with PTCL had triple the reoperation rate with the majority, three-quarters, being arthroscopies for persistent pain.

Knees with PTCL that achieved fair or poor outcomes were significantly younger with worse pre-operative function, compared to those who did not achieve fair or poor outcomes, however no other differences in baseline demographics were seen. Preoperative MRI findings (presence of FTCL on both the affected femur or tibia, subchondral oedema on both the affected femur or tibia, synovitis or effusion) did not provide additional prognostic information and these findings were not found to be associated with the clinical outcome.

The results of this study demonstrate that knees with PTCL in the medial compartment report significantly worse results, with a higher incidence of reoperations, compared to knees with FTCL in the medial compartment. Whilst some knees with PTCL do achieve good and excellent outcomes at present based on patient demographics and MRI, which some surgeons report as useful, we cannot identify which knees these will be. As such based on these poor results, and in the absence of selection criteria in knees with PTCL, at present UKR cannot be advised in this population.

It is not the senior surgeon's practice, as reflected by the low number of cases, to perform UKR in the setting of PTCL due to previous reported worse functional outcomes. Therefore, the results of this study represent a highly selected population, who it was believed would achieve good results. As such the results seen in this study may not be representative of all patients with PTCL who undergo UKR, and on a population level it is likely that the outcomes

of patients with PTCL may well be worse than seen here. As such we would recommend that UKR is not performed in the setting of PTCL.

In knees with PTCL in the medial compartment we have previously reported higher variability in functional outcomes with fewer patients achieving good or excellent results at a mean of two years (range 1 to 6) post-operatively compared to those knees treated for FTCL [8]. The results of the current study have confirmed that knees with PTCL have higher variability in functional outcomes, with overall worse functional outcomes that persist to beyond five years. This finding is contrary to Maier et al. (2015) who, reporting the outcomes of 32 knees with PTCL at a mean follow up of 3.5 years (range 0.8 to 6.9) who found no difference in functional outcomes, compared to knees managed with UKR for FTCL. However, Maier et al. did find a higher reoperation rate in knees with PTCL, with forty percent of reoperations for unexplained pain, which is consistent with the results of this study [20].

Why patients with PTCL have worse functional outcomes may relate to patient or disease factors. One possibility is that patients with PTCL are presenting earlier in their disease process and as such may have different tolerance levels to pain and as such their post-operative recovery may be different [8]. Alternatively, it may be that pain is mediated differently in PTCL, as compared to FTCL. As cartilage does not have a nerve supply, in early osteoarthritis it may be that the pain is predominantly driven by inflammatory mediators as opposed to mechanoreceptors, and as such the response to treatment may be different as the disease progresses[21,22]. Finally, it is known that at post-mortem PTCL is a common finding in the asymptomatic knee and as such it must be acknowledged that despite a complete assessment in some cases of PTCL the pain may be referred other sites and the medial compartment may not be the cause of symptoms.

The strengths of this study are that it is the largest, consecutive, series of patients treated with UKR for PTCL in the medial compartment with a comprehensive clinical follow up. The main limitation is that it represents the mid-term follow up of a highly selected cohort of patients and

probably does not represent outcomes of UKR in the population of patients with PTCL, which may well do worse.

The clinical relevance of this study is that it supports the indication for medial UKR as proposed by Goodfellow et al. which states that there should be FTCL on both the femur and tibia, identified by radiology (AP standing, varus stress or PA fixed flexion) or arthroscopy, in the medial compartment to achieve optimal results, as in the setting of PTCL worse results are seen[10]. Whilst some knees with PTCL do achieve good and excellent outcomes at present we cannot identify which knees these will be. In AMOA MRI has not been validated for patient selection for UKR and this study has found that it does not provide additional prognostic information in the setting of PTCL. A recent study has suggested that subchondral oedema may be associated with improved outcomes following UKR, however as this study was performed in a mixed FTCL and PTCL population, it is unclear whether extend of medial compartment disease was a confounding factor in this analysis [23]. Additionally, it has previously been reported that the diagnostic accuracy of MRI decreases as the grade of chondral lesion decreases and as such the use of MRI for patient selection for UKR may be misleading due the false-positive assessment of PTCL, which this study has identified as having worse results[24]. Further work is required to identify biomarkers that may be predictive of outcomes following UKR in the early arthritis population, however at present based on the results of this study we would recommend that UKR is not performed in the setting of PTCL.

Although PTCL seems to be a minor issue in our practice, perhaps representing 5% of our cases, we think that it is a major problem worldwide and contributes to the high failure rate of UKR in national registers. There are a number of reasons why surgeons frequently implant UKR in the setting of PTCL. Firstly medial PTCL is much more common than FTCL and if a patient has pain and PTCL many surgeons think that UKR will solve the problem. Secondly many surgeons are only comfortable to do a UKR if the retained lateral and patello-femoral joints are pristine, which tends to occur if the medial compartments has PTCL Thirdly surgeons know that TKR does not do well with PTCL so want to do a lesser operation such as a UKR

in this situation. If surgeons perform UKR in knees with PTCL, they will have poor results with many revisions, often done by other surgeons. In turn these revisions will do badly and often be re-revised because the surgery should not have been done in the first place. The solution therefore is not to do UKR in PTCL. Instead PTCL should be treated conservatively as in many cases the arthritis will progress and then a UKR could be implanted.

Conclusion

This study supports the current indications that medial UKR should be reserved for patients with FTCL in the medial compartment as in knees with PTCL the clinical outcomes are worse with twice as many patients reporting poor results and three times as many having reoperations. Whilst some patients with PTCL do achieve good results, at present, we cannot identify which these will be and in this situation MRI is not only unhelpful but may also be misleading.

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Table 1: Patient demographics and functional scores

Factor	Control* Group (n = 188)	All partial thickness cartilage loss* (n = 94)	P value	Partial thickness femur only (n = 18)	Partial thickness tibia only (n = 63)	Partial thickness both femur and tibia (n = 13)	P value
Age (years) Mean (SD)	63.6 (10)	64.2 (11)	0.87	64.2 (14)	63.6 (11)	66.9 (10)	0.67
% female n (%)	104 (55%)	54 (57%)	0.73	10 (56%)	37 (59%)	7 (54%)	0.93
Body Mass Index (BMI) Mean (SD)	29.7 (5)	29.1 (5)	0.58	29.4 (7)	29.2 (5)	28.6 (6)	0.66
ACL status n (%)							0.27
- Normal	116 (62%)	63 (67%)	0.74	9 (50%)	48 (76%)	6 (46%)	
- Synovial Damage	19 (10%)	8 (9%)		3 (17%)	4 (6%)	1 (8%)	
- Longitudinal splits	18 (10%)	7 (7%)		1 (6%)	4 (6%)	2 (15%)	
- Unknown	35 (18%)	16 (17%)		5 (28%)	7 (11%)	4 (31%)	
Preoperative							
OKS (SD)	24.6 (8)	23.9 (8)	0.34	23.3 (5)	23.9 (7)	24.8 (7)	0.77
AKSS-Objective (SD)	52.2 (18)	45.3 (24)	0.16	38.0 (117)	47.6 (25)	45.3 (24)	0.24
AKSS-Functional (SD)	69.3 (18)	70.1 (16)	0.69	70.5 (14)	71.7 (17)	63.3 (17)	0.19
Tegner Score (SD)	2.5 (1)	2.1 (1)	0.12	1.8 (0.4)	2.4 (1)	1.4 (1)	**0.03***

*post-hoc testing revealed that knees with partial thickness lesions of the tibia had significantly better pre-operative Tegner Activity Scores compared to knees with partial thickness lesions on both the femur and tibia (p=0.02). No difference was seen between other groups.

Table 2: Functional outcomes following UKR

Factor	Control Group (n = 188)	All partial thickness cartilage loss (n = 94)	P value	Partial thickness femur only (n = 18)	Partial thickness tibia only (n = 63)	Partial thickness both femur and tibia (n = 13)	P value
Year 1							
OKS (SD)	40.9 (8)	37.0 (9)	**<0.001**	38.9 (8)	36.1 (10)	38.5 (8)	0.57
AKSS-Objective (SD)	88.8 (11)	79.7 (20)	**0.007**	84.2 (15)	78.0 (23)	82.1 (16)	0.94
AKSS-Functional (SD)	88.9 (15)	85.2 (17)	0.08	90.7 (15)	84.3 (18)	82.0 (11)	0.23
Tegner Score (SD)	2.9 (1)	2.9 (1)	0.38	3.3 (1)	2.9 (1)	2.3 (1)	0.10
Year 2							
OKS (SD)	41.2 (8)	37.1 (11)	**0.02**	42.8 (3)	36.4 (11)	34.9 (12)	0.52
AKSS-Objective (SD)	88.2 (15)	76.7 (23)	**0.002**	90.0 (8)	73.5 (25)	82.6 (10)	0.29
AKSS-Functional (SD)	88.6 (15)	82.8 (19)	0.09	88.8 (16)	82.3 (20)	79.4 (17)	0.48
Tegner Score (SD)	2.9 (1)	2.9 (1)	0.69	2.8 (1)	3.0 (1)	2.6 (1)	0.81
Year 5							
OKS (SD)	41.9 (6)	39.3 (8)	**0.05**	41.8 (6)	38.5 (8)	38.9 (10)	0.45
AKSS-Objective (SD)	83.7 (13)	78.2 (13)	**0.02**	82.9 (13.5)	77.2 (13)	76.4 (15)	0.44
AKSS-Functional (SD)	87.0 (16)	80.9 (16)	**0.01**	85.5 (13)	79.5 (15)	80.0 (23)	0.54
Tegner Score (SD)	2.9 (1)	2.8 (1)	0.81	3.4 (1)	2.8 (1)	2.4 (1)	0.12

Table 3: Year One outcomes of UKR in the setting of PTCL based on MRI findings

1. MRI evidence of FTCL on both the femur and tibia within the medial compartment			
	Present (n = 12)	Absent (n = 24)	P value
OKS (SD)	35.8 (13)	38.3 (9)	0.70
AKSS-Objective (SD)	68.5 (38)	73.2 (20)	0.45
AKSS-Functional (SD)	79.6 (26)	86.5 (15)	0.70
Tegner Score (SD)	3.9 (2)	2.7 (2)	0.13
2. MRI bone marrow oedema on both femur and tibia within the medial compartment			
	Present (n = 5)	Absent (n = 31)	P value
OKS (SD)	32.4 (15)	38.1 (10)	0.39
AKSS-Objective (SD)	65.6 (44)	72.4 (26)	0.54
AKSS-Functional (SD)	84.0 (26)	83.8 (19)	0.75
Tegner Score (SD)	6.7 (1)	2.8 (4)	**0.003**
3. MRI evidence of medium or large suprapatellar effusion (12 medium, 3 large)			
	Present (n = 15)	Absent (n = 21)	P value
OKS (SD)	40.1 (6.3)	34.9 (12.7)	0.44
AKSS-Objective (SD)	80.2 (20)	63.8 (34)	0.19
AKSS-Functional (SD)	87.3 (17)	80.8 (22)	0.44
Tegner Score (SD)	3.6 (1)	2.8 (1)	0.50
4. MRI evidence of synovitis (7 mild, 4 moderate)			
	Present (n = 11)	Absent (n = 25)	P value
OKS (SD)	37.5 (11)	37.1 (10)	0.69
AKSS-Objective (SD)	70.7 (26)	71.0 (32)	0.82
AKSS-Functional (SD)	86.8 (16)	82.3 (22)	0.72
Tegner Score (SD)	3.2 (2)	3.2 (1)	0.62

Figure Legends

Figure 1: Box plot of OKS by year following UKR in the setting of full thickness cartilage loss and partial thickness cartilage loss in the medial compartment

Figure 2: Categorical outcomes using OKS criteria at one year (A), two years (B) and five years (C) following UKR in the setting of full thickness cartilage loss and partial thickness cartilage loss in the medial compartment. Significantly fewer patients with full thickness cartilage loss achieved fair or poor results at all time points.

Figure 3: Cumulative reoperation rate by year following UKR (standard deviation)