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Introduction

- Primary osteochondral allograft transplantation (OCA) to the knee has been shown to improve patient reported outcomes (PROs) at short-, mid-, and long-term follow-up.¹⁻³
- For cases of failed primary OCA...
 - Older patients: unicompartmental or total knee arthroplasty
 - Younger patients: arthroplasty = poor option due to concern for implant longevity and durability⁴
- For younger patients, revision OCA ± interventions addressing the causes of primary failure becomes the preferred option.⁵
- Promising short-term outcomes following revision OCA in prior studies, but the literature remains limited on midterm (minimum 5-years) outcomes.^{5,6}
- Purpose:** To examine midterm outcomes following revision OCA to the femoral condyle, as well as evaluate survivability from reoperation and failure, when compared to a matched cohort of primary OCA patients.
- Hypothesis:** The authors hypothesized that patients undergoing revision OCA transplantation would report improvement in outcomes with comparable reoperation and failure rates when compared to patients undergoing primary OCA transplantation at minimum 5-year follow-up.

Methods

- To conduct this study, the authors performed a review of prospectively collected data from 1999-2018 of patients who underwent primary OCA or revision OCA with a minimum of 5 year follow up.
- Inclusion Criteria:** ≥ 5-year follow-up
- Exclusion Criteria:** (1) < 5-year follow-up, (2) inflammatory arthropathy
- Clinical patient reported outcomes (PROs) evaluated included Lysholm score, International Knee Documentation Committee (IKDC) score, and Knee Injury and Osteoarthritis Outcome Score (KOOS) subscales, with previously established thresholds for **patient-acceptable symptomatic state (PASS)** utilized for each^{7,8}
- Reoperations** were defined as any subsequent surgical intervention to the transplanted allograft, including second-look arthroscopy for graft evaluation, debridement, or loose body removal.
- Failure** was defined as subchondral collapse of the OCA as confirmed via second-look arthroscopy, revision OCA, or conversion to knee arthroplasty.
- To create comparison groups, every 1 revision OCA patient was propensity matched to 2 primary OCA patients, based on age, BMI, defect size, and sex—which have all been shown to be associated with failure.^{2,9}

Variable	Primary OCA, n = 30 ¹	Revision OCA, n = 15 ¹	P-value
Sex			.999
Female	23 (77%)	11 (73%)	
Male	7 (23%)	4 (27%)	
Age (years)	35.1 ± 7.6	31.4 ± 10.0	.221
BMI	25.9 ± 3.8	25.9 ± 3.4	.998
Laterality			.010
Left	16 (53%)	2 (13%)	
Right	14 (47%)	13 (87%)	
Smoking status			.651
Current	4 (13%)	1 (6.7%)	
Former	26 (87%)	14 (93%)	
WC	3 (10%)	1 (6.7%)	.999
Prior surgeries	2.5 ± 1.5	5.6 ± 1.6	.001
Symptom duration (years)	4.7 ± 4.7	5.5 ± 5.6	.772
Defect width (mm)	19.9 ± 2.3	20.1 ± 2.6	.889

Table 1. Demographic variables for those included. BMI, body mass index. WC, workers' compensation. ¹categorical variables listed as n (% of respective group); continuous variables listed as mean ± SD

Variable	Primary OCA, n = 30 ¹	Revision OCA, n = 15 ¹	P-value
Defect location			
MFC	17 (56%)	7 (47%)	.396
LFC	13 (43%)	8 (53%)	.673
Concomitant procedures			
Major Concomitant Surgery	22 (73%)	11 (73%)	.999
LMAT	9 (30%)	5 (33%)	.999
MMAT	9 (30%)	3 (20%)	.722
HTO	2 (6.7%)	1 (6.7%)	.999
DFO	2 (6.7%)	1 (6.7%)	.999
TTO	1 (3.3%)	1 (6.7%)	.999

Table 2. Intraoperative variables for those included. DFO, distal femoral osteotomy; HTO, high tibial osteotomy; LFC, lateral femoral condyle; LMAT, lateral meniscal allograft transplantation; MFC, medial femoral condyle; MMAT, medial meniscal allograft transplantation; TTO, tibial tubercle osteotomy ¹categorical variables listed as n (%)

Characteristic	Primary OCA	Revision OCA	P-value
Subjective IKDC	7 / 9 (78%)	7 / 10 (70%)	.999
Lysholm	7 / 9 (78%)	5 / 6 (83%)	.999
KOOS Subscales			
Pain	8 / 9 (89%)	10 / 10 (100%)	.474
Symptoms	4 / 9 (44%)	7 / 10 (70%)	.370
Sport	7 / 9 (78%)	9 / 10 (90%)	.582
ADL	3 / 9 (33%)	8 / 10 (80%)	.070
QOL	9 / 9 (100%)	8 / 10 (80%)	.474

ADL, activities of daily living; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; PASS, patient acceptable symptomatic state; QOL, quality of life.

- 2 revision patients and 4 primary patients were excluded from PRO analysis due to lack of 5-year follow-up. PRO data was available for 10/13 (77%) of the remaining revision patients.
- In the **revision group**, all PROs demonstrated significant improvement at final follow-up when compared to baseline scores, with the exception of KOOS sport (p = .058).
- 5-Year PASS** achievement for each PRO ranged from **70-100%** in the **revision group**, and there were **no differences in PASS achievement** when comparing the two groups.

Results

- N = 15 revision OCA** patients w/ 5-year minimum f/u
 - Age: 31.4 ± 10.0 years
 - BMI: 25.9 ± 3.4 kg/m²
 - Follow-up: 9.3 ± 3.0 (5 – 15) years
- Revision OCA cohort:**
 - More previous surgeries** compared to primary
 - More-commonly right legged** compared to primary
 - No other demographic differences** compared to primary
- Concomitant procedure** performed in **73% of revision OCA** cases, which most consisted of meniscal allograft transplantation
- No differences** between primary and revision OCA cohorts with regards to **intraoperative variables**

Results Continued

- 8/15 (53%)** of patients in the **revision group** underwent **reoperation** at a mean of **3.9 ± 3.7 years** (0.6 – 11.2), with articular cartilage debridement of the graft being the most common.
 - Articular cartilage debridement: N = 5
 - Lysis of adhesions and synovectomy: N = 2
 - 2nd Look Arthroscopy with partial medial meniscectomy: N = 1
- No differences in survivorship free from reoperation at 5- and 10-years (P = .905)**
 - Primary: 60.0% and 60.0%
 - Revision: 60.0%, and 52.5%
- Failures:**
 - 20% of primary OCAs failed**
 - 3/15 (20%) revision OCAs failed**
 - Arthroplasty: N = 2 at mean 4.1 years following revision (1.7 – 6.4)
 - Gross failure on arthroscopy: N = 1 at 4.7 years following revision
- No differences in survivorship free from failure at 5- and 10-years (P = .577)**
 - Primary: 86.7% and 72.2%
 - Revision: 86.7%, and 78.8%

Discussion

- The primary finding from this investigation was that patients undergoing revision OCA reported a high rate of improvement in clinical outcomes at minimum 5-year follow-up, with PASS achievement rates ranging from 70% to 100% for various PROs.
- Reoperations following revision OCA were reported in 53% of patients, while failures were observed in 20%. No significant difference in reoperations or failures was appreciated when comparing patients undergoing revision OCA versus a matched cohort undergoing primary OCA.
- Of note, our study's reoperation and failure rates for revision OCA patients fell within the range of previously reported rates of revision OCA patients in the literature, with minor differences being likely attributed to differences in patient age and follow-up.
- Along with the inherent limitations found in retrospective reviews, this study is limited by its small sample size and the fact it evaluated patients from a single institution and surgeon. In addition, concomitant procedures occurred in 73% of revision patients, which may limit the generalizability to patients undergoing isolated revisions.

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