# Osteochondral Allograft Transplantation for Treatment of Primary and Salvage Femoral Condyle Osteochondritis Dissecans Lesions

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INTRODUCTION: Osteochondritis dissecans (OCD) is common disorder of articular cartilage and underlying subchondral bone. OCD is often diagnosed in teenage patients (12-19 years of age), with highest incidence reported in males. When OCD lesions are symptomatic and do not improve with nonsurgical management, surgical treatment options include: retroarticular drilling, bone grafting, marrow stimulation, osteochondral fixation, offloading osteotomy, autologous chondrocyte implantation (ACI), osteochondral autograft transfer, or osteochondral allograft transplantation (OCAT). OCAT provides the capabilities for treating irreparable femoral condyle OCD lesions of nearly any size and depth and has been reported to have advantages over other surgical treatment options for salvage treatment of failed prior procedures. The purpose of this study was to prospectively evaluate outcomes for patients undergoing OCAT for femoral condyle OCD based on patient reported pain and function and reoperation and treatment failure rates for primary vs. salvage OCAT. We hypothesized that OCAT for the treatment of large femoral condyle OCD lesions would lead to successful outcomes in >90% of cases for both primary and salvage cohorts.

METHODS: With IRB approval, patients were prospectively enrolled into a dedicated registry established to follow OCAT outcomes. All OCATs were performed using fresh, high-chondrocyte-viability allografts (MOPS®, MTF Biologics) between January 1, 2016, and December 31, 2021. Patients were eligible for inclusion when they underwent OCAT for treatment of one or more large (>2cm$^2$) OCD lesion(s) involving one or both femoral condyles. Patient cohorts were defined as: 1) primary OCAT: OCAT performed for femoral condyle OCD as first definitive surgical treatment, or 2) salvage OCAT: OCAT performed for femoral condyle OCD and at least one prior major surgical treatment attempted (retroarticular drilling, bone grafting, marrow stimulation, fixation, osteotomy, ACI, OCAT). OCATs were performed using either press-fit cylindrical (plug) or custom-cut patient-specific shell allografts saturated immediately before implantation with autogenous bone marrow aspirate concentrate (BMAC). In cases requiring resection of recipient bone to a greater depth (>9 mm) to reach viable, bleeding bone, Reamer Irrigator Aspirator (RIA) (DePuy-Synthes) bone graft obtained from the ipsilateral femur was placed into the defect prior to OCA implantation. Viable chondrocyte density (VCD) of OCAs at the time of OCAT was determined, when possible, as previously described. Each patient received procedure-specific postoperative rehabilitation instructions verbally and as a written prescription. Visual analog scale (VAS) for pain, International Knee Documentation Committee (IKDC), Single Assessment Numeric Evaluation (SANE), Patient Reported Outcomes Measurement Information System (PROMIS) physical function, and PROMIS Mobility scores were collected preoperatively, 3 months, 6 months and yearly after surgery. Patient satisfaction was assessed using the modified Surgical Satisfaction Questionnaire. Patient electronic medical records were used to determine demographic information, operative data, postoperative complications, and reoperations. Failure was defined as conversion to arthroplasty and revision was defined as reoperation to revise any of the previously implanted OCAs. Outcomes were categorized as successful when patients returned to functional activities without need for revision or arthroplasty surgery. Initial success rate was calculated using the formula: 100% - (%revision + %failure).
*Analysis:* Data were included for statistical analyses when applicable registry data were available for patients undergoing OCAT for femoral condyle OCD with ≥2-year follow-up data available. Descriptive statistics were calculated to report means, medians, ranges, and percentages. Normality tests were performed. One-way analyses of variance with Tukey post hoc analyses were used to assess for significant differences over time. Differences in patient-reported outcome measures were also assessed for minimum clinically important differences. Primary and salvage cohorts were compared for statistically significant differences using t-Tests or Fishers Exact Tests. Significance was set at $P < .05$.

RESULTS: All eligible patients with femoral condyle OCD who were prospectively enrolled in the registry and met inclusion criteria (n=22 consecutive cases) were included for analysis, with none lost to 2-year follow-up (mean: 40.3 months, range: 24-82 months). No significant differences were found between groups for age, BMI, lesion type, lesion size, chondral vs. osteochondral classification, plug vs. shell, or viable chondrocyte density of the graft used for surgery. The overall success rate for the entire study population was 90.9% (20/22). One patient in the primary OCAT cohort required revision OCAT and one patient in the salvage OCAT cohort required conversion to total knee arthroplasty (TKA). VAS pain, IKDC, SANE, PROMIS Physical Function, and PROMIS Mobility scores showed statistically significant ($p<0.05$) and clinically meaningful improvements for all cohorts at 1-year and final follow-up (**Table 1**). There were no significant differences in patients undergoing primary or salvage OCAT. At final follow-up, 20 patients (90.9%) reported that they were satisfied or very satisfied and 21 patients (95.5%) reported that they would opt for OCAT treatment again if in the same situation.

DISCUSSION: The results of this study support acceptance of the hypothesis in that OCAT for large femoral condyle OCD lesions was associated with successful outcomes in 91% of cases at a mean of >3 years after OCAT, with no significant differences between primary and salvage procedure outcomes. In the present study, one revision in the primary OCAT cohort and one conversion to TKA in the salvage OCAT cohort were documented. The revision OCAT was associated with radiographic healing and restored knee function 2 years after the second OCAT, bringing the overall success rate to 96%.

SIGNIFICANCE/CLINICAL RELEVANCE: The results of this prospective clinical study suggest that OCAT is an appropriate option for primary surgical treatment, and as a salvage procedure for patients that experience treatment failure after another primary surgical intervention, for femoral condyle OCD when high-chondrocyte-viability OCAs, optimized transplantation techniques, and robust patient management strategies can be implemented.

**Table 1 – Mean (range) Patient-Reported Outcomes after OCAT for Femoral Condyle OCD**

| | All (n=22) | | | Primary OCAT (n=11) | | | Salvage OCAT (n=11) | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Pre** | **1 yr** | **FFU** | **Pre** | **1 yr** | **FFU** | **Pre** | **1 yr** | **FFU** |
| **Pain** | 5.0 (2-8) | 1.5 (0-8.5) | 1.3 (0-6) | 5.2 (2-8) | 1.2 (0-5) | 1.2 (0-6) | 4.8 (3-7.5) | 1.7 (0-8.5) | 1.3 (0-4) |
| **IKDC** | 44.8 (26-62) | 60.1 (38-91) | 69.9 (51-98) | 47.3 (36-62) | 62.6 (38-91) | 72.6 (52-98) | 42.8 (26-54) | 57.5 (45-85) | 67.4 (51-91) |
| **SANE** | 54.5 (20-85) | 68.4 (42-100) | 80.4 (48-100) | 50.9 (20-82) | 72.0 (42-100) | 87.3 (70-100) | 58.1 (25-85) | 64.7 (45-85) | 75.3 (48-90) |
| **PROMIS PF** | 39.7 (21-49) | 45.6 (33-59) | 49.8 (36-61) | 37.2 (21-44) | 46.5 (39-58) | 51.5 (40-61) | 41.5 (34-49) | 44.7 (33-59) | 48.0 (36-60) |
| **PROMIS Mob** | 40.5 (27-60) | 44.8 (30-60) | 50.0 (36-60) | 37.7 (27-43) | 46.3 (40-60) | 50.8 (42-60) | 42.7 (33-60) | 42.7 (30-60) | 49.4 (36-60) |

Key – OCAT: osteochondral allograft transplant; Pre: Pre-operative; 1 yr: one year; FFU: final follow-up; IKDC: International Knee Documentation Committee; SANE: Single Assessment Numeric Evaluation; PROMIS PF: Patient-Reported Outcomes Measurement Information System physical function form; PROMIS Mob: Patient-Reported Outcomes Measurement Information System mobility form