Original Article

Immune Hypersensitivity Is Associated With Higher Graft Failure Rate After Osteochondral Allograft Transplantation of the Knee

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Purpose: To analyze the effects of 1 or more patient-reported allergies on clinical outcomes, in particular graft failure rate, and patient-reported outcomes (PROs) following osteochondral allograft transplantation (OCA) of the knee. **Methods:** Retrospective review of patients who underwent knee OCA from August 2010 to May 2021 with a minimum of 2-year follow-up. Patients were initially divided into 2 cohorts: those with at least 1 allergy and those without any allergies. Clinical outcomes assessed included graft failure, reoperation rates, deep vein thrombosis/pulmonary embolism, and manipulation under anesthesia/lysis of adhesions (MUA/LOA). PROs assessed, including the visual analog scale (VAS) for pain and satisfaction, the Knee injury and Osteoarthritis Outcome Score (KOOS), and return to sport rates, were compared. **Results:** In total, 285 patients were included with a mean clinical follow-up of 4.8 ± 2.0 years. The allergy cohort had a significantly higher rate of graft failure ($P = .008$). In a regression analysis controlling for confounding variables, graft failure remained significantly associated with the presence of medication allergies (odds ratio [OR], 3.631; 95% CI, 1.139-11.577; $P = .029$). Furthermore, an increasing number of allergies were associated with an increased rate of graft failure (OR, 1.644; 95% CI, 1.074-2.515; $P = .022$). There was no difference in rate of reoperation, complications, infection, and MUA/LOA. Of the 100 patients who completed PROs, there was no difference in VAS satisfaction, pain, and any of the KOOS outcome scores or return to sport. **Conclusions:** The presence of 1 or more patient-reported allergies was shown to be significantly associated with OCA graft failure. Furthermore, an increasing number of patient-reported allergies were associated with a higher rate of graft failure. However, there were no significant differences in VAS satisfaction or pain, KOOS symptom, quality of life, pain, or return to sport in patients with at least 1 patient-reported allergy and those without allergies. **Level of Evidence:** Level III, retrospective cohort study.

Localized chondral lesions are a common knee pathology.[1] Osteochondral allograft transplantation (OCA) is a restorative technique for addressing articular cartilage defects that involves the transfer of mature viable chondrocytes with subchondral bone from cadaveric donors into size-matched lesions.[2,3] OCA has become an increasingly popular procedure, with a growth in the number of procedures performed in the United States from 660 cases in 2005 to 1,619 transplants in 2011 and has continued to increase roughly 5% a year since then.[4,5] The OCA technique has produced good functional outcome and good survival rates.[6] Due to its increasing popularity and success, many studies have investigated factors that may impact outcomes after OCA.[7-9]

Unlike other forms of allogenic transplantation, OCAs are not human leukocyte antigen or ABO blood group matched prior to implantation and do not require immunosuppression post-transplant.[10] This is due to the low risk of clinically significant immune response within the joint, which is believed to be safeguarded by intact cartilage matrix preventing contact between donor chondrocytes and host antibodies.[11] However, immunogenic response after OCA transplantation has been observed following OCA transplantation and is of particular concern in patients with hyperactive immune responses.[10,12] Removing all marrow elements from the

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donor subchondral bone and limiting the amount of transferred bone are utilized to decrease any potential immunogenic response.

Studies have analyzed the effect of allergies on patient-reported outcomes (PROs) following OCA. For example, Wright-Chisem et al.[12] conducted a retrospective analysis of 245 patients after OCA of the knee from 1 large academic institution. They obtained information on patient-reported allergies and PRO scores and found that the presence of 1 or more drug allergies was not associated with worse PROs at the 2-year follow-up. However, while Wright-Chisem et al.[12] found no differences in PROs, they did not study the effect of patient-reported allergies on clinical outcomes like graft failure. Other knee surgeries, such as total knee arthroplasty (TKA), have been shown to have not only worse PROs for patients with allergies but also worse clinical and functional outcomes.[13-15] In particular, current literature has identified patient drug allergies as a risk factor influencing outcomes after OCA and other knee surgeries like TKA.[12,16,17] The reasons advanced for the worsened outcomes observed in patients with self-reported allergies in the orthopaedic literature include concomitant psychiatric disorders, including depression, which have been shown to have a higher prevalence among those with greater numbers of self-reported allergies, and the use of second-line antibiotics, which may increase the rate of prosthetic joint infection.[18,19] However, there has been a lack of study of the effect of patient-reported allergies on clinical outcomes following OCA.[12]

The purpose of the present study is to analyze the effects of 1 or more patient-reported allergies on clinical outcomes, in particular graft failure rate, and PROs following OCA of the knee. Our hypothesis is that due to an increased immunogenic response, patients with allergies will have worsened clinical outcomes and PROs, in particular a higher rate of graft failure.

Methods

Study Design

Institutional review board (protocol i19-01430) approval was obtained before commencing study activities. A retrospective review of patients who underwent an osteochondral allograft procedure from August 2010 to May 2021 at a single academic medical institution was conducted. All patients who underwent a unilateral osteochondral allograft implantation were initially included. Patients were then excluded if they did not have a minimum 2-year follow-up after surgery.

The electronic medical record was queried for demographic data such as age, sex, and body mass index (BMI). Medical history regarding postoperative course, reoperation rate, and graft failure were recorded for all subjects. Concomitant procedures, including high tibial osteotomy, tibial tubercle osteotomy, distal femoral osteotomy (DFO), meniscus allograft transplantation, anterior cruciate ligament reconstruction (ACLR), meniscus surgery, and medial patellofemoral ligament reconstruction/medial quadriceps tendon-femoral ligament reconstruction (MPFLR)/(MQTFLR), were also recorded through review of operative notes in the electronic medical record. Complications assessed included graft failure, infection, reoperation rates, deep vein thrombosis/pulmonary embolism (DVT/PE), and manipulation under anesthesia/lysis of adhesions (MUA/LOA). Lesion size and lesion location were obtained through review of operative notes in the electronic medical record. The presence of a concomitant psychiatric diagnosis, which has been shown to be associated with the presence of patient-reported allergies, was also obtained through review of the patient's chart.[19] The psychiatric diagnoses that were analyzed in this study were depression, anxiety, bipolar, schizophrenia, attention-deficit/hyperactivity disorder, posttraumatic stress disorder, obsessive-compulsive disorder, eating disorder, personality disorder, or severe substance addiction. History of previous ipsilateral knee surgery was also obtained through review of the patient's electronic medical record.

Graft failure was defined as subchondral collapse confirmed on imaging, removal or revision of primary OCA, or conversion to any form of arthroplasty. Subchondral collapse was identified on magnetic resonance imaging by a fellowship-trained musculoskeletal radiologist at our institution. The graft was evaluated for incomplete healing at the graft-bone interface through evaluation of the low signal subchondral bone plate, which normally appears smooth; subchondral collapse was defined as a deformation of this normally smooth surface.

The grafts used in the present study were OCA graft cores (JRF Ortho) or plugs harvested from patella, trochlear, or condylar allografts. The grafts are fresh, undergo standard contamination testing, and are used within 28 days following harvesting from a donor. Pulse lavage is used prior to implantation to minimize the transfer of immunogenic bone marrow element.

Patients were initially divided into 2 cohorts: those with at least 1 allergy (allergy cohort) and those with no reported medication allergies (no allergy cohort), and outcomes were compared. An additional analysis comparing patients with at least 1 medication allergy (med-allergy cohort) and no allergies (no-med allergy cohort) was conducted. A subanalysis of patients who completed PROs, including the visual analog scale (VAS) for pain and satisfaction, the Knee injury and Osteoarthritis Outcome Score (KOOS), and return to sport rates, were compared.

Table 1. Demographics and Clinical Outcomes of Patients With Osteochondral Allograft Transplantation Procedures in the Knee With or Without Any Allergy

Characteristic	Total Cohort (n = 285)	No Allergy (n = 199)	Allergy (n = 86)	*P* Value
Demographics				
Female	118 (41.4)	73 (36.9)	50 (58.3)	**.002**
Age, y	32.4 ± 11.1	31.9 ± 10.8	33.8 ± 11.6	.171
BMI	27.0 ± 5.2	27.8 ± 5.1	27.6 ± 5.5	.231
Clinical outcomes				
Graft failure	17 (6.0)	7 (3.5)	10 (11.6)	**.008**
Need for reoperation	55 (19.3)	35 (17.6)	20 (23.3)	.267
LOA/MUA	21 (7.4)	17 (8.5)	4 (4.7)	.250
DVT/PE	8 (2.8)	6 (3.0)	2 (2.3)	.747
Infection	2 (1.0)	1 (0.1)	1 (1.0)	.541

NOTE. Values are reported as number (%) or mean ± SD. Significant values are in bold font.
BMI, body mass index; DVT/PE, deep vein thrombosis/pulmonary embolism; LOA/MUA, manipulation under anesthesia/lysis of adhesions.

Clinical Outcomes

The KOOS was the primary PRO used to evaluate postsurgical knee symptoms, outcomes, and quality of life, given its widespread use within this population.[20-22] The KOOS subscores included in our analyses were pain, symptom, sport, and knee-related quality of life (QOL). Satisfaction with the outcomes of their surgical procedure and pain intensity were recorded on a VAS ranging from 0 to 100.

Return-to-Sport Participation

Patients were administered a survey obtaining information about the type and level of sport played prior to injury. Return to sport and level of return, including returning at a lower level or returning at the same level of sport or higher, was collected in the survey. Additionally, physical and psychological factors that influence return to preinjury activity were collected among patients who stated they were unable to return or those who returned at a lower level of play.

Statistical Analysis

Statistical analysis was completed using SPSS, Version 24 (IBM Corp). Normally distributed continuous variables between cohorts were compared using the 2-sample Student *t* test. The Mann-Whitney *U* test was used for non-normally distributed variables. The χ^2 analysis was done to compare categorical and binomial variables. Findings were considered significant at $P \leq .05$. Linear regression analyses were used to assess relationships with continuous dependent variables while logistic regression analyses were used to analyze relationships with binary or categorical dependent variables. Given the large number of confounding variables that could influence the outcomes of patients following OCA of the knee, in each of the regression analyses conducted in the present study, the following set of variables were controlled for as covariates; age, sex, BMI, lesion size, lesion location, the presence of the 7 different types of concomitant procedures, presence of a concomitant psychiatric diagnosis, and previous ipsilateral knee surgery.

An a priori independent samples *t* test power analysis was conducted with a medium effect size given by Cohen's $d = 0.4$, a desired statistical power of 0.8 with α set at 0.05, and an enrollment ratio of 3:1. This analysis suggested that cohort sizes of 198 and 66, respectively, would be necessary to identify a statistically significant difference between cohorts.

Results

Patient Demographics

In total, 330 patients underwent a unilateral OCA during the time period under study. Of these, 285 patients were found to have a minimum of 2 years of clinical follow-up and a mean clinical follow-up of all patients of 4.8 ± 2.0 years. There were no significant differences between the no-allergy and allergy cohorts with respect to age (31.8 ± 11.1 vs 34.1 ± 11.1, $P = .113$) and BMI (26.7 ± 5.0 vs 28.0 ± 5.8, $P = .101$). There was a significant difference in sex between no-allergy and allergy cohorts (41.4% females vs 53.4% males, $P = .02$) (Table 1). Concomitant procedures, including high tibial osteotomy, tibial tubercle osteotomy, distal femoral osteotomy, meniscus allograft transplantation, ACLR, meniscus surgery, and medial patellofemoral ligament reconstruction/medial quadriceps tendon-femoral ligament reconstruction, were recorded and compared between the no-allergy and allergy cohorts. There were no significant differences in the incidence of any of these concomitant procedures except that meniscus allograft transplantation occurred more often in the no-allergy cohort (8.0% vs 0.0%, $P = .008$) (Table 2). The mean size of the OCA graft used in the present study was 21.0 mm. Additionally, of the 285 patients in the present study, 262 (91.9%) had surgery with 1 plug while 23 (8.1%) patients had surgery with 2 plugs.

Table 2. Concomitant Procedures of Patients With Osteochondral Allograft Transplantation Procedures in the Knee With or Without Any Allergy

Characteristic	Total Cohort (n = 285), n (%)	No Allergy (n = 199), n (%)	Allergy (n = 86), n (%)	*P* Value
HTO	24 (8.4)	17 (8.5)	7 (8.1)	.910
TTO	50 (17.5)	37 (18.6)	13 (15.1)	.479
DFO	10 (3.5)	8 (4.0)	2 (2.3)	.475
Meniscus allograft transplantation	16 (5.6)	16 (8.0)	0 (0.0)	**.007**
ACLR	15 (5.2)	11 (5.5)	4 (4.7)	.761
Meniscus surgery	70 (23.5)	44 (22.1)	26 (26.1)	.397
MPFLR/MQTFLR	25 (8.8)	19 (9.5)	6 (6.8)	.481

NOTE. Significant values are in bold font.

ACLR, anterior cruciate ligament reconstruction; DFO, distal femoral osteotomy; HTO, high tibial osteotomy; MPFLR/MQTFLR, medial patellofemoral ligament reconstruction/medial quadriceps tendon-femoral ligament reconstruction; TTO, tibial tubercle osteotomy.

The overall graft failure rate was 6.0%. The mean time to graft failure was 1.91 ± 1.22 years (range, 0.05 to 4.13 years), and there was no significant difference in the time to graft failure between patients who did and did not have allergies (2.10 ± 1.20 vs 1.78 ± 1.33, $P = .711$).

All Allergy Analysis

Clinical Outcomes. The allergy cohort had a significantly higher rate of graft failure when compared to the no-allergy cohort (11.6% vs 3.5%, $P = .008$). Additionally, no significant difference was found between the no-allergy and allergy cohorts with respect to DVT/PE (3.0% vs 2.3%, $P = .747$), need for reoperation (17.6% vs 23.3%, $P = .267$), LOA/MUA (8.5% vs 4.7%, $P = .250$), and infection rate (0.1% vs 1.0%, $P = .541$) (Table 1).

Additionally, among the 55 patients who underwent reoperation in the present study, the reasons were heterogeneous, including 20 patients with recurrent pain (36.4%), 20 patients with postoperative stiffness (36.4%), 13 patients with failure of graft incorporation (23.6%), 1 patient for anterior cruciate ligament (ACL) surgery following ACL tear, and 1 patient for traumatic fracture after a fall.

Furthermore, in a logistic regression analysis controlling for age, sex, and BMI, graft failure rate (odds ratio [OR], 3.631; 95% CI, 1.139-11.577; $P = .029$) was found to be significantly associated with the presence of at least 1 allergy. However, need for reoperation (OR, 1.561; 95% CI, 0.756-3.221; $P = .228$), LOA/MUA (OR, 0.620; 95% CI, 0.163-2.362; $P = .483$), and DVT/PE (OR, 0.014; 95% CI, 0.000-1.765; $P = .084$) were still not associated with the presence of allergies.

Patient-Reported Outcomes Subanalysis. Of the 100 patients who completed PROs, 6 (6.0%) patients experienced graft failure. There was no significant difference in KOOS symptoms, pain, sports, or QOL scores between patients with at least 1 allergy and those without allergies. Furthermore, when a linear regression was performed controlling for confounding variables for KOOS pain, symptoms, sports, and QOL, there was no significant association with the presence of any allergies. Additionally, there was no significant difference in VAS pain or satisfaction scores between cohorts (Table 3).

Return to Sport. There was no significant difference in return to sport between the any-allergy cohort and no-allergy allergy cohort ($P = .936$). Furthermore, in a regression analysis controlling for confounding variables, there was no significant association with the presence of medication allergies and return to sport.

Total Number of Allergies Analysis. A logistic regression analysis that controlled for age, sex, and BMI found that an increasing number of allergies were

Table 3. Patient-Reported Outcomes of Patients With Osteochondral Allograft Transplantation Procedures in the Knee With or Without Any Allergy

Patient-Reported Outcome	No Allergy (n = 63), Mean ± SD	Allergy (n = 37), Mean ± SD	*P* Value
KOOS symptoms	74 ± 20	77 ± 16	.442
KOOS pain	77 ± 22	76 ± 17	.815
KOOS QOL	55 ± 24	56 ± 18	.866
KOOS sport/recreation	61 ± 28	53 ± 28	.159
VAS pain	32 ±30	33 ± 27	.861
VAS satisfaction	74 ± 28	67 ± 34	.224

KOOS, Knee injury and Osteoarthritis Outcome Score; QOL, quality of life; VAS, visual analog scale.

Table 4. Logistic Regression Analysis for Association of Increasing Number of Allergies With Clinical Outcome Variables

Characteristic	Odds Ratio	95% CI	*P* Value
Graft failure	1.644	1.074-2.515	**.022**
Need for reoperation	1.024	0.741-1.415	.885
LOA/MUA	0.566	0.213-1.503	.254
DVT/PE	0.006	0.000-1.820	.080

NOTE. Significant values are in bold font.
DVT/PE, deep vein thrombosis/pulmonary embolism; LOA/MUA, manipulation under anesthesia/lysis of adhesions.

associated with an increased rate of graft failure (OR, 1.644; 95% CI, 1.074-2.515; $P = .022$). Additionally, MUA/LOA (OR, 0.566; 95% CI, 0.213-1.503; $P = .254$), reoperation (OR, 1.024; 95% CI, 0.741-1.415; $P = .885$), and DVT/PE (OR, 0.006; 95% CI, 0.000-1.820; $P = .080$) were not found to have an association with the total number patient-reported allergies (Table 4).

Medication Allergy Subanalysis

Clinical Outcomes. There was no significant difference between med-allergy and no-med allergy cohorts with respect to graft failure (10.0% vs 4.8%, $P = .138$), DVT/PE (3.3% vs 2.7%, $P = .782$), reoperation (19.1% vs 19.6%, $P = .831$), LOA/MUA (5.1% vs 8.0%, $P = .431$), and infection rate (1.0% vs 0.4%, $P = .315$) (Table 5).

Furthermore, in a logistic regression analysis controlling for covariates for graft failure (OR, 1.752; 95% CI, 0.512-5.994; $P = .372$), DVT/PE (OR, 0.062; 95% CI, 0.001-5.307; $P = .221$), need for reoperation (OR, 0.825; 95% CI, 0.349-1.950; $P = .661$), and LOA/MUA (OR, 0.704; 95% CI, 0.154-3.214; $P = .651$) were not significantly associated with the presence of medication allergies.

Patient-Reported Outcomes Subanalysis. Of the 100 patients who completed PROs, there was no significant difference in KOOS symptom, pain, sports, or QOL between patients with at least 1 medication allergy and those without any medication allergy. Additionally, when a linear regression was performed controlling for confounding variables for KOOS pain, symptoms, sports, and QOL, there was no significant association with the presence of medication allergies. Additionally, there was no significant difference in VAS pain or satisfaction scores (Table 6).

Return to Sport. Of the 285 patients included in the study, 96 (33.6%) reported playing sports before surgery. Of these patients, 57 (59.4%) returned to sport. There was no significant difference in return to sport between the med-allergy cohort and no-med allergy cohort ($P = .976$). Furthermore, in a regression analysis controlling for confounding variables, there was no significant association with the presence of medication allergies and return to sport.

Number of Medication Allergies Analysis. A logistic regression analysis that controlled for confounding variables graft failure (OR, 1.490; 95% CI, 0.713-3.116; $P = .289$), MUA/LOA (OR, 0.615; 95% CI, 0.193-1.959; $P = .410$), reoperation (OR, 0.837; 95% CI, 0.477-1.467; $P = .534$), and DVT/PE (OR, 0.221; 95% CI, 0.001-5.307; $P = .221$) found no significant association with the number of medication allergies (Table 7).

Discussion

The principal finding of this investigation underscores a significant association between the presence of patient-reported allergies and an elevated rate of graft failure in individuals undergoing OCA transplantation of the knee. This observation substantiates our initial hypothesis, suggesting that patients with 1 or more allergies will exhibit compromised clinical outcomes,

Table 5. Demographics and Outcomes of Patients With Osteochondral Allograft Transplantation Procedures in the Knee With or Without Medication Allergy

Characteristic	Total Cohort (n = 285)	No Medication Allergy (n = 225)	Medication Allergy (n = 60)	*P* Value
Demographics				
Male	118 (41.4)	84 (37.2)	34 (56.7)	**.018**
Age, y	32.4 ± 11.1	31.7 ± 10.9	34.4 ± 12.0	**.040**
BMI	27.0 ± 5.2	26.9 ± 5.0	27.2 ± 6.5	.591
Clinical outcomes				
Graft failure	17 (6.0)	11 (4.8)	6 (10.0)	.138
Need for reoperation	55 (19.3)	44 (19.6)	11 (19.1)	.831
LOA/MUA	21 (7.4)	18 (8.0)	3 (5.1)	.431
DVT/PE	8 (2.8)	6 (2.7)	2 (3.3)	.782
Infection	2 (1.0)	1 (0.4)	1 (1.0)	.315

NOTE. Values are reported as number (%) or mean ± SD. Significant values are in bold font.
BMI, body mass index; DVT/PE, deep vein thrombosis/pulmonary embolism; LOA/MUA, manipulation under anesthesia/lysis of adhesions.

Table 6. Patient-Reported Outcomes of Patients With Osteochondral Allograft Transplantation Procedures in the Knee With or Without Medication Allergy

Patient-Reported Outcome	No Medication Allergy (n = 75), Mean ± SD	Medication Allergy (n = 25), Mean ± SD	*P* Value
KOOS symptoms	74 ± 19	79 ± 15	.216
KOOS pain	76 ± 21	78 ± 18	.751
KOOS QOL	54 ± 23	59 ± 30	.432
KOOS sport/recreation	59 ± 29	56 ± 28	.593
VAS pain	32 ± 29	33 ± 28	.857
VAS satisfaction	75 ± 27	62 ± 37	.057

KOOS, Knee injury and Osteoarthritis Outcome Score; QOL, quality of life; VAS, visual analog scale.

particularly with regard to graft failure, which is thought to be due to an exaggerated immune response. Our study revealed a dose-response relationship: an increasing number of allergies corresponds to an increased likelihood of graft failure. However, contrary to our hypothesis, the presence of allergies did not yield significant differences in PROs across the studied cohorts. Moreover, our hypothesis relating to the impact of medication allergies on clinical outcomes and PROs was invalidated, as no substantial disparities were observed in any clinical or PROs between patients with at least 1 medication allergy and those without.

This was a surprising and seemingly contradictory result as a higher rate of graft failure in the allergy cohort would be expected to be associated with lower PRO scores. It must be noted that 1 limitation of this study was the significantly smaller cohort of patients in the PRO analysis (n = 100) relative to the clinical outcomes analysis (n = 285). In particular, only 3 of the patients in the study who had allergies and graft failure also completed the PRO survey. Thus, it is likely that the PRO analysis was limited by type II error and unable to identify a statistically significant difference. One might also speculate a possible reason for the discrepancy in findings of an increased rate of graft failure among the allergy cohort but no difference in PROs in the much smaller PRO subanalysis could be due to an underrepresentation of graft failure patients among the PRO cohort. However, the proportion of patients with graft failure was the same (6.0%) in the overall cohort and the subset of patients who completed PROs, and therefore an underrepresentation of graft failure patients in the PRO subanalysis is an unlikely cause for the lack of a significant difference between cohorts.

Table 7. Logistic Regression Analysis for Association of Increasing Number of Medication Allergies With Clinical Outcome Variables

Characteristic	Odds Ratio	95% CI	*P* Value
Graft failure	1.409	0.713-3.116	.289
Need for reoperation	0.837	0.477-1.467	.534
LOA/MUA	0.615	0.193-1.959	.410
DVT/PE	0.221	0.001-5.307	.221

DVT/PE, deep vein thrombosis/pulmonary embolism; LOA/MUA, manipulation under anesthesia/lysis of adhesions.

Several studies have investigated the effect of allergies on PROs following orthopaedic surgery.[23,24] Wright-Chisem et al.[12] conducted a retrospective analysis of 245 patients following OCA transplantation of the knee. They found that the presence of 1 or more drug allergies was not associated with worse PROs at 2-year follow-up. Specifically, they found no significant difference in postoperative Knee Outcome Survey of Daily Living Scale, preoperative Marx Activity Scale, preoperative International Knee Documentation Committee subjective knee form, preoperative VAS pain, and VAS for subjective health state between those reporting a history of drug allergy and those who did not. Coxe et al.[23] conducted a retrospective cohort study of 137 patients undergoing ambulatory hand surgery and found no association between the presence of patient-reported allergies and postoperative pain or satisfaction levels. Similarly, Nixon et al.[24] retrospectively analyzed a cohort of 159 patients undergoing foot or ankle surgery and found that patient-reported allergies were not associated with postoperative Patient-Reported Outcomes Measurement Information System, pain, or depression scores. Bi et al.[25] conducted a retrospective cohort study of 141 patients who underwent MPFL reconstruction and obtained data on the presence of patient-reported allergies. They found that increasing numbers of patient-reported allergies were not associated with return to sport pain, functional outcomes, or satisfaction following surgery.

Our findings echo similar results to previous research as we did not find a difference in PROs and self-reported allergies with regards to OCA transplantation of the knee. Our study found no significant difference in return to sport, KOOS symptom, pain, sports, and QOL as well as VAS pain and satisfaction scores between patients with at least 1 patient-reported allergy and those without allergies. Furthermore, our subanalysis comparing patients with 1 or more patient-reported drug allergy to patients without any drug allergies found no significant differences in any of the

PROs analyzed, in agreement with Wright-Chisem et al.[12]

Although there is a lack of literature studying the effect of allergies on clinical outcomes after OCA transplantation of the knee, the effects of allergies on clinical and functional outcomes following other types of orthopaedic surgery have been studied. McLawhorn et al.[15] conducted a retrospective cohort study of 257 patients receiving primary TKA and recorded patient-reported allergies. They found that an increasing number of patient-reported allergies were significantly associated with increased length of stay following surgery and decreased Western Ontario and McMaster Universities scores at 2-year follow-up. Similarly, multiple studies have shown that patients who report allergies have less postoperative satisfaction following arthroplasty.[13-15,26,27] Swartwout et al.[28] found that patients reporting at least 1 allergy had worse self-reported outcomes following hip arthroscopy compared with patients with no allergies. Our study found that the presence of at least 1 patient-reported allergy was associated with a higher rate of graft failure following surgery and that an increasing number of allergies were associated with an increased rate of graft failure following surgery. While the outcomes variables analyzed by our study and those in McLawhorn et al.[15] were different, they both found worse clinical outcomes for patients with allergies undergoing these respective knee surgeries, in agreement with our study.

Limitations

Several limitations warrant acknowledgment in this study. The primary limitation of this study was the low number of patients who completed surveys for the PRO analysis. As a result, many of the comparisons that were made were likely underpowered to identify a statistically significant difference and were limited by type II error. Although PRO data were collected prospectively, the retrospective nature of the analysis introduces potential biases stemming from recall and response tendencies. Furthermore, the absence of preoperative PROs constrains the extent to which we can quantify postoperative improvements accurately. Additionally, the reliance on chart review of electronic medical records to obtain patient-reported allergy data may lead to underestimations if allergies were not duly recorded. Another noteworthy limitation pertains to the heterogeneity and multitude of concurrent procedures undertaken by the study participants, which might complicate the interpretation of clinical outcomes.

Conclusions

The presence of 1 or more patient-reported allergies was shown to be significantly associated with OCA graft failure. Furthermore, an increasing number of patient-reported allergies were associated with a higher rate of graft failure. However, there were no significant differences in VAS satisfaction or pain, KOOS symptom, QOL, pain, or return to sport in patients with at least 1 patient-reported allergy and those without allergies.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: L.J. reports a relationship with Arthrex that includes Research Support; is a consultant or advisor for Mitek Systems, Smith & Nephew, and Wolters Kluwer Health; is on the editorial or governing board for the *Bulletin for the Hospital for Joint Diseases* and *JBJS Reviews*; and has stock or stock options with Lazurite. E.S. is a board member of the American Academy of Orthopaedic Surgeons, American Orthopaedic Association, Arthroscopy Association of North America, and *Cartilage, Bulletin of the Hospital for Joint Diseases*; has provided paid expert testimony for Arthrex, Organogenesis, Smith & Nephew, and Vericel Corporation; has equity or stocks with Better Therapeutics; has received nonfinancial support from Carti-Heal Ltd; has received funding grants from Fidia Pharma USA, Jaypee Publishing, Stryker, Springer Media BV, and Organogenesis; and is a consultant or advisor for JRF Ortho, Subchondral Solutions, Organogenesis, Smith & Nephew, and Vericel Corporation. K.A.C. is a board member of the American Academy of Orthopaedic Surgeons and Arthroscopy Association of North America and received funding grants from Stryker. All other authors (M.M., L.V., I.H., S.Z., A.B., J.T., G.G.L.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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