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High Return to Sport in Patients Over 45 Years of Age Undergoing Osteochondral Allograft Transplantation for Isolated Chondral Defects in the Knee

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Abstract

Objective: The purpose of this study was to evaluate the efficacy of osteochondral allograft (OCA) in patients older than 45 years of age, particularly with respect to return to sport. *Design:* A retrospective review was performed to evaluate patients greater than 45 who underwent an OCA for a symptomatic osteochondral defect of the knee between June 2011 and January 2019. *Results:* Overall, there were 18 patients (76% male) that met our inclusion and exclusion criteria. Follow-up was attained in 14 of these patients (78%). The mean age of patients included was 52.6 years (48-57) with a mean of 37 months of follow-up (18-60). Visual Analogue Scale scores decreased significantly from the preoperative baseline to final follow-up (7.7 $\pm$ 1.7 vs. 2.0 $\pm$ 2.0, $P < 0.01$). Furthermore, the mean Visual Analogue Scale while playing sport was 3.4 $\pm$ 3.2, and the mean Knee Injury and Osteoarthritis Outcome Score was 77.5 $\pm$ 12.7 at final follow-up. Overall, 11 patients (78.6%) were able to return to their desired sport. No clinical failures were identified during the follow-up period. *Conclusion:* In our series of patients 45 years and older who were treated with OCA for focal osteochondral injuries of the knee, we found a significant improvement in clinical outcome scores at a midterm follow-up of 37 months with no revision OCA procedures or conversion to any form of knee arthroplasty. In addition, a high percentage of patients were able to return to their preferred level of athletic activity.

Keywords

osteochondral allograft, age, return to sport

Introduction

Chondral and osteochondral lesions of the knee are common, with as many as 34% to 62% of knee arthroscopies demonstrating the presence of focal cartilage damage.[1-4] Injuries to articular cartilage are often painful and may accelerate the development of osteoarthritis.[5,6] There currently is no gold standard treatment for symptomatic isolated chondral defects of the knee, but a variety of factors including the size, location, and status of the underlying subchondral bone plate can assist surgeons in selecting the most appropriate management strategy. Transplantation of osteochondral grafts has been shown to be efficacious for the treatment of cartilage lesions, with various studies highlighting a consistently positive impact on functional outcomes, reliable survivorship, and high rates of return-to-play in athletes.[7-11]

Osteochondral allograft (OCA) transplantation has traditionally been primarily indicated in young, active patients due to historical findings demonstrating less favorable outcomes in patients over the age of 30.[12] However, recent analyses[13-15] have explored potential confounding variables associated with age. Notably, other patient characteristics more commonly found in older populations, such as prior surgeries, long-standing defects, and high body mass index, have been shown to influence graft failure.[12,16] The literature surrounding the indications for OCA in older patients is scarce and predominantly uses 40 years of age as an arbitrary upper age threshold. With an increasing percentage of patients seeking to maintain youthful activity levels well

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past the age of 40, a critical analysis of the outcomes of a biologic treatment like OCA in this cohort becomes crucial. Moreover, as far as we are aware, the rate of return to play in older patients who undergo OCA transplantation has not been previously investigated.

The purpose of the current study is to evaluate the efficacy of OCA in patients older than 45 years of age. We hypothesized that active patients aged 45 or older would have acceptable clinical outcomes following OCA transplantation in the knee, with a high rate of return to sport and premorbid activity, with a low revision rate.

Methods

This study was approved by the local institutional review board (i20-01168). A retrospective review was performed from January 2011 to January 2019 for patients who underwent an OCA. Inclusion criteria included patients greater than or equal to 45 years of age with a preoperative diagnosis of an isolated chondral or osteochondral defect of the knee (ICRS grade IV) who were treated with OCA and had a minimum of 18 months of follow-up. Patients with a prior diagnosis of knee osteoarthritis (Kellgren-Lawrence grade >2) or inflammatory joint disease were excluded. Patients were not excluded on the basis of alignment or associated meniscal or ligamentous pathology.

Surgical Technique and Rehabilitation Protocol

Sized matched OCA was either harvested from a whole distal femur, femoral condyle, patella, or a fresh OCA core (JRF Ortho). The surgical technique was performed as previously described.[17] Meniscus and knee instability management as well as bony realignment procedures, including high tibial osteotomies, distal femoral osteotomies, or tibial tubercle osteotomies, were performed as indicated. Following surgery, patients were kept non-weight-bearing and in a hinged brace for the first 6 weeks. Continuous passive motion was used for all patients during this time. Patients were then gradually progressed to full weight-bearing between weeks 6 and 12, with range-of-motion goals of 100° by week 6, 130° of flexion by week 8, and full/painless knee range-of-motion by 3 months postoperatively. Activities such as jogging were permitted at 4 to 6 months, while return to athletic activity was permitted at 9 to 12 months postoperatively.

Follow-Up

Patients were contacted at a minimum of 18 months following their procedure. Consented patients' medical charts were reviewed for demographic information and intraoperative findings (i.e., lesion size and location, length of procedure, complications). Their clinical status was assessed using a Visual Analogue Scale (VAS) for pain, Knee injury and Osteoarthritis Outcome Score (KOOS), and Tegner Activity Level Scale. Additionally, each patient was asked to complete a short survey on their ability to return to their pre-injury sports. This survey assessed their level of return, factors that prevented return, and any additional surgeries that the patients had on their operative knee. Return to play was defined as an ability to return to the same pre-injury sport and return to play at the same/higher level was defined as a patient's ability to perform at the same/higher level prior to their injury.

Statistical Analysis

Descriptive statistics consisted of mean and standard deviation for continuous variables and frequency and percentage for categorical variables. Data for both groups were compared using the Mann-Whitney *U* test for continuous variables and the Fisher exact test for categorical variables. The Wilcoxon signed-rank test was performed to compare preoperative and postoperative outcome scores. The alpha level threshold for statistical significance was set at 0.05. SPSS version 25.0 (IBM Corporation, Armonk, NY) was used for all analyses.

Results

Patient Demographics

Overall, there were 18 patients who underwent OCA at our institution and met our inclusion and exclusion criteria. Follow-up was attained in 14 of these patients (78%). Mean time to follow-up was 37 months (18-60). Patient demographics are further illustrated in **Table 1**.

Surgical Characteristics

Fourteen percent of the included patients had undergone prior surgery on the involved knee. Just under half of patients had concomitant pathology ($n = 6$), most common of which was a meniscal tear. Allografts were harvested from a variety of locations ([condyle/patella/trochlea allograft] $n = 7$; [fresh core allograft] $n = 7$), depending on the location and diameter of the treated lesion. The average graft size was 18.5 mm (10to 30mm). All surgical characteristics are summarized in **Table 2**.

Clinical Outcomes

VAS scores decreased significantly from the preoperative baseline to final follow-up (7.7 ± 1.7 vs. 2.0 ± 2.0, $P < 0.01$). Furthermore, mean VAS when playing sport was 3.4 ± 3.2, and the mean KOOS score was 77.5 ± 12.7 at final follow-up. Overall, 11 patients (78.6%) were able

Table 1. Patient Demographics.

N (patients)	14
Gender (male)	10 (71.4%)
Mean age (years)	52.6 ± 3.6
BMI	27.0 ± 3.5
Follow-up (years)	3.1 ± 1.3
Prior ipsilateral knee surgery	2 (14.3%)

OCA, osteochondral allograft; BMI, body mass index.

to return to their desired sport. Of these patients able to return to sport, 8 patients (57.1%) were able to return to play at the same or higher level of play as before their injury. Of those unable to return, 1 was due to pain, 1 was due to fear of re-injury, and 1 was due to physical inability to return. There were also notable changes in Tegner scores when taken pre-injury (6.1 ± 1.9), postinjury/pre-surgery (3.2 ± 2.0) and postsurgery (4.6 ± 1.9). The patient reported outcomes are illustrated in **Table 3**.

Complications and Revision Surgeries

One patient (7.1%) required a postoperative irrigation and debridement for wound breakdown. No patient required a revision procedure during the postoperative assessment period.

Discussion

The most important finding in the current study was that OCA in patients aged 45 years and older resulted in significantly improved VAS pain scores. Tegner activity scores increased but did not reach statistical significance. Additionally, a high percentage of patients returned to their preferred sports, with the majority competing at or higher than their pre-injury activity level. Furthermore, no clinical failures were identified during the greater than 3-year mean follow-up period.

In studies of OCA performance in younger patients, rate of return to play is seen as a fundamental outcome measure. Return to play after OCA in younger patients has been investigated previously with rates reported between 75% and 88%, and 38% to 80% returning at the previous or higher level of play.[18-20] Other studies that have investigated the performance of OCA transplantation in older patients have not included return to play statistics, suggesting the alternative goals of pain relief and ability to perform low-impact activities for this population.[13,14] However, as this patient population continues to seek to maintain high activity levels and with greater numbers of them participating in organized and regular team sports and athletics, return to play statistics remain critically relevant for this cohort. We found a similar return to play (78.6%) to that described in younger populations, suggesting that active older patients with isolated chondral injuries can generally expect to return to their preferred activities after undergoing OCA transplantation.

The performance of OCA transplantation in older patients is a topic that is becoming increasingly studied, as indications for OCA transplantation are expanding. Our findings that older patients demonstrate significant improvement in functional outcome scores and return to play at high levels are similar to studies investigating the clinical performance of OCA transplantation in older individuals, as well as return to play studies focusing on younger athletes. Frank *et al*.[15] reported on 55 patients above the age of 40 years who underwent OCA transplantation and found significant improvements in International Knee Documentation Committee (IKDC), Knee Injury and Osteoarthritis Outcome Score (KOOS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Short Form-12 (SF-12) scores compared to preoperative values.[16] Authors of this study also found that the rate of failure in the older patients was no worse than that in the patients aged <40 years.

Wang *et al*.[13] also described the outcomes of 52 patients ≥45 years who underwent OCA transplantation and found significant improvements in pain, physical functioning subscales of the Short Form-36, IKDC subjective form, and Knee Outcome Survey–Activities of Daily Living. They did, however, note a 40% reoperation rate, including a 27% risk of failure (revision OCA or any form of knee arthroplasty), an underperformance compared to rates in younger populations. Anderson *et al*.[14] followed 38 patients with a mean age of 52.3 years who underwent OCA transplantation and compared their clinical results to a control cohort of patients with a mean age of 27 years. They found significant improvements in patient reported outcomes (KOOS, IKDC, and Veterans RAND 12-Item Health Survey) for both cohorts.

Our study corroborates the significant functional outcome improvements following OCA transplantation in older patients, and additionally offers that this specific population also reliably returns to sports at a high rate. Our study population with a mean age of 52.6 years is slightly greater than the Wang *et al*.'s study mean age of 48 years,[13] and Frank *et al*.'s study mean age of 44.9 years,[15] and similar to Anderson *et al*.'s study mean age of 52.3 years.[14] Interestingly, our study group identified no revision OCA procedures or conversions to unicondylar knee arthroplasty (UKA) or total knee arthroplasty (TKA) during the follow-up period. This is a key finding since the durability of this procedure and its potential to delay the need for a future arthroplasty in this active patient population matters in deciding on a treatment approach. We surmise that our strict inclusion/exclusion criteria played a role. Furthermore, it is

Table 2. Surgical Characteristics.

	OCA
N (lesions)	17
Lesion location (MFC/LFC/patella/trochlea)	8/3/4/2 (47.1%/17.6%/23.5%/11.8%)
Graft size #1 (mm)	18.5 ± 7.2
Graft size #2, if bipolar (mm)	15.8 ± 6.3 ($N = 3$)
Concomitant procedures (ACLR/HTO/TTO/DFO/MPFLR/meniscal repair/meniscectomy/MAT)	1/1/1/0/0/3/1/0 (7.1%/7.1%/7.1%/0%/0%/21.4%/0%)

OCA, osteochondral allograft; MFC, medial femoral condyle; LFC, lateral femoral condyle; ACLR, anterior cruciate ligament reconstruction; HTO, high tibial osteotomy; TTO, tibial tubercle osteotomy; DFO, distal femoral osteotomy; MPFLR, medial patellofemoral ligament reconstruction; MAT, meniscal allograft transplantation.

Table 3. Patient-Reported Outcomes.

	OCA
N	14
VAS (pre)	7.7 ± 1.7
VAS (current at rest)	2.0 ± 2.0
VAS (current with activity)	3.4 ± 1.9
KOOS (out of 100)	77.5 ± 12.7
Tegner (preinjury)	6.1 ± 1.9
Tegner (presurgery)	3.2 ± 2.0
Tegner (postsurgery)	4.6 ± 1.9
Return to sport, *N*	11 (78.6%)
Return to sport at same/higher level	8 (57.1%)
Those unable to return due to	
Pain	1
Physical inability	1
Fear of reinjury	1

OCA, osteochondral allograft; VAS, Visual Analogue Score; VAS (pre), VAS preoperatively; KOOS, Knee Injury and Osteoarthritis Outcome Score.

important that surgeons use discretion preoperatively and are intentional with who they indicate for OCA within this age group. Patients with several risk factors for graft failure should instead be referred to a joint specialist for replacement. Of note, the follow-up time in the current study is relatively short at a mean of 3.1 years. Continued follow-up to monitor for other complications or failures is warranted.

Limitations

Several limitations should be made evident regarding the outcomes of this study. First, the mean follow-up period for this study was only 37 months, which represents a midterm evaluation of OCA performance. Although OCA is a good midterm surgical option for older patients with focal chondral injuries in the knee, longer-term follow-up studies are needed to elucidate the risk factors for clinical failure. Future randomized trials may shed light onto whether an OCA does, in fact, mitigate the progression to arthritis and joint replacement in this patient population. Second, the absence of clinical failures or reoperations in our study may reflect both the lack of long term (>10 year) follow-up and the smaller size of our patient cohort. Third, medical comorbidities and smoking status were not collected, and may represent age-dependent confounding variables. Finally, these findings reflect the outcomes of patients treated by 4 high-volume surgeons at a single institution, which may introduce performance bias. Chondral defect patient populations tend to be heterogeneous by their very nature. Despite the study limitations, we feel that it captures a clinically relevant snapshot of "real-life" outcomes in this older patient cohort.

Conclusions

In our series of patients 45 years and older who were treated with OCA for focal knee chondral and osteochondral injuries, we found a significant improvement in clinical outcome scores at a midterm follow-up of 37 months with no revision OCA procedures or conversion to any form of knee arthroplasty. In addition, a high percentage of patients were able to return to their preferred level of athletic activity.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval

This study was approved by the local institutional review board (i20-01168).

Informed Consent

Verbal informed consent was obtained from all subjects before the study.

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