Midterm Results of Surgical Treatment for Adult Osteochondritis Dissecans of the Knee

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Midterm Results of Surgical Treatment for Adult Osteochondritis Dissecans of the Knee

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Background: Determination of appropriate treatment options for adult osteochondritis dissecans is difficult, as most published papers on surgical osteochondritis dissecans treatment report outcomes in a population consisting of both adult and juvenile patients.

Purpose: This study examines the outcomes of surgical procedures in patients with adult osteochondritis dissecans.

Study Design: Case series; Level of evidence, 4.

Methods: The cohort included 46 adult patients (48 knees) with adult osteochondritis dissecans of the knee who had undergone surgical treatment (debridement, drilling, loose-body removal, arthroscopic reduction and internal fixation, microfracture, osteochondral allograft, or autologous chondrocyte implantation). The average patient age was 34 $\pm$ 9.5 years (range, 20-49) and patients were followed for 4.0 $\pm$ 1.8 years. The mean defect size was 4.5 $\pm$ 2.7 cm^2. Outcomes were assessed via clinical assessment and established outcome scales, including the Lysholm, International Knee Documentation Committee (IKDC), Knee Injury and Osteoarthritis Outcome Score (KOOS), Tegner, Cincinnati, and Short Form-12.

Results: Statistically significant improvement ($P < .05$) was noted in all outcome scales, including Noyes, Tegner, Lysholm, IKDC, KOOS (subdivided into 5 categories including Pain, Symptoms, Activities of Daily Living, Sport, and Quality of Life), Short Form-12 Physical, and Short Form-12 Mental. Seven knees (14%) had clinical failure of the initial treatment and underwent a revision procedure at a mean follow-up of 14 months. Patients treated with arthroscopic reduction and internal fixation and loose-body removal demonstrated a statistically higher postoperative percentage score increase for the KOOS Sport ($P = .008$) and KOOS Quality of Life ($P = .03$) categories than those treated with an osteochondral allograft.

Conclusion: Patients with adult osteochondritis dissecans of the knee, treated with surgical cartilage procedures, show durable function and symptomatic improvement at a mean 4.0 years of follow-up. Patients treated with arthroscopic reduction and internal fixation and loose-body removal demonstrated a greater improvement in outcome scores than those treated with osteochondral allograft.

Keywords: adult osteochondritis dissecans (OCD); knee; cartilage

Osteochondritis dissecans (OCD) of the knee represents an important clinical entity in orthopaedics. Optimal decision making for the treatment of OCD relies on the differentiation between adult OCD (AOCD) and juvenile OCD (JOCD). Juvenile OCD, occurring in patients with open physes, generally has a good prognosis. Nearly half of all lesions heal with nonoperative management.[2] When surgical management is necessary, outcomes are generally reported as favorable in the literature.[4,10,17,24] On the other hand, AOCD usually requires surgical repair, and even then, healing potential is often inferior compared with that of JOCD.[1,12,25]

Interpretation of clinical outcomes after OCD treatment remains difficult, as the algorithm for surgical management is not well defined. Several options are available to treat adult OCD, including debridement, drilling, loose-body removal, microfracture, arthroscopic reduction and internal fixation (ARIF), osteochondral auto- and allografting, and autologous chondrocyte implantation (ACI). However, no consensus has been reached as to the best option for treatment. Further, outcome studies are often reported on mixed populations of patients that include both adult and juvenile OCD. Because the 2 entities differ in their response to nonoperative management and healing

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potential after surgical treatment, analysis can be difficult to interpret.

The purpose of this study is to report on the clinical outcomes after surgical management for OCD in an adult population.

MATERIALS AND METHODS

Patient Selection

This study's protocol was approved by the institutional review board of the medical center. Between July 1998 and December 2006, adult patients (minimum 20 years of age at the time of surgery) with diagnosed and surgically treated AOCD of the knee were prospectively enrolled into the study. Fifty-two patients at least 20 years of age, who had undergone surgical treatment for OCD of the femoral condyle and had a minimum of 2 years of follow-up, were included. Mean follow-up was 4.0 (±1.8 years; range, 2-10 years). Six patients were lost to follow-up, leaving 46 patients and 48 cases of AOCD.

Surgical Treatments

The spectrum of surgical options included 1 debridement, 9 fragment excision or loose-body removal,[1] 2 in situ drilling,[11] 15 ARIF,[8,18] 2 microfracture,[23] 16 osteochondral allograft,[16] and 3 ACI.[20]

Concomitant medial opening-wedge high tibial osteotomy (HTO) was indicated for greater than 10° of uncorrected varus alignment, especially in patients with condylar lesions and early wear of the ipsilateral tibial plateau. A Puddu (Arthrex, Inc, Naples, Florida) plate was used for fixation and secured with two 6.5-mm cancellous screws superiorly and two 4.5-mm cortical screws inferiorly.

Meniscus allograft transplantation was indicated in patients with history of total or subtotal meniscectomy with persistent pain localized in the involved compartment. Concurrent meniscus allograft transplantation was accomplished with a bridge-in-slot technique with interference screw fixation and peripheral suturing.

Clinical Assessment

Preoperatively, patients received a baseline survey, which was repeated postoperatively at 6 months, 1 year, and then annually. The survey included the following outcome scales: Noyes, Tegner, Lysholm, International Knee Documentation Committee (IKDC), Knee Injury and Osteoarthritis Outcome Score (KOOS), and Short Form-12 (SF-12). The KOOS score was subdivided and scored in 5 categories: Pain, Other Disease-Specific Symptoms, Activities of Daily Living Function (ADL), Sport and Recreation Function, and Knee-Related Quality of Life (QOL).[9,21,22]

Statistical Analysis

Descriptive statistics were performed according to standard methods, including frequencies, means, standard deviations, and ranges when appropriate. Patient data sets included the score on the previously listed scales at 2 time points: preoperatively and at most recent follow-up. Preoperative and postoperative scores were calculated using a paired t test. One-way analysis of variance was used to compare outcomes between loose-body removal, ARIF, and osteochondral allograft treatment groups, as these 3 groups had enough statistical power to make a comparison between groups. Multivariate analysis was conducted to determine independent predictors of improvement in Lysholm score. Statistical analysis was performed using GraphPad Prism software (GraphPad Software, La Jolla, California). Statistical significance was set at $P < .05$.

RESULTS

Between July 1998 and December 2006, 52 adult (minimum 20 years of age) patients with OCD of the knee that was surgically treated were prospectively enrolled. Osteochondritis dissecans was diagnosed according to physical examination, radiographs, and MRI scans. Lesions were differentiated from similar-appearing osteochondral lesions such as osteochondral fractures, normally seen in adolescents patients with a twisting injury. Six patients were lost to follow-up, leaving 46 patients and 48 cases of AOCD. The average patient age was 34 ± 9.5 years (range, 20-49 years) and patients were followed for an average of 4.0 ± 1.8 years (range, 2.0-10.6 years). The mean defect size was 4.5 ± 2.7 cm^2 (range, 0.9-15 cm^2). Small, stable lesions (mean size 1 cm^2) were treated with debridement. Arthroscopic reduction and internal fixation was performed when the unstable fragment had enough subchondral bone to provide union and support of the fixation system (mean defect size 2.14 cm^2 ± 0.49). Small lesions with unstable fragments that could not be stabilized were treated with microfracture (mean size 1 cm^2). Loose-body removal was indicated for lesions located in areas with less contact pressure and with no possibility of reduction and fixation (mean size 2.11 ± 0.56 cm^2). Large, unstable osteochondral lesions were treated with either an osteochondral allograft (mean size 2.4 ± 0.9 cm^2) or ACI (2.26 ± 0.5 cm^2), depending on the depth of the lesions.

Lesion distribution was 37 in the medial femoral condyle, 8 in the lateral femoral condyle, and 3 in both condyles.

Operative Procedures

The spectrum of surgical procedures included 1 debridement, consisting of shaving for mechanical removal of loose flaps and debris until stable borders were obtained; 9 fragment excision (loose-body removal) for those cases in which the fragment could not be initialized stabilized[1]; 2 in situ drilling[11]; 15 ARIF[8,18]; 2 microfracture[23]; 16 fresh osteochondral allograft[16] (graft size: 18-25 mm diameter and 6-8 mm depth); and 3 ACI.[20]

Concomitant Procedures

Five patients with an osteochondral allograft had a concomitant HTO, 2 had concomitant meniscus allograft transplantation, and 10 had a concomitant microfacture procedure.

Outcome Assessment

Completed survey data sets were available for 48 patients (92%) with mean follow-up of 4.0 ± 1.8 years after the surgical procedure was performed. Statistically significant improvement ($P < .001$) was noted on all outcome scales, including the Noyes (7 to 56, $P < .001$), Tegner (1 to 5, $P < .001$), Lysholm (27 to 39, $P < .001$), IKDC (36 to 51, $P < .001$), KOOS Pain (58 to 78, $P < .001$), KOOS Symptoms (59 to 74, $P < .001$), KOOS ADL (64 to 79, $P < .001$), KOOS Sport (31 to 66, $P < .001$), KOOS QOL (25 to 52, $P < .001$), SF-12 Physical (38 to 42, $P = .003$), and SF-12 Mental (51 to 56, $P = .0118$). Overall condition of the knee (0, unable to perform daily activities and 10, normal knee) improved from 3 to 7 ($P < .001$).

Subjectively, 16 of 48 patients (33%) were completely satisfied with the procedure, 20 of 48 (41%) were mostly satisfied, 8 of 48 (16%) were somewhat satisfied, and only 4 of 48 (8%) were unsatisfied. Forty-six patients (95%) responded that they would have the surgery again.

Multivariate analysis demonstrated no correlation between age and final outcome. No association was found between age, chondral defect size, and improvement of Lysholm score ($P = .882, r = .0, P = .59, r = –.07$). In contrast, multivariate analysis demonstrated that the Lysholm score tended to improve with longer follow-up ($P = .03, r = .9$).

The 8 patients with an OCD lesion in the lateral femoral condyle showed significant improvement in all clinical scores except for SF-12 (Tables 1 and 2). All would have the surgery again if they had the same problem in the other knee. Six patients were completely or mostly satisfied with the procedure, 1 was somewhat satisfied with the procedure, and 1 was not satisfied.

Subsequent Procedures

Seven knees (14%) had clinical failure of the initial treatment and underwent revision to an osteochondral graft (n = 2), osteochondral autograft (n = 1), microfracture (n = 3), or conversion to a total knee arthroplasty (n = 1) at a mean follow-up of 14 months (range, 0.4-44 months). One patient had failed results loose-body removal and later required a microfracture. Three patients initially treated with ARIF had failed results and were subsequently treated with either microfracture, osteochondral autograft, or an osteochondral allograft. One patient with a failed osteochondral allograft converted to a total knee arthroplasty. One patient failed initial drilling and needed a microfracture. One patient with failed ACI converted to an osteochondral allograft.

All 15 patients treated with ARIF had subsequent arthroscopy 2 months after the initial treatment for hardware removal.

TABLE 1
Demographic Data for the Patients With Osteochondritis Dissecans Lesions in the Lateral Femoral Condyle[a]

Number of patients	8
Patient age (mean)	36 ± 7 years
Gender (n)	
Male	6
Female	2
Single defect area (cm^2)	2.4 ± 0.35
Type of treatment	
ARIF	1
LBR	3
OA graft	3
ACI	1

[a]ARIF, arthroscopic reduction and internal fixation; LBR, loose-body removal; OA graft, osteochondral allograft; ACI, autologous chondrocyte implantation.

TABLE 2
Statistical Analysis of Preoperative and Postoperative Scores for the Patients With Osteochondritis Dissecans Lesions in the Lateral Femoral Condyle[a]

	Preop	Postop	*P* Value
Tegner	1	4	.020
Lysholm	28	36	.040
IKDC	31	55	.034
KOOS			
Pain	57	86	.012
Symptoms	50	80	.007
ADL	54	85	.034
Sport	31	68	.034
QOL	24	57	.023
SF-12			
Mental	40	43	.370
Physical	42	52	.112

[a]IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; ADL, Activities of Daily Living; QOL, Quality of Life; SF-12, Short-Form 12.

Comparison Between Treatment Groups

Patients treated with an osteochondral allograft, ARIF, and loose-body removal were compared, as they had significant statistical power. Other treatment groups (debridement, drilling, microfracture, and ACI), although included in the overall outcomes, could not be compared as they did not have significant power.

Preoperative scores for the osteochondral allograft group were statistically lower than both ARIF and loose-body removal group for KOOS ADL ($P = .048$) and SF-12 Mental ($P = .04$). No preoperative significant difference for Tegner ($P = .21$), Lysholm ($P = .64$), IKDC ($P = .3306$), KOOS Pain ($P = .05$), KOOS Symptoms ($P = .85$), KOOS Sport ($P = .85$), KOOS QOL ($P = .82$), or SF 12 Physical ($P = .502$) was evident between the 3 treatment groups.

The absolute final outcome score for Tegner score ($P = .07$), Lysholm ($P = .50$), IKDC ($P = .09$), KOOS Pain ($P =$

.625), KOOS Symptoms ($P = .32$), SF-12 Physical ($P = .67$), and SF-12 Mental ($P = .69$) was not significantly different between patients treated with ARIF, loose-body removal, or osteochondral allograft. Only KOOS ADL ($P = .0043$) and KOOS Sport ($P = .0048$) scores were significantly better in those patients treated with ARIF or loose-body removal than those treated with osteochondral allograft (Table 3). The improvement in score was significantly higher for those patients treated with ARIF or loose-body removal compared with osteochondral allograft for KOOS Sport ($P = .008$) and KOOS QOL ($P = .03$). However, those patients treated with osteochondral allograft showed greater improvement in the Tegner score in comparison with those treated with loose-body removal and ARIF ($P = .034$) (Table 3).

Thirteen of 15 patients treated with ARIF reported that they were totally or mostly satisfied with the procedure and would have the surgery again if they had the same problem in the other knee. Seven of 9 patients treated with loose-body removal reported they were totally or mostly satisfied with the procedure. All 9 reported that they would have the same procedure if they had the same problem in the contralateral knee. Ten of 16 patients treated with an osteochondral allograft reported they were totally or mostly satisfied and they would have the surgery again if they had the same problem in the contralateral knee. One patient did not respond to this question and the other 5 patients would not have the same surgery in the contralateral knee if they had the same problem.

TABLE 3
Outcomes of ARIF Versus LBR Versus OA Graft[a]

	ARIF	LBR	OA Graft	*P* Value
Tegner				
Preoperative	2	1	0	
Postoperative	3	5	6	
Improvement	1	4	6	.034[b]
P value	.430	.032	<.001	
Lysholm				
Preoperative	28	32	25	
Postoperative	42	44	37	
Improvement	14	12	12	.950
P value	.008	.110	.015	
IKDC				
Preoperative	37	37	31	
Postoperative	53	58	45	
Improvement	16	21	14	.630
P value	.005	.002	.004	
KOOS				
Pain				
Preoperative	65	65	52	
Postoperative	81	78	74	
Improvement	16	13	22	.590
P value	.007	.092	.002	
Symptoms				
Preoperative	54	55	59	
Postoperative	80	71	67	
Improvement	26	16	8	.290
P value	<.001	.180	.270	
ADL				
Preoperative	72	70	57	
Postoperative	86	87	67	
Improvement	14	17	10	.830
P value	.015	.025	.200	
Sport				
Preoperative	29	30	32	
Postoperative	80	77	46	
Improvement	51	47	14	.008[cd]
P value	<.001	.002	.037	
QOL				
Preoperative	25	26	29	
Postoperative	53	65	39	
Improvement	28	39	10	.030[d]
P value	.028	<.001	.062	
SF-12				
Mental				
Preoperative	53	54	49	
Postoperative	56	54	57	
Improvement	3	0	8	.260
P value	.134	.940	.407	
Physical				
Preoperative	36	36	41	
Postoperative	41	43	43	
Improvement	5	7	2	.330
P value	.002	.018	.087	

[a]Presented as preoperative and postoperative scores as well as the improvement (postoperative minus preoperative score) at time of follow-up. The *P* value for each survey represents the difference in preoperative and postoperative scores (Student *t* test; statistical significance set at $P < .05$). Analysis of variance (*P* value in final column) was completed to compare the amount of improvement (postoperative minus preoperative score) among the 3 subgroups.

ARIF, arthroscopic reduction and internal fixation; LBR, loose-body removal; OA graft, osteochondral allograft; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; ADL, Activities of Daily Living; QOL, Quality of Life; SF-12, Short-Form 12.

[b]ARIF < OA graft.

[c]ARIF > OA graft.

[d]LBR > OA graft.

Concomitant HTO and Meniscus Allograft Transplantation Procedure

Seven patients (14%), all having an osteochondral allograft for treatment of OCD, required a concomitant HTO or meniscus allograft transplantation. None of these patients required a subsequent procedure. Statistically significant improvements were seen for Tegner, Lysholm, and KOOS Pain and ADL clinical scores at 3.25 ± 1.7 years of follow-up (Table 4). Four of these 7 patients reported that they were completely or mostly satisfied with the procedure; the remaining 3 were somewhat satisfied. Only 1 patient reported he would not elect to have the surgery again.

DISCUSSION

This study investigates the clinical outcomes of surgical procedures in adult patients treated for OCD of the knee at an average of 4 years of follow-up. Patients demonstrate a reduction in symptoms and increase in function. The natural history of untreated lesions in AOCD is poorly defined. Linden[12] performed a long-term retrospective outcome study (average follow-up, 33 years) of patients with OCD of the femoral condyle. The author included 23 patients with JOCD and 48 with AOCD. Radiographically, patients with AOCD developed gonarthrosis about 10 years earlier than primary gonarthrosis.

Reparative surgical options for AOCD should attempt to preserve the patient's articular cartilage.[19] Previous

TABLE 4
Statistical Analysis of Scores for Patients Treated With an OA Graft and Concomitant HTO or Meniscus Allograft Transplantation[a]

	Preoperative	Postoperative	*P* Value
Tegner	1	6	<.001
Lysholm	23	34	.050
IKDC	29	43	.122
KOOS			
Pain	39	77	<.001
Symptoms	55	71	.816
ADL	54	76	.050
Sport	35	72	.165
QOL	29	40	.165
SF-12			
Mental	41	46	.797
Physical	50	56	.299

[a]OA graft, osteochondral allograft; HTO, high tibial osteotomy; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; ADL, Activities of Daily Living; QOL, Quality of Life; SF-12, Short-Form 12.

studies have shown good outcomes after internal fixation. Magnussen et al[13] recently reported on 12 patients who underwent ARIF for grade IV OCD with loose bodies. After surgery, patients did not have symptoms of osteoarthritis and had normal function in activities of daily life. In contrast to our study, these patients had a mean age of 19 years (range, 14-27). Makino et al[14] showed that after ARIF, lesions healed in 87% (13 of 15) of the knees per IKDC grading and 93% (14 of 15) per MRI assessment. However, only 4 of the 15 patients were over 20 years of age. Gomoll et al[8] evaluated 12 adolescent patients with unstable Cahill type 2C lesions treated with compression screw with average 6-year follow-up. All lesions healed without clinical or radiographic evidence of degenerative disease. None of the patients were more than 19 years of age. Our adult population showed outcomes similar to previous outcomes reported in a young population, with 86% of patients (13 of 15) treated with ARIF reported to be completely or mostly satisfied with the procedure.

In the event that the fragment cannot be preserved or fails to heal after initial fixation, loose-body removal may be an option. Denoncourt et al[3] treated 37 patients with arthroscopic loose-body removal and curettage of the lesion. Second-look arthroscopy confirmed complete healing in 10 cases. The authors recommended this treatment for both adult and young patients who failed nonoperative treatment. Similarly, Ewing and Voto[6] removed the loose body and subsequently drilled the defect in 29 patients. The authors noted 72% satisfaction at 1-year follow-up. However, these results are controversial. Recently published studies suggest that pain relief after loose-body removal may be temporary and emphasis should be placed on repair of the fragment. Anderson and Pagnani[1] evaluated 19 patients who were treated with loose-body removal at a mean follow-up of 9 years. Five of these patients had failed results, and the results according to the Hughston rating scale for OCD were 6 poor, 4 fair, 4 good, and only 1 excellent outcome. The authors suggest that loose-body removal produced short-term improvement that worsened with time. However, in contrast to our study, their study population was heterogeneous with both AOCD and JOCD. Our results suggest that loose-body removal for AOCD has satisfactory results in small lesions (<2 cm^2) at 4-year follow-up, with only 1 failure among 9 patients. All patients reported that they would have the surgery again, and 7 of the 9 (77%) were completely or mostly satisfied. However, a longer follow-up will be necessary to determine if the loose-body removal could be considered as a definitive procedure or is only used for temporary relief of the symptoms.

Restorative procedures such as osteochondral allograft or ACI are indicated as a second-line treatment option for those who fail their first procedure or for those patients with loose-body removal and a clinically relevant defect. These patients normally complain of achy discomfort, effusions unrelated to mechanical symptoms, or weightbearing pain. Osteochondral allografting is a good treatment option in patients with large, deep OCD lesions. It was the most commonly performed restorative procedure in our study. Emmerson et al,[5] in a cohort of 64 patients with AOCD and JOCD treated with a fresh osteochondral allograft, reported 72% good to excellent clinical outcomes at 7.7 years after surgery. In contrast to our study, this study included a mixed population of young and adult patients. Garrett[7] reviewed a series of 17 patients with an average age of 20 years (range, 16-46) treated with osteochondral allografts and reported a 94% clinical success at a mean follow-up of 3 years. In our study, although treatment with an osteochondral allograft yielded statistical improvement in most clinical scores with only 1 reported failure, only 62% of patients described themselves as mostly or completely satisfied. These patients tended to show a lower clinical score early in the postoperative period compared with those treated with ARIF or loose-body removal. Also, the improvement in outcome scores, as a percentage increase from preoperative to postoperative, was significantly lower for patients treated with an osteochondral allograft when compared with ARIF and loose-body removal. On the contrary, the Tegner score, which evaluates participation in various sports, suggested that patients treated with osteochondral allograft do better than those with ARIF and loose-body removal. These conflicting results may be explained by the limitation that the Tegner survey does not accommodate for patients who do not participate in the specific sport measured by the scale. Therefore, individuals who are active but do not participate in one of the sports evaluated in this rating scale may be incorrectly rated as having a lower activity level.[15]

When considering the difference in the biological treatment options for the treatment of an OCD lesion, all 3 (ARIF, loose-body removal, and osteochondral allograft) groups have clinical improvements at the time of follow-up. However, subjectively, those treated with an osteochondral allograft tend to show a lower satisfaction rate than the other groups at time of follow-up. All these patients initially had lower preoperative clinical scores, suggesting the importance of a timely diagnosis to maximize the opportunity to perform a restorative procedure.

CONCLUSION

According to our results, patients with adult OCD of the knee who were treated with surgical cartilage procedures showed good outcomes at 4-year follow-up. Whenever possible, the osteochondral fragment should be retained and repaired as these patients, although adults, still do well with this technique, with low incidence of failure and a high satisfaction rate.

When not possible, in small lesions, removal of the fragment and clinical observation is also a good initial treatment option. Most of these patients will improve with the removal of the fragment and will need no further treatment. Osteochondral allografting should be reserved as a second-line treatment option, as patients show less improvement in comparison with treatment with ARIF or loose-body removal.

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