

Does Operative Fixation of an Osteochondritis Dissecans Loose Body Result in Healing and Long-Term Maintenance of Knee Function?

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Background: Osteochondritis dissecans (OCD) can progress to loose body formation, resulting in a grade IV defect. The decision to fix versus excise the loose body is controversial. Published operative fixation outcomes are small case series with short follow-up.

Hypothesis: Operative fixation (ORIF) of the loose body into the grade IV defect will heal and approximate “normal” knee function at long-term follow-up.

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

Methods: Twelve patients were identified who underwent ORIF of a knee OCD loose body into the grade IV osteochondral defects ranging in size from 2.0 to 8.0 cm² (mean, 3.5 cm²). After 12 weeks, hardware was removed, and healing was assessed. Long-term outcomes were assessed with a Knee injury and Osteoarthritis Outcome Score (KOOS) and a Marx activity score.

Results: Arthroscopy for screw removal revealed stable healing in 92% (11 of 12) of patients. No patients required subsequent surgery for a loose body. At an average of 9.2 years' follow-up (range, 3.8-15.8 years), 83% (10 of 12) of patients completed the KOOS. The KOOS subscale scores for pain (mean, 87.8; range, 67-100), other symptoms (mean, 81.8; range, 61-96), function in activities of daily living (mean, 93.1; range, 72-100), and sports and recreation function (mean, 74.0; range, 40-100) were not significantly lower than those of published age-matched controls. However the KOOS subscale score for knee-related quality of life (mean, 61.9; range, 31-88) was significantly lower ($P = .003$).

Conclusion: Operative fixation of grade IV OCD loose bodies results in stable fixation. At an average 9 years after surgery, patients did not have symptoms of osteoarthritis pain and had normal function in activities of daily life. However, patients reported significantly lower knee-related quality of life. Operative fixation of OCD loose bodies is a better alternative to lesion excision.

Keywords: osteochondritis dissecans; ORIF; healing; functional outcome

Osteochondritis dissecans (OCD) is a lesion of subchondral bone primarily affecting juveniles and young adults. Multiple hypotheses have been put forward regarding the cause of this condition including inflammation,⁵⁵ ossification abnormalities,²⁰ ischemia,²⁴ and repetitive microtrauma.^{2,27,28,39} The natural history of the disease process has been studied by multiple authors using a variety of methods. These studies generally show the prognosis to be better for smaller lesions and those in the skeletally immature.^{10,27,28}

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Osteochondritis dissecans lesions have been classified based on their appearance at arthroscopy.²⁵ Stage I defects are stable to probing, stage II lesions show early signs of separation with intact cartilage, stage III lesions are partially detached, and stage IV lesions are characterized by craters and the presence of loose bodies. These loose bodies consist of articular cartilage with or without attached subchondral bone. If the fragment remains in its bed, magnetic resonance imaging (MRI) has been shown to be useful in the determination of lesion stability.¹⁴

Stable OCD lesions have long been managed by nonoperative means with healing rates noted to be between 50% and 94%.⁶⁰ Skeletal immaturity, small lesion size, and lesion location on the medial femoral condyle have been associated with higher healing rates.^{10,14,24,27,28,39,58,60} Three to 6 months of nonoperative management is advised by most authors, with treatment ranging from avoidance of

sports to strict immobilization and nonweightbearing.^{4,10,16,27,28,55,60} Drilling has been shown to result in union and good clinical results in 80% to 90% of lesions that failed previous nonoperative management.^{3,5,7}

Unstable lesions that remain in the defect (stage II or III), as determined by MRI or arthroscopy, are thought to require operative fixation, often in conjunction with drilling and/or local bone grafting.^{12,20,29,60} Reported healing rates by radiograph have been between 80% and 100% with good to excellent clinical outcomes in the majority of patients.[†]

Proposed treatment options for lesions that have progressed to loose body formation (grade IV) include excision of the loose body or replacement of the loose body in the defect. Results of excision of the loose body with or without drilling of the defect have been poor in up to 75% of patients.^{2,4,27,61} If the lesion is excised, the defect can be treated with abrasion, microfracture, osteochondral autograft transfer, osteochondral allograft, or autologous chondrocyte implantation.

Many authors recommend fixation of loose bodies of OCD when possible.[‡] However, published operative fixation outcomes are small case series (10 or fewer patients) with short (less than 5 years) follow-up. These series all focus on patients with loose bodies with a large amount of bone attached. We hypothesize that operative fixation (ORIF) of a loose body into a grade IV defect will heal and approximate "normal" knee function at long-term follow-up.

MATERIALS AND METHODS

Identification of Patients

A search of billing records at our institution was undertaken to identify all patients who underwent ORIF of OCD lesions by the senior author between January 1, 1991, and December 31, 2006. A search for CPT codes 29885 (drilling for OCD with bone grafting with or without internal fixation) and 29887 (drilling for intact OCD lesion with internal fixation) identified 36 patients. Medical records of these patients were reviewed, and 24 patients were excluded because the lesion had not progressed to a loose body and remained in the defect (14 patients), because they underwent drilling of the lesion without fixation of the loose body (5 patients), or because the defect was purely chondral without attached subchondral bone (5 patients). The remaining 12 patients had grade IV defects and underwent fixation of the loose body into the defect. These patients form the study group.

Operative Technique and Postoperative Protocol

A diagnostic arthroscopy was performed in each case to localize the OCD lesion and to find and assess the loose bodies. The anteromedial or anterolateral portal was then

extended into a mini-arthrotomy to visualize the lesions located on the medial or lateral femoral condyles or trochlea. In 2 cases, the lesion was located on the medial facet of the patella, requiring a larger arthrotomy and complete eversion of the patella to gain access to the lesion. In each instance, the loose body was extracted from the knee and all fibrous tissue removed. The OCD defect was then drilled with a Kirschner wire and curetted to bleeding bone. The loose body was then positioned in the defect to assess its relative size. When the loose body was larger than the defect, it was trimmed appropriately to fit the defect. If the defect was larger than the loose body, proximal tibial cancellous autograft was packed in the lesion until the size of the defect matched that of the loose body. The loose body was then positioned in the defect and fixed in place using 1 to 4 metal cortex screws (Synthes USA, West Chester, Pennsylvania) ranging in size from 1.5 to 2.7 mm. Screws were sunk until the head was flush with the articular cartilage. Postoperatively, patients were allowed full range of motion but kept nonweightbearing status on the operative extremity for 12 weeks. Continuous passive motion (CPM) devices were not used.

Arthroscopy for Removal of Hardware

All patients returned to the operating room 12 weeks after the index procedure for diagnostic arthroscopy and screw removal. The repaired lesion was identified and probed arthroscopically, and the stability of the replaced loose body was noted. Hardware was removed from 10 patients arthroscopically, while the 2 patients with patellar defects required mini-arthrotomy for hardware removal. Lesion stability was again assessed after hardware removal. One patient with an incompletely healed lesion underwent repeat fixation with subsequent hardware removal 12 weeks later.

Follow-up

After approval by our institutional review board, attempts were made to contact the 12 patients identified above by telephone. Those patients who were located were asked if they required subsequent surgery on the operative knee, and operative reports were obtained for any subsequent procedures. Additionally, the patients were asked to complete a questionnaire that allowed calculation of a Knee Injury and Osteoarthritis Outcome Score (KOOS)⁵³ and a Marx activity score.⁴⁵

Data Analysis

A KOOS and Marx activity score were calculated for each patient who completed the questionnaire. A mean and standard deviation were then calculated for the Marx activity score as well as the 5 components of the KOOS. The 5 KOOS components were then compared with previously published reference data⁵⁰ for patients in this age group using a *t* test. Statistical analysis was performed using Medcalc (Mariakerke, Belgium).

[†]References 1, 13, 16, 21, 28, 30, 34, 40, 43, 44, 48, 54.

[‡]References 3, 5, 8, 16, 23, 25, 31, 32, 37, 41, 42, 46, 49, 55-57, 59, 62.

TABLE 1
Patient Demographics

Patient	Age, ^a y	Sex	Skeletal Maturity ^b	Duration of Symptoms, mo	Lesion Location	Lesion Size, cm ²
1	21	Male	Mature	12	Lateral femoral condyle	2.0
2	14	Female	Immature	3	Medial femoral condyle	5.0
3	13	Female	Immature	3	Medial femoral condyle	6.0
4	21	Male	Mature	0.5	Lateral femoral condyle	2.3
5	27	Female	Mature	6	Medial femoral condyle	2.2
6	15	Male	Immature	4	Lateral femoral condyle	8.0
7	15	Female	Mature	2	Lateral trochlea	2.2
8	12	Female	Immature	2	Medial patellar facet	2.2
9	13	Female	Immature	0.5	Lateral trochlea	2.0
10	34	Male	Mature	4	Medial femoral condyle	2.2
11	22	Male	Mature	1	Medial patellar facet	2.2
12	23	Male	Mature	18	Medial femoral condyle	6.0
Mean	19.2	50% male	58% mature	4.7		3.5

^aAge at the time of operative fixation of the loose body.

^bMaturity defined as closure of the distal femoral physis.

RESULTS

Patient Demographics

The 12 patients identified above included 6 male patients (50%) and ranged in age from 12 to 34 years (mean, 19.2 years) at the time of surgery. Seven patients (58%) were skeletally mature at the time of the procedure. Duration of symptoms ranged from 0.5 to 18 months (mean, 4.7 months). Defects ranged in size from 2.0 to 8.0 cm² (mean, 3.5 cm²). Lesions were located on the medial femoral condyle (42%), lateral femoral condyle (25%), lateral trochlea (17%), and medial facet of the patella (17%). All 12 repaired loose bodies were osteochondral fragments with bone attached. These data are summarized in Table 1.

Follow-up

Twelve patients (100%) returned to the operating room for arthroscopic hardware removal 12 weeks postoperatively. We were able to contact 11 patients (92%) at a mean of 9.5 years (range, 3.8-15.8) postoperatively and inquire about further surgical intervention on the index knee. Our outcome questionnaire was completed and returned by 10 patients (83%). One patient was unable to complete the questionnaire due to severe mental illness, and 1 patient was not located.

Findings at Removal of Hardware at 12 Weeks

Each repaired defect was examined after the removal of hardware at 12 weeks postoperatively. Eleven of 12 lesions were noted to be completely healed and stable to probing. One patient with a large (8 cm²) lesion was noted to be partially healed. Approximately 75% of the lesion had fully healed, while the remaining 25% was noted to be loose.

This portion was removed, the bed was curetted to bleeding bone, and the piece was attached again with screws. At repeat arthroscopy 12 weeks later, the entire lesion was noted to be healed and stable.

Repeat Surgery

The 11 patients who were contacted by telephone were asked if they had undergone any surgery on the index knee after removal of hardware. Only 1 patient had undergone additional surgery on the knee because of pain after a reinjury. Review of the operative report indicated that the repaired lesion was stable, and grade II fibrillation of the surrounding articular cartilage was noted and debrided.

Clinical Outcome

The 10 patients who completed the questionnaire had a mean Marx activity score of 4.6 (range, 0-12), mean KOOS subscale scores for pain of 87.8 (range, 67-100), for other symptoms of 81.8 (range, 61-96), for function in activities of daily living of 93.1 (range, 72-100), and for sports and recreation function of 74.0 (range, 40-100). These scores were not significantly different from those of published age-matched controls. However the KOOS subscale score for knee-related quality of life (mean, 61.9; range, 31-88) was significantly different from published age-matched controls ($P = .003$). These data are presented in full in Table 2. No correlation was noted between Marx activity score and any KOOS subscale.

Complications

No patients experienced any perioperative complications at either the index surgery or subsequent removal of hardware.

TABLE 2
Arthroscopic Second Look and Long-Term Follow-up Knee Injury and Osteoarthritis Outcome Score Subscales^a

Patient	Age ^b at Surgery, y	Findings at Second Look Arthroscopy	Time to Long-Term Follow-up, y	Marx Activity Score ^c	KOOS Subscales				
					Pain	Other Symptoms	Function in Daily Living	Function in Sport and Recreation	Knee-Related Quality of Life
1	21	Healed	15.8	1	100	89	100	90	75
2	14	Healed	14.0	12	86	93	93	65	75
3	13	Healed	None	—	—	—	—	—	—
4	21	Healed	10.7	8	89	75	94	75	81
5	27	Healed	10.2	4	94	86	99	75	50
6	15	Partially healed	9.6	8	78	68	100	65	31
7	15	Healed	9.5	1	100	86	100	100	88
8	13	Healed	9.1	0	72	75	76	40	50
9	13	Healed	5.4	5	67	61	72	45	63
10	34	Healed	3.9	6	94	96	100	100	31
11	22	Healed	None	—	—	—	—	—	—
12	23	Healed	3.8	1	97	89	97	85	75
Mean	19.2	92% healed	9.2 ^d	4.6	87.8	81.8	93.1	74.0	61.9 ^e
Controls ^f					92	87	94	85	84

^aRange, 0-100. Higher scores indicate less pain and other symptoms and better function.

^bAge at the time of operative fixation of the loose body.

^cRange, 0-16. Higher scores indicated higher levels of activity.

^dMean time to follow-up for those who returned our questionnaire.

^eStatistically significant ($P = .003$) when compared with age-matched controls.

^fAge-matched controls: Paradowski PT, Bergman S, Sunden-Lundius A, Lohmander S, Roos EW. Knee complaints vary with age and gender in the adult population: population-based reference data for the Knee injury and Osteoarthritis Outcome Score (KOOS). *BMC Musculoskelet Disord.* 2006;7:38.

Two patients (17%) were noted to have minor scuffing of the articular cartilage of the tibial plateau adjacent to the repaired lesion.

DISCUSSION

Treatment of patients with grade IV OCD lesions is complicated by a lack of published data on the outcomes of different treatment options. Good short-term results have been reported with excision of the loose body and treatment of the defect with drilling, microfracture, or abrasion. Ewing and Voto¹⁹ noted 79% of patients had satisfactory results at 1 year, while Denoncourt et al¹⁵ demonstrated the presence of fibrocartilage in the defect at 5 to 15 months after surgery. However, significantly poorer results have been noted with longer term follow-up.^{2,4,61}

Several authors have attempted articular chondrocyte implantation (ACI) in conjunction with loose body excision for the treatment of OCD. All have shown significantly worse results in these patients than in patients with osteochondral defects from other causes, with failure rates ranging from 14% to 67%.^{38,51,52} One case study documented a good result when the lesion was repaired with an osteochondral autograft,⁶ while other authors have found that results of osteochondral autograft transfer are similar in patients with OCD to those with defects from other causes.³³

Multiple authors have opined that when possible, replacement and fixation of the loose body in the defect provide the best opportunity for the restoration of normal

anatomy and function. A review of the literature on this subject yielded 19 case reports and case series describing the fixation of OCD lesions that included at least one grade IV defect. These studies are summarized in Table 3 (available online at <http://ajs.sagepub.com/supplemental/>).[§] The results reported in these series are generally good, although incompletely reported. Many studies do not describe the number of lesions initially treated, instead reporting only the number evaluated in follow-up. Lesion size is frequently omitted, and follow-up is short or of unreported duration. Outcome measures are limited to radiographic assessments of union, and clinical outcomes are generally described as excellent, good, fair, or poor.

The current series provides short-term arthroscopic evaluation of union as well as long-term follow-up using validated clinical outcome tools with greater than 80% follow-up. Our data indicate that ORIF of the loose bodies in grade IV OCD results in stable union in 92% of cases at 12 weeks. Long-term follow-up demonstrates that these patients have not required subsequent surgery on the index knee for loose bodies and are able to function at a nearly normal level in activities of daily living without significant pain or knee symptoms. However, it is clear that these patients' knees are not normal, as evidenced by the statistically significant departure from normal controls in the knee-related quality-of-life subscale of the KOOS. This

[§]References 3, 11, 16, 22, 23, 25, 31, 32, 36, 37, 41, 42, 46, 47, 49, 55-57, 62.

finding likely represents a true clinical difference as well, as the difference exceeds minimum perceptible change in the KOOS subscale, which is considered 10 points.^{17,53}

While no rigid KOOS score cutoff exists that defines a symptomatic knee, Englund et al¹⁸ attempted to develop such criteria in a series of patients followed for 16 years after partial meniscectomy. They defined a "symptomatic knee" as those in which the knee-related quality of life and at least 2 of the other 4 subscales exhibited a decrease in score consistent with at least half of the questions being answered with at least a 1-point decrease from the best response. By these criteria, 50% of their patients had a "symptomatic knee." However, only half of these patients also showed radiographic evidence of osteoarthritis. With use of the KOOS subscale cutoffs described above, 4 of the 10 patients in our series have a "symptomatic knee" at 8 years' follow-up.

Significant limitations exist in this study. First, our use of a mailed questionnaire to obtain long-term follow-up exposes the study to certain biases. As was demonstrated by Kim et al,³⁵ patients with poorer outcomes are less likely to return questionnaires and tend to take longer to return them when they do so. We attempted to minimize this possible bias by being persistent in our data gathering, but our failure to obtain 100% follow-up must be considered when interpreting data from a small cohort of patients. Further, our long-term results consist only of patient-reported outcomes and a determination of whether the patient required subsequent surgery on the index knee. No imaging was obtained to verify the position of the repaired loose body long term. We believe that given the size and bony nature of the loose bodies, they would be symptomatic and require excision or repeat fixation if they were to again become loose bodies. This supposition is supported by the fact the patients initially had sufficient symptoms from these loose bodies that they required ORIF.

Additionally, we describe one method of treatment for this patient group without inclusion of a control group or comparison with another treatment method. However, previous authors have demonstrated poor outcomes or evidence of osteoarthritis in 50% to 75% of patients at 5- to 15-year follow-up.^{2,4,27,61} We believe this series demonstrates a viable alternative to lesion excision by ORIF of loose bodies.

Finally, the relatively small number of patients included in the study limits the accuracy of correlations made between patient and lesion characteristics and outcome. Specifically, our study only included 2 patients with patellar defects, and 1 was lost to follow-up. The patient with a patellar defect available for long-term follow-up demonstrated the lowest scores in nearly all KOOS subscales and the lowest Marx activity score. Given the relatively poor results of treatment of articular cartilage defects of the patella with multiple techniques,^{9,26} increased difficulty in treating OCD lesions in this location is not unexpected. Similarly, we were unable to demonstrate any relationship between lesion size and clinical outcome as has been previously described.^{10,28,29} Outcome data on more patients are necessary to determine the influence of lesion size and location on clinical outcome.

CONCLUSION

Operative fixation of grade IV OCD loose bodies resulted in stable fixation in 92% of patients at 12 weeks after surgery. At an average 9 years after surgery, patients had minimal pain and exhibited normal function in activities of daily life. However, patients reported significantly lower knee-related quality of life. Only prospective comparative studies can determine relative advantages of the available treatment choices for these lesions.

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