Arthroscopic Fixation of Osteochondritis Dissecans of the Knee

Clinical, Magnetic Resonance Imaging, and Arthroscopic Follow-up

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Background: Optimal treatment of osteochondritis dissecans of the knee is still controversial.

Purpose: To review a group of patients with osteochondritis dissecans of the knee who were treated with arthroscopic compressive screw fixation and who were evaluated with magnetic resonance imaging studies and a second-look arthroscopic procedure at follow-up.

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

Methods: A total of 14 patients (15 knees) with osteochondritis dissecans of the knee were treated with arthroscopic titanium Herbert screw fixation of the osteochondral fragment. A second-look arthroscopic procedure was performed to remove hardware and to evaluate fragment stability. At final follow-up, magnetic resonance imaging studies were used to evaluate potential healing of the subchondral bone. Outcomes were clinically evaluated at a mean follow-up of 50 months (range, 25-104 months) by the Lysholm score and by the International Knee Documentation Committee score.

Results: At second-look arthroscopy, 14 of 15 knees showed evidence of a stable fragment with an intact smooth surface. According to magnetic resonance imaging parameters, 14 knees showed evidence of a healing process of the osteochondral fragment. The average Lysholm score improved 18 points from a mean of 79 preoperatively to 97 postoperatively, and according to the International Knee Documentation Committee score, 13 of 15 knees showed a normal result.

Conclusion: This study suggests that magnetic resonance imaging parameters of a healed osteochondral fragment and patients with satisfactory functional results correspond with arthroscopic evidence of fragment stability. According to this study, arthroscopic fixation with compressive screws is an effective method of repair for osteochondritis dissecans of the knee.

Keywords: osteochondritis dissecans; fixation; magnetic resonance imaging (MRI); second-look; knee

Osteochondritis dissecans (OCD) is a localized condition that affects bone and articular cartilage, leading to the separation of a segment of cartilage from the subchondral bone.[10,26]

The most commonly affected portion of the knee is the lateral aspect of the medial femoral condyle.[2] Although the origins of OCD are unknown, possible causes include focal microtrauma due to repetitive contact with the tibial spine, ischemia, abnormal ossification within epiphyses, genetic and endocrine factors, or a combination of any of these factors.[26]

Surgery is indicated when symptomatic OCD lesions do not respond to nonoperative treatment and when there are symptomatic loose bodies or fragment detachment. Numerous surgical techniques have been used to treat OCD, depending on the stage of the condition.[7,9,22,23,32] When the osteochondral fragment is large and not fragmented, arthroscopic debridement of the nonunion site, followed by arthroscopic reposition and internal fixation of the osteochondral fragment, may be performed.[6,16,25,31,33] This technique is designed to restore the joint surface with the patient's native articular cartilage.

The purpose of this study was to review a group of patients with OCD of the knee who were treated with arthroscopic screw fixation of the osteochondral fragment and who were evaluated with MRI studies and a second-look arthroscopic procedure at follow-up.

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METHODS

Between July 1993 and May 2002, 21 patients (22 knees) with OCD of the femoral condyle underwent operative treatment at our institution. The same surgical team treated all patients by using the same technique. In these 22 knees, the surgical procedure consisted of an arthroscopic fibrous tissue debridement of the subchondral crater followed by reposition and internal fixation of the osteochondral fragment. We excluded 2 patients because of the use of bioabsorbable pins for the fixation. In 19 patients (20 knees), a Herbert cannulated compressive screw was used for internal fixation, and a second-look arthroscopic procedure was performed for hardware removal. Fourteen patients (15 knees) had more than 2 years of follow-up and so were included in the study. The mean follow-up of this series was 50 months (range, 25-104 months) from the second-look arthroscopic procedure.

There were 12 male patients and 2 female patients in the study group. The mean age of the patients at the time of arthroscopic treatment was 20 years (range, 12-35 years). The involved knee was the right knee in 12 cases and the left knee in the remaining 3 cases. One patient had OCD lesions in both knees, and that patient had surgery for both lesions. The location of the lesion was categorized by the classification system described by Cahill.[5] The lesion was located at the typical inferocentral area of the medial femoral condyle in 14 knees (Cahill 2B) and in the lateral femoral condyle in only 1 knee (Cahill 4B). The size of the osteochondral lesion was measured on T1-weighted images as the area of low signal intensity and was evaluated according to the Lotke method,[18] which is expressed as a percentage of the diameter of the medial femoral condyle.

All patients underwent a preoperative MRI, which provided information regarding the status of the osteochondral fragment and the underlying subchondral bone, the integrity and condition of the articular surface, and the structure of the interface between the osteochondral fragment and the parent bone.[3,8,11,21] The images were assessed according to the criteria of De Smet et al, based on T2-weighted images[8,24]: (1) a line of high signal intensity of at least 5 mm in length between the fragment and the underlying bone; (2) an area of increased homogeneous signal at least 5 mm in diameter beneath the lesion; (3) a focal defect of 5 mm or more in the surface of the articular cartilage; and (4) a high signal line traversing the subchondral plate into the lesion.

Arthroscopic Surgical Technique

The arthroscopic procedure was performed with the patient under regional anesthesia and with the use of a tourniquet. Standard anteromedial and anterolateral portals were used. The arthroscope was introduced through the anterolateral portal, and the surgical operation was performed internally because the majority of the lesions were located in the medial femoral condyle. The osteochondral lesion was examined for integrity of the surface and stability of the fragment (Figure 1A) and evaluated according to the often-used arthroscopic classification of Guhl.[13]

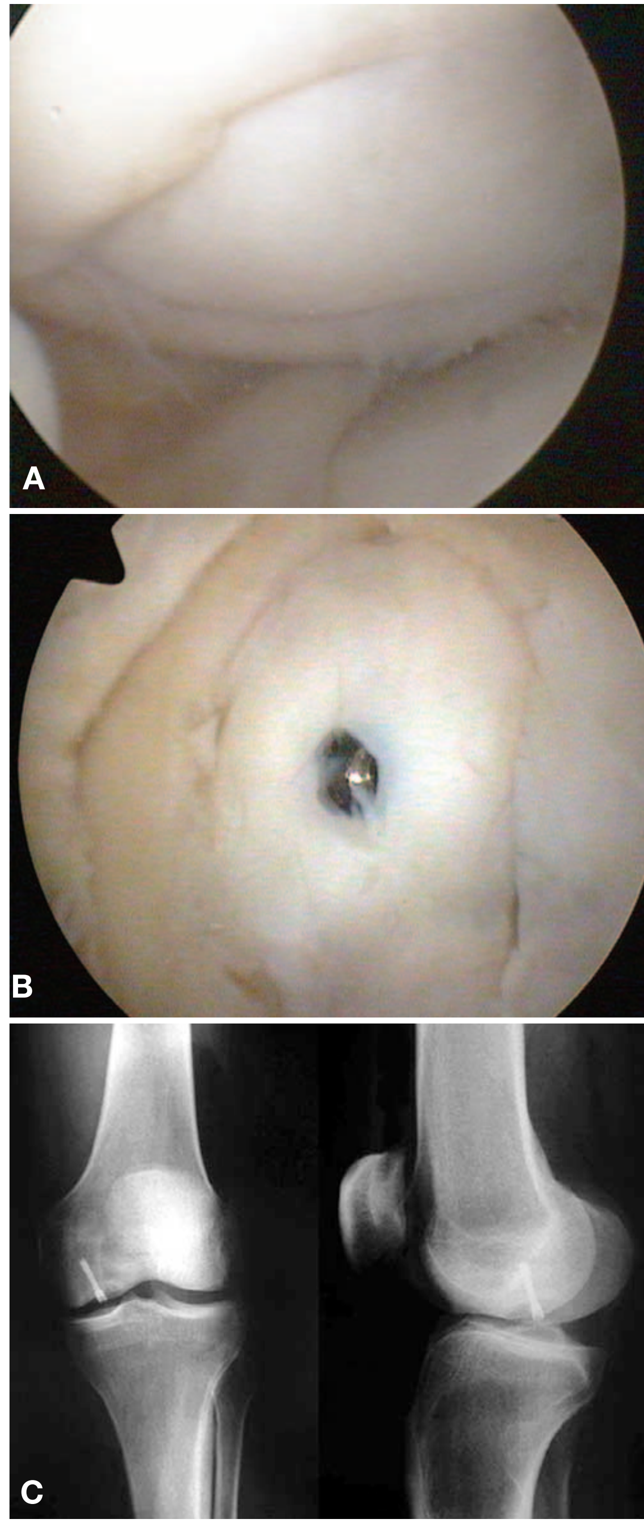

Figure 1. A 26-year-old man with pain in the medial joint of the knee. A, arthroscopic view showing the well-circumscribed lesion on the medial femoral condyle; B, arthroscopic view showing the osteochondral fragment after reposition in the crater and fixation with a Herbert compressive metallic screw; C, immediate postoperative anteroposterior and lateral radiographs showing the osteochondral lesion, which was fixed with a metallic screw.

TABLE 1
Patient Data[a]

Case No.	Age, y	Sex	Skeletal Maturity	Localization	No. of Screws Used	Pre-operative Lysholm Score	Post-operative Lysholm Score	Time to Second-Look Arthroscopic Procedure, d	ICRS Rating[b]	IKDC Score[c]	Follow-up, mo[d]
1	17	M	Mature	MFC	1	86	100	63	Normal	Normal	25
2	29	M	Mature	MFC	2	76	91	91	Nearly normal	Nearly normal	25
3	20	M	Mature	MFC	1	86	100	126	Normal	Normal	27
4	14	M	Immature	MFC	2	81	100	126	Normal	Normal	32
5	20	M	Mature	MFC	2	65	94	214	Nearly normal	Normal	34
6	35	M	Mature	MFC	1	81	100	51	Normal	Normal	39
7	14	M	Immature	MFC	1	86	100	70	Normal	Normal	42
8	14	F	Immature	MFC	1	86	100	220	Normal	Normal	44
9	16	M	Immature	MFC	1	81	100	91	Normal	Normal	46
10	33	M	Mature	MFC	1	50	64	68	Abnormal	Abnormal	50
11	23	M	Mature	LFC	1	85	100	77	Normal	Normal	58
12	20	M	Mature	MFC	1	76	100	77	Normal	Normal	71
13	12	F	Immature	MFC	1	81	100	97	Normal	Normal	71
14	14	F	Immature	MFC	1	86	100	85	Normal	Normal	74
15	16	M	Immature	MFC	1	86	100	63	Normal	Normal	104

[a]ICRS, International Cartilage Repair Society; IKDC, International Knee Documentation Committee; F, female; M, male; LFC, lateral femoral condyle; MFC, medial femoral condyle.
[b]Evaluation performed at second-look arthroscopic procedure.
[c]Clinical evaluation performed at final follow-up.
[d]Months between second-look arthroscopic procedure and final follow-up.

A probe was used to palpate the OCD lesion, with care taken not to disrupt the medial chondral hinge. In all knees, the osteochondral fragment was separated from the subchondral bed, and a superficial debridement was performed on the crater and the fragment to remove interposing fibrous tissue. Multiple small drill holes were then made at the base of the crater to increase its vascularity. Excessive debridement of the fragment and base was avoided to minimize the loss of bone substance and subsequent depression of the fragment with compression screw fixation. No patients required bone grafting. Once the reduction was congruent, the osteochondral fragment was repositioned in the crater with a probe. The preliminary guide wire secured the fragment in situ. The instrumentation included a cannulated calibrated drill. The small guide pin facilitated the passage of the cannulated screw through the soft tissues. Tapping was not used. The screwdriver was cannulated, and we fixed all the fragments with Herbert compressive titanium screws inserted perpendicular to the chondral surface (Figure 1B). The screws should bridge the pseudarthrosis but not transgress the epiphysis if the epiphysis remains open. These headless screws have a rounded proximal end and are sunk below the articular surface so that they may prevent scuffing of the tibial articular surface and provide a secure fixation of the fragment under compression. In 12 cases, the osteochondral fragment was fixated with only 1 screw; in 3 cases, 2 screws were used (Figure 1C). The reason we used more than 1 screw fixation in 3 cases was that the lesions were larger than the others and the shape of the fragments was ovoid or rectangular. After fixation, an assessment was made of the stability of the fragment.

Patients began mobilization of the knee joint the day after the surgery and were restricted to nonweightbearing crutch ambulation for 4 weeks and then partial weightbearing ambulation until the screw was removed.

Clinical, MRI, and Arthroscopic Follow-up

At a mean of 101 days after surgery (range, 51-220 days), a second-look arthroscopic procedure was performed to remove the compressive screw. During the procedure, fragment stability and healing of the osteochondral lesion were evaluated using the International Cartilage Repair Society (ICRS) cartilage repair assessment,[4] which takes into account the degree of defect repair, integration of the fragment with the surrounding cartilage, and macroscopic appearance of the articular surface, resulting in a normal, nearly normal, abnormal, or severely abnormal rating.

At final follow-up (mean, 50 months; range, 25-104 months), clinical results were assessed by the Lysholm score[30] and International Knee Documentation Committee (IKDC) evaluation form.[14] An MRI was also performed to evaluate healing of the osteochondral fragment. On the postoperative MRI, the osteochondral fragment–subchondral bone interface was evaluated for the presence of a demarcation line or for the presence of fluid in this interface, which indicates a lack of consolidation of the osteochondral fragment[3,11,21] (Table 1).

We compared preoperative and postoperative Lysholm score values with a paired *t* test. We expressed the results with a mean difference and the 95% confidence interval (95% CI).

RESULTS

Preoperative MRI on T1-weighted images demonstrated a convex subchondral semioval lesion of low intensity with sharp demarcation from healthy bone marrow (Figure 2A). In the 9 lesions in which arthroscopic evaluation showed irregularity and softening of articular cartilage with a mobile fragment to compression, T2-weighted images exhibited a heterogeneous high signal fragment–subchondral bone interface that did not make contact with the articular surface. In the remaining 6 lesions in which arthroscopic evaluation showed an articular cartilage breached with a nondisplaceable or displaceable fragment but attached by some overlying articular cartilage, T2-weighted images exhibited a homogeneous high signal fragment–subchondral bone interface that made contact with the articular surface, representing the presence of articular fluid in this interface and thus indicating instability of the osteochondral fragment. We measured the size of the osteochondritic image found during the MRI, and we obtained a mean of 43%, with a range from 20% to 78%, expressed as a percentage of the diameter of the medial femoral condyle.

During the first surgery, the osteochondral lesions were evaluated according to the arthroscopic classification of Guhl.[13] Nine lesions had irregularity and softening of articular cartilage with a mobile fragment to compression (grade I), 5 lesions had an articular cartilage breached with a nondisplaceable fragment (grade II), and 1 lesion had a displaceable fragment but was attached by some overlying articular cartilage (grade III).

At second-look arthroscopy, the fragment was stable to probing and had an intact smooth surface in 14 knees. In 12 of 14 knees, the osteochondral fragment had a complete integration of the border to the articular surface, a normal result in the cartilage repair assessment of the ICRS. In the remaining 2 knees with an intact smooth surface, the fragment border had a demarcation line with the surrounding articular cartilage, a nearly normal result in the cartilage repair assessment of the ICRS. In 1 knee, the fragment had partial integration with the surrounding articular cartilage and had several small fissures on its surface, an abnormal result in cartilage repair assessment of the ICRS. There were no incidents of infections, bleeding episodes, thromboembolism, or stiffness.

Postoperative MRI showed a completely healed fragment in 14 knees. On T1-weighted images, both the fragment and subchondral bone showed normal homogeneous signal intensity, with no demarcation line between them (Figure 2B). On T2-weighted images, the interface between the fragment and subchondral bone had disappeared. In all these knees, the fragment surface was level with the surrounding cartilage. These cases corresponded to the 14 knees with a normal and nearly normal result at second-look arthroscopic evaluation.

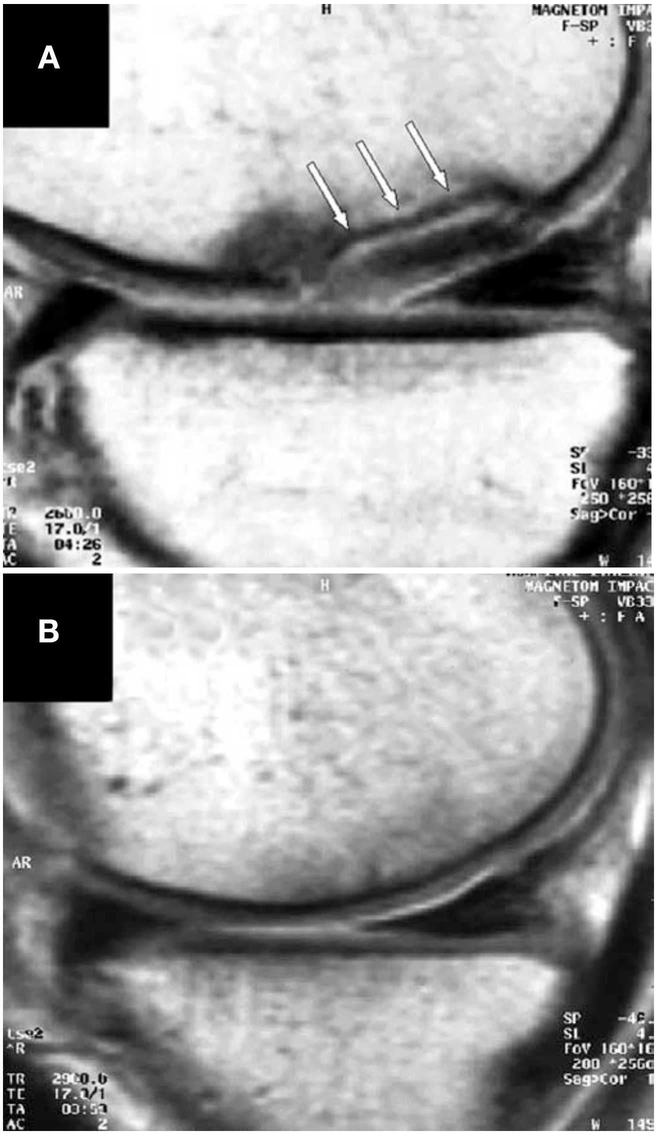

Figure 2. An MRI of the same patient in Figure 1. A, sagittal image of the preoperative MRI. Note the presence of a fluid interface between the osteochondral fragment and the parent bone, which indicates an unstable lesion (arrows). B, sagittal image, made 3 years postoperatively, showing the consolidation of the osteochondral fragment.

Postoperative MRI of the remaining knee showed splintering of the osteochondral fragment that had heterogeneous low signal intensity on T1-weighted images (Figure 3). On T2-weighted images, peripheral high signal intensity indicated the presence of articular fluid in the fragment– subchondral bone interface, demonstrating a lack of union of this partially detached osteochondral fragment. This case corresponded to the patient with an abnormal result in the arthroscopic cartilage repair assessment of the ICRS.

The Lysholm score improved from a mean of 79 (SD, 9.9; range, 50-86) preoperatively to 97 (SD, 9.4; range, 64-100) postoperatively, with a mean difference of –18 (95% CI,

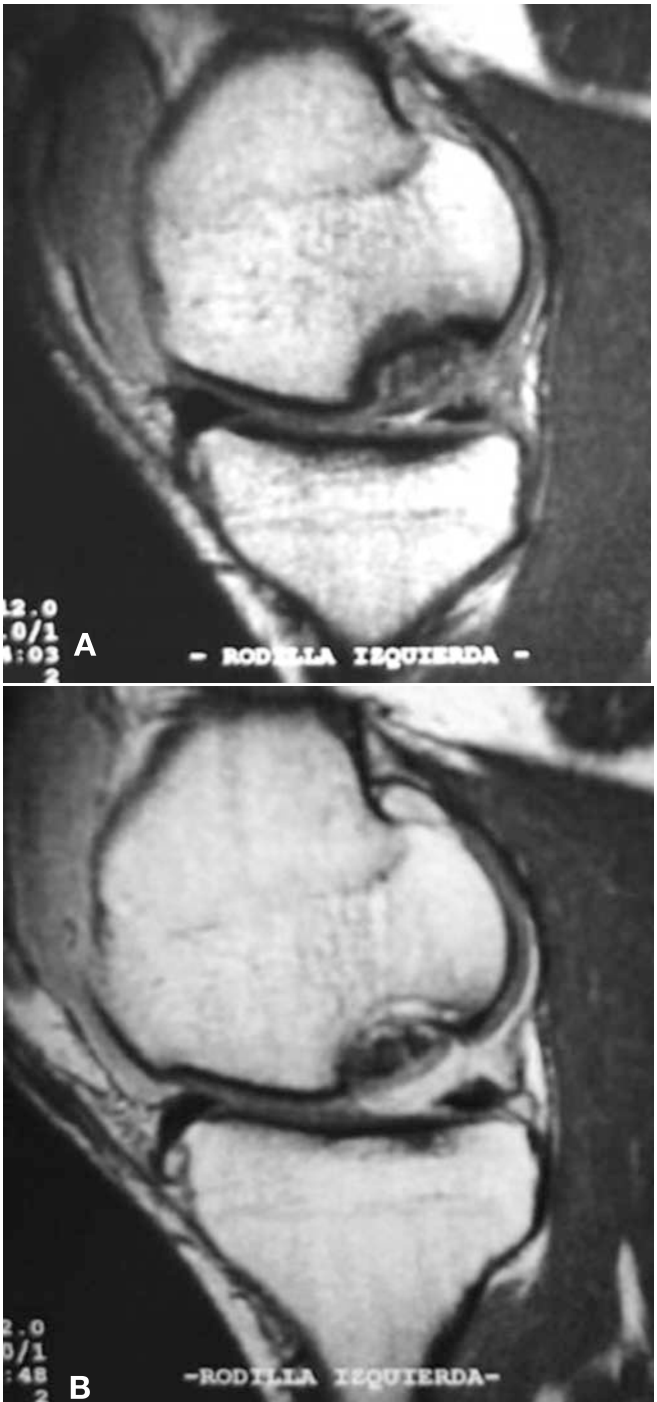

Figure 3. An MRI of the patient with an abnormal result in the International Knee Documentation Committee evaluation. A, sagittal image of the preoperative MRI; B, postoperative MRI showing disintegration of the osteochondral fragment.

–19.6 to –14.6; $P < .001$). The results were excellent in 12 knees, good in 2 knees, and poor in 1 knee.

The IKDC evaluation showed a normal result in 13 knees, a nearly normal result in 1 knee, and an abnormal result in the remaining knee.

DISCUSSION

Treatment of osteochondritis dissecans at an early stage, when there is only pain without locking or giving way, involves nonoperative therapy. Some authors have proposed a brace or cast, limitation of activities until the patient is free of symptoms, and protected weightbearing with use of crutches. It has already been published that nonsurgical treatment is more successful in younger, skeletally immature patients, as they have a much greater potential to heal.[26] If symptoms persist despite this nonoperative treatment, a variety of surgical options may be indicated, including debridement, drilling, internal fixation, transplantation, and autologous chondrocyte implantation, depending on the patient's age and the stage of the lesion.

One weakness of this study is that our population was not homogeneous with respect to age, with 7 patients being skeletally immature and 8 being skeletally mature. It is known that prognosis after surgical treatment is better in immature patients; however, in mature patients, prognosis is not affected.

Smillie[28] was the first author to publish results of reposition and internal fixation of the osteochondral fragment in the knee. He suggested that final results were better when surgery was performed at an early stage of the disease, before splintering and separation of the osteochondral fragment from the subchondral bed.[29]

Several methods have been used for internal fixation of the osteochondral fragment.[1,12,15-17,19,27,33,34] In a study of osteochondritis dissecans managed by Herbert compression screw fixation, Thomson[31] reported a cure rate of 88%. Using the same technique, Rey Zuniga et al[25] had an excellent or good outcome in 82% of the patients. In our study, we had excellent and good clinical results in 93% of our patients. What differentiates the present study from other previously published studies with regard to this technique is the use of preoperative and postoperative MRI for all patients and the much longer follow-up.

The advantage of the Herbert compressive metallic screw is that it provides secure fixation and has a compression effect on the fragment in the subchondral bed.[20,25,34] Also, the device is designed so that the end of the screw can be sunk beneath the surface of the articular cartilage. The disadvantage of this method is that the metallic screw may require an additional operation for removal because in some cases, the screw compression is lost, allowing erosion on the opposite tibial side. The second-look arthroscopic procedure can help assess the healing of the osteochondral fragment and the integrity of the articular surface.

We obtained healing of the osteochondral lesion with good clinical results in 14 of the 15 knees in our series. At second-look arthroscopy in these 14 knees, the articular surface appeared intact and stable. The osteochondral fragment was level with the surrounding cartilage and had a complete integration of the border to the surrounding articular surface. This percentage of good results (93%) is similar to the findings of other published series that had patients who were treated with reposition and fixation of the osteochondral fragment.[6,16,25,31,33] When there was a substantial loss of bone because of a pathological condition or surgical debridement, the screw compression resulted in significant depression of the fragment. If the depression was minimal, it did not adversely affect the patient's clinical assessment in the short term.[16] Bone grafting in selected cases would restore the articular contour and provide a stimulus for healing. Even though Johnson et al[16] reported subsequent loosening of 4 fragments that at second-look arthroscopy appeared solid, we did not have that problem in our patients.

Retrospectively analyzing the poor result obtained in 1 of our patients, we believe that this result was because of the fragmentation of the osteochondral lesion at the time of the first surgery. We realize that this patient was not an ideal candidate for this method of treatment because of the probable disintegration of the osteochondral fragment with the screw insertion and compression.

The use of MRI is useful in the diagnostic stage of this condition.[3,8,11,21] On T1-weighted images, it is possible to evaluate the location, size, and extension of the osteochondral fragment, especially in radiologically negative stages. T2-weighted images provide information regarding the integrity of the articular surface, and the presence of a fluid interface between the osteochondral fragment and the parent bone may indicate an unstable lesion. This information is helpful for making the diagnosis at an early stage of the disease, when results from treatment generally are better. Also, MRI seems to be the method of choice for follow-up of the different techniques used in the treatment of osteochondritis dissecans of the knee. In all our 15 cases, we observed a correspondence between postoperative MRI images and stability of the osteochondral fragment at second-look arthroscopy. Thus, MRI allows the assessment of the healing process in a noninvasive way, with results similar to those found at second-look arthroscopy. Furthermore, MRI can detect the fluid interface between the fragment and the parent bone beneath the articular surface not seen with arthroscopy.

According to this study, arthroscopic fixation with compressive screws seems to be an effective method of repair for osteochondritis dissecans of the knee. This study also suggests that MRI parameters of a healed osteochondral fragment and patients with satisfactory functional results correspond with arthroscopic evidence of fragment stability.

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