Arthroscopic Treatment of Osteochondritis Dissecans

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The experience of many orthopedic surgeons has shown that osteochondritis dissecans in children and most juveniles will heal with some form of conservative treatment, usually including immobilization, as was first shown by Green and Banks[7] and later by Campbell.[5] Helfet,[10] however, stated that sometimes a period of six to 12 months was necessary for healing to occur, and that not all cases would respond to this method of treatment.

Prolonged immobilization has many disadvantages. Smillie[15] was the first to suggest that the period of immobilization should not exceed 12 to 16 weeks in these patients. By that time, if healing was not adequate at roentgenographic examination, he would suggest surgery. Smillie also showed that surgical preparation of the bed, and drilling and pinning in properly selected cases would prevent fragment separation and result in healing and restoration of anatomy. Furthermore, he replaced and fixed separated fragments. More recently, Smillie[16] stated that in most cases of osteochondritis dissecans, surgical treatment should be considered immediately, suggesting that healing ability was lost with maturity, perhaps in early adolescence.

Many other forms of surgical treatment have been discussed in the literature, including excising the fragment, debriding the crater, and different forms of fixing and grafting.[1,2,11,13,14] Because of this diversity in preferred methods of treating osteochondritis dissecans, the early 1970s were primed for the development of a new treatment. It was thus inevitable that the role of the arthroscope would develop.

METHODS AND MATERIALS

Of 50 patients treated for osteochondritis dissecans during the past five years, 44 were treated arthroscopically by the author, two by open arthrotomy, and four by conservative means. Twelve of the cases were bilateral, and five of these were treated arthroscopically; hence, a total of 49 knees were treated by arthroscopic methods. Eight patients in the series had previous treatment: six conservative and two by open surgery. Patients ranged in age from 11 to 29 years.

SELECTION

Skeletal age and radiographic size and location of the lesion were the criteria used to qualify for this procedure. Generally, those patients who are 12 years of age or older and have lesions larger than 1 cm located primarily in the weight-bearing area, should be scoped and treated immediately. It is contraindicated to perform the procedure in those patients who skeletally are younger than 12 years of age or who demonstrate lesions that are inaccessible arthroscopically. Additional contraindications include unusually large salvagable fragments, large craters with fixed sclerotic bases, and lesions where several loose bodies must be replaced. It should be emphasized that this type of surgery obviously should not be done by anyone not adequately experienced in arthroscopic surgery.

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Roentgenographic Evaluation

Anteroposterior, lateral, and tunnel view roentgenographs were required in all cases. Roentgenograms of the left hand and wrist should be obtained to determine skeletal age because the pathophysiologic condition of the lesion differs as maturity approaches. The contralateral knee should be radiographed to determine bilateral involvement. Position is important when radiographing lateral views to avoid superimposing the lesion on the tibial spine. In patients beyond maturity, laminograms should be obtained initially and pertinent cuts recorded for future follow-up. Magnification views are diagnostic in older patients. Consistent technique for comparison purposes can not be overemphasized. Radiographic location of the lesion is important in planning the surgical approach and in positioning the knee for surgery and casting. Lesions of the medial femoral condyle are central, centrolateral, and inferocentral. Those of the lateral femoral condyle are inferocentral and often posterior.[12] Those in the medial femoral condyle in the lateral view are usually in the weight-bearing area, bordered by a line projecting from the posterior femoral shaft and intersecting by a line projecting from the femoral groove.

Evaluation by Arthroscopy

The arthroscopic examination is done in the operating room suite under general anesthesia, using sterile technique. The entire joint should be thoroughly examined to rule out any associated pathologic conditions.[4] A large incidence of loose bodies has been reported in earlier series[17,18] as well as a significant per cent of coexisting meniscus pathology.[17,18] The development of arthritic changes can often be determined earlier using the arthroscope than by roentgenographic evaluation. Chondromalacia may coexist or develop with prolonged immobilization.

The location, extent, and nature of the lesion can be arthroscopically determined by several techniques. Light dimming or installation of methylene blue dye will bring further detail of the lesion into relief.[9] Probing will indicate softness, looseness, or separation of the lesion. The oblique scope will emphasize details not visible with the direct viewing scope. It is important to inform patients personally that arthroscopic follow-up may be necessary, before they undergo surgery.

The follow-up examination is easily done under local anesthesia, and provides information regarding the state of the lesion and future prognoses. Biopsies can also be obtained at this time.

On the basis of the arthroscopic examination, the lesion is classified into one of the following groups:[8] (1) *intact lesions*; (2) *lesions showing signs of early separation*; (3) *partially detached lesions*; and (4) *craters with loose bodies* (salvageable or unsalvageable).

After the joint has been diagnostically explored and the lesion located and classified, surgery is planned.

Surgical Treatment

Arthroscopic surgery is performed with the knee well flexed to bring the entire area into view. The procedure and the findings are documented by 35 mm slides or a closed circuit color television. An image intensifier may be necessary for use in an occasional intact lesion if few or no articular cartilage changes are apparent. Usually, a substantial portion of the lesion can be outlined by arthroscopic appearance and the remainder accurately determined radiographically for reference and comparison.

Intact lesions in children younger than 12 years of age are generally treated by immobilization and/or nonweight-bearing, while those older than 12 years are considered for drilling. Lesions showing signs of early separation are drilled, part of the border is usually debrided, and they are pinned with one or more pins. Partially detached fragments should have the undersurface of the fragment and the crater thoroughly debrided before undergoing reduction, drilling and pinning. Bone grafting is considered in patients nearing maturity. Craters are treated by reconstruction, *i.e.*, they are debrided, trephined and drilled. Loose bodies are removed or occasionally, when salvageable, are replaced and pinned.

Four of the cases were treated conservatively; 15 were drilled; eight were drilled and pinned; two were debrided, reduced and pinned; and ten underwent reconstruction. One case had a large loose body removed and one a large fragment replaced, twelve cases were bone-grafted, and two were treated by open arthrotomy. Several of the 12 cases that were grafted were also drilled and pinned, and a number of the reconstructed lesions had one or more loose bodies removed.

Drilling

Intact lesions are treated by drilling with a 0.062 Kirschner wire. The triangulation method is used with one portal for the arthroscope and the other for the 2.2 mm needlescope cannula (Fig. 1). When the desired position is obtained, the Kirschner wire is inserted through the cannula and then drilled through the lesion in several different directions, from one or more entry points,

to freshly bleeding bone. The weight-bearing area is avoided when possible. Centrolateral lesions are usually drilled from the contralateral side, and inferocentral lesions from the ipsolateral side. In the latter, often both approaches are used.

Pinning

If any signs of early separation are noted, the fibrous tissue in the margin should be removed using basket forceps or dental type power driven burs. The lesions are then drilled and pinned in place. Smooth 0.062 Kirschner wires that are nine inches long, with a raised thread over the distal three inches, are used. Unthreaded pins can be used, but not completely threaded pins because of their tendency to break and because they are difficult to direct and remove. The wires are positioned, tapped a few millimeters with a mallet, and then drilled through the femoral condyle in a proximal direction using the power drill (Fig. 2). A jig or guide, *e.g.*, the Hewson ligament guide, may be helpful. Wires are withdrawn retrograde until the threaded end disappears into the joint and can not be felt with a double gloved finger or thumb (Fig. 3). The joint is distended and the arthroscope is reinserted. Care should be taken not to scratch the lens. Final withdrawal is done under arthroscopic visualization until the end is flush with the articular cartilage or counter sunk. The proximal end is cut beneath the skin and buried. The pins are removed four to six weeks postoperation, under local anesthesia. As determined by experience, the fragment will usually remain in place by this time, even if motion is started. If the pins are kept in longer, they tend to erode through the skin and migrate.

Lesions of the lateral femoral condyle are usually located inferocentral and posterior. Occasionally it is not possible to treat these arthroscopically.

Debridement, Reduction, and/or Replacement

Partially detached fragments are usually held anteromedially by a "hinge" or stylus or articular cartilage, or by some of the posterior cruciate ligament fibers. In this case, the undersurface of the fragment and bed must be debrided of most fibrous and granulation tissue, using dental sinus ring curettes, small down biting ronguers, basket forceps, motorized shavers and cutters, and power-driven burs. After the debridement, the margin is trimmed and the fragment accurately reduced and pinned in place. If there is a "step off" or incongruous reduction, cancellous or cortical graft material is pushed down through a channel to "even up" the reduction.

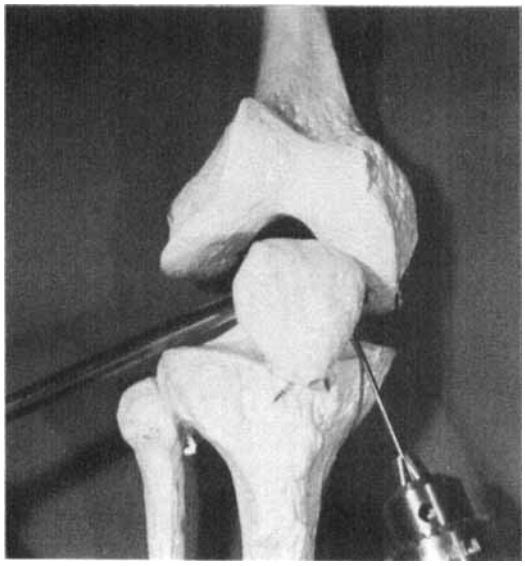

Fig. 1. Drilling by triangulation method with one portal for the arthroscope and the other for the Kirschner-wire.

Reconstruction

The unsalvageable loose bodies are removed, the craters are debrided and trimmed, and the base in denuded down to cancellous bone and drilled to stimulate regrowth of the fibrocartila-

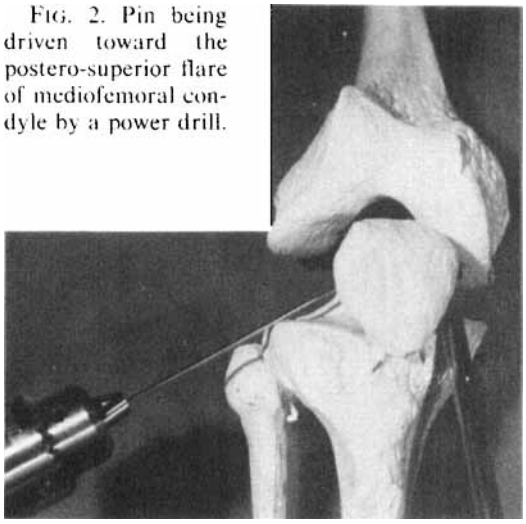

Fig. 2. Pin being driven toward the postero-superior flare of mediofemoral condyle by a power drill.

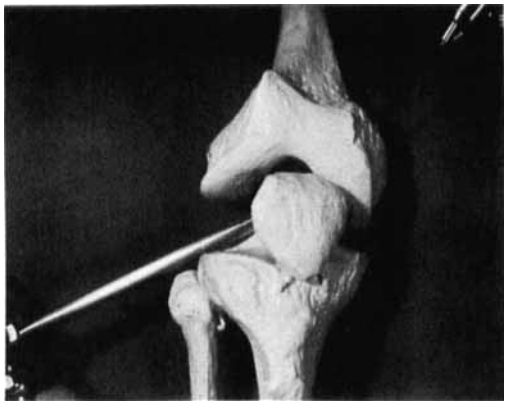

FIG. 3. The pin is withdrawn retrograde until the threaded end is flush with the articular cartilage, under arthroscopic control.

ginous surface. This surface is far less abrasive to the opposing articular hyaline cartilage than is the fibrous tissue, but not as acceptable as the hyaline cartilage. Postoperatively, motion is started immediately. Whether weight-bearing should be allowed is controversial. In the author's opinion, weight-bearing is not harmful to some of the smaller lesions. Larger lesions comprising several centimeters in cross-sectional area should remain nonweight-bearing for a period of eight weeks.

The trimming, debriding, and "freshening" procedure is accomplished using small knives, dental-type instruments, basket forceps, curettes, burs, and motorized cutters. The bed is drilled using a 0.062 Kirschner-wire, making about eight to ten holes for a lesion 2 cm in diameter.

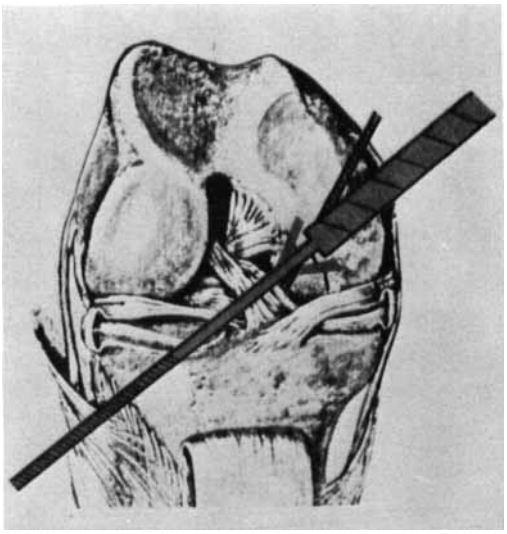

FIG. 4. The channel is reamed to pass the bone graft from above, down to the lesion.

BONE GRAFTING

Older adolescents who are skeletally older than 16 years, and adults, should be selectively considered for bone grafting via roentgenographic and arthroscopic evaluation, despite that the epiphysis may not have closed. Some cases have been found not to heal without grafting. Radiographic criteria include a fairly large lesion, with a sclerotic border and radiolucent margin. The arthroscopic criteria are signs of early separation or partial detachment. Lesions with fissures that have a large amount of protruding fibrous tissue should be especially considered. Local cancellous bone graft currettments, corticocancellous cores, iliac match stick grafts, and freeze dried allografts have been used. The preferred grafts have been the iliac match stick and corticocancellous grafts, but considering the morbidity, experience has shown that the others are just as adequate. Corticocancellous grafts can be obtained from the iliac crest using a small incision and an 8 or 10 ml Michelle trephine.

There are two methods of grafting. One is to pass a graft through a channel, from above, to the site of the lesion (Fig. 4). A well-placed Kirschner wire is passed from below through the lesion, driven proximally, and withdrawn as described previously. The 5 ml cannulated, calibrated reamer is passed over the guide wire down to, but not through, the articular cartilage of the lesion under arthroscopic control. Two or more channels can be employed if necessary. Graft material is then passed down the channel. In four cases, freeze-dried grafts with cancellous bone were used. Of the remaining cases, iliac corticocancellous or match stick grafts were used in three and cancellous currettings in six.

Another method is to place the Kirschner-wire in an appropriately selected area of the lesion, triangulating with the arthroscope from below. The reamer is passed proximally from a distal position to about 3.0 cm deep (Fig. 5). The wire and reamer are withdrawn and a 5 ml cannula is aligned with the channel under arthroscopic visualization. The appropriate grafts are passed through the cannula into the channel and tapped until they are counter sunk below the articular cartilage (Fig. 6). It is paramount when grafting that an ample amount of bone is used and is well placed.

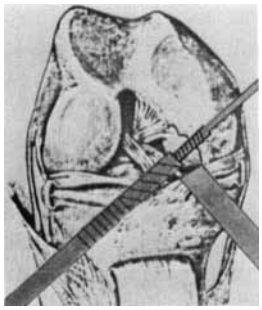

FIG. 5. A Kirschner-wire is drilled into an appropriately selected area of the lesion by triangulation with the arthroscope from below, with reamer over wire.

FIG. 6. Wire and reamer are withdrawn and a 5 ml cannula is aligned with the channel under arthroscopic visualization, with graft inserted through the cannula from below.

POSTOPERATIVE CARE

The extremity is casted in a flexed position and the patient is kept nonweight-bearing until radiographic healing is satisfactory, regardless if lesions are pinned or grafted. The immobilization period is kept as short as possible, but continues until at least some portion of the fragment is bridged by bony trabeculae, usually within about two or three months. Nonweight-bearing is recommended for another two or three months until the trabecular bridging is more adequate. In older patients, a significant amount of bone scarring always remains. Treatment of young patients who had intact lesions that were drilled consisted of using an immobilizer and crutches for a few weeks followed by restricted activity until healing occurred. Many of these patients were once treated by casting and nonweight-bearing of many months' duration. Patients that have had large defects reconstructed, *i.e.*, larger than approximately 2 cm, should be immediately mobilized, but kept nonweight-bearing for about eight weeks. Lesions smaller than this need not be protected from weight-bearing. Patients who have bilateral lesions have been at times treated postoperatively by casting the extremity with the larger lesion in flexion and then immobilizing the controlateral extremity in extention for full weight-bearing on crutches. This is done when the lesion is sufficiently small or posterior on the extended side so that there is little contact between it and the weight-bearing tibial surface.

CASE REPORTS

The following two cases illustrate examples of pinning, drilling, reduction, and grafting.

Case 1. A 20-year-old man had a partially detached lesion (Fig. 7). Treatment was complete debridement of the fragment's undersurface and bed, reduction and pinning using three pins (Figs. 8 and 9). He healed in 4½ months. At three years' follow-up, he was playing raquetball, basketball, and skiing. No graft was used. Nevertheless, in this type of case, and with a patient who is of this age, grafting should be done to ensure healing.

Case 2. A 16½-year-old girl who had a large centrolateral lesion of the medial femoral condyle (Fig. 10), was grafted with local cancellous bone packed down from above, and with freeze-dried graft inserted from below by the second method. She healed in five months and remains asymptomatic (Fig. 11).

OPEN ARTHROTOMY

Since 1975, two patients who had this problem could not be treated arthroscopically. One patient had very large inferocentral lesions of both lateral femoral condyles, and the other patient had a large salvagable loose fragment. Open surgery was evaluated as best in both cases because of the size of the lesions.

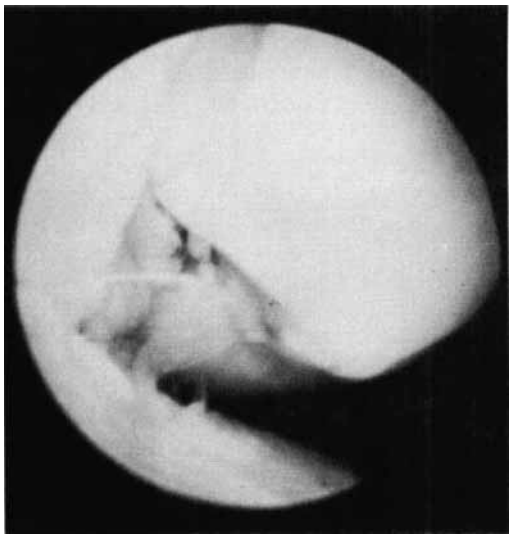

FIG. 7. Arthroscopic view of partially detached lesion.

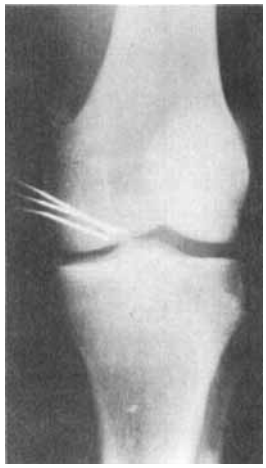

FIG. 8. Anteroposterior view of partially detached lesion after reduction and fixation with three pins.

RESULTS

Forty-four patients (49 knees) underwent arthroscopic procedures by the author (Table 1). Of these, 32 were followed and fully evaluated. The final evaluation in six patients was determined via findings at the last office visit. In six other patients, owing to geographical reasons, the last follow-up evaluation was performed by the referring orthopedic surgeon, and radiographs were forwarded to the author for review. The follow-up interval ranged from one (for the last case) to five years (mean, approximately three years).

Of the 49 knees treated by arthroscopy, 44 healed, two failed and three were undetermined. Of the 46 knees with adequate follow-up information, 22 had results classified as excellent, 18 good, four fair, and two poor. Criteria that were used for this evaluation were as follows: Excellent when no symptoms were present, x-rays were normal, and an essentially normal knee on examination; good when there were no symptoms present, there was a scar on x-ray, and there was slight thigh atrophy and a few degrees limitation of flexion and/or extension; fair when there was occasional mild aching with activity and/or swelling, the x-rays showed slight flattening or ridging, and there was slight thigh atrophy and/or limitation of motion; poor when there was aching or swelling approaching or equivalent to a disability, the x-rays showed early arthritic changes, and there was tenderness, and atrophy of the quadriceps.

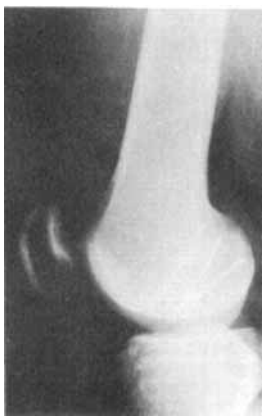

FIG. 9. Lateral view of partially detached lesion after reduction with three pins.

Poor results defined disabling symptoms or a physical abnormality that could be attributed to the lesion. In assessing the final result, pre and postoperative roentgenographs were also obtained. The criteria compared were the defect's size, and the presence of degenerative changes and loose bodies, indicating fragment separation.

The final roentgenographs were tabulated as those showing normal contours and those with scars, ridges, flattening, or early arthritic changes. In all patients beyond maturity, any bone scarring or flattening that existed preoperatively was also present postoperatively, despite that they were asymptomatic.

Of the 18 good results, six could not be expected to rate any higher and of the four fair results, all could not be expected to rate any higher because of the preoperative clinical and roentgenographic picture. Therefore, 22 patients had excellent results, 12 good, ten satisfactory, and three undetermined. There were two failures.

The time required to heal ranged from three to nine months (mean, five months). The immobilization period ranged from six weeks to seven months (mean, four months).

The nonweight-bearing interval, except in young patients who had intact lesions that were drilled, ranged from two to nine months (mean, 5½ months).

There were five repeat procedures using the arthroscope. Two patients had a repeat debridement and drilling and three a repeat bone grafting. No open procedures were required as repeat procedures.

The results are evaluated according to procedure: those lesions treated conservatively healed; all were considered excellent except for one, which was undetermined. Of the 15 that were drilled, 14 healed and one was undetermined: 11 were excellent, two were good, one was fair, and one was undetermined. Eight lesions were drilled and pinned and of these, all healed; five were excellent and three were good. Two lesions were debrided, reduced, and pinned; both healed and were excellent. Ten lesions were reconstructed, and of these, one was rated excellent, six good, two fair, and one was undetermined. Of the 12 bone grafts, nine healed; three were excellent, five good, one fair, two failures or poor, and one was undetermined. The single lesion with a large loose body removed previously filled in and had a good result. The one case in which the fragment was replaced healed and had a good result.

The patients were evaluated with respect to age at treatment. Of those treated while ranging in age from 11 to 15 years (19 knees), 14 were rated excellent, two good, one fair, one poor and one was undetermined. Of those treated while ranging in age from 16 to 20 years (18 knees), 17 healed; five were rated excellent, ten good, two fair and one poor. Of those treated while ranging in age from 20 to 29 years (7 knees), all healed; one was rated excellent, five as good, and one as fair.

Complications

Two pins were placed too superficial and eroded through the skin. However, they caused no problem. Two pins broke, leaving

FIG. 10. Anteroposterior view of lesion prior to bone grafting.

the distal ends buried in place.[14] One pin became loose in the joint during surgery and was replaced. Two grafts were displaced; one was reinserted immediately and the other replaced in a subsequent procedure. Chondromalacia was clinically diagnosed in three patients postoperatively.

DISCUSSION

There are many advantages with treating osteochondritis dissecans arthroscopically. The shorter period of hospitalization, reduced costs, lack of disfiguring scars, and fewer complications are the same as for other arthroscopic procedures. By these means, immediate physical evaluation of the lesion is possible, and coexisting pathology can be determined. Total immobilization and nonweight-bearing time is reduced by treating the patient earlier. Radiolucent loose bodies can be found and the character of the tissue in the crater determined. The

FIG. 11. Anteroposterior view of lesion five months after grafting, almost healed.

TABLE 1. Summary of Treatment and Results

Case No.	*Age*	*Name*	*Treatment*	*Date*	*Results*	*Excellent*	*Good*	*Fair*	*Poor (Failure)*	*X-ray Normal Contour*	*Bone Scars*	*Ridges Flattening*	*Early Arthritis*
1	15	DP	D & P	8/14/75	Hd	×				×			
2	12	TL	Cons	3/16/76	Hd	×				×			
3	13	DE	D	5/11/76	Hd	×				×			
4	16	RG	D	7/19/76	Hd		×				×		
5	14	RN	D	7/20/76	Hd	×				×			
6	16	MP	D & P	8/16/76	Hd	×				×			
7	13	TB	D	9/1/76	Hd	×				×			
		TB	Cons	9/1/76	Hd	×				×			
8	13	LP	D	9/21/76	Hd	×				×			
9	17	LC	Rec	8/17/77	Hd		×					×	
10	16	EM	D & P	9/6/77	Hd		×						×
			D & P	9/9/77	Hd		×						×
11	20	WH	BG	4/7/77	Hd		×					×	
12	14	JS	D & P	11/21/77	Hd	×				×			
13	15	CW	R, D & P	11/29/77	Hd	×					×		
			Remove LB	12/2/77	Hd		×				×		
14	18	KN	D	12/16/77	Hd		×			×			
15	20	SB	R, D & P	1/4/78	Hd	×					×		
16	14	MH	D	3/9/78	Hd	×				×			
17	16	DM	D	5/17/78	Hd	×				×			
18	14	RS	D & P	5/23/78	Hd		×			×			
19	14	JS	Replaced	6/12/78	Hd		×				×		
20	16	JA	D	8/28/78	Hd	×				×			
21	19	JS	BG	9/20/78	F				×				×
			EV	9/20/78									
22	19	SS	BG	9/20/78	Hd			×			×		
			EV	9/20/78									
23	18	DP	BG	11/15/78	Hd	×					×		
24	13	CS	D & P	12/5/78	Hd	×				×			
			D	12/19/78	Hd	×				×			

25	14	MC	Rec (Patella)	12/20/78	U							
26	24	DH	Rec	1/9/79	Hd			×			×	
27	29	KG	Rec	2/13/79	Hd		×					×
			BG	4/9/79	Hd	×					×	
28	25	EH	Rec	3/1/79	Hd		×				×	
29	11	KP	Cons	1/15/79	U							
30	24	JB	Rec	2/7/79	Hd		×				×	
31	18	DK	BG	4/3/79	Hd		×				×	
32	13	JR	D	5/3/79	Hd	×				×		
33	19	PM	Rec	5/20/79	Hd	×					×	
34	16	CS	BG	7/10/79	Hd		×				×	
			BG	7/27/79	Hd	×				×		
35	19	GS	Arthrotomy BG	7/11/79	Hd		×				×	
			No Treatment									
36	18	RM	BG	7/16/79	Hd		×				×	
37	14	DM	D	9/5/79	Hd			×				×
38	14	LH	D	9/9/79	Hd	×				×		
39	11	JG	Cons	10/22/79	Hd	×				×		
			Cons	10/22/79	Hd	×				×		
40	20	RG	Rec	11/21/79	Hd			×				×
41	15	BD	BG	2/20/80	F				×			
42	25	MJW	BG	2/30/80	Hd		×				×	
43	17	WE	Rec	3/27/80	Hd		×					×
			No Treatment									
44	11	RF	D	3/27/80	Hd	×				×		
			Cons	3/27/80	Hd	×				×		
45	13	JS	D & P	4/28/80	Hd	×				×		
46	14	TH	D	6/17/80	U							
47	11	JC	Cons	7/21/80	Hd	×				×		
			Cons	7/21/80	Hd	×				×		
48	19	DT	BG	4/8/80	U							
49	16	SB	Arthrotomy R, D & P	8/27/80	Hd		×			×		
50	29	PB	Rec	8/27/80	Hd		×				×	

BG: bone graft; Cons: conservative; D: drilling; D & P: drilling and pinning; EV: evaluation; LB: loose body; R, D & P: reconstruct, drill, pin; Rec: reconstruction.

* Cases 7, 10, 13, 21, 22, 24, 27, 34, 39, 43, 44, 47 are bilateral knees treated arthroscopically (10, 13, 24, 27, 34, treated arthroscopically bilaterally).

* Case 35 is bilateral knees treated by arthrotomy (right knee only).

state of fixation of the lesion can be assessed and better reduction obtained by these techniques. Furthermore, the status of the healing defect can be evaluated by repeat arthroscopy under local anesthesia. Repeat treatment, if necessary, is much less of a problem. Finally, earlier motion, less quadriceps atrophy and osteoporosis, and a lessened psychological impact to the patient can be expected.

The disadvantages are the increased operative time and technical difficulties, which should be reduced with experience and improved instrumentation.

SUMMARY

Forty-nine knees with osteochondritis dissecans were evaluated and in many cases, treated by arthroscopic means. The lesions were classified as to location and degree of separation. Arthroscopic treatment involved drilling, pinning, reduction of fragments, removal and replacement of fragments, and bone grafting. Of the cases, 90% had healed in an average period of approximately five months. The mean follow-up was three years.

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