CHAPTER

56

Microfracture Technique in the Knee

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MICROFRACTURE TECHNIQUE IN THE KNEE IN A NUTSHELL

History:
Pain in ipsilateral compartment; recurrent effusions

Physical Examination:
Pain in ipsilateral compartment; rule out coexisting pathology

Imaging:
Standing radiographs, including 45-degree posteroanterior and mechanical axis views; magnetic resonance imaging commonly shows articular cartilage lesion

Indications:
Grade III or IV lesions, 2 to 3 cm^2

Contraindications:
Larger lesions (>3 cm^2 in high-demand patients); diffuse degenerative lesions

Surgical Technique:
Diagnostic arthroscopy: position to allow full flexion of knee for evaluation of all surfaces; evaluate lesion for size and depth; evaluate and treat concomitant pathology
Arthroscopic debridement: use shaver or curet to debride unstable flaps
Use curet to create vertical walls for adherence of clot
Use curet to remove calcified layer from base of lesion; this provides a better surface for adherence of clot and improved chondral nutrition
Microfracture defect: use an awl to place holes 3 to 4 mm apart; progress peripheral to central; do not allow holes to become confluent
Confirm adequate penetration: stop arthroscopic pump to confirm marrow elements flowing from area of microfracture

Postoperative Management:
Femoral condyle: continuous passive motion 6 to 8 hours for 4 to 6 weeks; touch-down weight bearing for 6 to 8 weeks
Patella/trochlea: continuous passive motion 6 to 8 hours for 4 to 6 weeks; weight bearing as tolerated in hinged brace with 30-degree-flexion stop for 8 weeks

Without intervention, articular cartilage injuries have a limited ability to heal. Two main factors contribute to this limited intrinsic repair capacity: the avascular nature of the tissue, and the relative absence of an undifferentiated cell population that can respond to injury. Many of the surgical techniques used to treat full-thickness lesions of articular cartilage are designed to stimulate a local influx of undifferentiated mesenchymal cells from the subchondral marrow.

The technique of microfracture was popularized by Steadman.[7,10] The premise of this technique is to repair a focal chondral defect with fibrocartilage. Fibrocartilage repair occurs through surgical penetration of the subchondral plate, which exposes the damaged area to progenitor cells that reside within the subchondral bone. Microfracture is theoretically favored over subchondral drilling and abrasion arthroplasty for several reasons: (1) it is less destructive to the subchondral bone because it creates less thermal injury than drilling does, (2) it allows better access to difficult areas of the articular surface, (3) it provides controlled depth penetration, and (4) use of a correctly angled awl permits the microfracture holes to be made perpendicular to the surface of the subchondral plate.[9,10]

History

Patients with symptomatic chondral lesions typically complain of knee pain localized to the particular compartment affected by the lesion. Weight-bearing activities typically aggravate symptoms from lesions on the medial or lateral femoral condyle. Patellofemoral lesions are aggravated by sitting, stair climbing, and squatting. Recurrent effusions can occur with symptomatic chondral lesions.

Physical Examination

Typically, patients are tender along the ipsilateral joint line. A positive patellar grind test can indicate a patellar or trochlear lesion. An effusion may be present. It is essential to evaluate for concomitant pathology that would modify treatment recommendations, such as malalignment or ligament deficiency.

Imaging

Diagnostic imaging should begin with a standard weight-bearing anteroposterior radiograph of both knees in full extension, a non–weight-bearing 45-degree-flexion lateral view, and an axial view of the patellofemoral joint. Additionally, a 45-degree-flexion weight-bearing posteroanterior radiograph is recommended to identify subtle joint space narrowing that traditional extension views may fail to show. Special studies such as a long-cassette mechanical axis view should be ordered if there is any degree of clinical malalignment. Magnetic resonance imaging can help delineate the extent of articular cartilage lesions, especially in the setting of completely normal radiographs. Techniques include two-dimensional fast spin echo and three-dimensional fat suppression with or without intra-articular gadolinium. Evolving magnetic resonance imaging techniques provide accurate information about the presence and size of articular cartilage lesions, which can aid in diagnosis and preoperative planning.

Indications and Contraindications

The microfracture technique can be used to treat patients with moderate symptoms and midsized lesions, grade III or IV, by the modified Outerbridge classification (Fig. 56–1).[6] Specifically, microfracture is recommended for active patients with small lesions (<2 to 3 cm^2) and no more than moderate symptoms, or for lower-demand patients with larger lesions (>2 to 3 cm^2) and mild symptoms.[1] Results in higher-demand patients with larger lesions are generally less favorable and shorter lived. In general, microfracture should not be used for defects more than 10 mm deep.[2]

Preoperative Planning

It is important to address any concomitant pathology at the time of microfracture. In addition, it is essential to discuss postoperative restrictions with the patient before performing the microfracture technique, because success depends on strict adherence to the postoperative treatment regimen, including 6 to 8 weeks of partial weight bearing.

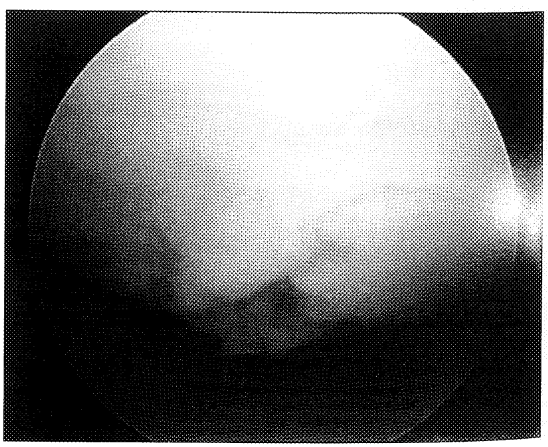

Figure 56–1 Symptomatic grade IV chondral lesion of the medial femoral condyle before preparation for microfracture.

Surgical Technique

Examination under Anesthesia

An examination under anesthesia should be performed to confirm full range of motion and that there is no concomitant ligamentous laxity.

Positioning

Depending on surgeon preference, the limb can be placed in a standard leg holder or maintained in the unsupported supine position. However, a leg holder, with the end of the table flexed, may provide better access to the extreme flexion surface of the femoral condyle.

Diagnostic Arthroscopy

A routine, 10-point diagnostic arthroscopy is performed, with careful examination of the posterior aspects of the medial and lateral femoral condyles. A probe is used to assess the quality of the cartilage surface, and any changes on the articular cartilage surface are noted. If global chondral changes are found, microfracture is not performed. However, multiple isolated chondral lesions in separate compartments of the knee can be treated concomitantly.

Arthroscopic Preparation of the Lesion

The initial step for arthroscopic preparation is debridement of the focal chondral defect. An arthroscopic shaver or curet can be used to sharply debride any unstable cartilage flaps (see Fig. 56–1). A curet is then used to create vertical walls around the cartilage defect (Fig. 56–2). In addition, debridement of the calcified cartilage layer from the base of the lesion is necessary. Both these steps—creating vertical walls and removing the calcified cartilage layer—are crucial. The vertical walls provide an area for the clot of progenitor cells to form and adhere, as well as a discrete load-bearing transition zone. Removal of the calcified cartilage layer provides a better surface for adherence of the clot and improved chondral nutrition through subchondral diffusion, which can increase the percentage of the defect that is filled.

Microfracture

Any associated intra-articular disease should be addressed before microfracture is performed. A surgical awl (Linvatec, Largo, FL) is used to create multiple small holes in the exposed bone of the chondral defect (Fig. 56–3). The microfracture holes are first made in the periphery and then brought toward the center of the lesion. The holes should be placed 3 to 4 mm apart (three to four holes per cm^2) (Fig. 56–4). The holes should not connect or become confluent in order to protect the integrity of the subchondral plate. To aid healing of the repair tissue to the surrounding normal articular cartilage, the most peripheral aspects of the lesion at the transition zone should be microfractured.

After completion of the procedure, the arthroscopic pump is stopped, and blood and fat droplets should be seen flowing from the area of the microfracture (Fig. 56–5). Intra-articular drains should not be placed, to allow adherence and stabilization of the blood clot to the lesion.

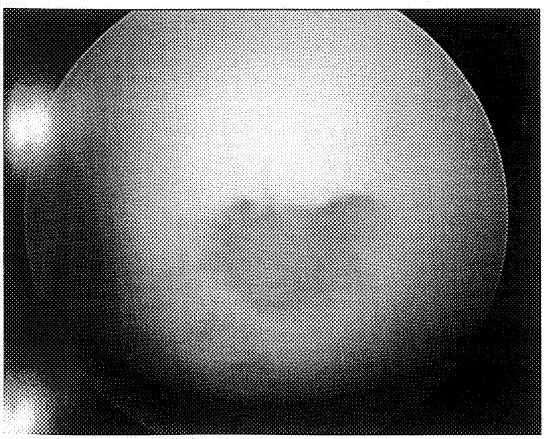

Figure 56-2 The lesion has been prepared with a curet to create stable vertical walls and debride the calcified cartilage layer.

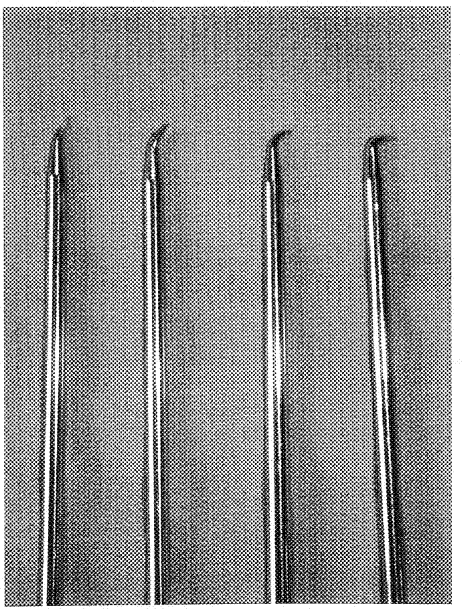

Figure 56-3 Microfracture awls (Linvatec, Largo, FL).

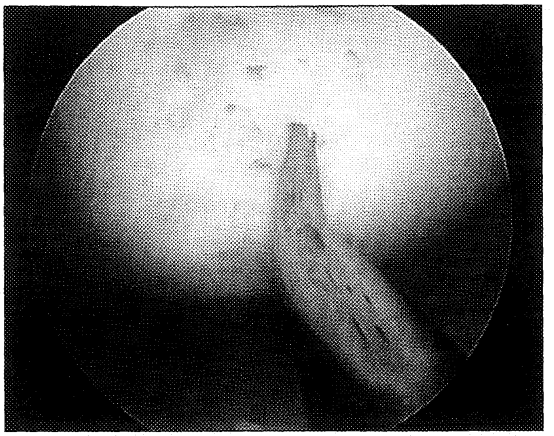

Figure 56–4 The microfracture awl is used to penetrate the subchondral plate, with holes spaced 3 to 4 mm apart.

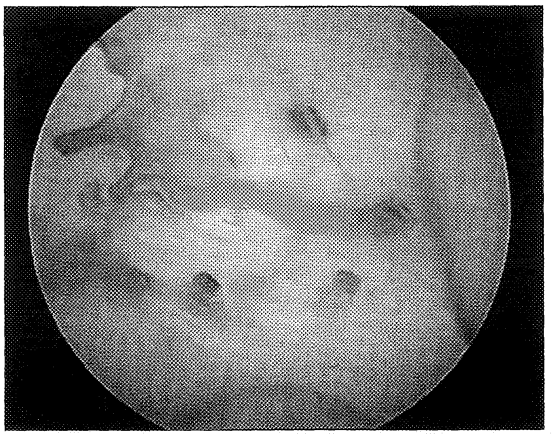

Figure 56–5 The arthroscopic pump is stopped, and bleeding is confirmed from the microfracture site.

Postoperative Management

Postoperative rehabilitation plays a vital role in achieving the best results from microfracture.[5,7,9] All patients should use a continuous passive motion machine on the day of surgery and continue it at home for 4 to 6 weeks, 6 to 8 hours a day. Full knee passive range of motion can be performed without a machine—500 repetitions, three times a day.[7,9]

The anatomic location and size of the defect dictate the amount of postoperative weight bearing. If the microfractured area is in the medial or lateral compartment, the patient is kept on strictly touch-down weight bearing (15% weight bearing) for 6 to 8 weeks. If the lesion is in a non–weight-bearing region of the compartment, weight bearing may begin earlier, depending on the size of the affected area. Patients with patellar and trochlear groove lesions should be placed in a hinged brace with a 30- to 45-degree-flexion stop for at least 8 weeks. However, patients with these lesions may be allowed weight bearing as tolerated with these motion restrictions.[9] The brace protects the lesion because the median ridge of the patella does not engage the trochlear groove until after 30 degrees of flexion.

After the period of protected weight bearing, patients begin active range-of-motion exercises and progress to full weight bearing. No cutting, twisting, or jumping sports are allowed until at least 4 to 6 months postoperatively.[9,10]

Results

The clinical results of microfracture treatment for focal chondral defects are limited (Table 56–1). Steadman et al.[9] reported that the microfracture procedure has been performed in more than 1800 patients. The first study of the long-term results of microfracture was presented at the first annual meeting of the International Cartilage Repair Society.[4] A summary of these results was provided by Gill and MacGillivray.[3] The results of microfracture were reviewed in more than 100 patients with full-thickness chondral defects, with an average follow-up of 6 years. Microfracture resulted in statistically significant reduction in pain, swelling, and all functional parameters studied.[3] The ability to walk 2 miles, descend stairs, perform activities of daily living, and do strenuous work showed significant improvement. Maximal functional improvement was achieved 2 to 3 years after the microfracture procedure.[3,4]

Gill and MacGillivray reviewed the results of microfracture for isolated chondral defects (mean size, 3.2 cm^2) of the medial femoral condyle at the Hospital for Special Surgery.[3] The study included 19 patients at a mean follow-up time of 3 years. The calcified cartilage layer was not routinely debrided, and patients did not routinely use continuous passive motion or limited weight bearing for 6 weeks. Seventy-four percent of these patients reported minimal or no pain, and 63% rated

Table 56–1 Clinical Results of Microfracture

Author (Date)	Mean Follow-up (yr)	No. of Patients	Outcome
Gill and MacGillivray (2001)[3]	6	100	Significant reduction in pain and swelling and improved function
Gill and MacGillivray (2001)[3]	3	19	74% minimal or no pain; 63% good or excellent
Steadman et al. (2002)[8]	11	71	Lysholm score improved (55.8 to 88.9); Tegner score improved (3.1 to 5.8)

their overall condition as good or excellent. In addition, magnetic resonance imaging was performed on all patients postoperatively. Despite the good subjective results, only 42% of the patients had 67% to 100% fill of the defect, 21% had 31% to 66% fill, and the remaining 37% had 0 % to 30% fill.[3]

The results of microfracture for the treatment of traumatic, full-thickness chondral defects were recently presented.[8] Seventy-one knees were treated, with a follow-up of 2 to 17 years. There was significant improvement in both the Lysholm and the Tegner scores from preoperative to postoperative status in these patients. The authors concluded that microfracture leads to statistically significant improvement in pain and function in patients with traumatic chondral defects.

Complications

Complications of microfracture are rare and mimic those seen following arthroscopic debridement and lavage. Occasionally, if a steep perpendicular rim is made in the trochlear groove during preparation of the cartilage defect, patients may experience catching or locking as the apex of the patella rides over this lesion.[9] These symptoms generally dissipate within 3 months. In addition, a recurrent painless effusion can persist following microfracture and can be treated conservatively.[9] Progressive cartilage degeneration and recurrent symptoms are the most common complications, and close postoperative monitoring of patients is required.

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