Outcomes of Full-Thickness Articular Cartilage Injuries of the Shoulder Treated With Microfracture

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Purpose: The purpose of this study was to determine whether microfracture provides pain relief and improves shoulder function in patients with chondral defects of the glenohumeral joint. **Methods:** Microfracture was performed in glenohumeral joints with full-thickness chondral lesions. Concomitant procedures were performed as indicated. Patients aged 60 years or older and those with complete rotator cuff tears were excluded. We included 31 shoulders in 30 patients in this study. Included were 25 men and 5 women with a mean age of 43 years (range, 19 to 59 years). Of the 31 surgeries, 6 (19%) progressed to another surgery. Subjective data obtained at a minimum of 2 years' follow-up were available in 24 patients (25 shoulders). Patient pain and functional outcomes were measured by use of the American Shoulder and Elbow Surgeons (ASES) score and patient satisfaction. Data were analyzed by use of paired *t* tests and regression analysis. **Results:** The mean follow-up was 47 months (range, 25 to 128 months). The mean pain scores decreased from 3.8 to 1.6 postoperatively (0, no pain; 10, worst pain). The patients' ability to work, activities of daily living, and sports activity significantly improved postoperatively ($P < .05$). Painless use of the involved arm improved postoperatively ($P < .05$). The mean ASES score improved by 20 points over the preoperative score ($P < .05$). Mean satisfaction with surgical outcome was 7.6 of 10. There was no association between age or gender and surgical outcomes. The greatest improvements were seen in patients who had microfracture of isolated lesions of the humerus. **Conclusions:** Failure occurred in 6 of the 31 shoulders (19%). In the remaining patients there was a significant improvement of 20 points (range, −11 to 45 points) in the ASES score compared with preoperatively. In those patients in whom just the humerus was treated, the greatest improvement was seen, with an increase of 32 points (range, 3 to 87 points). There was a negative correlation between the size of the lesion and ASES improvement ($r = -0.351$, $P = .12$). Our data showed the greatest improvement for smaller lesions of the humerus with the worst results in patients with bipolar lesions. **Level of Evidence:** Level IV, therapeutic case series. **Key Words:** Microfracture—Glenoid—Humeral head—Cartilage defect—Shoulder arthroscopy—Shoulder—Articular cartilage.

Up to 20% of the elderly population are affected by degenerative joint disease (DJD) of the shoulder.[1] Persons with DJD of the glenohumeral joint can obtain pain relief and improved function from hemiarthroplasty or a total shoulder replacement. Although shoulder arthroplasty provides excellent pain relief, it comes with significant activity restrictions and a limited implant lifespan, particularly in younger individ-

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uals.[2] Young active patients with relevant articular cartilage lesions of the glenohumeral joint present a treatment challenge.[3-5] The prevalence of Outerbridge grade IV lesions at shoulder arthroscopy has been estimated at 5%.[6] Current treatment protocols for chondral injuries of the shoulder rely primarily on nonoperative treatment, which includes anti-inflammatory medication, injections, and/or physical therapy to relieve symptoms.[7]

Extensive research efforts have shown that articular cartilage defects rarely heal spontaneously, regardless of whether they are acute, chronic, or degenerative.[8] Most of the research studies have been devoted to treatment of knee articular cartilage defects. The spectrum of surgical techniques for damaged chondral surfaces in the shoulder includes debridement,[8] microfracture,[9] autologous chondrocyte implantation,[10-12] osteochondral drilling,[7] interpositional allografts, capsular release, osteoarticular autograft or allograft plugs, and prosthetic replacement. Microfracture has become the preferred treatment for knee chondral defects, and several studies have shown good long-term results.[13-15]

Microfracture is a marrow-stimulating procedure that brings undifferentiated stem cells from a subchondral perforation into the chondral defect. A marrow clot forms in the microfractured area, providing an environment for both pluripotent marrow cells and mesenchymal stem cells to differentiate into stable tissue.[16] Histologic analysis of microfractured lesions has shown that fibrocartilaginous hyaline-like tissue fills the defect.[17,18]

Although it seems logical to conclude that the same basic principles can be applied in the shoulder, there are no studies reporting patient outcomes of microfracture in the shoulder. The purpose of this study was to determine the outcomes of microfracture for full-thickness articular cartilage lesions of the glenohumeral joint. We hypothesized that microfracture of the shoulder can result in satisfactory pain and functional outcomes.

METHODS

Patients were retrospectively selected from a database to be included in the study, based on their prospectively collected findings at surgery and a minimum of 2 years' follow-up. Sixty-six patients underwent the microfracture technique for full-thickness contained chondral lesions of the glenohumeral joint from 1992 to 2003. Nine patients with full-thickness tears of the rotator cuff were excluded from this study because an insufficient rotator cuff may lead to asymmetric erosion of the cartilage. Nine patients who were aged 60 years or older were eliminated to limit confounding factors such as age-related joint degeneration. Forty-eight subjects who underwent concomitant procedures such as synovectomy, loose body removal, partial cuff tear debridement (<50% of tendon thickness), acromioplasty, capsular release, and instability reconstruction were included. Three patients died of unrelated causes and were unavailable for follow-up. Of the remaining 46 patients, an extensive effort was made to obtain subjective follow-up by mailed questionnaire. Of the 46 patients, 30 (67%) were included in this study (31 shoulders). There were 25 men and 5 women with a mean age of 45.5 years (range, 19 to 59 years). Of the 31 surgeries, 6 (19%) progressed to subsequent surgery, and these patients' pain and function scores were excluded from the reported outcome measures. Of the remaining patients, data from a minimum of 2 years' follow-up were available in 25 shoulders. The mean follow-up was 45 months (range, 25 to 131 months). The patients' pain and functional outcomes were measured by use of the American Shoulder and Elbow Surgeons (ASES) score (range, 0 to 100) and patient satisfaction level (1, unsatisfied; 10, very satisfied). Various other pain- and function-specific questions were measured on Likert scales.

All data were prospectively collected and stored in a database. Other surgical treatments performed in combination with microfracture included 6 instability procedures, 10 subacromial decompressions, 7 capsular releases or manipulations under anesthesia, 7 SLAP lesion debridements or repairs, and 3 biceps releases. The size of the chondral defects was estimated by the operating surgeons, who routinely quantify the size of chondral defects, using arthroscopic instruments of known sizes as references. We have shown previously in experimental settings the ability to accurately quantify the size of defects with this technique.[16]

Changes in responses to preoperative and postoperative pain and function questions were compared by use of paired *t* tests. Comparison of ASES improvement for binary categorical variables was performed by use of the independent-samples *t* test, and for multiple (>2) categorical variables, it was performed by use of 1-way analysis of variance. Comparison of ASES improvement for continuous variables was performed by use of the Pearson correlation coefficient. The ASES score and patient satisfaction with outcomes were the primary outcome measures, and a