Microfracture and Microfracture Plus

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KEYWORDS

• Osteochondral defects • Osteochondral allografts • Articular cartilage
• Hyaline cartilage • Microfracture

KEY POINTS

- Review indications for microfracture with or without augmentation.
- Review outcomes of microfracture with or without augmentation.
- Review surgical technical considerations.

INTRODUCTION

Marrow stimulation of the bone bed of a cartilage lesion is a mainstay of cartilage defect surgery. However, with limited long-term success compared with chondroplasty/debridement of lesions, attempts to improve this treatment continue to evolve. The goal of any technique is to restore the cartilage surface to as-close-to the native state as possible and to return the joint to its natural biomechanics and biology. Cost-effectiveness continues to be of concern for health institutions and patients. The ability to care for patients in the most cost-effective manner must also be considered. With the limited biological environment in which cartilage resides, attempts at repair are further constrained. This limitation results in fibrocartilage healing of the defect, which is inferior to healing by hyaline cartilage. Enhancing this environment to create a more hospitable area for healing with as-close-to native cartilage as possible in a single-stage fashion would be ideal for the treatment of chondral injuries. The authors review the technical aspects of microfracture with or without augmentation and the outcomes of healing with these techniques.

BACKGROUND

Marrow stimulation with the Pridie procedure (microfracture) or abrasion arthroplasty has been used as a technique for the attempted healing of chondral injury since Insall[1] reported on the Pridie procedure in 1974. In the short-term, small lesions seem to do well; however, microfracture has had limited success in larger lesions.[2–6]

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Meta-analyses confirm that results for larger lesions deteriorate over time (after 2 years) and that after 5 years any size lesion treatment can be expected to fail.[6–8] In pediatric patients with osteochondritis dissecans, there is no difference in outcomes with or without microfracture added to simple debridement.[9] In fact, more than 90% of the time, fibrocartilage will form in a chondral defect without marrow stimulation if the damaged area is unloaded by correcting malalignment.[10–12]

Augmentation with a scaffold follows the rationale that the goal of cartilage injury treatment is to provide a viable cost-effective long-term solution for patients in a single surgery. Other current techniques for cartilage restoration or regeneration are nonoptimal because of the morbidity of a donor site (osteochondral autografts), requirement of a second procedure (autologous chondrocyte implantation [ACI]), need for donor availability (allograft sources), limited shelf life, or are limited in exploitation of biological regeneration sources (Cartilage Autograft Implantation System, DePuy Mitek, Inc, Norwood, MA; or DeNovo, Zimmer, Warsaw, IN).[13–20] Although microfracture allows for mesenchymal cells to access the cartilage defect, it forms fibrocartilage without significant return of the normal biomechanics of hyaline cartilage.[21] More recent attempts are being made to approach a reliable single-stage surgery that can regenerate a durable hyaline cartilage and will stand up long-term. In 2013, Irion and Flanigan[22] described scaffold-based technologies around the world that were not available for public use and had promising but short-term successes. These scaffolds generally fall into 4 main classes: (1) synthetic, (2) protein based, (3) carbohydrate based, or (4) a combination.[22] Kon and colleagues[23] reviewed the literature that compared use of scaffoldings with and without autologous cells and found no absolute significant difference in success rates. These findings further support a single-stage surgery. Chawla and colleagues[24] reviewed the literature for pediatric patients showing that, with greater than 3 cm^2 lesions, there was improvement in patient outcomes using osteochondral autograft transplantation, or one of the 3 generations of ACI, although microfracture also improved outcomes up to 4 years postoperatively particularly in smaller lesions.[25–37] Although more human and long-term studies of all these scaffolds are needed, BioCartilage (Arthrex Inc, Naples, FL) has been shown to produce the desired result of hyaline cartilage regeneration in animal models. Combined with its relative low cost compared with other commercially available materials and promising initial results, it is a viable option for first-line surgical treatment of these injuries.[13]

At present, there is a marked lack of literature considering the short- or long-term clinical outcomes of microfracture alone versus microfracture with the addition of a scaffold. Xing and colleagues[21] (2013) randomized 66 rabbits into a microfracture group and a microfracture plus osteochondral paste (experimental) group and studied regenerated tissues at 4, 8, and 12 weeks postoperatively. The experimental group boasted majority hyaline-like regenerate tissue, whereas microfracture alone was fibrocartilagelike tissue mostly at 12 weeks. The glycosaminoglycan content was significantly increased in the experiment group at all 3 time points and collagen gene expression higher at 12 weeks, indicating greater-quality tissue healing. These short-term animal model results encourage long-term improved outcomes for use of microfracture plus scaffolding in humans.

INDICATIONS FOR MICROFRACTURE ALONE OR WITH THE ADDITION OF A SINGLE-STAGE SCAFFOLDING

Based on the aforementioned literature, there is no true consensus on indications for optimal surgical treatments per patient. Thus, the general approach to be adopted for osteochondral or chondral injuries involves patient-shared decision-making. When direct repair is not possible for small lesions, less than 1 cm^2, debridement with or without microfracture is a reasonable alternative. For lesions measuring 1 to 2 cm^2 and larger,