

Strategies in Articular Cartilage Restoration—Present Advances in Biologic Intervention for Adult Knee Problems

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Although a number of new methods have improved our ability to treat articular injuries of the knee, no procedures have yet been proven to restore injured hyaline cartilage to its original state. Multiple techniques are used to address full-thickness chondral or osteochondral defects. This review briefly examines surgical options for this pathology. If amenable, all attempts should be made to repair osteochondral injuries. If unable to do so, preoperative anatomic factors, such as alignment, ligamentous stability, and meniscal integrity, should be carefully considered. Additionally, indications for surgery and patient factors must be thoroughly reviewed to identify appropriate candidates for treatment. Size and previous attempts at treatment often dictate care, which may include microfracture, osteochondral transplantation (osteochondral transfer system and mosaicplasty), or autologous chondrocyte implantation. Upcoming advances intend to minimize surgical morbidity while improving cartilage regeneration and articular incorporation. Despite the new developments surrounding this field, much is still unknown, and novel treatments should be addressed with caution.

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Despite the broad use of the term “restoration” when addressing advances in cartilage defect care, no current techniques have proven to return or reproduce injured hyaline cartilage to its original state. However, multiple innovative procedures now offer patients hope to enhance the longevity of their articular surfaces in anticipation of treating pain, improving function, and delaying the onset of early osteoarthritis. Although our knowledge of the operative outcomes is limited, promising results have generated excitement among both orthopedic surgeons and their patients. This topic has generated extensive debate and research interest as well as financial investments from various public and private sources because of the substantial impact of knee pain on today’s society. The purpose of this article is to provide a

contemporary overview of relevant operative treatment strategies addressing articular cartilage restoration.

Review

As previously mentioned, there are no current procedures that can restore chondral injury to previously uninjured states. Thus, when an osteochondral fragment is available and amenable to repair, every attempt should be made to fix the piece to its original donor site of injury. Operative reduction may be performed through either open means or with arthroscopic assistance. In traumatic, acute osteochondral lesions and young patients with symptomatic, unstable osteochondritis dissecans, fixation should be the first option for operative treatment, even if no, or little, bone is present on the cartilage. Fixation may be achieved through a number of options, including inert, bioabsorbable screws (Fig. 1).

Many essential principles should be carefully considered and adhered to before the execution of cartilage restoration procedures. To optimize the chances of a successful outcome, surgeons must carefully consider a number of factors to determine appropriate patient eligibility. In addition to the

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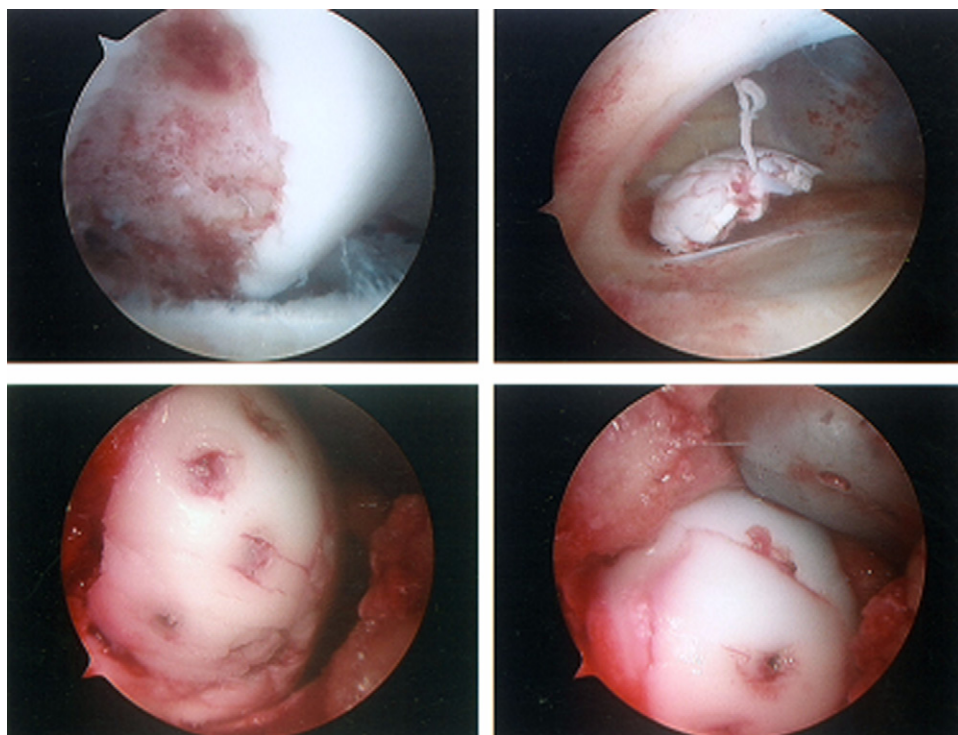


Figure 1 Osteochondral repair of a loose fragment with bioabsorbable screw fixation. (Color version of figure is available online.)

personal investment established by the surgeon and high patient expectations for relief, the financial cost in performing these procedures can be profound. Compliance to strict indications for surgery is fundamental to the success of surgery and should not be assumed or ignored. In a recent study examining the indications and contraindications for the rejection of autologous chondrocyte implantation (ACI) cases by insurance companies, the authors noted that in 23 of 24 cases, the indications for ACI were not met, and 63% of these cases contained multiple contraindications.¹

First, eligible patients should be symptomatic with reproducible complaints corresponding to the documented site of pathology. A history and physical examination should demonstrate localized pain affecting quality of life with swelling and symptoms dependent on the level and intensity of activity. Screening radiographs, including bilateral weight-bearing extension, 45° flexion (posteroanterior), lateral, and 45° Mercer Merchant views of the patella should initially be performed and may demonstrate minimal, localized arthritis. Likewise, patients with magnetic resonance imaging studies demonstrating an isolated surface defect with underlying marrow edema are ideal candidates for surgery. However, patients with differing degrees of bony inflammation may be carefully considered on an individual basis, and a bone scan may be used to further characterize the extent of metaphyseal involvement.

The overall lower extremity patellar alignment and mechanical axis should be carefully studied with alignment favoring the lesion. Addressing cartilage defects alone with a restorative procedure is not recommended in the context of axial malalignment.² Surgical procedures to unload the in-

involved compartment should be performed before or concurrently with cartilage procedures to obtain the best results. Valgus alignment is commonly corrected with a varus osteotomy of the distal femur (Fig. 2), varus alignment is addressed with a valgus osteotomy of the proximal tibia, and patellar malalignment can be corrected with anteriomedialization of the tibial tuberosity.

With regard to the anatomy of the articular cartilage injury, the defect should be a full- or near-full-thickness lesion that is contained with a narrow zone of transition to adjacent normal native cartilage. “Kissing lesions” or corresponding lesions of the femur and tibia are not amenable to articular restoration, and the number of lesions should ideally be limited to 2 or less. Additionally, the knee must have functionally competent ligaments because instability can shift the weight-bearing line, increasing shear articular stress. Likewise, an intact meniscus is essential for the appropriate distribution of joint contact forces, and meniscal transplantation should be strongly considered in deficient individuals.

In addition to the previously mentioned anatomic characteristics, patient factors should be carefully considered. Articular cartilage procedures are typically reserved for young patients (under the physiological age of 40), nonobese individuals, nonsmokers, and people who are willing to remain compliant to rigorous postoperative restrictions and rehabilitation protocol. Also, surgeons must establish realistic patient expectations. Open preoperative discussions should include the concept that cartilage restoration is meant to improve symptoms but cannot restore the knee to its normal, previously uninjured state. Additionally, long-term out-

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