

Knee Cartilage Repair and Restoration: Common Problems and Solutions



Kristina Linnea Welton, MD^a, Stephanie Logterman, MD^{b,c,*},
Justin H. Bartley, MD^a, Armando F. Vidal, MD^{d,e},
Eric C. McCarty, MD^a

KEYWORDS

- Cartilage defects • Osteochondral defects • Knee • Complications
- Osteochondral autograft • Osteochondral allograft • Microfracture
- Autologous chondrocyte implantation

KEY POINTS

- There are a wide variety of surgical techniques to repair or restore symptomatic focal cartilage defects of the knee and each is associated with its own profile of potential complications.
- Complications associated with microfracture commonly include poor defect filling, osseous overgrowth, and deterioration over time.
- Autologous chondrocyte implantation (ACI) can be impeded by graft hypertrophy, insufficient regenerative cartilage, and disturbed fusion while osteochondral autograft transfer (OAT) can be complicated by donor site morbidity, donor-to-recipient site incongruity, and hemarthrosis.
- Complications encountered with particulated juvenile allograft cartilage (PJAC) are graft hypertrophy and displacement while loosening, fragmentation, subchondral collapse, and nonunion are potential complications encountered with osteochondral allografts (OCA).

Disclosure Statement: K.L. Welton, S. Logterman, and J.H. Bartley have no disclosures to report. A.F. Vidal acts as a Stryker consultant. E.C. McCarty receives institutional support from Stryker, Smith and Nephew, Depuy, and Arthrex. He acts as a consultant for Zimmer Biomet and receives book royalties for Elsevier.

^a Department of Orthopedic Surgery – Sports Medicine, University of Colorado, CU Sports Medicine and Performance Center, 2150 Stadium Drive, Boulder, CO 80309, USA; ^b Department of Orthopedic Surgery, University of Colorado, 12631 E. 17th Avenue, Mailstop B202, Aurora, CO 80045, USA; ^c Department of Orthopedic Surgery, University of Colorado, Anschutz Medical Campus, 13001 East 17th Place, AO1 Building – 4th Floor, Aurora, CO 80045, USA; ^d Department of Orthopedic Surgery – Sports Medicine, University of Colorado, 2150 Stadium Drive, Boulder, CO 80309, USA; ^e Department of Orthopedic Surgery, CU Sports Medicine Center, 2000 South Colorado Boulevard, The Colorado Center Tower One, Suite 4500, Denver, CO 80222, USA

* Corresponding author. Department of Orthopedic Surgery, University of Colorado, Anschutz Medical Campus, 13001 East 17th Place, AO1 Building – 4th Floor, Aurora, CO 80045.

E-mail address: Stephanie.Logterman@ucdenver.edu

Clin Sports Med 37 (2018) 307–330
<https://doi.org/10.1016/j.csm.2017.12.008>

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INTRODUCTION AND BACKGROUND

Articular cartilage injuries of the knee are common with a reported incidence of up to 66% in diagnostic knee arthroscopies performed to investigate knee pain.^{1–3} Cartilage injuries can result from multiple causes including trauma and osteochondritis dissecans; typical symptoms include swelling, mechanical symptoms, and pain that is equivalent to that of end-stage arthritis.^{4,5} In addition, cartilage lesions (9 mm or greater) have been reported to be biomechanically unstable with a high propensity of progression to degenerative joint disease.^{6,7} History and physical examination vary and MRI is helpful to evaluate cartilage lesions; factors to consider include lesion size, depth, location, leg alignment, and concomitant meniscal and/or ligamentous injury. Patient factors, such as age and activity level, should also be considered. There is limited self-healing potential because of the poor regenerative capacity and avascular nature of cartilage, therefore surgery is often necessary in the symptomatic setting.^{8,9} Surgical treatment consisting of microfracture or chondroplasty can temporarily relieve symptoms but heals with fibrocartilage and likely does not address the potential for long-term joint degeneration.^{10,11} Unfortunately, fibrocartilage has been found to exhibit diminished resiliency, less stiffness, and poor wear characteristics in comparison with native articular cartilage.^{12,13} Because of this, the ideal treatment of focal articular cartilage defects is an approach that restores organized hyaline cartilage with minimal morbidity and pain-free survivability over a long period of time.¹⁴ Current advanced surgical treatment options that continue to be investigated and potentially offer these advantages include autologous chondrocyte implantation (ACI), osteochondral autograft transfer (OAT), and osteochondral allograft transplantation (OCA). In addition, new techniques that use implantation of particulate juvenile allograft cartilage (PJAC; DeNovo Natural Tissue, Zimmer, Warsaw, IN) have promise but clinical outcome data remain limited.^{8,15} Multiple treatment algorithms have been proposed; however, they continue to evolve as additional information and long-term follow-up are acquired.⁸ The focus of this case-based review is to highlight common complications associated with common surgical techniques that restore focal articular cartilage defects of the knee, emphasizing how these complications were recognized, how they were addressed, and techniques on how they are avoided.

MICROFRACTURE

Microfracture was developed by Steadman and colleagues¹⁶ to treat full-thickness chondral defects of the knee because articular cartilage has severely limited regenerative capacity. It is the most commonly used technique for treating small articular cartilage lesions in the knee. Microfracture is a bone marrow stimulation technique that aims to surgically induce the formation of a marrow-rich clot to cover the lesion. Mesenchymal stem cells and growth factors induce the remodeling of the fibrin clot into fibrocartilage composed primarily of type I collagen, with only minimal type II collagen.⁸ Indications for microfracture include grade III or IV articular cartilage defects in a weight-bearing area of the knee (femoral condyle, tibia, patella, or trochlear groove), unstable cartilage overlying subchondral bone, and focal degenerative changes in a knee with proper coronal alignment.¹⁷

Although meta-analysis of microfracture demonstrates positive short-term functional improvement, there is a paucity of data exploring long-term results of this procedure. Factors positively affecting outcome following microfracture include age less than 40 year old, symptoms less than 12 months, defect less than 4 cm², body mass index less than 30 kg/m², and repair cartilage volume (defect fill) of greater than 66%.¹⁸ This technique is limited by its ability to consistently provide adequate hyaline

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