Cartilage Allograft Techniques and Materials

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KEYWORDS

• Cartilage • Osteochondral lesion • Talus • Bone marrow stimulation • Allograft

KEY POINTS

- Hyaline cartilage lacks a vascular supply having the inability to mount an inflammatory response to injury.
- Allograft cartilage extracellular matrix provides a scaffold for marrow elements to interact with entering the site of injury after bone marrow stimulation.
- Chondrocyte density within juvenile cartilage is significantly increased compared with adult cartilage.

INTRODUCTION

Hyaline cartilage consists of 95% extracellular matrix (ECM) and 5% chondrocytes. One component of the ECM is collagen consisting of types II, V, VI, IX, X, XI, XII, and XIV; type II collagen is the most abundant.[1] Glycoproteins (proteoglycans) are another component of the ECM. Glycoproteins carry a negative charge in effect attracting water, with water making up 70% to 80% of the wet weight of hyaline cartilage. This attraction of water allows cartilage to resist compressive forces.[2] The role of the 5% of chondrocytes present is vital for the proper function of articular cartilage, being that they produce the ECM.[1] Hyaline cartilage is structured into 4 zones consisting of the superficial, transitional, radial, and calcified cartilage zones.[3]

Chondrocytes lack a vascular supply, relying on nutrients to be supplied from the synovial fluid.[4] Because hyaline cartilage is avascular, injury does not result in damage to blood vessels. Therefore, the inflammatory and repair phases of injury are absent, a scaffold consisting of a fibrin clot is not produced, and undifferentiated cells are not brought to the site of injury. The small number of chondrocytes present does not allow an adequate response to the injury, and the cartilage surface is not repaired.[5]

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BONE MARROW STIMULATION TECHNIQUES

Bone marrow stimulation (BMS) allows mesenchymal stem cells to enter the site of injury and differentiate to produce reparative cartilage.[1] With time, the cells within the reparative cartilage take the appearance of fibroblasts, with tightly packed type 1 collagen making up the matrix. This fibrocartilage is weaker than hyaline cartilage.[6] Although fibrocartilage is weaker than hyaline cartilage, various systematic reviews have revealed good to excellent outcomes in more than 80% of patients with osteochondral lesions of the talar dome (OLTs) using this technique.[7–10] Building on the technique of BMS is the adjunct use of an allograft cartilage ECM (ACEM). An ACEM preparation has become available as BioCartilage (Arthrex, Inc, Naples, FL).[11] ACEM contains type 2 collagen and proteoglycans, as well as growth factors found in articular cartilage, acting as a scaffold for marrow elements entering the site of injury to interact with after BMS.[11] A study looking at the interaction of adult stem cells and native articular cartilage ECM revealed a significant amount of type 2 collagen produced.[12] Another study looking at baboons revealed hyaline-like cartilage at 9 weeks using a cartilage scaffold.[4,13] Clinical trials have yet to be published regarding the outcome using ACEM.

This procedure can be performed using an open or an arthroscopic technique (**Fig. 1**). When dealing with OLTs, the senior author typically uses an arthroscopic technique. After adequate debridement of the OLT, BMS is performed. The remaining

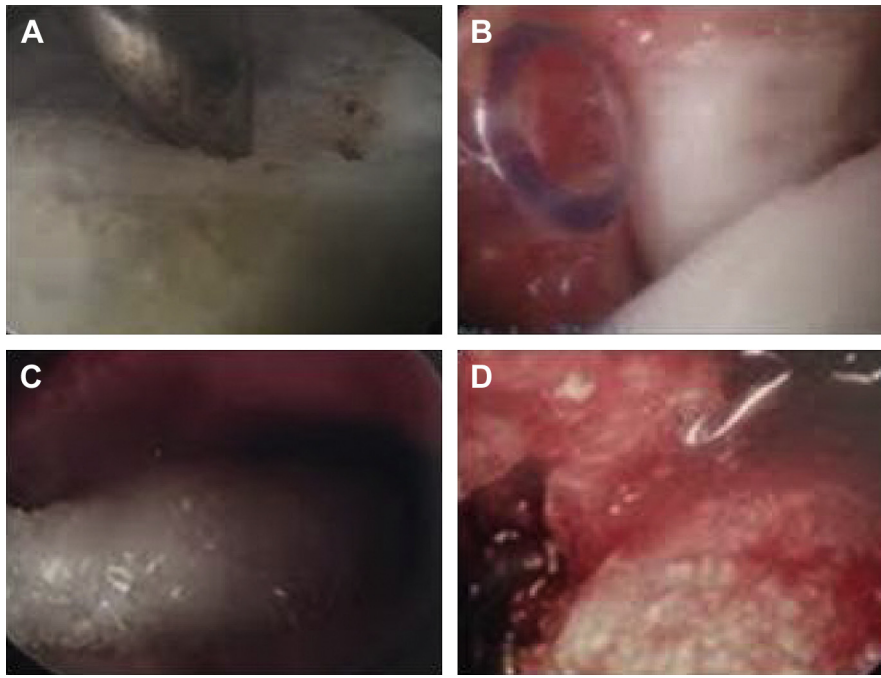

Fig. 1. (*A*) After adequate debridement of hyaline cartilage bone marrow stimulation is performed. (*B*) An abdominal insufflator is placed through one of the portals to dry the area before placement of the allograft cartilage extracellular matrix. (*C*) Allograft cartilage extracellular matrix (ACEM) is placed into the defect after marrow stimulation and drying of the area. (*D*) ACEM is made level with the surrounding cartilage followed by placement of fibrin glue.