Allograft Cartilage Replacements

Michael H. Theodoulou, DPM[a], Laura Bohman, DPM, AACFAS[b,*]

KEYWORDS

• Allograft • Scaffold • Cartilage • Talus • Foot

KEY POINTS

- Articular cartilage is a complex structure of cellular chondrocytes and extracellular matrix that provides frictionless movement and resists compressive forces; however, it lacks the ability to restore itself after damage.
- Allograft tissues are used with increasing frequency to help restore native cartilage, eliminate donor site morbidity, and, most frequently, provide a single stage surgery.
- Acellular allograft scaffolds can include products using components of extracellular matrix and serve as a skeleton to promote the creation of hyaline-like cartilage.
- Cellular allografts provide viable chondrocyte cells to promote healing. Often juvenile samples that demonstrate greater cellular density and increased mitotic activity among other capabilities are used.
- Allograft tissues are often used in foot and ankle surgery for repair of articular cartilage damage.

INTRODUCTION

The body's ability to repair injured articular cartilage is poor due to the inherent physiology of cartilage. Joint arthritis, whether through injury or increasing age, is a prevalent condition. Treatment of an articular cartilage injury may include arthroplasty, fusion, or repair. A popular pathway of treatment in a salvageable joint is often to avoid donor site morbidity and place increased effort to re-establish native cartilage with the use of allografts. This article discusses current research on acellular and cellular allografts for articular cartilage restoration.

Disclosure: Dr M.H. Theodoulou is a paid consultant for Arthrex and Cartiva surgical device companies, and BSN medical. All other authors declare that they have no conflicts of interest.

[a] Department of Surgery, Cambridge Health Alliance, Harvard Medical School, 1493 Cambridge Street, Cambridge, MA 02139, USA; [b] Podiatry Associates of Cincinnati, 10615 Montgomery Road, Suite 100, Cincinnati, OH 45242, USA
* Corresponding author.
E-mail address: bohman.laura@gmail.com

Clin Podiatr Med Surg ■ (2018) ■–■
https://doi.org/10.1016/j.cpm.2018.02.003 **podiatric.theclinics.com**

ARTICULAR CARTILAGE ANATOMY

Articular cartilage is a combination of relatively few cells, chondrocytes, and extracellular matrix. It lacks blood vessels, lymphatic drainage, and innervation, and it receives nutrients via synovial joint fluid. Articular cartilage along with synovial fluid allows for smooth gliding of the joint and a functional joint that can adapt to and resist compressive forces.[1] Articular cartilage is arranged in 4 layers of differing composition and organization of chondrocytes and extracellular matrix. These layers provide adherence of the cartilage to bone, channels for nutrient dispersal, collagen framework to house necessary macromolecules, and a smooth frictionless surface for joint motion. These layers in composition and thickness are specialized for different joints, such as the knee versus the ankle (**Fig. 1**). In general, chondrocytes are the cellular component of cartilage that creates and organizes the extracellular matrix. The extracellular matrix is composed of fluid, collagen, proteoglycans, and small amounts of other proteins. Collagen forms the skeleton of the cartilage housing chondrocytes, fluid, and proteoglycans. Proteoglycans are molecules that expand in fluid to provide resistance against compression.[1] Overall, the complex network, elasticity, and lack of capability of self-repair of cartilage provides insight to the difficulty in attempted restoration.

HISTORY OF CARTILAGE REPAIR

Throughout history it was widely known that cartilage lacked the ability to heal or restore itself after significant damage, but it was not until the late 1950s that the physiology of cartilage nutrition and repair was described.[2,3] In 1959, subchondral drilling was described by Insall and colleagues,[3,4] as a way to repair articular cartilage injury using the subchondral bone as a vascular supply to stimulate healing. The most current technique of microfracture, that is still in use today was described by Steadman and colleagues.[3,5] In 1976, Gross and colleagues[6] used osteochondral allografts for repair after tumor resections in the knee, and in the mid-1980s, Yamashita and colleagues[3,7] used osteochondral autografts to treat

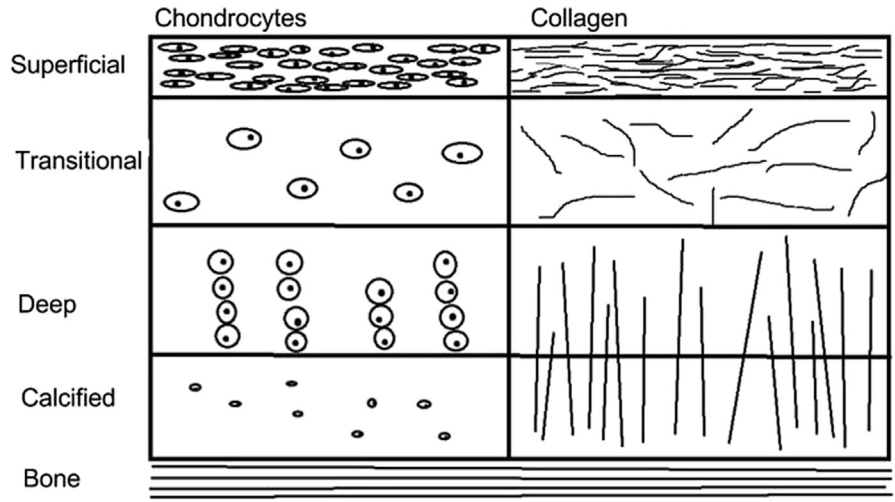

Fig. 1. Cartilage organized by orientation of chondrocytes and collagen throughout the 4 differentiated layers.