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## Arthroscopic Implantation of a Cartilage Matrix for an Osteochondral Defect of the Talus: A Case Report

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## ABSTRACT

Advances have been made in the treatment for osteochondral defects of the talus, but these injuries continue to be a challenge for foot and ankle surgeons. We present an arthroscopically assisted technique that uses an allogenic cartilage graft in treating an osteochondral lesion of the medial dome of the talus. A brief discussion on current surgical options for osteochondral defects of the talus is also provided.

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Osteochondral defects (OCDs) of the talus, which involve both the articular cartilage and the subchondral bone, typically lead to the development of fibrocartilage. Fibrocartilage has been shown to be biomechanically inferior to native hyaline cartilage (1). Because of the innate inability of cartilage to heal, OCDs remain a challenge to treat. If left alone, OCDs can cause reduced function and risk progressive degenerative changes in the joint, leading to osteoarthritis. A variety of surgical procedures have been described with the goal of repairing cartilage defects and providing the best functional outcomes.

The talus is the third most common bone to be affected by OCDs, after the knee and elbow joints (2,3). Damage to the talus can be caused by direct force, but the etiology of OCDs of the talus in patients without a history of trauma remains unknown. Repetitive microtrauma, vascular abnormalities resulting in avascular necrosis, and congenital factors have been speculated to play roles (4). Females have been found to have a 1.5 times greater risk for OCDs than do males, with teenagers being 7 times more likely to develop an ankle OCD compared to children (5).

There are numerous types of surgical treatments available for OCDs, including debridement, bone marrow stimulation techniques such as drilling or arthroscopic microfracture, osteochondral autograft transplantation system (OATS), mosaicplasty, autologous chondrocyte implantation, matrix-assisted chondrocyte implantation, bone marrow-derived

cell transplant, and open or arthroscopic delivery of particulated juvenile cartilage. Each surgical technique has benefits and disadvantages. It has been suggested that further studies are needed to determine stage-dependent algorithms for the surgical treatment of OCDs (6).

If OCDs of the talus become refractory to conservative treatment, then the first-line treatment commonly involves arthroscopy microfracture and curettage. Large lesions of 15 mm in diameter or lesions with cystic changes may require secondary procedures such as a talar autograft or allograft. However, it has been suggested that OCD allograft transplantation be limited to large-volume cystic lesions and salvage procedures (7).

ProChondrix® (AlloSource, Centennial, CO) is an intact, living cellular, fresh cartilage matrix processed from adult donors and designed to aid in the repair and regeneration of damaged cartilage tissue. This cartilage matrix can be used arthroscopically and placed into the osteochondral defect with a fibrin sealant and does not require a harvest site.

We present a novel procedure for the treatment of an OCD of the talus using the ProChondrix® fresh cartilage matrix through the use of ankle arthroscopy. To our knowledge, this is the first published report on ProChondrix® being used to arthroscopically treat an OCD of the talus.

### Case Report

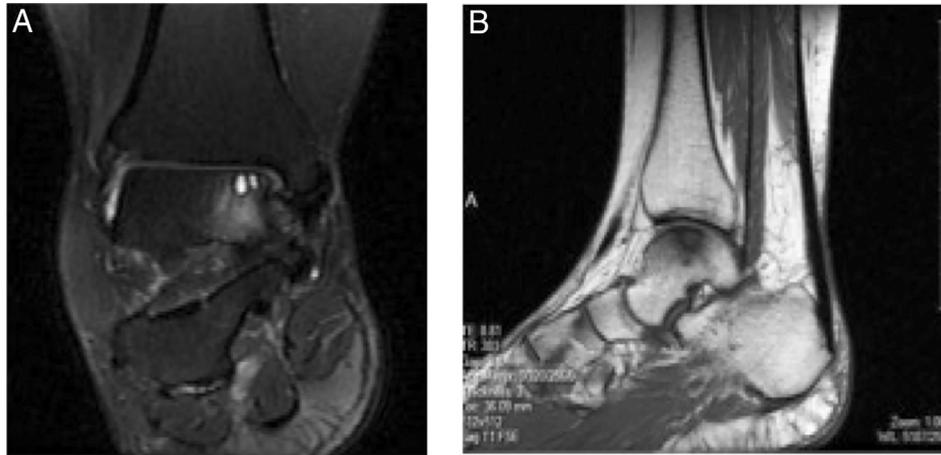
A 34-year-old female presented to the clinic complaining of chronic right ankle pain after suffering an injury playing soccer 2 years earlier. The patient reported self-treatment with rest and ice. She said her ankle remained unstable and that it would “constantly give out on her.” The

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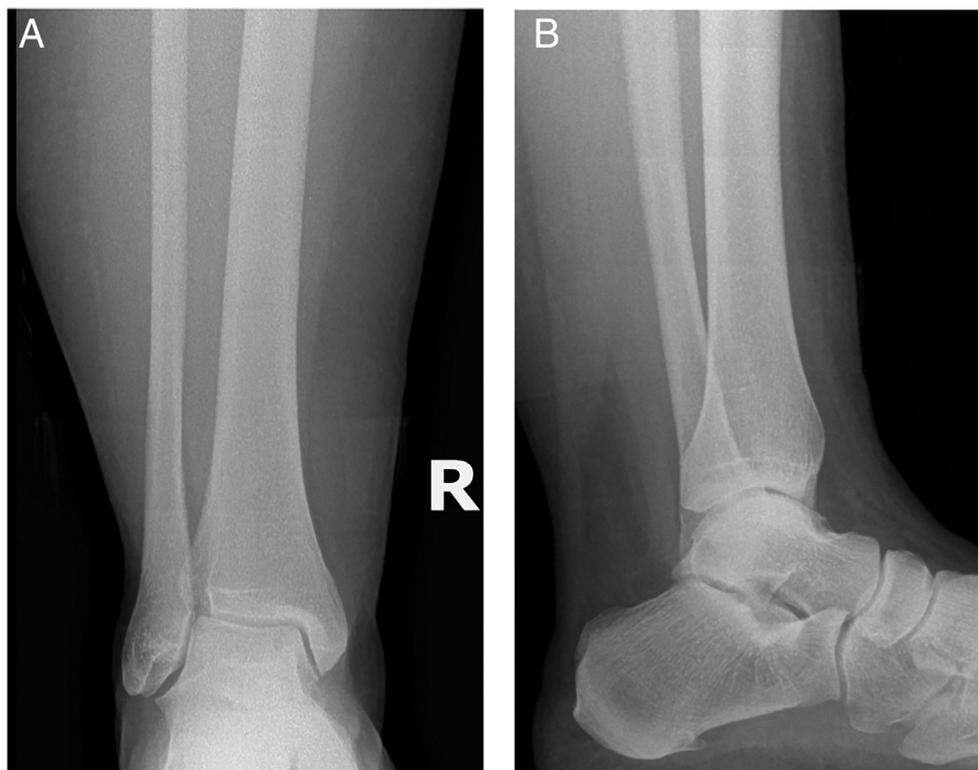
**Fig. 1.** (A, B) Magnetic resonance scan shows an osteochondral defect of the talus.

patient was chasing her son 5 weeks ago and heard a “pop” from the ankle. The patient reports having persistent pain since then and has been to the emergency department, in which a magnetic resonance scan revealed an OCD of the talus (Fig. 1A and B). The physical examination showed tenderness to palpation along the anteromedial ankle and medial ankle gutter. There was instability of the ankle and tenderness to palpation along the anterior talofibular ligament. On plain film radiographic ankle views, there appeared to be a cystic lesion of the medial talar dome (Fig. 2A and B). Magnetic resonance scan results were reviewed, and a 6 × 8-mm chronic appearing defect of the medial talar dome was noted. Given the 2-year history of pain and given the recent

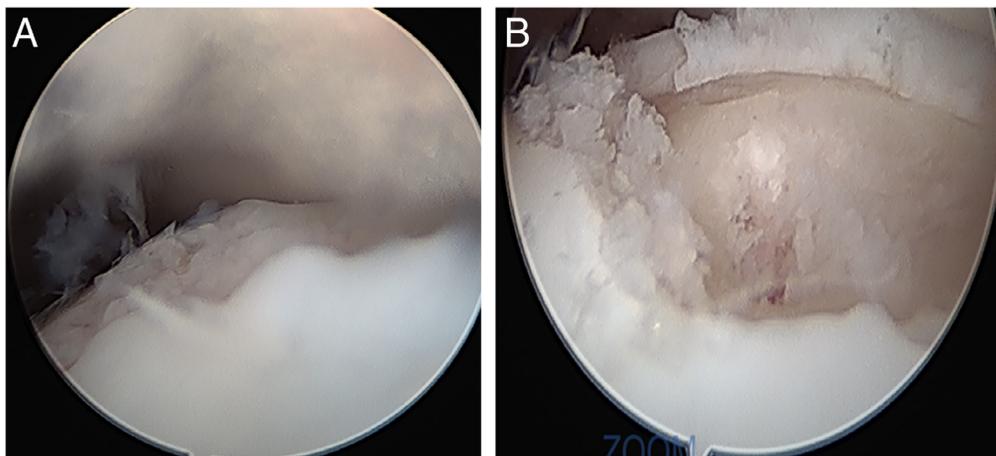
ankle sprain with multiple attempts at conservative treatment, the patient opted for surgical intervention.

#### *Surgical Technique*

The patient was placed in the supine position on the operating table with a tourniquet placed on the proximal thigh and with a leg holder for the right leg. After the induction of general anesthesia, the patient’s right foot was inserted into an ankle distractor, and the ankle was accessed through standard anteromedial and anterolateral portals. With the use of a 2.7-mm and 30° angle arthroscope, the ankle joint



**Fig. 2.** (A, B) Plain film radiographic ankle views of a cystic lesion of the medial talar dome.



**Fig. 3.** (A, B) Inspection of the cartilage identifies the osteochondral defect, which is debrided.

was inspected; a significant amount of synovitis was present and excised by using a shaver. Then, a probe was used to inspect the cartilage, and the OCD was identified and debrided (Fig. 3A and B). Next, bone marrow stimulation was performed with an awl. The ankle joint underwent fluid extraction and was dried, and a layer of fibrin glue was placed at the base of the lesion. A 9 × 9-mm ProChondrix® matrix was placed on the fibrin glue with another layer of fibrin glue placed over the top of the graft (Fig. 4A and B). The ankle scope was removed, and the portal sites were sutured. Next, attention was directed to the lateral ankle, in which a standard modified Brostrom procedure was performed by using two 3.5-mm bone anchors.

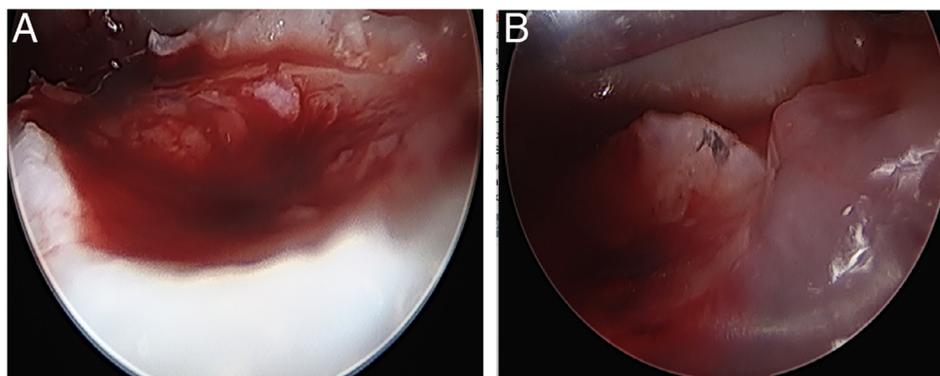
#### Postoperative Management

The patient remained non-weightbearing with biweekly cast changes for 6 weeks. After 6 weeks, the patient was placed in a controlled ankle motion boot and remained in partial weightbearing. The patient was then transitioned to weightbearing in an athletic shoe at 8 weeks postoperatively with an ankle support orthotic brace. At 3 months postoperatively, the patient began physical therapy and continued to not participate in high-impact activity. At 4 months, the patient began to progress with activity as tolerated. At 12 months, the patient was performing preoperative activities without any discomfort, and postoperative radiographs showed a resolved OCD of the talus (Fig. 5A and B).

#### Discussion

Allograft cartilage restoration matrix is a new product that uses a 3-dimensional cartilage scaffold to fill OCDs with live functional cells and other biological components necessary to repair damaged cartilage. The use of an extracellular matrix can help support cellular migration and promote new cartilage growth. The signaling environment of cartilage is notably complex and is composed of many important growth factors that play indispensable roles in maintaining healthy cartilage tissue (8). It is commonly understood that juvenile cartilage contains more cells than adult cartilage. Arthroscopic implantation of a cartilage allograft can decrease operative time and morbidity because it is available “off the shelf” in the operating room. The procedure also eliminates the need for multiple chondrocyte-harvesting procedures.

Arthroscopic microfracturing for OCD of the talus causes marrow stimulation and has the advantage of being less invasive than other surgical procedures. Unfortunately, marrow stimulation techniques cause fibrocartilage formation, which can eventually break down and lead to osteoarthritis. Marrow stimulation procedures do not promote excretion of growth factors or extracellular matrix proteins needed for the repair of articular cartilage, making it a short-term solution. Adams et al (9) compared patients with OCDs of the talus undergoing the OATS procedure versus patients undergoing repeat microfracturing and found that OATS was significantly superior to repeat arthroscopic treatment of OCDs after a mean follow-up of 48 months.



**Fig. 4.** (A, B) A 9 × 9-mm ProChondrix® matrix was placed on the fibrin glue with another layer of fibrin glue placed over the top of the graft.



Fig. 5. (A, B) Postoperative radiographs shows a resolved osteochondral defect of the talus.

Two related procedures have been developed: mosaicplasty and OATS. Both are reconstructive bone grafting techniques that use 1 or more cylindrical osteochondral grafts from the less weightbearing periphery of the ipsilateral knee, which are then transplanted into the prepared defect site on the talus. The aim of this technique is to restore mechanical, structural, and biochemical properties of the original hyaline articular cartilage (10). There are disadvantages, including the need for graft harvest and the associated donor-site morbidity, differences in surface curvature between the graft and host tissues, the poor potential for spontaneous healing at the cartilage interface of the graft, and the possible need for an osteotomy (7). Al-Shaikh et al (11) evaluated 19 patients undergoing the OATS procedure, and concluded that osteochondral autograft transplant for OCDs of the talus demonstrates excellent postoperative ankle scores including improvement of pain and function with minimal knee donor-site morbidity. Even with good results reported, others show that cysts remain an issue after mosaicplasties (12).

OCD allograft transplantation involves a replacement procedure in which a cadaver graft of viable hyaline cartilage and its underlying subchondral bone are harvested and transplanted to the donor site. OCD allografting keeps the hyaline cartilage intact and can be modified so the graft can fit into a specific lesion. Some disadvantages consist of a relatively difficult process of graft preparation, risk of disease transmission, and higher cost. This method for treating OCDs has been noted to have good outcomes in defects  $>30 \text{ cm}^3$  (13).

Autologous chondrocyte implantation allows the transplantation of cultured chondrocytes into the defect. The periosteum-covered technique uses an injection of chondrocyte cell suspension under a sutured periosteal flap harvested from the distal end of the tibia (7). Some limitations include a 2-staged procedure, uneven distribution of cells, and cell leakage. Use of the matrix-associated technique has the benefit of delivering the cartilage via an arthroscopic technique (14). Laboratory data have confirmed the presence of reconstructed cartilage with chondrocytes and expression of collagen II, characteristic of hyaline cartilage (15).

A similar technique and product for the treatment of OCDs have been described with the use of particulated juvenile allograft, which

has shown promising results (9,16). Both techniques lack many of the disadvantages of conventional cartilage repair procedures. An all-arthroscopic or extended portal technique is a single-stage procedure that alleviates the need for malleolar osteotomy or cartilage biopsy, thus eliminating donor-site morbidity. A study by Barrett et al (17) demonstrated that chondrocytes from adult cartilage grew out of the cartilage matrix faster than did those from juvenile cartilage. Histologically, juvenile collagen has appeared less mature and less cross-linked than adult cartilage.

Our study had several limitations that could have affected the validity of our results, including the retrospective nature of our study, the use of only a single case report, and a short follow-up period. In addition, there was another procedure performed that could have affected the outcomes. With this procedure, there can be a steep learning curve that is dependent on the surgeon's arthroscopic skills. We believe the use of an allograft cartilage matrix can be considered for the treatment of OCDs of talus because it involves a single-stage procedure and low morbidity and because there is a prevalent supply.

In conclusion, we present a technique using a new product for the repair of talar dome OCDs that has the benefit of being used with an all-arthroscopic approach, with decreased morbidity and the potential to create hyaline cartilage. Proceeding with an arthroscopically delivered cartilage matrix with adult live cells can be an effective technique for treating OCDs of the talus.

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