Allograft Juvenile Articular Cartilage Transplantation for Treatment of Talus Osteochondral Defects

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What is This?
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Abstract: Osteochondral (OCD) lesions of the talus are frequent sequelae of traumatic ankle injuries such as ankle sprains, fractures, and recurrent ankle instability. Initial management of talus lesions in most cases involves arthroscopy and microfracture/curettage. Tissue resulting from the microfracture is fibrocartilage. Clinical improvement in pain is seen in approximately 75% to 85% of people in a number of studies with long-term follow-up. Often, large lesions (>1 cm²) or those with cystic changes require secondary procedures such as talus allograft/autograft or autologous chondrocyte implantation. The use of a juvenile articular chondrocyte allograft is an option for large or refractory lesions and has the advantage of obviating the need for a tibial or fibular osteotomy. The purpose of this article is to describe a novel arthroscopic surgical technique for transplantation of juvenile chondrocytes as a treatment for talus OCD defects.

Levels of Evidence: Level IV

Keywords: osteochondral defect; cartilage transplantation; microfracture

Introduction

Surgical management for talus osteochondral (OCD) lesions is used for lesions refractory to conservative management. Initial management in most cases involves arthroscopy and microfracture/curettage.1,2 The recent advent of juvenile fresh allograft chondrocytes for cartilage lesions has created the potential to treat lesions refractory to microfracture treatment. This method has the possibility to reliably reproduce hyaline cartilage architecture without the morbidity and technical difficulties attendant to other currently available restorative techniques.2-4 The DeNovo NT (Zimmer Inc, Warsaw, IN) is a prepacked, off-the-shelf allograft from donors less than 13 years old with a high chondrocyte viability (Figure 1). One package can be used to cover a 2.0 cm² defect. The purpose of this article is to describe a novel arthroscopic surgical technique for transplantation of juvenile chondrocytes.5-8

Preoperative Planning

The ideal patient for the use of DeNovo NT is a young patient (<50 years old) with a symptomatic, isolated talus OCD lesion that has failed conservative treatment and previous microfracture. Large lesions (>1 cm²) have...
a decreased possibility to respond well to microfracture or bone marrow stimulation and are a relative indication. Kissing lesions, global osteoarthritis, or active infection are contraindications. Standing weight-bearing ankle radiographs and MRI or CT scans are valuable aids in preoperative planning to identify the location of the lesion and depth of bone involvement. Instability or misalignment of the ankle must be corrected at the time of surgery.

**Technique**

Following induction of general anesthesia, the patient is placed supine on the operating table. A roll is placed under the ipsilateral greater trochanter to facilitate optimal rotation of the operative ankle, and a pneumatic tourniquet is applied to the thigh. The operative leg is then placed in a commercially available positioner with the hip and knee flexed at approximately 30°.

Routine ankle arthroscopy is performed without traction, and anterior osteophytes and/or capsular scarring are removed. Next, noninvasive distraction is placed on the ankle (Figure 2).

Next, loose or delaminated articular cartilage is excised with a curette, and a stable border of the lesion is established (Figure 3). Any bony cysts underlying the lesion should also be curetted at this time, and placement of autograft or allograft into the cyst greater than 5 mm deep can be performed at this time. An arthroscopic probe is used to measure the lesion in 2 dimensions to determine the size of the lesion. Once preparation of the defect is completed, the ankle is evacuated of any arthroscopic fluid, and the remainder of the procedure is completed “dry.” The portal providing the most direct access to the lesion is enlarged sufficiently to provide unencumbered access to the lesion—usually 15 to 20 mm (Figure 4).

Using 1 package of DeNovo NT per 2.0 cm² of defect size, the packaging fluid is removed using a 25-gauge needle and is loaded retrograde into a small-joint arthroscopy cannula. The graft is then set aside until implantation.

Under arthroscopic visualization, the lesion is dried of any fluid utilizing fine-tip suction and pledges, with care taken to ensure that there is no bony bleeding from the surface of the lesion. The surface of the lesion is then covered with a thin layer of fibrin glue (Figure 5).

While the fibrin glue is still liquid, the graft is expressed from the cannula using the trochar and is gently spread with an elevator to cover the defect (Figure 6). An additional layer of fibrin is then applied to cover and secure the graft in position. The fibrin is allowed to set for 5 minutes and then the ankle is ranged. Arthroscopic visualization of the graft after range of motion is crucial to ensure that the graft did not delaminate (Figure 7). The arthroscopic portals are then closed with nylon suture, and the operative ankle is immobilized in a plaster splint.

**Postoperative Management**

The patients are kept non–weight bearing for 6 weeks. At 2 weeks, a generic cast boot is placed, and gentle active and passive range-of-motion exercises are
initiated to prevent anterior scar formation. Strengthening and elastic band resistance exercises with limited plantar flexion (<20°) are done to protect graft containment. A night splint can be used depending on lesion size. After week 6, the patient is advanced to weight-bearing as tolerated in a boot, with increasing range-of-motion exercises, bike, non-impact cardio, and pool therapy. From weeks 12 to 24, the patient is encouraged to walk and engage in a gradual increase in activity. After weeks 24 to 52, the patient may return to running and loading activities.

**Results/Complications**

The results of a multicenter trial reporting on the use of juvenile cartilage allograft were presented at the American Orthopaedic Foot & Ankle Society annual meeting in June 2012. There were 12 male and 11 female patients with an average age at surgery of 35.0 (range 17.5-69) years and an average BMI of 27.7 ± 5.8. The average follow-up was 16.2 (range = 10.5-25.6) months. Average outcome scores at final follow-up (n = 23 or 24) were American Orthopaedic Foot & Ankle Society (AOFAS), 85 ± 18; Short Form (SF)12 Physical Component Summary, 46 ± 10; SF12 Mental Component Summary, 55 ± 7.1; Foot and Ankle Ability Measure (FAAM) Activities of Daily Living, 82 ± 14; FAAM Sports, 63 ± 27; and Visual Analogue Score, Pain (100 mm), 24 ± 25. An AOFAS score ≥80 was considered a good/excellent outcome in the combined assessment of ankle pain, function, and alignment; a SF12 score of 50 represents average health status.

**Case Report**

A 36-year-old woman had 4 years of pain and catching of her ankle after a sprain (Figure 8). She was unable to run or exercise without experiencing swelling and had pain while climbing stairs. Her lesion size was 18 mm × 18 mm. Her preoperative Foot Function Index was 75, which improved 6 months postoperatively to 25. Subjectively, at 6 months, she felt that her function improved and had no pain with stairs or daily activities (Figure 9). Her function remained stable at 18 months, and she was playing soccer for 90 minutes without pain (Figure 10).

**Summary**

The DeNovo NT graft is an FDA-approved allograft that has been in use since 2007, with more than 1700 grafts placed in the ankle, knee, and shoulder. Cartilage from juvenile donors has been shown to proliferate more robustly in vitro and resist differentiation while in culture, retaining a cartilage phenotype more reliably than adult chondrocytes with 10 times more cartilage cell density. OCD allografts have been used for reconstructive procedures with few adverse graft-related reactions reported over 3 decades. In addition, arthroscopic transplantation of juvenile chondrocytes does not suffer many of the disadvantages of conventional restorative techniques for treatment of talar cartilage lesions. An all-arthroscopic or extended-portal technique is a single-stage procedure that obviates the need for malleolar osteotomy or cartilage biopsy, thus eliminating donor-site morbidity. At the authors’ institution, this procedure has shown favorable short-term results in selected patients, and its clinical promise necessitates further investigation. Currently, prospective trials of
arthroscopic treatment of large-talus OCD lesions are under way at the authors' institutions.

References


