The Use of a Cryopreserved Fresh Osteochondral Allograft for Repair of an Osteochondral Defect of the First Metatarsal Head: A Case Presentation

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Abstract

Osteochondral defects of the first metatarsophalangeal joint (MTPJ) are focal areas of articular damage leading to significant pain, decreased motion and impaired function. Cartilage restoration techniques have evolved significantly over recent years, and advancements in technology and surgical technique now allow repair of damaged cartilage with autografts and allografts. This case demonstrates the use of a cryopreserved, fresh osteochondral allograft that uses live functional cells and growth factors to regenerate hyaline cartilage and repair an osteochondral defect in the first metatarsal head. At the 14-month follow-up after surgery, our patient had complete resolution of symptoms.

Introduction

An osteochondral defect (OCD) is a focal area of damage involving injury to both the cartilage and the adjacent subchondral bone (1,2). Foot and ankle surgeons most commonly see OCD's in the talus and metatarsal heads caused by acute trauma, microtrauma, avascular necrosis, osteochondritis dissecans, or intraoperatively (3).

Treatment depends on the location and size of the defect as well as presence of secondary degenerative changes. At earlier stages, several treatment options exist including subchondral abrasion, microfracture, osteochondral autografts and osteochondral allografts. Osteochondral allografts provide donor allografts for repair of the defects, and allow the ability for hyaline cartilage regeneration in a single staged procedure. In addition, they have increased healing potential since they are more metabolically active, have a denser concentration of chondrocytes, and initiate less of an immune response (6-8).

Case Report

A 34-year old female presented with pain and swelling of the first metatarsal head of the left foot. She injured the left first metatarsophalangeal joint (MTPJ) during yoga 5 years ago. At that time, she noted immediate pain, swelling and bruising of the left first MTPJ area. She was treated by another podiatric physician, who placed her in a CAM boot, which she wore for approximately 3 months. She reported continued, intermittent pain of the first MTPJ area over the past 3-4 years. She described the pain as a dull, achy pain of the dorsal left first MTPJ that was aggravated with activity and ambulating. She had been treating the injury at home with rest, ice and over-the-counter NSAID's without any relief.

On physical exam, the patient's range of motion of the left first MTPJ was within normal limits. There was some pain elicited at end dorsiflexion of the first MTPJ, but there was no crepitus or locking appreciated. There was pain on palpation of the dorsal left first MTPJ area and slight edema noted.

Her past medical history was significant for asthma and a heart murmur for which the patient took no medication. The only medication she was taking at the time was ethinyl estradiol and norgestimate, for oral contraception. She denied any past surgical history and had no known drug allergies. She was a former cigarette smoker, and consumed alcohol once a week socially.

The patient had preoperative radiographs taken which were unremarkable. An MRI of the left foot revealed a focal osteochondral lesion at the central to lateral aspect of the first metatarsal head at the MTP joint, measuring 4 x 6 mm at the articular surface. This lesion was manifested by chondral softening, a full-thickness chondral fissure, subchondral plate flattening, subchondral sclerosis, and minimal subchondral bone edema (Fig. 1 - Fig. 3).

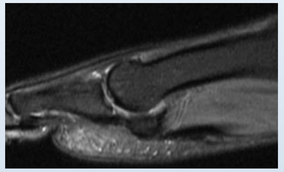

Figure 1. Preoperative MR image, in the T2 Sagittal PD view, displaying the focal subchondral lesion that undermined a region of bone-chondral interface consistent with incomplete/nondisplaced chondral delamination at the first metatarsal head.

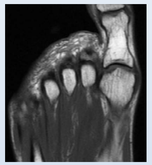

Figure 2. Preoperative MR image, in the T1 Axial view, demonstrating focal osteochondral lesion at the central to lateral aspect of the 1st metatarsal head along with metatarsal head flattening.

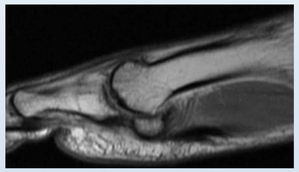

Figure 3. Preoperative MR image, in the T1 Sagittal PD view, displaying the focal subchondral lesion in the first metatarsal head.

Procedure

The surgical technique involved the patient positioned on the operative table in the supine position. The procedure was performed under general anesthesia and local anesthesia was obtained about the left foot. A sterile ankle tourniquet was utilized at 250 mmHg and a linear incision was made on the dorsal aspect of the left first MTPJ. Next, standard exposure of the first MTPJ was performed and the osteochondral lesion was identified. The lesion measured approximately 4 x 6 mm with cartilage delamination noted. Next, utilizing a #15 blade and curette, the osteochondral lesion was debrided to allow the cartilage graft to sit flush with the native cartilage (Fig. 4). A layer of fibrin glue was then placed at the base of the lesion and allowed to partially dry (Fig. 5). Next, the chondral graft was placed within the osteochondral lesion site (Fig. 6). An additional layer of fibrin glue was placed on the superior surface of the graft and allowed to completely dry (Fig. 7). The wound was then flushed and closed in a standard layered technique.

Post operatively, the patient was kept non-weight bearing in a posterior splint for 2 weeks followed by partial weightbearing in the CAM boot as tolerated. At 6 weeks, she was transitioned to a surgical shoe. At 7 weeks post op, the patient reported practically no pain and progressed into normal athletic shoe gear as tolerated. She returned to normal activity without restrictions at 4 months post operatively.

A telephone interview was conducted with her at 14 months post operatively, where she reported complete resolution of preoperative symptoms and full return to activity. She denied any pain or discomfort of the first MTPJ. The patient also reported complete satisfaction and that she would have the procedure again. The patient has progressed to normal shoe gear and returned to all of her normal activities without restrictions.

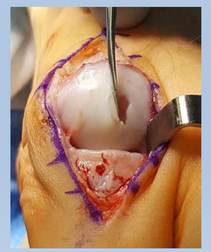

Figure 4. Intraoperative image demonstrating the first metatarsal immediately after the osteochondral lesion and subchondral bone debridement with #15 blade and curette, allowing the cartilage graft to sit flush with the native cartilage.

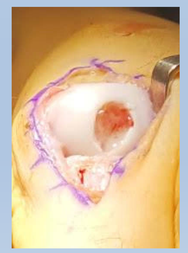

Figure 5. Intraoperative image displaying a layer of fibrin glue that was placed at the base of the lesion and allowed to partially dry prior to cartilage graft insertion.

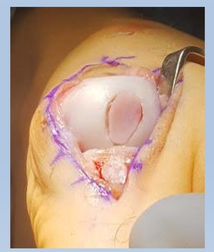

Figure 6. Intraoperative image of the fresh osteochondral allograft placed within the osteochondral defect on the first metatarsal head.

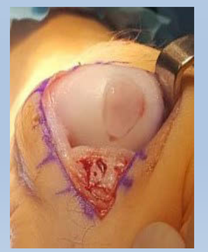

Figure 7. Intraoperative image displaying the final step of allograft insertion. An additional layer of fibrin glue was placed directly on the superior surface of the cartilaginous graft and allowed to dry completely.

Discussion

Osteochondral defects (OCD's) can cause a significant decrease in joint motion and function, leading to debilitating pain (7). Surgical intervention is indicated once all conservative measures have been exhausted (8). Traditional surgery involves removal of loose cartilage and bone fragments from the joint followed by subchondral drilling or abrasion chondroplasty (9). In many cases, subchondral drilling may not be adequate requiring a more advanced restoration technique such as osteochondral grafting.

Allogenic osteochondral grafting provides the advantage of abundant supply, the avoidance of donor site morbidity, and the ability to perform the repair in a single staged procedure. Disadvantages to osteochondral allografts include the possibility for graft rejection and extended recovery time (10).

The allograft used in this study is a fresh osteochondral allograft, from adult donors, that uses live cells to supply a matrix conducive for recipient cells to support regeneration of cartilage. It also provides the cells necessary to facilitate remodeling of the subchondral bone including viable chondrocytes and osteoblasts (11). Most current osteochondral allografts require the removal of recipient subchondral bone prior to implantation. However, some patients still have healthy subchondral bone and could benefit from a thinner osteochondral allograft that provides bone to bone healing, like this allograft (11).

A study by Delaney et al. in 2016 concluded that the levels of growth factor proteins shown in this allograft can augment the reformation potential of a healthy articular surface and provide the necessary growth factors and matrix for promotion of hyaline cartilage regeneration (12).

We believe that this is the first report on a case using this allograft for repair of an osteochondral defect in the first metatarsal head, and have found our clinical results to be consistent with the findings of previous studies that performed this technique at other sites. We attribute the improved surgical outcome to the ability of this allograft to provide growth factors necessary for the regeneration of hyaline cartilage.

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Disclosures

- Brett D. Sachs, DPM, FACFAS is a consultant for AlloSource (Centennial, CO).
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