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CASE REPORT

Case Report

Fresh-Stored Osteochondral Allograft for Treatment of Osteochondritis Dissecans the Femoral Head

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Abstract Osteochondral defects of the femoral head are exceedingly rare, with limited treatment options. Restoration procedures for similar defects involving the knee and ankle have been well described. In this report, we present a young patient who had a symptomatic osteochondral defect of the femoral head develop secondary to trauma and underwent subsequent treatment using a fresh-stored osteochondral allograft via a trochanteric osteotomy. At the 1-year followup, the patient was symptom free with near-complete incorporation of the graft radiographically. Our observations in this case suggest osteoarticular implantation may be an appropriate alternative to consider when treating osteochondral defects of the femoral head.

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Introduction

Osteochondritis dissecans of the femoral head is an uncommon clinical entity (approximately 2% of all cases of osteochondritis dissecans [13, 20]) with limited treatment options. Critical to the pathogenesis is the limited intrinsic healing capacity of hyaline articular cartilage. As with full-thickness cartilage defects of other weightbearing surfaces, this limited healing may lead to intractable pain and early degenerative changes. Potential treatment options include microfracture, autologous chondrocyte implantation, autologous whole-tissue transplantation, allograft tissue transplantation, osteotomy, and arthroplasty [6, 23]. Regardless of the method selected, the goal of any cartilage repair technique should be restoration of articular surface congruity with preservation of normal joint kinematics to allow for pain-free range of motion. Fresh-stored osteochondral allografts reportedly are useful to treat osteochondral defects about the knee and ankle [4, 10, 17, 21]. Using similar methods to reconstruct symptomatic osteochondral defects of the femoral head may provide a similarly useful way to treat patients with substantial pain and associated disability.

We present a young patient who had a symptomatic osteochondral defect of the femoral head develop secondary to trauma and who subsequently was treated with a fresh-stored osteochondral allograft via a trochanteric osteotomy.

Case Report

A healthy 32-year-old man had worsening left hip pain after jumping off a vehicle from a height of approximately 4 feet. In the subsequent months, the patient had mechanical symptoms of the affected hip, including catching and

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14. ABSTRACT
Osteochondral defects of the femoral head are exceedingly rare, with limited treatment options. Restoration procedures for similar defects involving the knee and ankle have been well described. In this report, we present a young patient who had a symptomatic osteochondral defect of the femoral head develop secondary to trauma and underwent subsequent treatment using a fresh-stored osteochondral allograft via a trochanteric osteotomy. At the 1-year followup, the patient was symptom free with nearcomplete incorporation of the graft radiographically. Our observations in this case suggest osteoarticular implantation may be an appropriate alternative to consider when treating osteochondral defects of the femoral head.

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locking related to work and everyday activities. On clinical examination, the patient had an antalgic gait and ambulated with a cane. Although range of motion of the hip was full and symmetric, his hip was painful with the extremes of passive internal rotation and abduction. There was no compensatory external rotation with flexion of the hip. The Harris hip score [15] before allograft reconstruction was 69 points. Initial radiographs showed a focal defect on the weightbearing surface of the femoral head (Fig. 1). The subchondral lesion was well circumscribed and separated from the remainder of the femoral head by a radiolucent line. Initial treatment included activity modification and nonsteroidal antiinflammatory drugs (NSAIDs) with minimal improvement in symptoms. A subsequent T2-weighted MRI showed osteochondral separation with no displacement of the major fragment as evident by high signal intensity between the osseous components (Fig. 2). A CT scan confirmed the diagnosis of an osteochondral defect, with fragmentation of the lesion measuring approximately 2.5 × 2.5 cm (Fig. 3).

Twelve months after the onset of hip pain and a course of nonoperative management, including extensive physical therapy after failure of the activity modification and NSAIDs, we reconstructed the articular defect with a fresh-stored osteochondral allograft using a size-matched femoral head donor. The time between donor procurement and implantation of the allograft was 15 days and the age of the donor was 22 years. The allograft was produced by a local tissue bank and was processed by Allograft Tissue Systems, Inc (Bonita Springs, FL). Screening of the donated tissue included serology for hepatitis A, hepatitis B, hepatitis C, and HIV. Testing for bacterial contamination also

Fig. 1A–B (**A**) Anteroposterior and (**B**) lateral radiographs reveal an osteochondral defect of the femoral head.

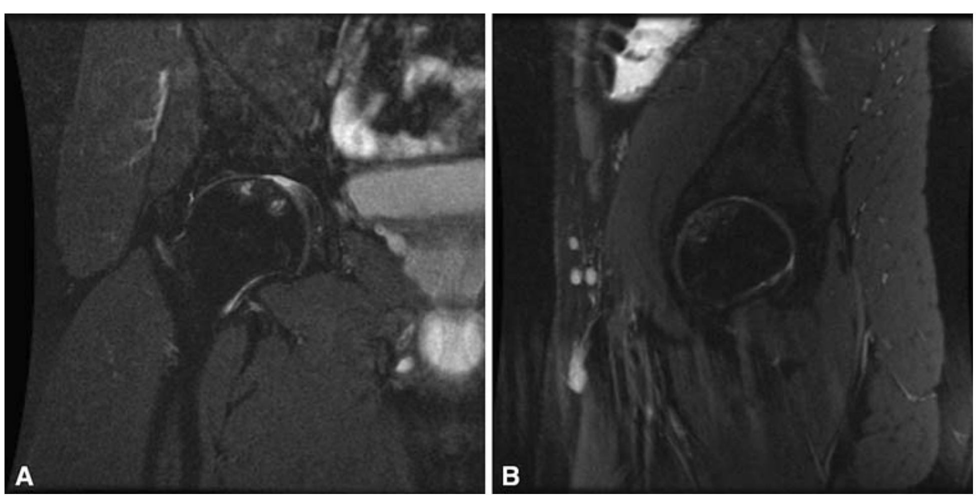

Fig. 2A–B (**A**) Coronal and (**B**) sagittal T2-weighted MRI scans of the femoral head defect show the areas of high signal intensity are not contiguous and do not undermine the lesion, suggesting the fragment is stable without evidence of collapse.

Fig. 3A–B (**A**) Coronal and (**B**) sagittal CT scans show fragmentation of the lesion.

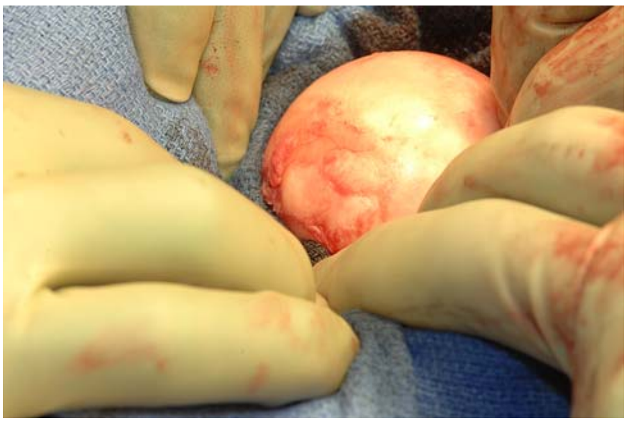

Fig. 4 An intraoperative photograph shows the lesion involving the anterior superomedial aspect of the femoral head.

Fig. 5 An intraoperative photograph shows the osteochondral plug after harvesting.

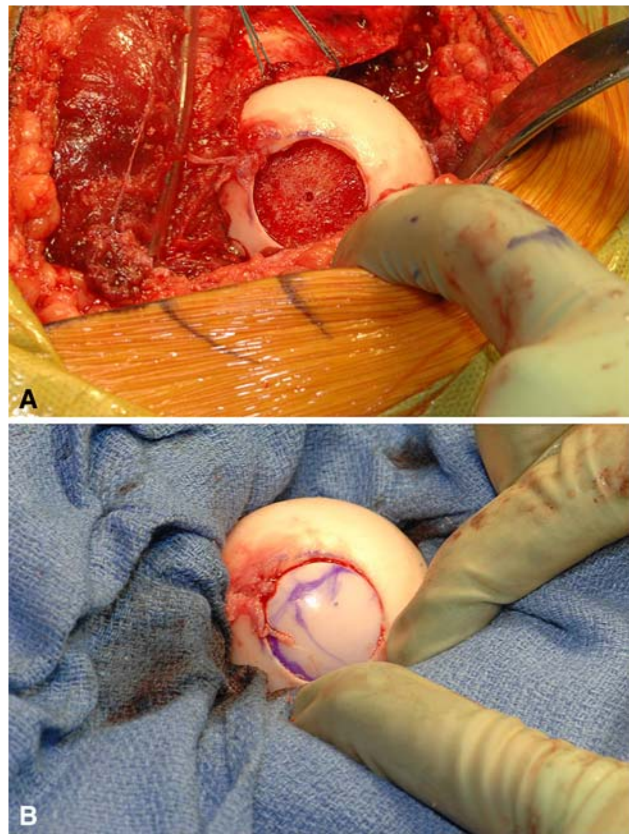

Fig. 6A–B Intraoperative photographs illustrate (**A**) the host defect after preparation and (**B**) the osteochondral allograft after implantation.

was performed before delivery. The femoral head was stored in 750 mL of a nutritive medium at 4°C and not removed until the time of implantation.

The surgical implantation was performed with the patient in the lateral position using the surgical dislocation approach described by Espinosa et al. [9], with a trochanteric osteotomy. The femoral head was dislocated and the lesion identified. The cartilaginous lesion was sclerotic and involved the superior dome of the femoral head (Fig. 4). There was no evidence of delamination of the articular cartilage. The diameter of the round defect measured 23 mm with a depth of 15 mm. A commercially available system (Arthrex, Naples, FL) was used to prepare the host defect and donor graft for implantation. The host defect was prepared to receive the allograft by creating a cylindrical defect using a power reamer over a guidewire. Next, the matching area to be harvested from the donor graft was marked using a surgical pen. The plug height measured approximately 12 mm after harvesting (Fig. 5). The osteochondral plug then was placed gently into the defect

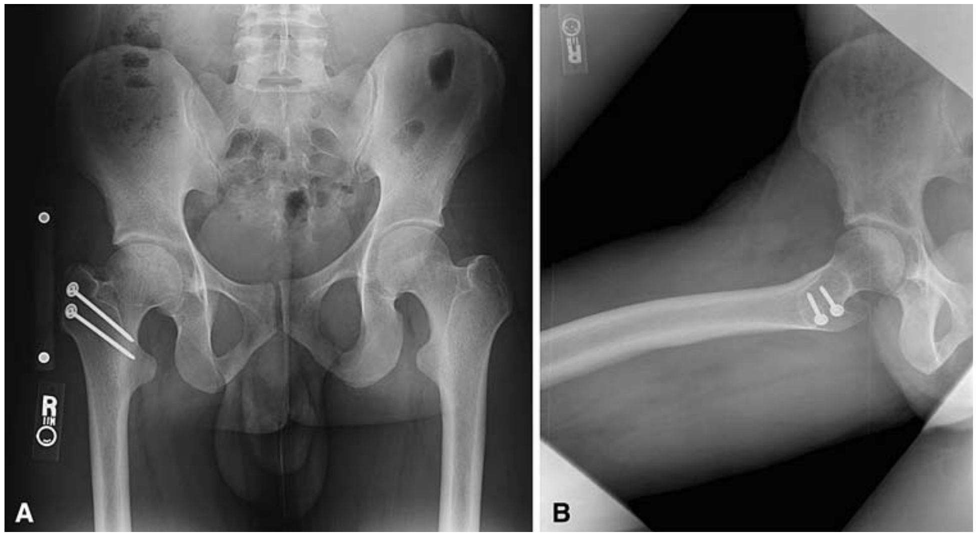

Fig. 7A–B Postoperative (**A**) anteroposterior and (**B**) lateral radiographs at 1-year followup show graft incorporation.

and tamped into position until the articular surface was flush with the host articular cartilage (Fig. 6). The hip was reduced and the capsule closed. The greater trochanter osteotomy was fixed using two 3.5-mm fully threaded cortical screws.

After surgery, the patient was nonweightbearing for 6 weeks followed by advancement to full weightbearing after healing of the greater trochanter osteotomy was confirmed radiographically. At the most recent followup 12 months after surgery, the patient had full range of painless motion with no additional complaints of rest pain or pain related to activities. The Harris hip score was 94 points. His postoperative radiographs showed near-complete incorporation of the graft with preservation of the native joint space (Fig. 7). An MRI also was obtained at the 1-year followup but was of little clinical use and diagnostic value owing to scatter from the metal screws used to repair the greater trochanter osteotomy.

Discussion

The first published reference of osteochondritis dissecans of the hip was by Haenisch in 1925 with several reports to follow soon thereafter [13]. It is a multifactorial condition of uncertain etiology that is often an incidental finding on routine radiographic evaluation of the involved joint. Commonly accepted theories related to pathogenesis include accessory centers of ossification and genetic predisposition [27]. Although adult osteochondritis dissecans may arise de novo, it is usually secondary to occult trauma or ischemia [8, 14, 27]. A comparison study by Lindholm et al. [20] supports the idea of stable preexisting lesions that remain clinically silent and only become symptomatic after an inciting traumatic event. In children, osteochondritis dissecans of the hip is rare and has been associated with Legg-Calvé-Perthes disease [26]. A well-circumscribed lesion demarcated by a radiolucent line is characteristic of osteochondritis dissecans on plain radiography. In a retrospective review of osteochondritis dissecans of the hip, Linden et al. [19] reported all lesions were detected on plain radiography and, in a majority of cases, located adjacent to the fovea centralis of the femoral head, which is further suggestive of a vascular etiology. MRI permits observation of loose bodies and the degree of fragment displacement as evident by the level of signal intensity beneath the lesion.

The natural history of symptomatic osteochondritis dissecans of the hip is poor [8, 13, 20] with limited treatment options. Unlike osteochondritis dissecans of the knee, lesions of the hip most often involve the weightbearing dome and remain intact in its crater. This, in conjunction with high loading forces across the hip, lends to the development of early degenerative changes about the joint. At this time, no studies provide conclusive evidence that osteoarticular transfers are successful for treatment of osteochondral defects of the femoral head, as has been described for similar lesions about the knee and ankle. The literature also does not support the use of other articular surface restoration procedures such as drilling or cancellization for treatment of osteochondral defects of the hip owing to poor outcomes [8, 19].

Reports of successful use of cell-based cartilage repair or autologous whole-tissue transplantation for treatment of large articular cartilage defects of the femoral head are rare: we found only one reference to osteoarticular transfer (mosaicplasty) for treatment of articular defects of the hip [16]. The case involved a patient with a deep osteochondral defect of the femoral head caused by a penetrated resorbable screw after fixation of a displaced large single fragment of the posterior acetabular rim. The defect was treated by using osteoarticular plug transfers from the ipsilateral knee with relative success. Technical challenges associated with autogenous osteochondral plugs include matching host-site geometry and regional differences in the material properties of the articular cartilage [7]. There also has been reported success using autologous chondrocyte implantation with bone grafting for osteochondral defects attributable to posttraumatic osteonecrosis [1]. Disadvantages of this approach include an additional operative procedure and prolonged rehabilitation.

Although joint arthroplasty is considered the gold standard for pain relief and restoration of function, the concern in young, active patients is reduced implant longevity and survivorship [7, 30, 31]. A rotational osteotomy is another viable option because it is a joint-preserving procedure and delays the need for a potential joint arthroplasty until a later age, similar to osteochondral allograft transplantation. However, a major disadvantage is its limited success in the treatment of conditions affecting the weightbearing surface of the femoral head in young patients, and the additional challenges of conversion to a THA [5, 25, 28]. Conversely, osteochondral allograft transplantation has the advantage of minimal deformity of the native anatomy and will not substantially complicate subsequent THA should the need arise, as has been described for similar conditions about the knee [22].

Osteochondral allografts for chondral and osteochondral defects of the femoral condyle, tibial plateau, and ankle, reportedly are associated with a survival rate of as much as 75–85% at 10 years [2, 17, 29]. Gole et al. [11] reported load-bearing of an osteochondral graft has positive effects on cell viability, suggesting grafts placed in weightbearing regions will perform better than those in other locations [11]. Additional advantages of osteochondral allograft transplantation include the presence of immunoprivileged and metabolically active chondrocytes in an existing extracellular matrix [3, 7] and the lack of donor site morbidity associated with alternative procedures. Because the graft contains cartilaginous and osseous components, it addresses defects of the articular cartilage and the underlying subchondral bone. Therefore, osteochondral allograft transplantation permits resurfacing of large chondral defects of the hip and provides geographically matched articular cartilage with mature, viable chondrocytes [2, 7]. This allows for a more anatomic reconstruction of the recipient femoral head when using a size-matched donor.

Another important aspect of this case that contributed to a successful outcome was the length of graft storage after procurement. The viability and function of osteochondral allografts are negatively affected by prolonged hypothermic storage in culture medium [3, 32]. To decrease the risk of infection, allografts generally are not implanted before 14 days after procurement to allow for extensive screening and cultures of the donor specimen [12]. For our patient, the time from procurement of the donor allograft until implantation was 15 days. Although chondrocyte viability is maintained for up to 45 days after procurement [24], studies suggest a substantial decrease in viability after 28 days of storage [3, 32]. Williams et al. [32] reported chondrocyte viability and viable cell density remained relatively unchanged after storage for 7 and 14 days and then declined precipitously after 28 days. The biochemical composition and structural properties of the grafts were not adversely affected by the storage time. Furthermore, LaPrade et al. [18] correlated chondrocyte viability with outcomes by showing functional and clinical improvements in patients with symptomatic osteochondral defects after transplantation of allografts stored up to 28 days. These findings suggest implantation of viable chondrocytes by the critical 28-day mark is essential to maintenance of the integrity of the extracellular cartilaginous matrix, preservation of the physiologic and biochemical properties of the graft, and ultimate graft survival with time.

We believe fresh-stored osteochondral allograft transplantation is a reasonable option for treatment of large osteochondral defects of the femoral head in young patients without evidence of preexisting arthrosis. Factors contributing to a successful outcome in our patient include the inherent advantages of fresh-stored allograft, the relative short period of graft storage after procurement increasing the likelihood of long-term graft survival, and the lack of donor site morbidity allowing for faster rehabilitation and earlier return to function. We recognize data from one patient with 1-year followup provides limited information, and long-term results from multiple cases are needed to establish the appropriateness of the approach, but current concepts regarding articular surface restoration suggest osteoarticular implantation may be appropriate for treatment of osteochondral defects of the femoral head.

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