Osteochondral Autograft Transfer for a Posttraumatic Osteochondral Defect of the Femoral Head

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Abstract

Posttraumatic osteochondral defects in the femoral head are uncommon, and management options are limited. Osteochondral defects may lead to pain and early degenerative changes. When conservative management fails, total hip arthroplasty is typically performed as the salvage procedure. However, this procedure may not be the best option in young, active patients.

In this study, we report 2 cases of posttraumatic osteochondral defects of the femoral head. The patients, an active 15-year-old adolescent boy and a 29-year-old woman, were both treated with osteochondral autograft transfer from the ipsilateral knee to the femoral head, with successful clinical and radiographic results at a mean follow-up of 4.3 years.

We submit that this treatment option should be considered for patients with similarly small-to-medium osteochondral defects of the femoral head. Additional research is warranted to more clearly define the indications for this procedure.

Isolated osteochondral defects in the hip are uncommon. As with osteochondral defects of other weight-bearing surfaces, these defects may lead to pain and early degenerative changes.[1,2] For other joints, such as the knee and the ankle, several procedures have been proposed to improve symptoms and restore joint surface integrity. These procedures include microfracture, osteochondral autograft transfer (OAT), osteochondral allograft transplant, and variations on autologous chondrocyte implantation (ACI). However, clinical data that can be used to guide management in the hip joint are lacking.

OAT involves relocating a healthy osteochondral plug from a low weight-bearing area to a small or medium-sized focal chondral or osteochondral defect. OAT is limited by defect size and number of plugs harvested from the donor site.[3] In cases in which multiple small plugs are used to fill the defect, the technique is referred to as *mosaicplasty*. A decisive advantage of OAT over microfracture and ACI is bone restoration, which makes OAT a consideration in the management of osteochondral defects in the hip. OAT for localized defects in the knee has 80% to 90% good or excellent outcomes in multiple series.[4-6] Using similar methods to reconstruct osteochondral defects of the femoral head may preserve the hip joint and provide a useful way to delay, and possibly eliminate, the need for total hip arthroplasty.

In this study, we report 2 cases of posttraumatic focal osteochondral defect of the anterosuperior femoral head after posterior hip dislocation and closed reduction. The patients were successfully treated with OAT to the femoral osteochondral defect, with follow-up of more than 4 years. The patients provided written informed consent for print and electronic publication of their case reports.

In addition, we present autologous mosaicplasty as a viable option for osteochondral defects of the femoral head at midterm follow-up, review the literature for previously reported cases of OAT in the hip, and propose indications for OAT in cases of osteochondral defects of the femoral head.

Case Reports

Case 1

A 15-year-old boy was referred to our clinic 4 weeks after a motor vehicle crash in which he sustained a right posterior hip dislocation that required closed reduction. He began to mobilize with partial weight-bearing but continued to have significant pain in the hip and the groin. On physical examination, hip flexion was limited to 80° with apprehension on further passive flexion. Plain radiographs were obtained (Figure 1), and magnetic resonance imaging (MRI) was performed (Figure 2). Management

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Am J Orthop. 2012;41(10):472-476.

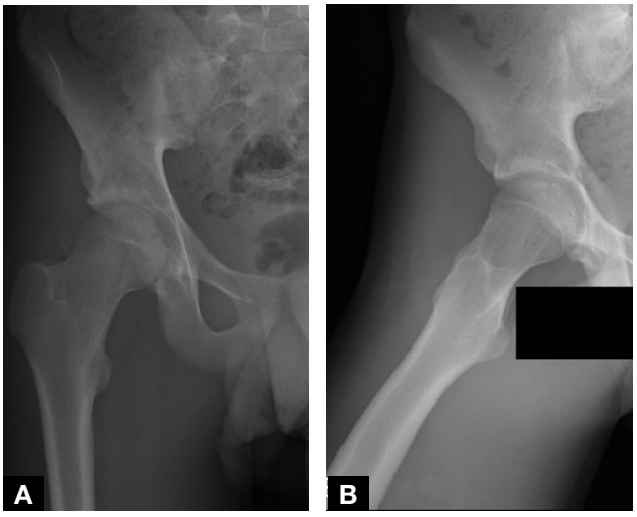

Figure 1. Case 1: Preoperative anteroposterior (A) and frog-leg lateral (B) radiographs of right hip after closed reduction show concentrically reduced hip with loose osteochondral fragment and irregularity of femoral head.

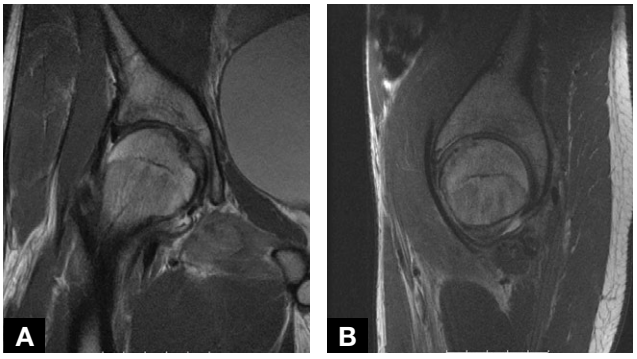

Figure 2. Case 1: Coronal (A) and sagittal (B) T_1-weighted MRI shows impacted osteochondral fracture of weight-bearing aspect of femoral head with slight displacement, depression of articular surface, multiple chondral loose bodies, and area of full-thickness cartilage loss of anterosuperior femoral head.

involved surgical hip dislocation, fixation of the impacted osteochondral fracture, loose body removal, and OAT from the ipsilateral knee.

The patient was placed in the lateral decubitus position, and surgical dislocation of the right posterior hip was performed with a trochanteric osteotomy. Several osteochondral and chondral fragments were removed from the joint. The acetabulum showed no significant cartilage or labral injury. On inspection of the femoral head, a 3×3-cm area of cartilage impaction was found. This impaction was stabilized with three 1.5-mm × 2-cm bioabsorbable nails (SmartNail, ConMed Linvatec, Utica, New York). After fixation, there was a 2-cm × 5- to 8-mm area of osteochondral defect in the anterosuperior weight-bearing portion of the femoral head. Using the Osteochondral Autograft Transplantation System (Arthrex, Naples, Florida), 3 osteochondral plugs (8, 7, and 5 mm) were harvested from the lateral portion of the lateral femoral trochlea and press-fit into the femoral head defect (Figure 3).

Case 2

A 29-year-old professional equestrian was referred to our clinic 1 week after falling from a horse. She had sustained a left posterior hip dislocation, which had required closed reduction. On physical examination, any passive motion of the hip resulted in pain. Figure 4 shows the patient's preoperative imaging. Management involved surgical hip dislocation, loose body removal, and OAT from the ipsilateral knee.

The patient was placed in the lateral decubitus position and surgical dislocation of the left posterior hip was performed. Several osteochondral and chondral fragments were removed from the joint. The acetabulum showed no significant cartilage injury. On inspection of the femoral head, a 2×2-cm osteochondral fracture fragment was found. Two interfragmentary screws were used for fixation, which left a 1×2-cm area of osteochondral defect at the anterosuperior weight-bearing portion. Using the Osteochondral Autograft Transplantation System (Arthrex), two 10-mm osteochondral plugs were harvested from the lateral trochlea of the ipsilateral knee and press-fit into the femoral head defect.

Recovery in Case 1 and 2

Continuous passive motion was started immediately after surgery. Patients were kept partial weight-bearing for 2 months after surgery and then were gradually returned to full weight-bearing as tolerated. MRI at 6 months showed complete incorporation of the osteochondral plugs into the femoral head (Figure 5). At 4.1-year follow-up, the patient in Case 1 had a modified Harris Hip Scale (HHS) score of 96 and a Hip Outcome Scale (HOS) score of 100 each for sports and activities of daily living (ADLs). At 4-year follow-up, the professional equestrian (Case 2) was competing at her previous activity level. She had a modified HHS score of 100 and a HOS score of 100 each for sports and ADLs. In both patients, radiographs showed heterotopic ossification with maintenance of the joint space (Figure 6), and there were no knee symptoms from the donor site.

Discussion

We have reported the cases of 2 young, active patients, in whom OAT was successfully used to manage posttraumatic defects of the femoral head through midterm follow-up. On MRI, osteochondral autografts showed evidence of incorporation into surrounding host bone. In addition, the patient in Case 1 was able to return to recreational sports, and the patient in Case 2 was able to return to work as a professional equestrian.

Only a few cases of using OAT for hip osteochondral defects have been reported in the literature.[5,7,8] Hangody and Füles[5] included 6 femoral head OATs in a series of 831 patients who underwent mosaicplasty, but there

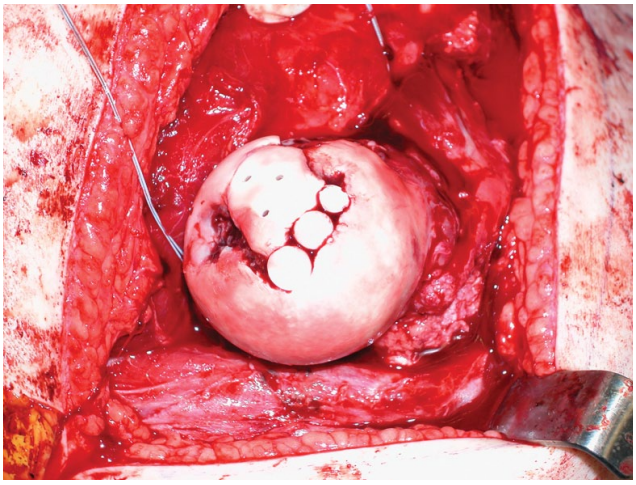

Figure 3. Case 1: Intraoperative photograph shows 3×3-cm impacted osteochondral fracture fragment fixed with 3 bioabsorbable screws and adjacent osteochondral autograft plugs (8, 7, and 5 mm in diameter) filling osteochondral defect. Fovea is visible more inferomedially.

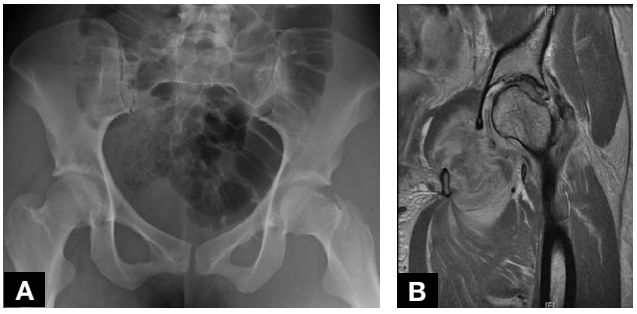

Figure 4. Case 2: (A) Anteroposterior radiograph of pelvis after closed reduction of left hip shows large osteochondral fracture fragment. (B) Coronal T_1-weighted MRI shows osteochondral defect of anterosuperior femoral head.

Figure 5. Case 1: 6-month postoperative coronal (A) and sagittal (B) T_1-weighted MRI of hip (Figure 2) shows incorporation of osteochondral autograft plug into surrounding host bone and rounded contour of femoral head articular cartilage.

was no subset analysis or description of these patients' outcomes. Hart and colleagues[7] reported the case of a young man with a deep osteochondral defect of the femoral head caused by a penetrated resorbable screw after internal fixation of a displaced large single fragment of the posterior acetabular rim and subsequent management with mosaicplasty. At 6-month follow-up, the patient had an HHS score of 100 points, though no imaging was performed. Sotereanos and colleagues[8] reported the case of a successful autologous osteochondral transfer to the femoral head after avascular necrosis in a 36-year-old man. Radiographs obtained more than 5 years after surgery showed no subchondral collapse and no significant arthrosis. Rehabilitation in all reported cases, including the 2 cases we have reported, is similar to OAT in the knee. After surgery, patients were treated with early range of motion and use of a continuous passive motion machine. Partial weightbearing was initiated at 6 to 8 weeks, and any impact activities, such as running, were resumed 6 months after surgery, provided the patient's symptoms and imaging were satisfactory.

Our surgical technique is similar to that used in the studies mentioned. Mosaicplasty with use of a press-fit technique for fixation was originally reported by Matsusue and colleagues[9] and further developed by Hangody and colleagues[6] and Bobić.[10] Many commercially available systems can be used to harvest cylindrical cartilage-bone plugs and implant them into prepared defects with press-fit fixation. The first step after thorough debridement of a defect is to size it to stabilize the vertical walls of healthy surrounding cartilage. A sizing guide is used to determine the length, size, and number of plugs needed. The plugs are then harvested while maintaining a perpendicular relationship between articular surface and donor graft in order to achieve congruent plug placement in the recipient site. Ideally, donor plugs rest flush with the surrounding cartilage, and gentle impaction minimizes any chondrocyte damage. Hangody and colleagues[6] found that 3% of patients had slight donor site disturbances in the fibrocartilage covering donor sites. In our 2 patients, we back-filled the donor sites with either osteochondral allograft or a synthetic bone void filler. Consideration can also be given to harvesting osteochondral autograft plugs from the head-neck junction of the ipsilateral hip, depending on the character of the injury. An alternative for avoiding donor site morbidity is osteochondral allograft, use of which has recently been reported in the femoral head for larger osteochondral defects.[11-13]

The indication for cartilage procedures continues to evolve for the knee, and a similar strategy may be adopted for the hip joint. Management of an articular cartilage lesion in the knee must be based on defect size, defect location, patient age, and activity level.[14] OAT is limited by defect size and number of plugs harvested from the donor site.[3] Donor site availability and other technical considerations have limited the optimal amount of defect coverage to 1 to 4 cm^2.[14-16] Extending the indication to larger defects (8-9 cm^2) in the knee has been shown to result in a higher rate of donor site morbidity.[5] We recommend that a similar size indication be used in the hip, as donor site morbid-

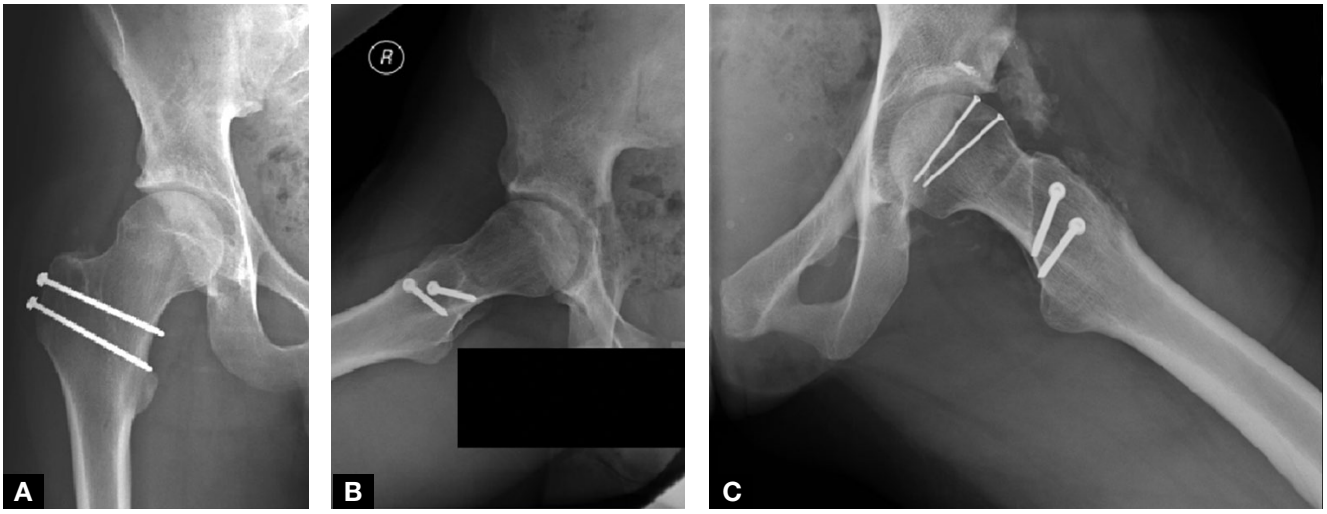

Figure 6. Case 1: Anteroposterior (A) and frog-leg lateral (B) radiographs of right hip at final follow-up show no significant hip arthrosis; also visible is mild heterotopic ossification at greater and lesser trochanter. (C) Case 2: Frog-leg lateral radiograph of left hip at final follow-up shows no significant hip arthrosis, but moderate heterotopic ossification is present.

ity increases for larger lesions[17] and may outweigh the benefit of the surgery. Lesions smaller than 1 cm may remain well shouldered by the surrounding cartilage, not cause increased subchondral loading, and therefore remain relatively asymptomatic without progression.[18] Donor sites for OAT in the hip can be the ipsilateral knee or the non–weight bearing aspects of the femoral head-neck junction. For larger defects, osteochondral allograft transplantation may be considered.[11-13] However, graft availability and the possible risk for disease transmission need to be considered with use of this management technique. Regarding lesion location, we recommend that OAT be limited to lesions in the weight-bearing area of the joint. In our experience, traumatic parafoveal chondral lesions tend to respond symptomatically with simple removal of the chondral loose bodies. In previous cartilage repair studies involving the knee, age also appeared to affect clinical outcome, with patients at a threshold of approximately 40 years doing relatively worse at longer follow-up.[19] In addition, it is important to consider preinjury activity level and condition of surrounding cartilage when indicating a patient for this procedure.[5] More studies are needed to develop definitive guidelines for managing isolated osteochondral lesions in the hip joint.

The surgical technique we have presented is not without potential for serious complications. With any surgical hip dislocation, there is the possibility of disruption of the blood supply to the femoral head and subsequent avascular necrosis. Limiting this risk involves using the technique of Ganz and colleagues,[20] including anterior dislocation through a posterior approach with a trochanteric flip osteotomy. With this approach, the external rotator muscles are not divided, and the medial femoral circumflex artery is protected by the intact obturator externus. In 213 hips, Ganz and colleagues[20] reported no subsequent avascular necrosis. In addition, there is also the potential for donor site morbidity in the knee. In our 2 patients, all osteochondral plugs were harvested from the superolateral margin of the trochlea, as Simonian and colleagues[21] determined that contact pressures are lowest in this area. Hangody and Füles[5] found that long-term donor site reports in a series of several hundred OATs, as measured by the Bandi score, were relatively minor and present in 3% of patients. With OAT, the benefits at the recipient site must be weighed against the morbidity that may result at the donor site.

The main limitation of this study is that both patients were surgically treated with a hybrid technique of femoral head biological reconstruction, including fixation of the osteochondral shear fragment and osteochondral autologous transfer. Although isolated fixation of the fragment and excision of the bone fragment were available as management options, either would have left a significant osteochondral defect in the weight-bearing portion of the articulating hip joint. Biomechanical data support restoration of the full contour of the femoral head,[22] and we believe it is important to do everything possible in young, active patients to avoid the 20% risk for posttraumatic arthritis that occurs with similar injuries.[23]

Osteochondral defects of the femoral head are uncommon, but physicians must be aware of alternatives to total hip arthroplasty, particularly for young, active patients. In this article, we have reported 2 cases of successful OAT and suggested that this procedure may be an appropriate alternative to consider when treating a young patient with an isolated osteochondral lesion in the femoral head. Although our 2 patients had excellent results at a follow-up of more than 4 years, the long-term durability and surgical indications for autologous osteochondral transfer in the hip joint needs to be evaluated.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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