

# Surgical Hip Dislocation and Fresh Osteochondral Allograft Transplantation for Femoroacetabular Impingement and Concomitant Chondral Lesion



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**Abstract:** Chondral lesions of the hip in young patients are frequently associated with additional articular pathology. Parafoveal osteochondral lesions have been reported to be a manifestation of cam lesions in the setting of femoroacetabular impingement (FAI). Although arthroscopic surgery is useful to treat intra- and extra-articular pathology, large lesions located in areas that are difficult to access represent a limitation of the technique. Open surgical dislocation and osteochondral allograft transplantation (OCA) allow treatment of larger surface areas and underlying morphologic abnormalities such as cam lesions. We present our technique for open surgical dislocation of the hip through a stepped trochanteric osteotomy, osteochondral transplantation of fresh-stored femoral head allograft, and osteoplasty of the head/neck junction.

Management of chondral lesions of the hip in young patients represents a challenge for orthopedic surgeons. Chondral lesions often produce pain and loss of function and can lead to degenerative joint disease.<sup>1</sup> Rarely isolated, they are prevalent in the setting of other intra-articular conditions such as osteonecrosis, labral tears, loose bodies, femoroacetabular impingement (FAI), arthritis, and dysplasia (Figures 1 and 2). Previously published articles have reported a possible association between cam impingement and parafoveal osteochondral lesions, as a manifestation of the complex pathomechanics associated with FAI.<sup>2,3</sup>

Hip-preserving strategies have gained in popularity, and treatment options include chondroplasty, marrow stimulation, autologous chondrocyte implantation

and osteochondral autograft/allograft transplants.<sup>1,4</sup> Although the existing literature on hip osteochondral allograft transplantation (OCA) is limited,<sup>5,6</sup> especially in the setting of large lesions (>2 cm<sup>2</sup>), open surgical dislocation and OCA represent a viable option that facilitates simultaneous treatment of underlying morphological

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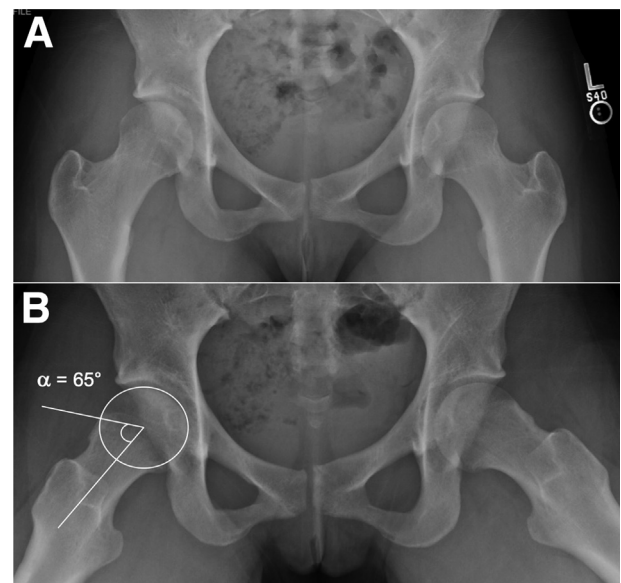
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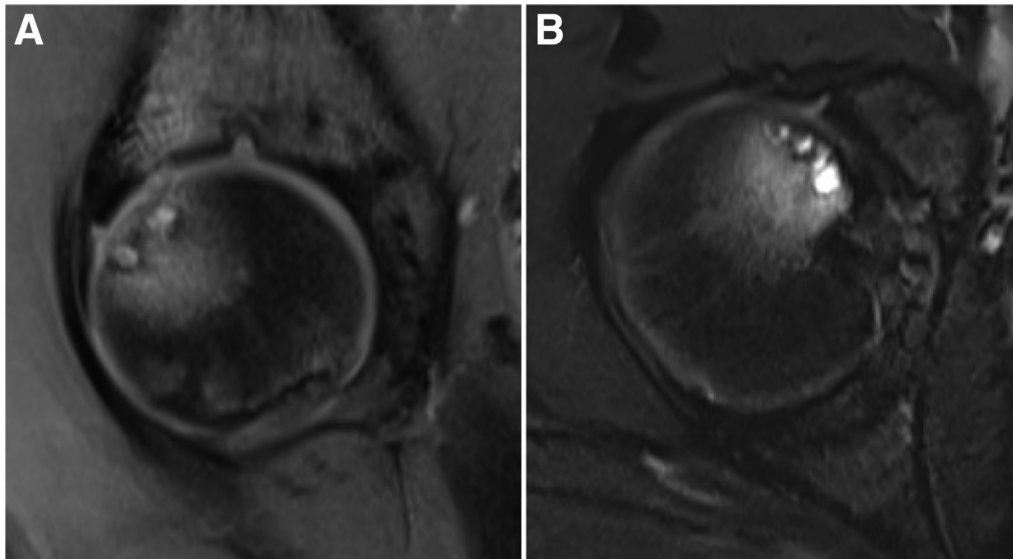
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**Fig 1.** Preoperative x-rays. Anteroposterior (A) and frog-leg lateral (B) views of both hips show an area with increased sclerosis located anteromedial in the right femoral head, with no associated subchondral collapse. The  $\alpha$  angle (B) measured 65°, compatible with a cam lesion.



**Fig 2.** Preoperative magnetic resonance imaging of the right hip. Sagittal (A) and axial (B) views reveal subchondral cystic changes of the femoral head with increased surrounding marrow edema. The lesion is compatible with an evolving osteochondral lesion secondary to a traumatic event. It is located medial and not directly beneath the sourcil. Note the lack of a geographic or serpentine lesion, which would be more consistent with avascular necrosis.

abnormalities, such as cam lesions. In this article, we describe our preferred surgical approach for this type of lesion (Video). Tables 1 and 2 summarize the indications and contraindications for this procedure, along with the advantages and disadvantages.

## Surgical Technique

### Bone Marrow Aspirate Concentrate Preparation, Patient Positioning, and Approach

The ipsilateral anterior iliac crest is prepared in a sterile fashion, and the overlying periosteum is anesthetized with 1% lidocaine. The trochar is percutaneously inserted through the skin down to the iliac crest. The inner and outer table of the crest is palpated to ensure proper orientation of the trochar as it is manually inserted using a mallet. A total of 60 mL of bone marrow aspirate is obtained and processed using the Arthrex Angel System Centrifuge (Arthrex, Naples, FL). Approximately 7 cc of bone marrow aspirate concentrate (BMAC) is generated from this sample and placed on the back table for use during the procedure.

The patient is placed in left lateral decubitus position with bony prominences appropriately padded. An

incision centered over the trochanter and femoral shaft is performed. The fascia lata is identified and split in line with the incision, taking care to split the fibers of the gluteus maximus proximally. The gluteus maximus split is typically performed in line with a prominent raphe at the junction of the posterior two thirds and anterior one third of the muscle. A Charnley retractor is inserted, and the gluteus medius is retracted anteriorly to better visualize the piriformis insertion onto the greater trochanter. A Doppler probe is then used to localize the blood flow into the femoral head, such that the osteotomy is performed lateral to the blood vessels. If the vessels are unable to be localized using the Doppler, staying lateral to the piriformis is crucial to ensure protection of the femoral head blood supply.

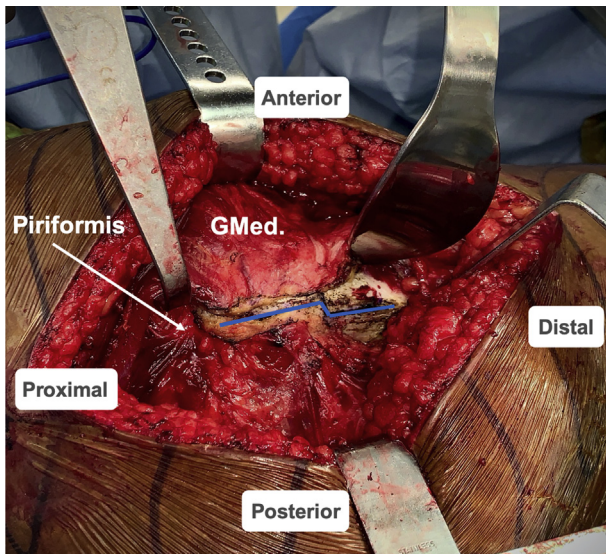
A stepped trochanteric osteotomy is performed (Figure 3) using a combination of a microsagittal saw and osteotomes. The microsagittal saw is used initially to create the proximal and distal limbs of the step cut from posterior to anterior. The saw is advanced to the far anterior cortex, and then a straight half-inch

**Table 1.** Surgical Indications and Contraindications

Indications	Contraindications
Age <55 years	Diffuse osteoarthritis
Large lesion (>2 cm <sup>2</sup> )	Inflammatory joint disease
Outerbridge III/IV	Inability to follow postoperative rehabilitation
Weightbearing area	Active infection
Failed nonsurgical treatment	Bipolar chondral lesion (acetabular involvement)
	Advanced osteonecrosis with extensive head involvement
	Smoking

**Table 2.** Advantages and Disadvantages

Advantages	Disadvantages
Simultaneously address underlying morphological abnormalities	Postoperative weightbearing restrictions
Single-stage procedure	Obtaining matched donors is a difficult and expensive process
Future total hip replacement is not compromised	Potential for disease transmission
Provides definitive treatment with hyaline cartilage	Potential danger to the vascularity of the femoral head and avascular necrosis
Lack of donor-site morbidity	



**Fig 3.** The patient is placed in the left lateral decubitus position, and a lateral approach to the trochanter is performed via a gluteus maximus split. Stepped trochanteric osteotomy is marked with the blue line. It is crucial that the osteotomy exits the trochanter lateral to the piriformis insertion to preserve the blood supply to the femoral head. Gmed, gluteus medius.

osteotome is used to complete this limb of the step cut. A quarter-inch osteotome is used to connect the steps, also being advanced from posterior to anterior. Again, care must be taken to ensure that the osteotomy exits lateral to the piriformis insertion site proximally, to ensure preservation of the blood supply to the femoral head. The osteotomized segment is retracted anteriorly using a combination of flexion, external rotation, and abduction. The gluteus minimus is then peeled off the capsule anteriorly.

A Z-shaped capsulotomy is performed as described by Ganz et al.<sup>7</sup> to avoid compromising the blood flow to the femoral head. The most distal limb of the capsulotomy runs medial to lateral along the trochanteric ridge. The proximal extent of this limb is the anterolateral junction of the trochanter and the femoral neck. The middle limb runs along the anterolateral aspect of the femoral neck aimed toward the femoral head. This limb is advanced to the capsular labral junction under direct visualization, taking great care to not damage the underlying labrum. A no. 12 scalpel blade is useful in performing the capsulotomy to avoid damaging the labrum as the capsular flap creation moves proximally toward the acetabular rim. The final limb of the capsulotomy is completed by completing the third limb, which runs parallel to the acetabular rim in a posterolateral direction. The ligamentum teres is released with a curved Mayo scissors, and hip dislocation is gently achieved (Figure 4). A Doppler probe is then used to confirm maintenance of the blood supply to the femoral head. If changes are noted in the Doppler signal, then

the hip should be reduced temporarily to mitigate potential vasospasm during dislocation.

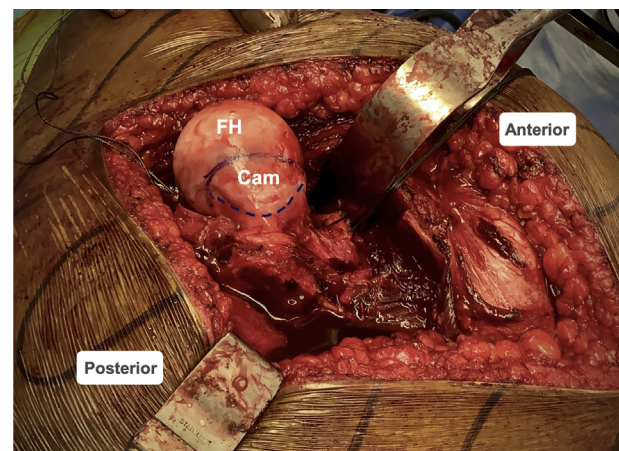
### Femoral Osteoplasty

After hip dislocation, the labrum is inspected for possible tears or detachments and treated if necessary. In the presence of a cam lesion, osteoplasty of the head and neck junction is performed (Figure 5). An angled osteotome is used to perform the majority of the bony resection, followed by contouring with an acorn bur to ensure femoral head sphericity and a smooth transition from the femoral head to the femoral neck. The femoral head is relocated, and the hip is placed through a complete range of motion to ensure that the head is stable and free from impingement.

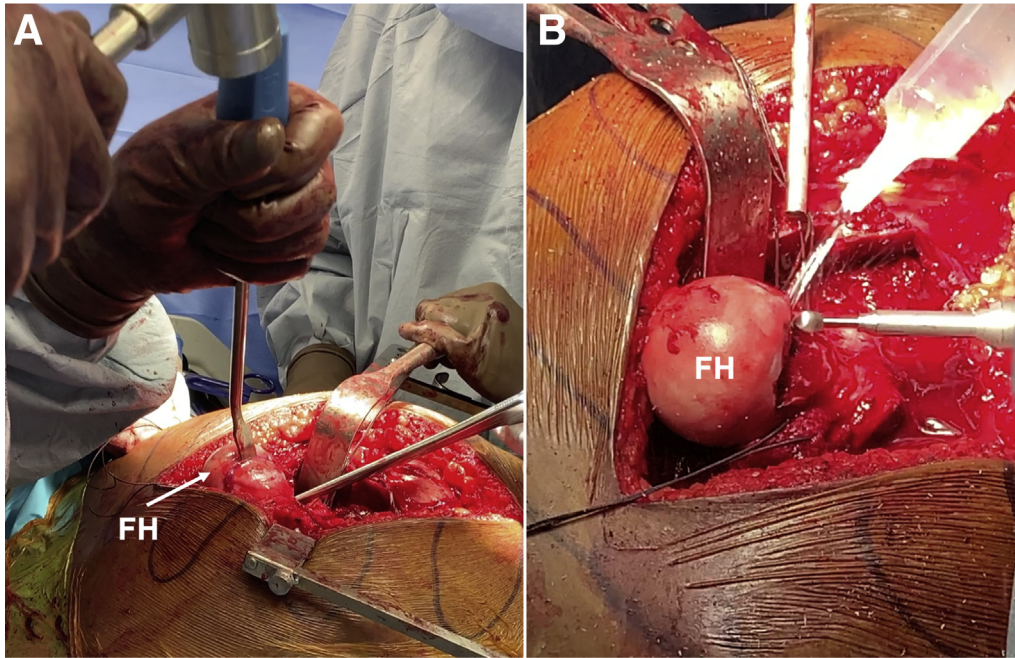
### Recipient Femoral Head Defect Preparation, Allograft Preparation, and Graft Insertion

The femoral head is redislocated, and the osteochondral lesion is addressed (Figure 6). Damaged cartilage and flaps are debrided until healthy edges are obtained. The defect is identified and templated using the OCA-specific instrumentation system (JRF Ortho, Centennial, CO). A 2.4-mm Kirschner wire (K-wire) is placed centrally through the sizing dilator (Figure 7) and overreamed to a depth of ~6 to 8 mm using a standardized reamer. The underlying subchondral bone must appear healthy and demonstrate adequate bleeding capacity. Measurements of the depth in the 4 quadrants of the socket are taken and recorded.

A fresh femoral head allograft is prepared on the back table, and a dowel is taken from an analogous position on the femoral head (Figure 8). The dowel is trimmed and contoured using the measurements previously taken from the recipient. Pulse lavage is used to eliminate all marrow elements, and the plug is left to soak in BMAC for ~5 minutes. A small K-wire is used to make perforations within the exposed bone of the recipient socket, and finally the plug is inserted with press-fit



**Fig 4.** Dislocated right femoral head. The cam lesion is delineated by blue lines. FH, femoral head.



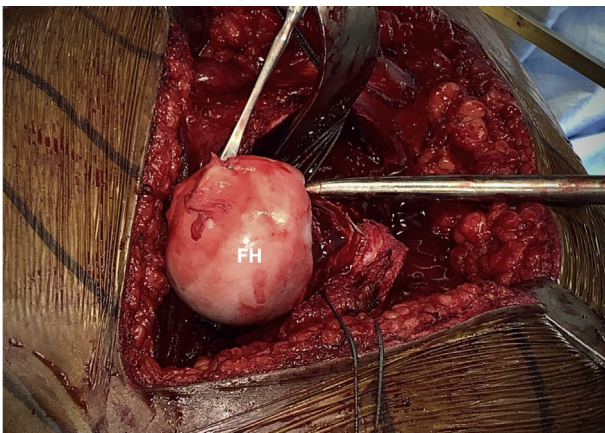
**Fig 5.** Dislocated right femoral head. An osteochondroplasty is performed with an angled osteotome (A) and finished with an acorn bur (B). FH, femoral head.

fixation (Figure 9). It is important to critically assess for any incongruity; the plug must be flush with the surrounding cartilage. Further manual probing and hip range of motion are done to assess stability of the graft.

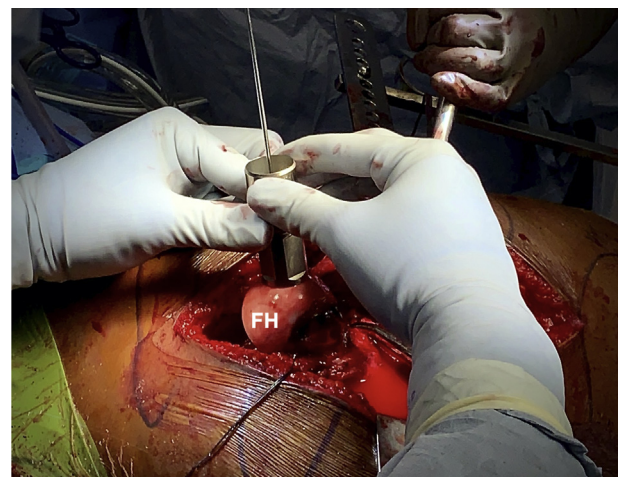
#### Hip Reduction and Closure

Final reduction is performed, taking the hip through range of motion, ensuring there is no mechanical clicking or impingement during the full range of motion. The wound is copiously irrigated, and the capsulotomy is repaired using interrupted no. 1 Vicryl suture.

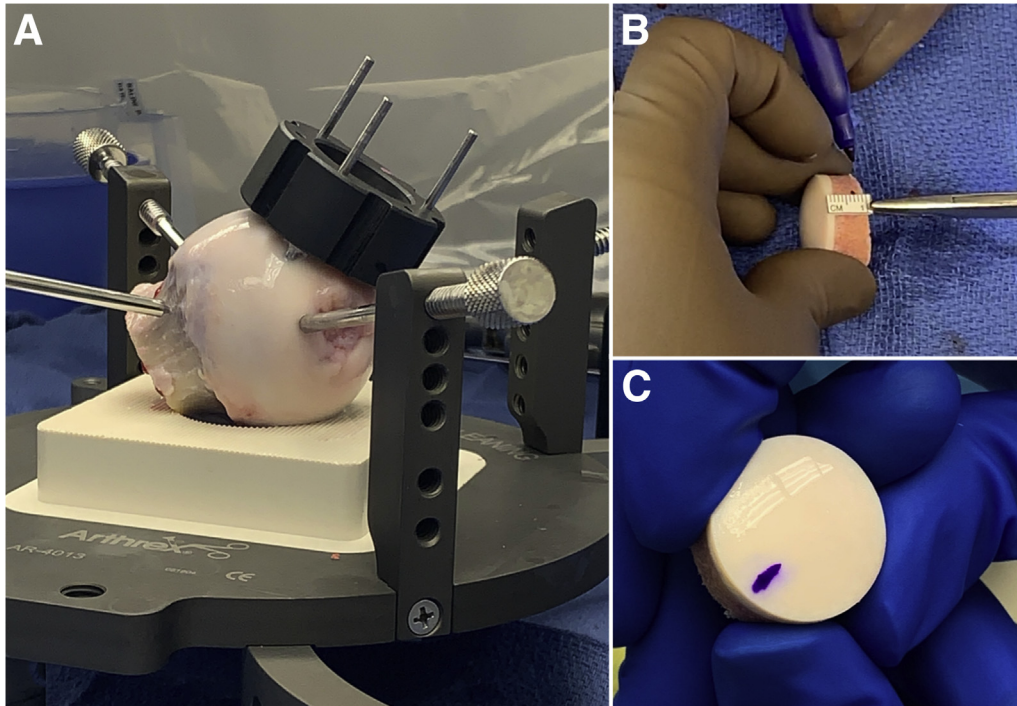
The trochanteric osteotomy is then reduced anatomically and fixed with two or three 6.5-mm partially threaded Synthes (Zuchwil, Switzerland) compression screws. Intraoperative radiographs are obtained to confirm anatomic reduction of the osteotomy and hip reduction (Figure 10). The fascia is closed with interrupted no. 1 Vicryl suture and then oversewn with a heavy, running, barbed suture. Subcutaneous tissues are closed with interrupted 2-0 Vicryl suture. The skin is closed with interrupted 2-0 Monocryl in the subcuticular layer, Dermabond, and a Prineo dressing. Once the Dermabond has dried, an additional island dressing may be applied.



**Fig 6.** Dislocated right femoral head after cam lesion is resected. Osteochondral defect is seen slightly lateral and anterior to the fovea. The lesion measured  $24 \times 18$  mm with a loose cartilage flap. A freer is shown passing between the cartilage and the underlying necrotic subchondral bone. FH, femoral head.



**Fig 7.** Dislocated right femoral head. A 2.4-mm Kirschner wire is placed centrally through the sizing dilator into the femoral head. FH, femoral head.

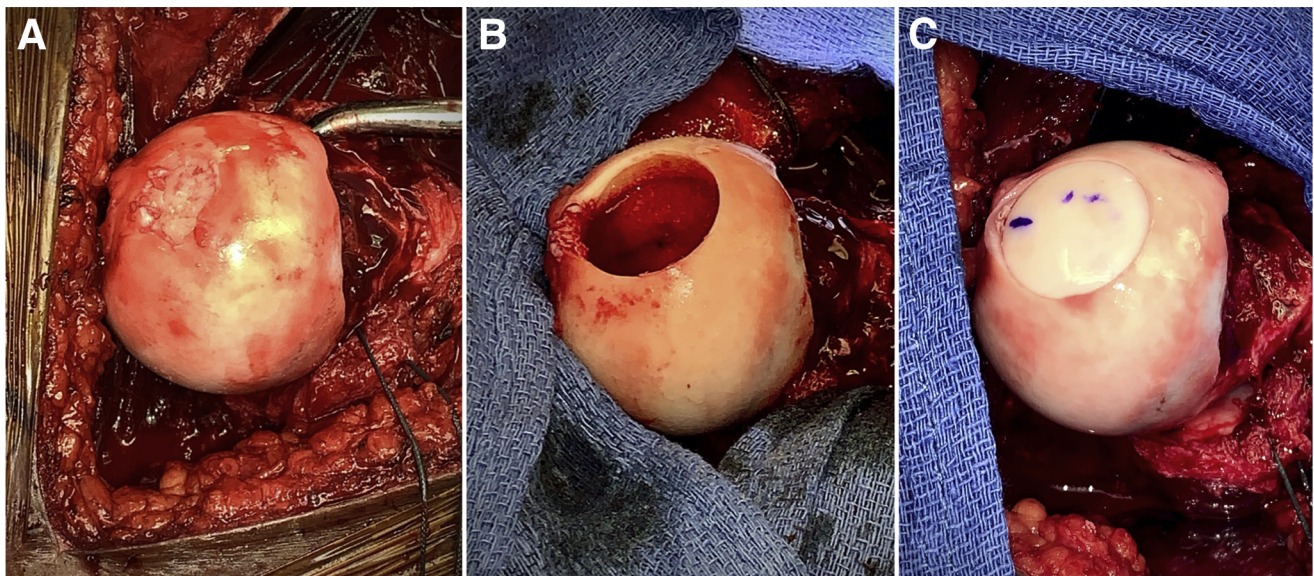


**Fig 8.** (A) Fresh femoral head allograft secured in Arthrex Workstation; the donor harvester guide is attached with 3 pins. (B) The dowel plug is measured in 4 quadrants, corresponding to a clock face. (C) Definitive plug with the blue line indicating the 12 o'clock position.

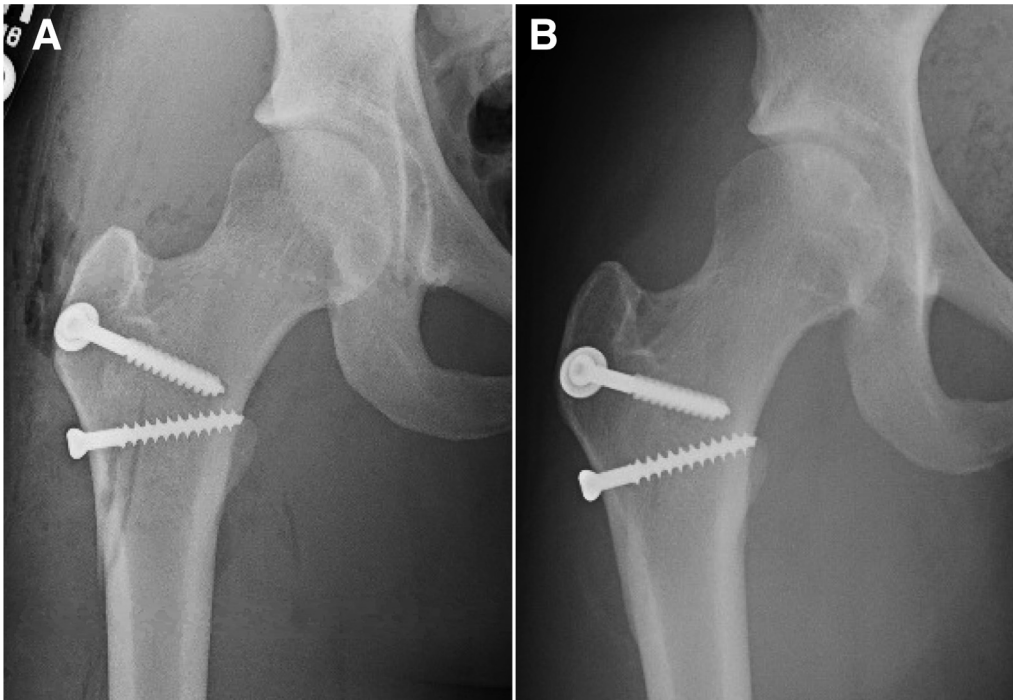
### Postoperative Rehabilitation

The patient is placed in a hip abduction brace with 20-lb “foot flat” weightbearing precautions during the first 4 weeks. Weightbearing is progressively advanced until 8 weeks, when full weightbearing is allowed. Active abduction is discouraged for the first 6 weeks after surgery.

Passive range of motion exercises are initiated during the first week using a continuous passive motion (CPM) machine to prevent adhesions and keep the joint lubricated. We recommend 4 to 8 hours of therapy daily on an intermittent basis with a maximum range of 0° to 60°. During the first 4 weeks after surgery, the patient is precluded from flexion past 90° and active



**Fig 9.** Right femoral head after initial debridement (A), after recipient site preparation (B), and after allograft implantation (C).

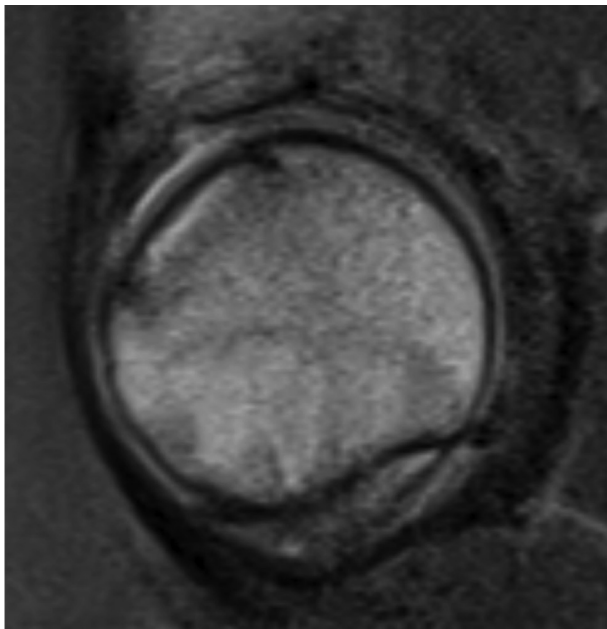


**Fig 10.** Immediate post-operative x-rays showing fixation of osteotomy with 6.5-mm partially threaded Synthes screws (A). Post-operative x-rays (4 months), demonstrating complete healing of the trochanteric osteotomy (B). Additionally noted is anatomic concentricity of the joint and allograft plug in the femoral head.

abduction. The patient wears an abduction brace while out of bed, maintaining a resting abduction of 20° and a flexion stop at 90°

At 4 weeks after surgery, radiographs are obtained (Figure 10). After confirmation of osteotomy position, devoid of migration or hardware loosening, weightbearing is advanced. Dual- and single-leg strengthening

exercises are advanced gradually, under therapist supervision, during this time as well. Walking as tolerated is initiated at 9 weeks, with walk/jog programs beginning at the 12-week postoperative time point. Dual- and single-leg strengthening exercises are also advanced under therapist guidance. At 6 months after surgery, magnetic resonance imaging is obtained to assess graft incorporation (Figure 11) to aid in decision making for eventual return to athletic activity.



**Fig 11.** Postoperative magnetic resonance imaging obtained at 6 months to assess graft incorporation. Sagittal view shows anatomic placement and incorporation of the graft.

## Discussion

Femoroacetabular impingement syndrome plays a significant role in the pathogenesis of hip chondral lesions.<sup>8</sup> Patients with cam lesions have restricted hip movements and complex biomechanical properties of the hip and pelvis that may progress to early-onset arthritis. We present our technique for surgical hip dislocation for the treatment of FAI and concomitant osteochondral lesion of the femoral head. Pearls and pitfalls associated with this technique are listed in Table 3.

Fresh OCA transplantation has become a reliable option in the treatment of knee osteochondral lesions; however, few studies have been published on hip lesions. Khanna et al.<sup>6</sup> published a series of 17 patients with hip cartilage defects treated with fresh OCA. With a mean follow-up of 41.6 months, 76% of patients had fair to good clinical outcome scores. Underlying diagnoses were osteochondritis dissecans, avascular necrosis, Legg-Calve-Perthes, and a femoral head fracture. They stated that the ideal candidate for this treatment would be a young, compliant

**Table 3.** Pearls, and Pitfalls

Pearls	Pitfalls
Perform meticulous dissection during surgical dislocation approach.	Disruption of vascular supply to femoral head during surgical dislocation
Preserve integrity of abductor and vastus lateralis insertions on greater trochanter.	Incorrect depth of plug (or plugs) relative to depth of recipient holes
Ensure that the osteotomy remains lateral to the piriformis insertion on the greater trochanter.	Plug or recipient preparation not perfectly perpendicular to chondral surface
Size graft correctly to replace both diseased cartilage and pathologic subchondral bone.	After manual insertion of the graft, a small tamp and mallet can be used to seat the graft flush to the articular surface. It is best to avoid forceful insertion of the graft and use repetitive light tamps with the mallet to avoid inadvertent malinsertion and preserve chondrocyte viability.
Pulse-lavage the graft to remove antigenic marrow elements, and soak the graft in bone marrow aspirate concentrate while preparing the defect. This may aid in biologic healing and subsequent graft incorporation.	
Slowly insert the graft using manual hand pressure so that it advances into the socket evenly along the circumference of the graft. The surgeon can insert a #2 suture behind the graft with the tails left outside the socket before insertion. If the graft is not seated properly within the socket, these tails can be used to pull the graft out of the socket to adjust it appropriately flush to the surrounding articular margin.	

patient with minimal pre-existing degenerative changes or deformity, and a cartilage defect that is not related to long-term steroid use.<sup>6</sup> In a series of 10 patients, Oladeji et al.<sup>5</sup> reported similar results, with 70% of successful clinical outcomes at 1.4-year mean follow-up. Smoking, avascular necrosis etiology, acetabular involvement, and concomitant procedures were associated with unsuccessful outcomes.

Regarding combined treatment for osteochondral lesions along with osteochondroplasty, Güngör et al.<sup>3</sup> reported 2 cases with successful short-term outcomes. They opted for autograft from anterolateral femoral condyle instead of allograft. Zaltz and Leunig<sup>2</sup> published a series of 10 patients with painful FAI and associated full-thickness parafoveal chondral lesions. Each patient underwent a femoral head or neck osteochondroplasty as well as either a labral repair or debridement. Seven of the 10 patients were treated by microfracture alone, and 3 were treated using a second-generation bone marrow stimulation technique. All patients were able to return to their preoperative level of function, with the exception of one, whose contralateral hip precluded participation.<sup>2</sup>

Open hip dislocation, osteochondroplasty, and fresh OCA represents a viable treatment option for young patients with large OC lesions and cam lesion. It allows for a single-stage procedure to restore mature hyaline cartilage and the underlying subchondral bone, which corrects the impingement morphology, thereby normalizing hip mechanics.

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