

Osteochondral Allograft Transplantation Of Posterior Femoral Condyle Lesions Utilizing An Open Posterior Approach To The Knee



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Abstract: Osteochondral allograft transplantation is a viable option for large chondral defects >2 cm squared, as well as in a revision setting after failure of a previous surface chondral restoration procedure. Osteochondral lesions involving the posterior aspect of the femoral condyle, however, are less common and easily underappreciated. Treatment of posterior osteochondral lesions is more technically demanding because they cannot be adequately addressed through standard arthroscopic approaches or an anterior arthrotomy. The challenges of the posterior approach include the relative unfamiliarity for many surgeons and the inherent risks due to the proximity of the neurovascular structures. The following technique reviews relevant anatomy and approach to osteochondral allograft transplant involving the posterior femoral condyles.

Posterior osteochondral lesions of the femoral condyle are uncommon and literature focusing on the treatment of these is limited. Standard anterior arthroscopy cannot fully visualize the most posterior articular margin, and damage in the resulting “hidden zones” of the femoral condyle may be more difficult to treat.¹ Direct inspection and access to chondral lesions of the posterior femoral condyle require posterior arthroscopy with the use of additional accessory portals

(Fig 1). Arthroscopic treatments are limited to chondroplasty and microfracture while larger lesions require an open approach. The posterior approach to the knee is unfamiliar to many surgeons, and the neurovascular structures are inherently at increased risk; however, this is technically safe with meticulous soft tissue management. The following technique reviews the relevant anatomy and approach to the posterior aspect of the knee, as well as steps for osteochondral allografting (OCA) of the posterior femoral condyle.

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Surgical Technique

Please refer to [Video 1](#) for technical demonstration.

Positioning and Preparation

To confirm that a lesion cannot be accessed anteriorly, this distance can be estimated on magnetic resonance imaging (MRI).¹ Alternatively, it may be beneficial to begin with a supine position and standard arthroscopy. The knee can be maximally flexed, and the area of maximal anterior exposure can be identified. Posterior arthroscopy can confirm extension of the lesion beyond this point. The amount of the femoral condyle that lies behind the maximal anterior visualization point is often underestimated. Any anterior treatment either open or arthroscopic can then be performed as indicated. Anterior techniques have been well described elsewhere in the literature. The patient can then be re-prepped and repositioned for the posterior portion of the procedure.

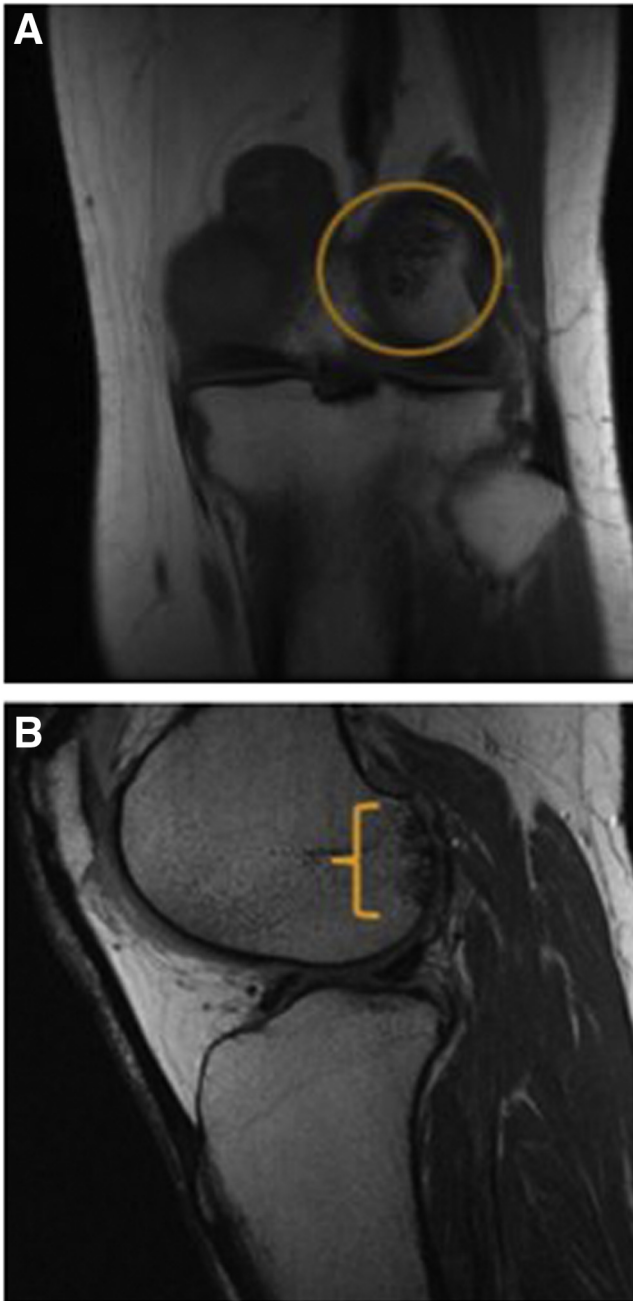


Fig 1. Coronal (A) and sagittal (B) MRI images demonstrating a large posterolateral femoral condyle osteochondral lesion. The majority of this lesion cannot be visualized through standard anteromedial or anterolateral arthroscopy portals. Circle indicates an approximately 20 mm osteochondral defect on the posterior aspect of the lateral femoral condyle. Bracket indicates the same osteochondral defect involving both cartilage and underlying bone on the sagittal image.

After the induction of general anesthesia, the patient is placed in the prone position. Care is taken to pad all bony prominences, especially at the knees. Chest rolls are used under the torso to allow excursion of the chest and abdomen. A standard mid-thigh tourniquet is placed and is sealed just distally with a nonsterile

impermeable drape. This prevents distal migration of the tourniquet. The remainder of the limb is prepped, and the foot and lower leg are placed in an impermeable stocking and overwrapped with an elastic wrap. This allows for flexion and extension of the knee. It should be ensured terminal extension can be achieved as this is necessary to access the most posterior lesions. Flexion can be used to relax the posterior soft tissues aiding in palpation of the posterior joint line.

Superficial Dissection and Retraction

The proximal popliteal crease is identified and a transverse incision approximately 5 cm along the posterior flexion crease is planned. This is curved an additional 3 to 5 cm proximally on the side corresponding to the pathology being addressed (Fig 2). The transition from transverse to longitudinal should be gently curved to prevent sharp edges which can increase the risk of skin necrosis.

The initial skin incision should be kept very superficial, particularly laterally because the common peroneal nerve is subcutaneous in this location. Once skin is incised, blunt dissection with Metzenbaum scissors is performed through subcutaneous tissue until the common peroneal nerve is identified. The apex of the skin flap may then be loosely tacked to the intact medial skin to provide retraction throughout the duration of the procedure (Fig 3).

Laterally, neurolysis of the common peroneal nerve is performed both proximal and distal to allow lateral retraction with minimal tension. The remainder of the popliteal neurovascular bundle (tibial nerve, popliteal artery, and vein) are retracted medially. Complete exposure of the bundle is not required if deep dissection



Fig 2. Planned incision to access a posterolateral femoral condyle osteochondral lesion. Image of the left knee with the patient in the prone position. A transverse incision is made along the primary flexion crease. In this case a proximal, longitudinal extension was made in line with the biceps femoris to aid in exposure of the posterior lateral femoral condyle.

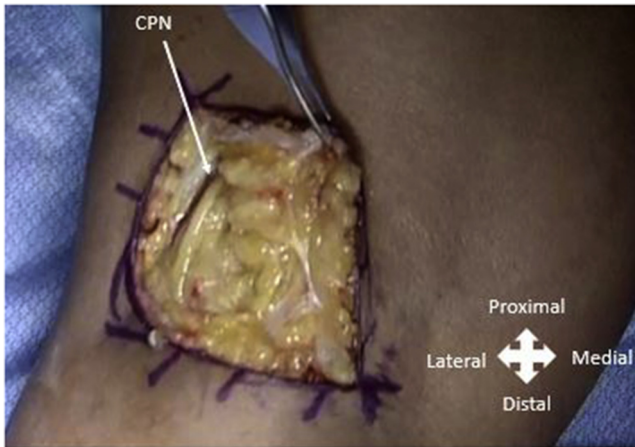


Fig 3. Identification and neurolysis of the common peroneal nerve. Left knee in the prone position. The common peroneal nerve is found superficially in the subcutaneous layer, mobilized, and protected throughout the duration of the case. (CPN, Common peroneal nerve.)

is performed immediately inferior to the common peroneal nerve down to the gastrocnemius fascia. This allows the perineural fat and soft tissue to be retracted medially en masse and adds additional tissue to lessen pressure from the medial retraction (Fig 4). All dissection should be performed bluntly until the level of the capsule is encountered.

Once the interval between the peroneal nerve and the popliteal neurovascular bundle is established the fascia of the lateral or medial head of the gastrocnemius will be encountered. At this point it may be helpful to use a ratcheting anterior cervical discectomy and fusion (ACDF) retractor which has small adjustable arms but provides deep stable retraction.

Gastrocnemius muscle fibers are split and bluntly dissected with the aid of a small Cobb or key elevator until the white fibers of the posterior capsule are clearly visualized. The self-retaining ACDF retractor can then be placed deeper to aid in deep retraction for protection of neurovascular structures and the elevated muscle (Fig 5).

Flexion and extension are then performed with digital palpation over the joint line to identify the appropriate level for capsulotomy. The transverse capsulotomy should be positioned directly over the posterior aspect of the lateral femoral condyle to be exposed. With the knee in extension, the posterior capsular fibers are tight and robust. Care should be taken to prevent iatrogenic injury to the meniscus or any intact posterior cartilage (Fig 6).

Superior and inferior limbs of the transverse capsulotomy can be tagged to aid in retraction and later repair. If necessary, the transverse capsulotomy can be converted to an “H” type capsulotomy by extending the medial and lateral extents longitudinally. If this is required, it is important to be aware of the location of the meniscus to prevent a radial laceration of the meniscus. Generally, the self-retractor is adequate at

this final dissection, but, if necessary, Hohmann retractors can be placed along medial and lateral aspects of the femoral condyle providing adequate exposure of the osteochondral lesion to be addressed.

Recipient site preparation

Sizing guides are then placed within the wound. Complete coverage of the most posterior portion of the condyle is typically 18 mm for the lateral side and 20 mm for the medial femoral condyle in an averaged sized male patient. A guide pin is placed perpendicular to the cartilage surface and the lesion is reamed to a depth of 10 mm (Fig 7). Recently literature suggested the optimum depth of reaming for OCA is 8 mm,² but the depth of the effected bone on MRI should be considered as well when determining the depth of bony resection. When between sizes the surgeon should err on the side of less coverage as over reaming can result in a loss of containment and press fit, which is a difficult problem to correct. Reaming is then performed over the guide pin, while the lesion is irrigated to ensure removal of all bony and chondral material.

Depth measurements are taken at all 4 quadrants to prepare for donor plug sizing. The 4 quadrants are recorded and labeled on a towel or the drapes, so they are available for reference during graft preparation. By convention, the authors refer to the positions as 12, 3, 6, and 9 o'clock, with the 12 o'clock position referring to the most proximal position. A dilator is placed into the lesion for final recipient site preparation. The wound is then irrigated again, and retractors are removed while attention is then turned to donor preparation.

Graft Preparation

A size-matched femoral condyle based on the patient's MRI and harvest is preordered. In some cases, a

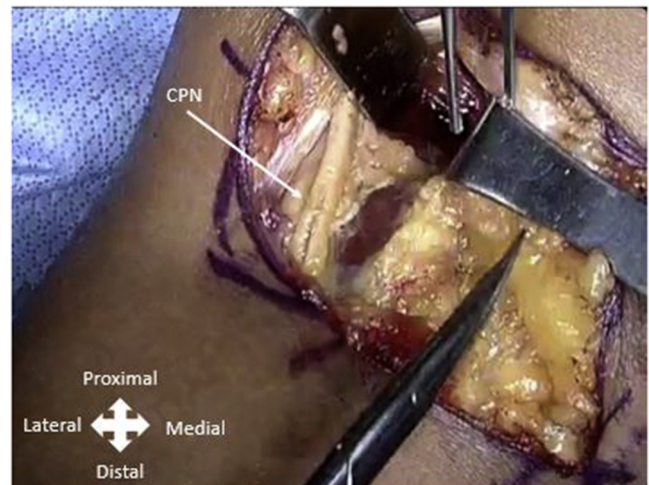


Fig 4. Mobilization of the common peroneal nerve and exposure of the lateral gastrocnemius fascia. Left knee in the prone position. (CPN, Common peroneal nerve.)

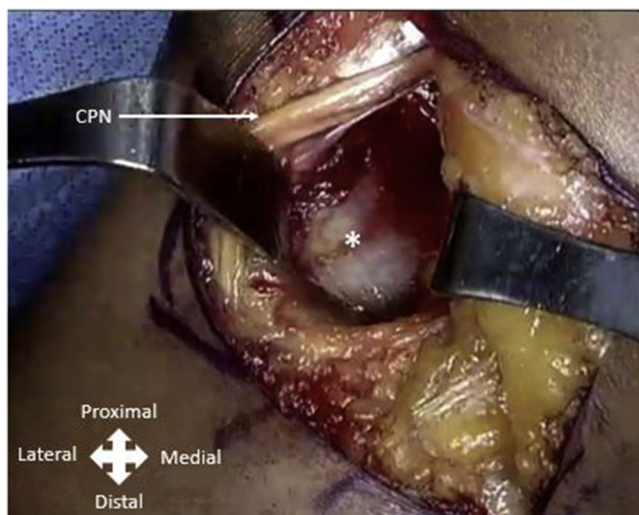


Fig 5. Exposure of the posterior left knee capsule with patient in the prone position. Fibers of the lateral gastrocnemius are split and are bluntly dissected from the posterior capsule using a key elevator. The knee can then be flexed/extended to determine the exact location of the joint line in preparation for posterior arthrotomy. (CPN, common peroneal nerve; Asterix marks posterior joint capsule.)

lateral femoral condyle can be used for medial lesions and vice versa.³ The allograft is placed in a jig and held in place with the corresponding sizing block in the corresponding location along the posterior aspect of the femoral condyle to optimize congruency of the donor plug. A dedicated graft harvest and preparation station facilitate graft preparation (Allograft OATS Instrumentation System; Arthrex Inc., Naples, FL). It is helpful to place a mark with a surgical pen at the proximal (12 o'clock) position to maintain orientation after graft harvest. The graft is harvested to a depth much deeper than the prepared recipient site, and a micro-sagittal saw is used to transect the base of the graft. A freer elevator may be placed under the graft, and a towel clip can then be used to remove the plug. After a full-length core is harvested, marks corresponding to the four quadrants are made on the cylinder so the graft can be cut flush at the appropriate depth around all four quadrants using a micro-sagittal saw and a specialized clamp for this purpose (Allograft OATS Instrumentation System). The edges that will be impacted are lightly chamfered with a rongeur to allow ease of insertion. Finally, the bony portion of the graft should be washed thoroughly with a pulse lavage to remove any transport medium, while keeping the cartilage surface protected from unnecessary impact.

Graft insertion

After confirming correct graft size and depth by remeasuring the four quadrants on both the donor and recipient and confirming orientation with a purple mark at the proximal 12 o'clock position, medial and

lateral retractors are replaced to expose the lesion. Prominence of up to 1 mm may be preferable if there are areas of surrounding cartilage that are compromised. If the depth of the recipient site appears too deep relative to the complete graft size, a small amount of demineralized bone matrix may be placed in the area that is deepest to improve fit and prevent countersinking.

One pitfall is dropping the completed graft during implantation. One way to mitigate this risk is to hold the graft with a towel clip on the bony side of the graft to allow alignment and orientation before impaction. Ultimately, the graft is aligned and gently impacted until flush or just prominent to the surrounding articular cartilage (Fig 8). The knee is then cycled through a full range of motion to ensure solid fixation and smooth motion.

Posterior wound closure

The wound is then copiously irrigated to remove any residual debris. The capsulotomy is closed using absorbable suture in a running fashion. The tourniquet is deflated, and meticulous hemostasis is achieved while the absence of vascular injury is confirmed. The common peroneal nerve is confirmed to be intact and returned to its natural anatomic location. The remainder of the closure is performed according to standard technique.

Postoperative management

After surgery, the patient is placed in a hinged knee brace locked in extension until the first postoperative visit when adequate wound healing is confirmed. If

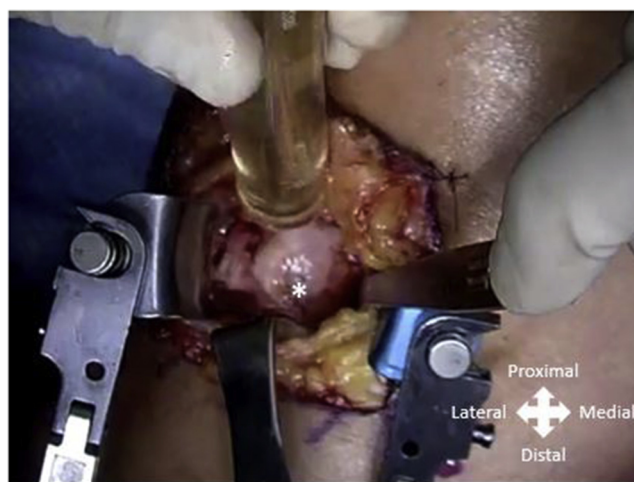


Fig 6. Exposure of posterolateral femoral condyle osteochondral defect. A transverse arthrotomy has been made and ACDF retractor has been placed to protect neurovascular structures. A Hohman retractor placed within the intercondylar notch may also aid in exposure. (Asterix marks osteochondral lesion of the posterolateral femoral condyle.)

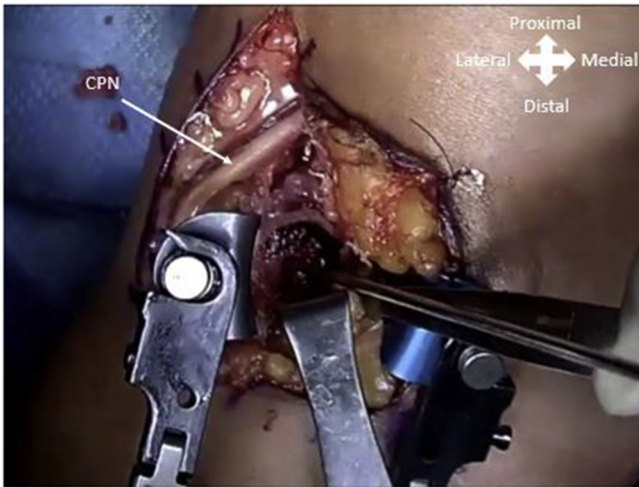


Fig 7. Preparation of the recipient site with guide pin placed in the center of the defect. ACDF retractor provides excellent visualization while protecting critical neurovascular structures. (CPN, common peroneal nerve.)

only the posterior condyle is treated, the patient can be allowed weightbearing as tolerated locked in extension in the brace, because the lesion will not engage in terminal extension. If combined anterior chondral or meniscal treatment is required, toe-touch weightbearing is imposed for 6 weeks. Physical therapy is initiated after the first postoperative visit and range of motion progresses 0° to 90° in the brace progressing after 6 weeks to full motion. After 6 weeks, gait training is initiated with progression to full and unrestricted walking without assistive devices or brace by 8 to 10 weeks. Increasing resistance and impact is introduced gradually at 18 weeks, with full return to activity 6 months after surgery. Pearls and pitfalls of the technique are reviewed in [Table 1](#).

Discussion

Osteochondral allograft transplantation has become a valuable and reliable tool for the orthopedic surgeon in treating large osteochondral defects both in the primary and revision setting.^{2,4} Basic science research has established this procedure yields viable hyaline cartilage that persists with very low risk of host immune response to allograft tissues.^{5,6} This technique can address both cartilage and subchondral bone pathology with restoration of bony architecture and hyaline cartilage. Clinical studies have demonstrated excellent patient reported outcomes in >80% of patients, with these results persisting beyond 10 to 15 years in most patients.⁷⁻⁹ Although there are no series dedicated to posterior femoral condyle lesions, most studies include a variety of lesions, and we believe these results can reasonably be extrapolated to predict outcomes in posterior lesions.

Although most articular cartilage lesions of the femoral condyles are easily accessible through standard anterior approaches, there are portions that cannot be visualized without posterior arthroscopy nor can be adequately addressed without a posterior approach. This has been described previously as the “hidden zone,” highlighting these lesions can easily go unrecognized.¹ Posterior femoral condyle lesions may simply be an extension of a larger lesion raising the risk of inadequate treatment, or they can be an isolated lesion, in which case patients may only have symptoms with deep flexion.¹⁰ Given the extra challenges involved with both visualization and treatment, some may assume these lesions cannot be effectively treated with means other than debridement, microfracture, or both.

The posterior approach to the knee is well described but remains unfamiliar and intimidating to most surgeons treating chondral lesions of the knee because indications for this approach are more commonly related to trauma, tumor, or more historical approaches to meniscus pathology.^{11,12} This approach involves a transverse incision along the posterior knee flexion crease with medial or lateral longitudinal extensions as needed for more medial or lateral joint access. The primary structures at risk include the common peroneal nerve, tibial nerve, popliteal artery, and popliteal vein. The common peroneal nerve lies immediately in the subcutaneous tissues, just posterior to the biceps femoris tendon; thus, after incising through skin, meticulous blunt dissection must be performed to identify, mobilize, and protect this nerve. The medial sural nerve and superficial saphenous vein also lie more medial in the subcutaneous tissues and can serve as a guide to the tibial nerve and popliteal vessels, respectively, which will be approximately midline. Depending on the amount of exposure needed, formal dissection of the popliteal neurovascular bundle may not be necessary,



Fig 8. Final seating of osteochondral allograft plug through the posterior approach to address a posterolateral femoral condyle osteochondral lesion.

Table 1. Pearls and Pitfalls

| Pearls | |
|--|--|
| Diagnostic arthroscopy for full evaluation of the lesion and its extent can aid in determining whether a posterior approach will be required to address a posterior femoral condyle lesion. | |
| Self-retaining ACDF retractor can aid in deep tissue retraction and protection of neurovascular structures during the posterior approach. | |
| Range of motion is not initiated until the posterior wound has healed. | |
| Attempt to cover as much of the lesion as possible through the posterior approach because it still may be difficult to fully address the remainder of the lesion through an anterior arthrotomy. | |
| Pitfalls | |
| The common peroneal nerve resides in the subcutaneous layer and is very superficial at the level of the popliteal fossa. This should be identified early and protected throughout the case. It should be mobilized enough to avoid excessive pressure during retraction. | |
| The major neurovascular structures reside relatively midline within the popliteal fossa. This does not necessarily require formal dissection; however, it should be positively identified and protected throughout the procedure. | |
| Avoid imbrication or overtightening of the posterior capsulotomy during closure to prevent flexion contracture. | |

thus maintaining soft tissue attachments and protection during retraction.^{10,13}

Deep dissection should also be performed bluntly with careful removal of the medial or lateral heads of the gastrocnemius to expose the posterior joint capsule. The circumflex geniculate arteries may be encountered at this level and require ligation to prevent significant bleeding. Once exposure of the joint capsule has been achieved, arthrotomy may be performed at the joint level or at the insertion of the capsule along the posterior condyle. Care must be taken while performing this to prevent any iatrogenic damage to the meniscus or underlying cartilage. Repair of the capsule should be performed at the conclusion of the procedure.

Conclusion

In summary, posterior femoral condyle lesions are uncommon and present significant difficulty regarding evaluation, diagnosis, and definitive treatment. These lesions, however, can be approached open and treated effectively with osteochondral allograft. Lesions that cannot be adequately addressed through standard anterior approaches may be safely and effectively addressed through an open posterior approach. Thorough knowledge of the relevant anatomy and meticulous soft tissue handling is critical to performing this safely.

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