The Direct Posterior Approach to the Knee

Surgical and Anatomic Approach

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ABSTRACT: The direct posterior surgical approach to the knee provides broad exposure of posterior neurovascular structures, the posterior aspect of the femoral condyles and tibial plateau, the posterior joint capsule, and a variety of additional soft-tissue structures including the popliteus, hamstring insertions, and origins of the gastrocnemius. Reported indications for this approach include tumor resection, posterior synovectomy, open reduction and internal fixation of posterior tibial plateau shear fractures, fixation of bone avulsions associated with a posterior cruciate ligament (PCL) injury, repair of posterior vascular injuries, and more recently, posterior inlay PCL reconstructions. However, use of this approach is uncommon and as a result, orthopedic residents and practicing orthopedic surgeons may not be familiar with the appropriate surgical anatomy. This report demonstrates in stepwise fashion the surgical approach and relevant anatomy through a detailed series of fresh cadaveric dissections.


INTRODUCTION

The direct posterior approach to the knee is a useful means for addressing a variety of pathologies, including neoplastic conditions, such as pigmented vil-lonodular synovitis,9 as well as both musculoskeletal and vascular sequelae of trauma.2,3,5,18 This approach provides broad access to the posterior aspect of the femoral condyles and tibial plateau, the medial and lateral heads of the gastrocnemius, the tibial attachment of the posterior cruciate ligament, the posterior capsule, and the neurovascular structures of the popliteal space.1,4,10,13,16 Safe execution of this approach demands a thorough knowledge of both superficial and deep surgical anatomy, particularly given the proximity of major neurovascular structures such as the popliteal artery, tibial nerve, and the common peroneal nerve.

Injury to these structures can result in potentially devastating complications, including significant motor or sensory deficits and vascular compromise.12,15 In light of the relatively infrequent need for the direct posterior approach, orthopedic residents and fellows-in-training, as well as practicing orthopedic surgeons, may not possess an adequate comfort level with this exposure. The purpose of this study is to describe a detailed, step-by-step sequence demonstrating the direct posterior surgical approach to the knee, along with relevant superficial and deep surgical anatomy.

MATERIALS AND METHODS

All dissections were performed on fresh-frozen cadaveric specimens. Two sets of photographs were taken. The first set of images show an intact specimen and was intended to reproduce the limited operative field that one can expect while performing the approach in vivo. The second set of photographs was obtained on a specimen after removal of all skin and subcutaneous tissue, and permitted unrestricted exposure of relevant deep anatomy. These two sets of images were then used to illustrate in...
side-by-side fashion the expected in vivo operative exposure and correlative deep anatomy.

The patient is placed in a well-supported prone position with a padded tourniquet on the thigh of the operative extremity. It is helpful to apply the tourniquet prior to placing the patient in the prone position. The extremity is prepared and draped in usual fashion. The foot is included in the field to permit frequent intraoperative vascular checks. The toes are wrapped with an impermeable, bacteriostatic adhesive barrier.

An S-shaped skin incision is made from proximal-lateral to distal-medial (Figures 1 and 2B). The length of each incision depends on the extent of exposure required and is sometimes affected by the amount of subcutaneous tissue. The proximal-lateral incision facilitates identification and protection of the common peroneal nerve. The distal-medial incision permits easy dissection along the insertion of the semimembranosus when treating certain synovial pathologies, such as pigmented villonodular synovitis or Baker’s cyst. Following incision, superficial dissection consists of identification of the small saphenous vein along the midline, several centimeters distal to the joint line. This facilitates identification of the medial sural cutaneous nerve, which rests immediately lateral to the small saphenous vein (Figure 2A).

The deep fascia is incised and the medial sural cutaneous nerve is traced proximally to the tibial nerve, allowing identification and protection of the popliteal neurovascular bundle. The raphe between the medial and lateral heads of the gastrocnemius is identified, as well as the medial border of the biceps femoris and the lateral border of the semimembranosus, structures that form the boundaries of the popliteal fossa (Figures 2B and 3). Proximal to the level of the joint line, the sciatic nerve will have already separated into the common peroneal and tibial components, with the former assuming a more lateral position, beneath cover of the short head of the biceps femoris. In a more midline position within the popliteal fossa, the tibial nerve lies superficial and slightly lateral to the popliteal vein and artery, the latter of which assumes the deepest position, juxtaposed to the posterior capsule of the knee, almost directly posterior to the posterior horn of the lateral meniscus.

The muscle belly of the semimembranosus can be retracted to reveal the tendinous origin of the medial head of the gastrocnemius (Figure 4). The medial head of the gastrocnemius can be gently retracted to reveal the posteromedial joint capsule (Figure 5). Excellent exposure is generally obtained with retraction of the medial head of the gastrocnemius. When it is necessary to obtain broad exposure of the posteromedial joint capsule, including the oblique popliteal ligament, the medial head of the gastrocnemius can be reflected medially and subsequently repaired during closure (Fig-
Figure 3. The medial sural cutaneous nerve can be identified and traced proximally to the tibial nerve, which is medial to the common peroneal nerve. Note that the common peroneal nerve is posterior to the biceps femoris tendon. (L=lateral, BF=biceps femoris, TN=tibial nerve, JL=joint line, CPN=common peroneal nerve, MG=medial gastrocnemius, SCN=medial sural cutaneous nerve, LG=lateral gastrocnemius, M=medial.)

Figure 4. Medial retraction. (L=lateral, BF=biceps femoris, TN=tibial nerve, SM=semimembranosus, JL=joint line, MG=medial gastrocnemius, LG=lateral gastrocnemius, M=medial.)

Figure 5. A second retractor has been placed laterally and is protecting and retracting the neurovascular bundle. (BF=biceps femoris, PJC=posteroinferior joint capsule, SM=semimembranosus, JL=joint line, MG=medial gastrocnemius.)

ures 6A and 6B). Placement of a stay suture within the tendinous portion of the medial head of the gastrocnemius facilitates control of the reflected portion of the muscle during both exposure and closure. Also, when this approach is used for posterior tibial plateau shear fractures, which can include a significant posteromedial fragment, one may need to elevate a portion of the semimembranosus insertion to obtain accurate visualization of the fracture lines. Finally, when exposure is necessary using the tibial inlay method in posterior cruciate ligament reconstruction, the joint can be approached posteriorly between the medial gastrocnemius, and retracted to protect the neurovascular bundle laterally and the semimembranosus medially.2,11

Exposure of the lateral posterior structures begins with identification of the common peroneal nerve as it runs deep to the biceps femoris (Figures 2B and 7). On the basis of the degree of exposure required, the common peroneal nerve can be either dissected and mobilized centrally or left in place in its course beneath the biceps femoris. After either lateral retraction or central mobilization of the common peroneal nerve, the origin of the lateral head of the gastrocnemius can be easily identified (Figure 7) and, if needed, reflected (Figure 8)
to grant broad exposure of the deep structures of the lateral aspect of the posterior joint, including the arcuate ligament and popliteus.

The tourniquet is released prior to closure, vascular status is checked, and meticulous hemostasis is obtained to minimize the risk of postoperative hematoma formation. The incision is closed in layers, and the skin is closed with simple, interrupted 3-0 nylon sutures with a no-pinch technique, in which one avoids pinching the skin edges with a forceps. On the basis of the procedure performed, a soft, bulky dressing* lock-hinged knee brace may be used. Sutures are removed no earlier than 14 days postoperatively.

**DISCUSSION**

As previously described, the direct posterior approach to the knee offers broad exposure of the posterior femoral condyles and tibial plateau, as well as the posterior soft tissue structures of the popliteal fossa, including the popliteal artery and vein, tibial nerve, common peroneal nerve, and a variety of tendinous origins and insertions.39,10,13,15 Chin et al6 used the posterior approach in combination with a standard anterior parapatellar approach for complete synovectomy in the treatment of pigmented villonodular synovitis of the knee. In a series of 40 patients, Chin et al6 reported 93% good or excellent results, with an 18% recurrence rate and no postoperative surgical complications directly related to the approach.

In a cohort of 12 patients, Bhattacharyya et al5 used the direct posterior approach for open reduction and internal fixation of posterior tibial plateau shear fractures. The exposure provided by the direct posterior approach facilitated anatomic fracture reduction, which was found to be significantly correlated with outcome in this small study. Despite the complexity of the approach and injury pattern, we encountered only two postoperative complications: one wound dehiscence and one flexion contracture.

In addition, use of the posterior approach to the knee has been cited in the literature for benign (Baker's cyst)5,13
and malignant tumor resection, and posterior cruciate ligament reconstruction using the tibial inlay technique (Figure 9), and repair of vascular injuries.

Use of this approach is uncommon. Thus, this article provides a detailed discussion of relevant surgical anatomy and planes of dissection that should facilitate safe execution of this approach.

REFERENCES


