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The posterior cruciate ligament (PCL) has been referred to as the cornerstone of ligamentous stability of the knee and in multiligamentous injuries has been our focus. The PCL is a primary stabilizer of the knee joint, the major restraint to posterior translation of the tibia on the femur, and the first ligament addressed in management of bicruciate knee injuries. Historically, injury to the PCL has been an uncommon and often unrecognized ligamentous injury. Complete ruptures of the PCL account for approximately 3% of all knee ligament injuries in the general population in one study.[1] As a result of the low frequency of injury and the significant rate of primary healing, the indications for surgery and surgical technique for reconstructing a torn PCL have taken years to define. Nonetheless, most authors will agree that isolated injuries to the PCL can oftentimes be treated nonoperatively with good results. However, reconstruction is indicated in the patient with a chronically symptomatic isolated grade III PCL injury or in the patient with a multiligamentous knee injury.[2] The most common scenario for surgery involves a complete PCL injury associated with an injury to the posteromedial or posterolateral corners, and in our extensive experience - in the bicruciate injured knee.[3]

Most PCL reconstruction techniques use both tibial and femoral bone tunnels for graft placement with arthroscopic assistance (transtibial technique). In this approach, intraoperative radiographs or fluoroscopy is used during drilling of the tibial tunnel to avoid plunging and potentially damaging limb-threatening popliteal neurovascular structures. Tibial tunnel reaming is then followed by preparation of the femoral tunnel. The graft is then passed through the tibial tunnel, into the joint, and retrieved out of the femoral tunnel. The turn around the tibial tunnel has been termed the "killer curve." There has been some concern that as the graft exits out the posterior tibia and turns superiorly and anteriorly towards its position on the medial femoral condyle that there may be excess stress on the graft resulting in early failure due to the tibial tunnel-graft interface edge. These basic science controversies and studies have been minimized by long-term clinical studies. Fanelli et al. has published multiple studies where the outcomes for combined anterior cruciate ligament (ACL)/PCL and PCL/posterolateral complex reconstructions using the transtibial single-bundle technique provide long-term

functional stability with successful return to pre-injury level of activity observed in all patients. Moreover, the longevity of reconstruction stability with this technique was demonstrated at 3 to 8 year follow-up using stress radiography.[4] Regardless of the long-term effects of the "killer curve," the acute turn from the posterior tibia to the femoral notch does often complicate graft passage during surgical reconstruction, but in many authors' experiences does not play out clinically.

An alternative technique for PCL reconstruction that has been described involves placement of the graft's bone block anatomically on the back of the tibia (inlay technique).[5] The tibial inlay technique avoids passing the graft around the "killer curve" found in the transtibial technique, thus preventing tibial edge stress on the graft as described earlier. The most often described technique for inlay involves initially starting with the patient in the supine position. While in the supine position, standard arthroscopy with graft harvest is performed and the femoral tunnel is prepared. The patient must then be repositioned in the prone position. The posterior tibia is then accessed using Burks' posteromedial approach. The landmarks for this approach are the medial border of the medial head of the gastrocnemius, the posterolateral border of the semimembranosus, the popliteal crease, and the midline of the distal thigh. The medial head of the gastrocnemius is retracted laterally to protect the neurovascular structures and the interval is between the medial head of the gastrocnemius and semimembranosus. This allows visualization of the posterior capsule and ultimately direct visualization of the PCL origin on the posterior tibia.

The most common tibial inlay technique described above can be cumbersome to many surgeons as it involves flipping the patient from supine to prone and back again, adding additional time to the case with the entire leg needing to be reprepped and draped each time. Furthermore, any graft adjustments would require repositioning, adding to an already complicated and lengthy procedure. One of the senior authors (RCS) prefers the use of a novel operative technique for the tibial inlay method of PCL reconstruction using a modification of Lobenhoffer's posteromedial approach, allowing the patient to remain in the supine position throughout the procedure.[6] This modification uses an interval between the posterior aspect of the medial
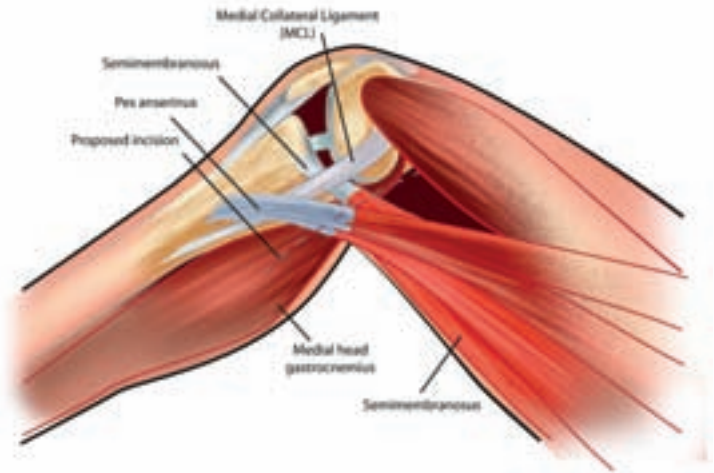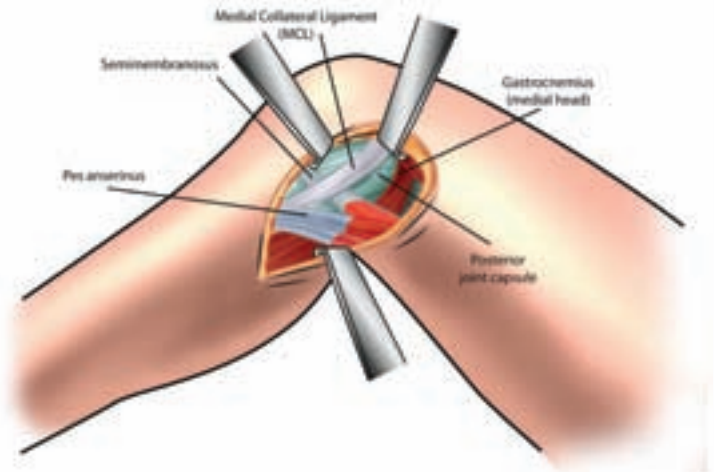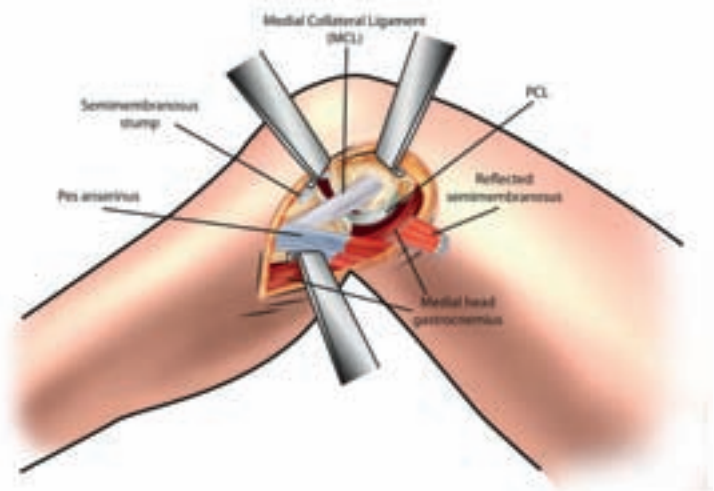
Figure 1: Posteromedial approach to the tibial attachment of the PCL. **A.** The patient is placed in the supine position with the knee flexed 30° to 60° and the leg and hip externally rotated. **B.** A skin incision is placed at the back edge of the medial tibia, coursing proximally to the posterior edge of the medial epicondyle. Superficial dissection is made through the sartorius fascia along the line of the skin incision. **C.** Deep dissection is made between the posterior knee joint capsule and the gastrocnemius. Partial detachment of the semimembranosus is required to access this interval. **D.** Exposure of the proximal tibia and capsulotomy allow identification of the PCL.

Right Knee PCL inlay technique

Figure 2: A posterior cruciate ligament reconstruction utilizing a tibial inlay technique.

collateral ligament (MCL) and posterior tibia and the pes anserinus (gracilis and semitendinosus). This approach thus stays anterior to the gastrocnemius but requires taking down distal portions of the semimembranosus (with subsequent repair). By flexing the knee to 90° while externally rotating the hip (unilateral frog leg position), the surgeon is able to clearly and safely visualize the back of the tibia while standing on the opposite side of the table (Figure 1).[7] Additional technical modifications include rotating the tibial inlay trough/graft medially towards the medial tibial border (Figure 2). This allows for ease of placement of the 4.0mm cannulated screws such that they are positioned slightly lateral to midline, thus avoiding the ACL tunnel in the scenario of a bicruciate reconstruction.

The choice of surgical technique for PCL reconstruction is largely a matter of surgeon preference. Some techniques may be more cumbersome than others – requiring the patient to be flipped from supine to prone and back again, or can potentially lead to mechanical degradation of the graft as it passes around the "killer curve" in the transtibial technique. The modification of the posteromedial approach where prone positioning is avoided is particularly useful for multiligamentous knee injuries involving the medial structures of the knee (KDIIIM). In these cases, incisions are minimized, compared to use of inlay with a KDIIIL or KDIV, allowing safe exposure for combined medial and posterior ligament reconstruction. In addition, the modified technique gives the orthopaedic surgeon another option for a revision case in which the failed index PCL reconstruction utilized a transtibial approach (Figure 3). Although more studies are needed, we hypothesize that there will be no difference in how one reconstructs the PCL, but will find improvement in outcomes depending on how well the PCL origin on the tibia is reestablished, including appropriate management of the corners.

Figure 3: **A, B.** KD3M injury treated with transitional PCL reconstruction. **C, D.** Conversion to inlay PCL reconstruction with double bundle ACL reconstruction after failure of both primary ACL and PCL grafts.

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