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ACL Reconstruction in the Multiple Ligament Injured Knee

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Abstract

Multiple ligament knee injuries are complex and can result from sports injuries or high energy trauma. The proper diagnosis and treatment of multiple ligament knee injuries are essential, and careful evaluation and planning are required to achieve successful outcomes. Anterior cruciate ligament (ACL) reconstruction in the multiple ligament injured knee is complicated by several factors, necessitating additional technical considerations. Patient selection, surgical timing, graft selection, and surgical technique require consideration specific to the ACL component of these injuries. We present a summary of the current knowledge with respect to the treatment of ACL injuries in the context of the multiple ligament injured knee.

Keywords

- anterior cruciate ligament reconstruction
- knee dislocation
- posterior cruciate ligament
- medial collateral ligament

Preoperative Planning

Multiligament knee injuries are unusual in both their rarity and complexity. In addition to ligament injuries, vascular and neurologic injuries can occur as well.[1–3] The low incidence of multiligament knee injuries has made large, prospective clinical trials difficult, and thus high-quality evidence on which to base treatment decisions is lacking.[1–3]

Preoperative planning begins with a detailed history and physical examination.[4] Following these assessments, the decision can be made to pursue either operative treatment or conservative management. Most patients with multiligament knee injuries are recommended operative treatment in view of better outcomes.[2–10] Arthrofibrosis and loss of range of motion (ROM) are concerns following surgery.[6,11] In addition, relative contraindications to consider, include advanced age, medical contraindications, active infection, intra-articular or periarticular fractures, morbid obesity, and limited functional demand prior to injury.[2,4,12–14] For these patients, conservative management may be preferred, consisting of bracing and rehabilitation. Delayed surgery is possible if indicated for chronic instability.

Graft selection is an important consideration. For isolated anterior cruciate ligament (ACL) reconstruction, autografts are generally preferred, due to the lower retear rate compared with allograft.[15] However, in the case of multiligament knee injuries, allografts may have the advantage of decreased donor site morbidity in a situation where the knee is severely traumatized and the surgery is extensive.[2,4,5] For posterior cruciate ligament (PCL) reconstruction in multiligament knee injuries, no difference in outcomes has been found for patients reconstructed with autografts and those with allografts, but similar evidence does not exist for, or against, ACL reconstruction in the multiligament injured knee.[16,17] When three or four ligaments are injured, allografts may be used to reduce donor site morbidity and operative time.[18,19] Achilles, patellar, or tibialis anterior tendon grafts are generally used.[2,6] Because allograft quality can vary, surgeons should select their supplier carefully, with adherence to federal guidelines.[2,20]

Age is also an important consideration, as ACL allografts have an unacceptably high failure rate in patients less than 25 years old.[10,20] For young athletes who plan to return to sports following multiligament knee reconstruction, autograft ACL should be considered.

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Surgical Technique

Prior to surgery, a detailed and thorough ligament examination should be performed under anesthesia, including the following tests: Lachman, pivot shift, reverse pivot shift, posterior drawer, external rotation drawer, dial test, and degree of varus and valgus opening.[4,20] If no vascular injury is found during the preoperative workup, a thigh tourniquet can be used during the open or arthroscopic part of the procedure.

There are a few important factors to consider when performing ACL reconstruction in the context of a multiligament injured knee. First, absence of the PCL can make identification of normal ACL footprint anatomy more difficult. As such, use of other anatomic landmarks is necessary.[7]

In transtibial ACL and PCL reconstructions, it is important to leave an adequate bone bridge when drilling the PCL tunnel on the anteromedial tibial cortex to avoid tunnel coalescence. The bone bridge should be at least 1 cm wide. To achieve this, guide pins are placed at least 2 cm apart on the tibia.[5,12] This is not a consideration for isolated ACL reconstruction, where only one tunnel is created on the anteromedial tibial cortex. It is also essential to leave room for tibial fixation of the medial collateral ligament (MCL) on the tibia to avoid overcrowding on the proximal medial tibia when doing ACL reconstruction in conjunction with PCL and MCL.

The surgery is performed arthroscopically, with the patient positioned supine on a table with a knee post.[12–14] For the ACL, a transtibial or anteromedial portal approach is recommended depending on surgeon preference and whether the transtibial approach can recreate the anatomic femoral footprint.[4] For the PCL, a transtibial, single-bundle is generally used to reproduce the anterolateral bundle.[12]

First, the anatomic femoral and tibial footprints on the femur should be prepared arthroscopically, followed by the establishment of the posteromedial accessory portal under direct visualization. A shaver and thermal ablation device can then be used to debride the tibial stump of the PCL via the posteromedial portal to expose the PCL facet. Initially, inserting the ACL guidewire in the tibia followed by the PCL guidewire eliminates the risk that the PCL tunnel will be too proximal on the anterior tibial cortex, which limits the room available for the ACL tunnel. The wires should be placed approximately 2 cm apart, to leave an adequate bone bridge after reaming, as described earlier.

Fluid leak via tunnels can impair visualization and the order of tunnel creation should be planned accordingly. The PCL tibial tunnel is the most technically demanding, because the neurovascular structures are at risk. The ACL tibial pin is placed first. To avoid fluid leak, the ACL tunnel should not be reamed at this point.[12–14] Rather, prior to any fluid leak, the PCL guide pin should be placed subsequently, and the PCL tunnel reamed first under optimal visualization. Use of a protector for the reamer posteriorly is critical to avoid neurovascular injury. Fluid pressure should be maintained to optimize visualization through the posteromedial portal to observe the reamer entering the knee.[12,21] The tibial PCL pin position can be confirmed with intraoperative fluoroscopy if necessary.

Next, the femoral ACL socket should be created. As this is a socket, not a tunnel, there is no resulting fluid leak so visualization is not compromised. Next, the ACL tibial tunnel can be reamed, followed by the PCL femoral tunnel. Appropriate scope orientation is critical for proper tunnel placement with both cruciate ligaments absent. The surgeon should recreate the anterolateral bundle of the PCL using an outside-in mini-subvastus approach, a vastus splitting approach, or an inside-out technique.[12] The bundle should be created at the center of the anterolateral bundle, approximately 1 to 2 mm away from the articular margin. Once both tunnels are reamed, the PCL graft can be passed, followed by the ACL graft. They are then both fixed on the femoral side. A switching stick is used in the posteromedial portal to act as a pulley and facilitate PCL graft passage.

Fixation of the allografts first on the femoral side with interference screws is recommended, followed by metallic interference or bioabsorbable screws on the tibial side.[12] Metal screws are preferred by the senior author for several reasons, including avoidance of suspensory fixation, lower cost in comparison to bioabsorbable screws, better subjective "bite" on insertion, visibility on X-ray, and less bone lysis, tunnel expansion, or inflammatory reactions compared with bioabsorbable screws. The PCL should be definitively fixed first on the tibia with the knee at 90 degrees, followed by the ACL with the knee in full extension.[4,12] Collateral ligaments are fixed last. Back-up fixation is added if needed to improve the security of fixation. Meniscal lesions are treated either by repair or partial meniscectomy as indicated.[4]

Rehabilitation

Use of a postop hinged knee brace is generally recommended for at least 6 to 8 weeks following surgery.[2,12,15,22] Patients can then be transferred into a custom brace for up to 9 to 12 months, depending on the case. Patient-specific factors, such as generalized joint hyperlaxity, should be considered during the progression of knee ROM.[15] Toe-touch weight bearing is allowed for the first 4 weeks postop followed by progression to full weight bearing, also depending on other considerations, such as knee effusion, ROM, quadriceps strength, neuromuscular control, and gait patterns.[12,15,23] Braces should be locked in full extension for the first week, and potentially up to 4 weeks depending on the case. Following this period, unlimited ROM is allowed. The goal is to obtain at least 90 degrees of knee flexion by 8 weeks.[4] Most patients are allowed to return to sports or heavy labor at 9 to 12 months postoperatively, depending on the ROM, proprioception, and strength.[4]

Conclusion

While further research is necessary to refine the indications for, timing of, rehabilitation and surgical technique for ACL reconstruction in the multiligament injured knee, there are several important considerations. Preoperative planning is critical. Suitability of allograft tissue for the patient should be evaluated. The order of tunnels, graft passage, and fixation should be determined and decided upon prior to surgery. Following these recommendations will help optimize outcomes.

Conflict of Interest
R.G.M. reports personal fees from *Journal of Bone and Joint Surgery*, personal fees from *Journal of Bone and Joint Surgery* Evidence Based Orthopedics, personal fees from Mend, personal fees from Springer and Demos Health, outside the submitted work.

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