Percutaneous Lateral Collateral Ligament Reconstruction

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Abstract: The lateral collateral ligament (LCL) is 1 of the 3 major static stabilizers of the lateral knee. It acts as a restraint to varus stress as well as posterolateral rotation of the knee. Injury to the LCL rarely occurs in isolation. It is usually associated with injuries to other structures such as the anterior and/or posterior cruciate ligament, as well as other ligaments of the posterolateral corner. Grade I and II tears are usually treated conservatively, whereas complete tears are treated by either primary repair or reconstruction. This article describes a surgical technique in which the LCL is reconstructed percutaneously using an autograft.

The posterolateral structures of the knee comprise the lateral collateral ligament (LCL), popliteofibular ligament, popliteal tendon, popliteal-femoral ligament, and posterolateral capsule. All these structures contribute to valgus and rotational stability of the knee joint.

Posterolateral corner (PLC) injuries are usually associated with injuries to the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). If left untreated, posterolateral instability may lead to chronic pain and residual instability. Persistent posterolateral instability may also lead to varus thrust gait, which increases forces in the medial compartment of the knee. This may result in meniscal injuries and accelerated medial-compartment osteoarthritis.[1,2] Furthermore, because most structures in this anatomic region have low potential to heal, posterolateral rotational instability results in a deterioration in patients' quality of life, impaired biomechanics of the knee, and increased tension on other ligaments and the meniscus.[3] Moreover, unrecognized posterolateral instability may lead to failure of ACL and PCL reconstruction.[3] It is understood that anatomic reconstruction is superior to extra-anatomic techniques, leading to better clinical results.[4] In this article, we present a technique in which the LCL is reconstructed anatomically using a minimally invasive approach.

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Indications

LCL injuries are usually associated with other knee ligament injuries such as ACL and/or PCL injuries. LCL tears can occur because of direct varus stress, hyperextension, or twisting injuries of the knee. Grade I and II tears were initially managed conservatively; however, more recent studies have shown that although the PLC structures will undergo scarring down or healing, the knee essentially heals with increased laxity of the PLC structures when compared with a native, uninjured knee.[5] Untreated LCL injuries result in varus instability of the knee, as well as increased forces in the medial compartment due to varus thrust gait.[2] Our indications for percutaneous reconstruction of the LCL include grade III injuries and multiligament knee injuries involving the LCL.

Surgical Technique

The patient is placed supine while under spinal anesthesia, and a tourniquet is applied on the operative lower extremity (Video 1). The lower half of the operating table is removed. The operative knee is flexed 90°, dangling from the edge of the operating table. The contralateral leg is placed in a stirrup with the hip abducted and the knee flexed. Appropriate padding is placed to ensure protection of bony prominences and neurovascular structures. Orthopaedic sepsis and antiseptic technique is performed. Sterile draping is applied.

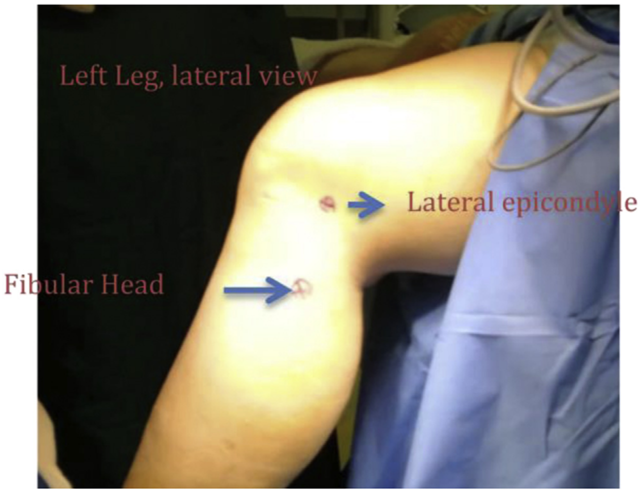

Fig 1. The patient is in the supine position, with the left leg dangling from the edge of the table; the right leg is placed in a stirrup with the hip abducted and extended to give ample space for surgery. Bony landmarks are marked with a surgical pen on the left leg: fibular head and lateral epicondyle of femur.

The extremity is then exsanguinated, and the tourniquet is inflated to 300 mm Hg.

Bony landmarks for the procedure are marked using a surgical pen, comprising the fibular head and the lateral epicondyle of the femur (Fig 1). The hamstring tendons are used for the graft. Harvesting is performed in standard fashion, and the graft is prepared on a separate sterile table. The graft is prepared with an appropriately

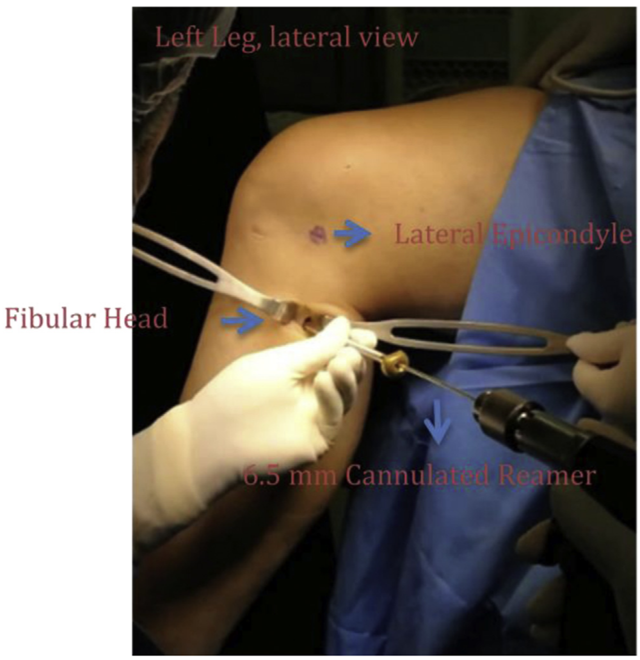

Fig 2. In a left leg, a 6.5-mm cannulated reamer is drilled through the fibular head; the drilling direction is parallel to the joint line. The reamer exits slightly anteromedial to the tibia, ensuring that it does not exit posteriorly.

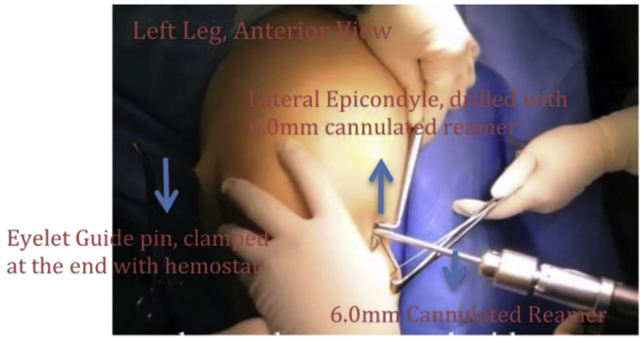

Fig 3. Anterior view of left leg and knee. A 6.0-mm cannulated reamer is used to drill the lateral epicondyle tunnel. The direction of drilling is superior and posterior to avoid penetrating the intercondylar notch and possibly going intra-articular.

sized EndoButton loop (Smith & Nephew, Andover, MA) attached to 1 end of the graft. For fixation of the other end, a bioabsorbable interference screw is used.

Tibiofibular Tunnel

For the fibular head tunnel or tibiofibular tunnel, a 2-cm vertical skin incision is made over the fibular head; the fibular LCL attachment is identified and subperiosteally dissected to prepare the tunnel. An eyelet guide pin is then drilled through the fibular head and passed directly to the tibia. The direction of drilling is slightly anteromedial to avoid going posteriorly; the drilling direction is also parallel to the joint line. Next, a 6.5-mm cannulated reamer is drilled through the tunnel (Fig 2). A suture loop is then placed to help facilitate graft passage later.

Femoral Tunnel

For the femoral tunnel, a 2-cm vertical skin incision is made over the lateral epicondyle. The LCL attachment is identified and dissected subperiosteally. An eyelet guide pin is drilled in a superomedial direction toward

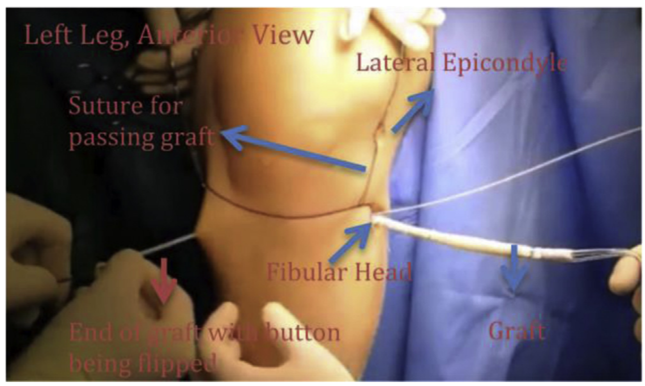

Fig 4. Anterior view of left leg and knee. The end of the graft to which the EndoButton is attached is passed through the fibular head tunnel. The EndoButton is then flipped and secured.

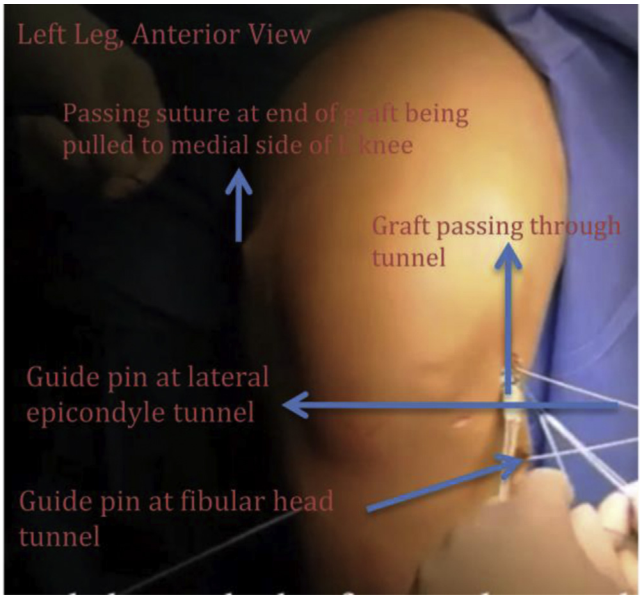

Fig 5. Anterior view of left leg and knee. The graft is passed through the subcutaneous tissue superiorly to facilitate passage to the femoral tunnel. The graft is then passed through the femoral tunnel using the suture loop initially placed.

the medial side of the femur; this is done to avoid penetrating the intercondylar notch. A 6.0-mm cannulated reamer is then used to drill the tunnel (Fig 3). A suture loop is placed for subsequent graft passage.

Graft Passage and Fixation

A suture loop is passed beneath the iliotibial band from the lateral side of the leg to the lateral side of the femur; this will facilitate subsequent graft passage. The end of the graft with the EndoButton loop is passed through the tibiofibular tunnel using the suture loop placed earlier. The EndoButton is then flipped and secured (Fig 4). The other end of the graft is passed underneath the iliotibial band using the suture loop and pulled to the lateral side of the femur. The graft is then passed through the femoral tunnel using the suture loop placed earlier (Fig 5) and is fixed using a Biosure PK interference screw (Smith & Nephew) with the knee in 30° of flexion and a valgus position (Fig 6). Varus stress testing is performed to check for stability.

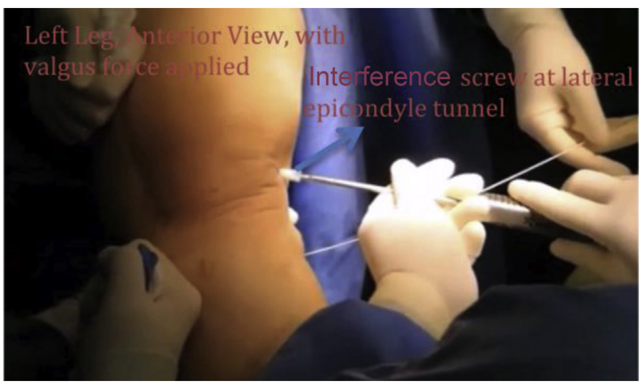

Fig 6. Anterior view of left leg and knee. The graft is fixed using a Biosure PK interference screw, with the other end of the graft being pulled at the medial side, with the knee in 30° of flexion and a valgus force applied.

Table 1. Advantages and Disadvantages

Advantages	
	Anatomic reconstruction of LCL is achieved.
	The minimally invasive approach reduces complications such as knee stiffness, skin necrosis, nerve injury, and fibular head fracture.
	The chance of iatrogenic nerve injury is decreased because of the direction of the tunnel holes.
	Lesser exposure of the soft tissues compared with other open techniques decreases the need for analgesics and antibiotics, which results in a shorter hospital stay and faster recovery time.
	The chance of fracture of the fibula is reduced by using an EndoButton.
Disadvantages	
	Tunnel jam may occur if the technique is performed with reconstruction of other ligaments such as the ACL and PCL.
	If used in multiligament reconstructions, the interference screw and EndoButton sutures may interfere with the other implants used.

ACL, anterior cruciate ligament; LCL, lateral collateral ligament; PCL, posterior cruciate ligament.

Postoperative Management and Rehabilitation

LCL reconstruction together with reconstruction of other ligaments such as the ACL and PCL will require the use of a knee brace postoperatively. Full range of motion is allowed, whereas weight bearing is delayed until 6 weeks postoperatively. After 6 weeks, partial weight bearing is allowed while using the knee brace. Strengthening of the hamstrings and quadriceps muscle is started, which will continue for 6 weeks. At 12 weeks postoperatively, the knee brace may be removed and full weight bearing is started. A full return to unrestricted activities may be allowed at 6 months postoperatively after physical evaluation of knee stability.

Discussion

Numerous techniques have been proposed for reconstruction of the PLC structures of the knee, although many recent studies have shown that anatomic reconstructions offer better results than nonanatomic reconstructions. There is still no general consensus as to which technique is the best. Some

Table 2. Pearls and Pitfalls

The appropriate graft size must be chosen to avoid creating a large tunnel through the fibular head and thus increasing the chance of fracture.
The tunnel direction for the fibular head tunnel must be parallel to the joint line to avoid going through the joint.
Drilling of the femoral tunnel should be directed in a superior and posterior direction to avoid the femoral notch.
Fixation of the femoral tunnel should be performed with a valgus force applied to the knee.

techniques for LCL reconstruction require large soft-tissue dissections and exposure of vital neurovascular structures.

Our surgical technique was developed to restore the function of the LCL while reducing complications associated with other open techniques, such as knee stiffness, skin necrosis, nerve injury, and fibular head fracture (Tables 1 and 2). Advantages of this technique include more precise positioning of the LCL attachment than with other open procedures, smaller incisions, fewer soft-tissue injuries, less postoperative pain, shorter hospital stay, and faster recovery time. Moreover, the risk of potential iatrogenic neurovascular injury is decreased because extensive exploration of the posterolateral aspect of the knee is not required. Some disadvantages of our technique include the occurrence of "tunnel jam." If this technique is performed with ACL or PCL reconstruction, the tibial fixation of the ACL or PCL reconstruction may be hit or damaged during drilling of the tibiofibular tunnel. In addition, during drilling of the femoral tunnel, there is a possibility of hitting or damaging the graft or fixation of the femoral tunnel of the ACL or PCL reconstruction (Table 1).

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