Prevention of Medial Femoral Condyle Injury by Using a Slotted Cannula in Anterior Cruciate Ligament Reconstruction

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Abstract: Anterior cruciate ligament injury is one of the most common ligament injuries of the knee in sports medicine. The treatment of choice is anterior cruciate ligament reconstruction, which requires an experienced surgeon. Complications may occur at every step of the procedure. The surgeon should be especially careful when performing the step of femoral tunnel creation. Damage to the medial femoral condyle (MFC) could occur; thus, the full functional outcome of the knee might be affected. There are many surgical techniques to avoid MFC injury. We propose a surgical technique that could reduce the risk of MFC injury. This technique uses a Fast-Fix slotted cannula (Smith & Nephew) as a protector. Because such equipment is available in all meniscus instrument sets, this surgical technique is a feasible and easy method to use during the femoral tunnel creation step.

A nterior cruciate ligament (ACL) injury is one of the most common ligament injuries of the knee in sports medicine.1-4 The treatment of choice is ACL reconstruction, which improves the stability and function of the knee and reduces the risk of chondral and meniscal damage.5 The procedure requires surgical experience.6,7 The surgical techniques involve single- and double-bundle ACL reconstructions. Anatomic ACL reconstruction is the ideal procedure to achieve. However, the procedure is technically demanding8 and may require independent femoral and tibial bone tunnel drilling to achieve anatomic positioning than a transtibial technique.8 Medial femoral condyle (MFC) injury is one of the most serious complications of the transportal technique, especially in the low flexion position.8-11 This complication may significantly cause postoperative symptoms (e.g., pain, swelling, and effusion) while affecting functional outcome, degree of satisfaction, and activity level. Our surgical technique is described in surgical steps to avoid MFC injury during ACL reconstruction.

Surgical Technique

Application of Anesthesia

The patient is placed in the supine position on the operating table. The position of the knee is confirmed by the surgical and anesthesia team. A femoral nerve block combined with a spinal nerve block is administered to the patient. Intravenous antibiotic injection is started 1 hour before surgery.

Patient Positioning

The patient is lying in the supine position. Hair removal is performed from mid thigh to mid leg with clippers. A tourniquet is placed at the most proximal part of the thigh on the operative side. A surgical tourniquet is placed at the end of the table, and the affected leg is placed in an arthroscopic holder. The position of the thigh should be adjusted until parallel to the floor. The most important step is to allow the knee to be in full flexion
or more than 120°. The unaffected leg is placed in the leg holder in a position of abduction and flexion (Fig 1).

Fig 1. Supine hanging-leg position with leg holder.

Portal Creation

The affected leg is prepared and draped from the tourniquet level to the toes. A stockinet is used to cover the entire affected thigh and leg. Two portals are created to approach the knee joint. A 1-cm anterolateral portal is created at the level of the inferior pole of the patella, as close as possible to the lateral border of the patellar tendon (Fig 2). This portal is used as a viewing portal. A 1-cm anteromedial (AM) portal is created at the level of the inferior pole of the patella and 2 cm medial to the medial border of the patellar tendon. It is a working and instrumentation portal (Fig 2).

Fig 2. Anterolateral portal (AL), anteromedial portal (AM), and far anteromedial portal (far AM).

Fig 3. The patient is supine in the hanging-leg position, with the left knee in 90° of flexion. The anterolateral (AL) is the viewing portal, whereas the anteromedial (AM) portal is the working portal. Portal creation in AM portal and far AM portal.

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Fig 4. The patient is supine in the hanging-leg position, with the left knee in 130° of flexion. The anterolateral (AL) is the viewing portal, whereas the anteromedial portal is the working portal. The medial femoral condyle is injured by the drill bit.
During the AM portal creation step, the surgeon should avoid creating a portal too far from the medial border of the patellar tendon. If the portal is created medially, the direction of the guide pin will have a more perpendicular orientation to the lateral wall of the notch, resulting in a shorter ACL femoral tunnel, having a more circular tunnel aperture and being close to the MFC articular cartilage (Fig 3). Thus there is a risk of MFC articular cartilage injury (Fig 4). The intra-articular structures are examined after the standard portals are created. If the diagnosis of an ACL injury is clear, the surgeon can start with a graft harvest.

### Graft Harvest

A 3-cm oblique incision is made 3 fingerbreadth distal to the joint line and 1 fingerbreadth medial to the tibial crest or over the palpated pes anserinus. The incision is made through the subcutaneous tissue. The sartorius fascia is incised proximally to the palpated semitendinosus and gracilis tendons. Each tendon is identified and dissected to the distal region. Right-angle clamp forceps are used to grasp the tendons that are looped around with a 0.5-inch gauze drain. Each tendon is detached from the distal region, and the distal end is sutured with a whipstitch. The attachment of each tendon is incised to free tissue. Each tendon is harvested. The sartorius fascia is closed with No. 3-0 Vicryl (Ethicon).

### Tunnel Creation and MFC Protection

The femoral tunnel is made through the AM portal. A microfracture awl is used to create the landmark at the anatomic position of the femoral ACL attachment at the medial aspect of the femoral condyle by use of the bony ridge landmark. After deep knee flexion to 110° to 130°, the guide pin is inserted through the AM portal to the landmark and drilled to make the tunnel. During this step, the surgeon must always turn the post of the camera 180° to look at the MFC. Thereafter, the EndoButton drill bit (Smith & Nephew) and reamer are inserted to perform femoral tunnel creation in steps. The surgeon’s hand should be used to insert the EndoButton drill bit and reamer through the AM portal until reaching the anatomic position of the femoral ACL attachment and then

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**Fig 5.** Fast-Fix slotted cannula.

**Fig 6.** The patient is supine in the hanging-leg position, with the left knee in 130° of flexion. The anterolateral (AL) is the viewing portal, whereas the anteromedial portal is the working portal. (A) The femoral tunnel has been created with the EndoButton drill bit. (ACL, anterior cruciate ligament.) (B) The guide pin is inserted at the anatomic position of the femoral anterior cruciate ligament attachment. (C) The guide pin is advanced through the femoral skin until the position of 5 to 10 mm projecting from the femoral attachment is reached.
follow the guide pin instead of using the ComPact Air Drive II (Synthes) because it will create an injury. To avoid injury to the MFC articular cartilage by the head of the drill bit, we use the described surgical technique. The key instrument is the Fast-Fix slotted cannula (Smith & Nephew) (Fig 5); such equipment is available in all meniscus repair instrument sets. The surgical technique for prevention of accidental MFC injury during ACL reconstruction is shown in Figure 1. The guide pin is initially inserted at the anatomic position of the femoral ACL attachment (Fig 6 A and B) and then advanced through the femoral skin until the position of 5 to 10 mm projecting from the femoral attachment is reached (Fig 6C). The Fast-Fix slotted cannula is inserted through the AM portal to protect the MFC articular cartilage by turning the slot to face the medial femoral condyle articular cartilage; it is inserted until reaching the medial wall of the lateral femoral condyle and over the guide pin (Fig 7A). The surgeon should always look back at the MFC during femoral drill bit insertion (Fig 7B). The tip of the drill bit is inserted to interdigitate the guide pin (Fig 7C). Thereafter, the surgeon can perform femoral tunnel placement using the steps. The key points; indications, contraindications, pearls, and pitfalls; and advantages and disadvantages of using this surgical technique during ACL reconstruction are shown in Tables 1 to 3, respectively.

Discussion

MFC cartilage injury is one of the most serious intraoperative complications. The risk increases while performing femoral tunnel creation in the low flexion position of the knee or through the accessory AM portal. This complication may influence the postoperative symptoms, degree of satisfaction with the operation, activity level, and development of osteoarthritis. There are many surgical techniques to prevent intraoperative MFC injury during ACL reconstruction.

First, the surgeon must not create the AM portal or accessory AM portal more medially (in the case of 3-portal placement). In a standard AM or accessory AM portal, the direction of the guide pin is more oblique with respect to the lateral wall of the notch and produces a longer ACL femoral tunnel length, as well as a more elliptical tunnel aperture. If the portal is created more medially, the direction of the guide pin has a more perpendicular orientation to the lateral wall of the notch; produces a shorter ACL femoral tunnel, with a more circular tunnel aperture; and is close to the MFC articular cartilage (Fig 2).

Second, the position of the knee must be hyperflexed from 110° to 130° to allow the trajectory of the guide pin directly in the center of the femoral footprint. After the knee is hyperflexed, the distance between the guide pin and reamer is increased.

Third, the surgeon must always look at the MFC while inserting the reamer. The knee is hyperflexed

Table 1. Key Points of Surgical Technique During Anatomic ACL Reconstruction

| Anatomic ACL reconstruction is ideal. | A transportal technique is more accurate in anatomic positioning than a transtibial technique. |
| MFC injury is one of the most serious complications of the transportal technique. | The key instrument is the Fast-Fix slotted cannula. |
| The anatomic femoral tunnel can be created safely and precisely. | ACL, anterior cruciate ligament; MFC, medial femoral condyle. |
Table 2. Indications, Contraindications, Pearls, and Pitfalls of Surgical Technique During Anatomic ACL Reconstruction

| Indication | Contraindication | Pearls | Pitfalls |
|------------|------------------|--------|----------|
| Creation of the femoral tunnel in anatomic ACL reconstruction | Inability to achieve deep flexion of the knee | The instrument should be inserted over the guide pin before the step of drill bit insertion. The surgeon should always turn the post of the camera 180° to look at the MFC during drill bit insertion. | Not maintaining the instrument over the guide pin Not turning the post of the camera 180° to look at the MFC during drill bit insertion |
| Inability to achieve deep flexion of the knee | | An assistant who is not skillful |

ACL, anterior cruciate ligament; MFC, medial femoral condyle.

Table 3. Advantages and Disadvantages of Surgical Technique During Anatomic ACL Reconstruction

| Advantages | Disadvantages |
|------------|--------------|
| Shielding of articular cartilage of MFC from injury by drill bit head | Increased steps for femoral tunnel creation |
| Shielding of medial meniscus from injury by drill bit head | Need for special equipment |
| Shielding of PCL from injury by drill bit head | |
| Shielding of skin at the AM portal from injury by drill bit head | |

ACL, anterior cruciate ligament; AM, anteromedial; MFC, medial femoral condyle; PCL, posterior cruciate ligament.

before the guide pin is inserted into the femoral ACL attachment. While the reamer is inserted, the surgeon must always rotate the camera 180° to look at the MFC. If there is a risk of injury to the MFC articular cartilage, the surgeon must use other surgical techniques to prevent this risk.

Fourth, according to the surgical technique described by Branam and Hasselfeld in 2013, the guide pin is inserted at the anatomic position of the femoral ACL attachment and advanced through the femoral skin until the position of 5 to 10 mm projecting from the femoral attachment is reached. The tip of the drill bit is inserted to interdigitate the guide pin. The guide pin is pushed back into the drill hole until sufficiently deep in this hole. Femoral tunnel placement is performed in steps.

Fifth, a drill bit design for avoiding injuries to the MFC articular cartilage is used. Nowadays, a sentinel drill bit is available to protect the cartilage and soft tissue before drilling. The surgeon should rotate the sentinel drill bit opposite the MFC while inserting the sentinel drill bit through the AM portal.

Sixth, the surgeon’s hand inserts the drill bit carefully through the AM portal until reaching the anatomic position of the femoral ACL attachment and then follows the guide pin through the drill bit and creates a femoral tunnel. Seventh, after measurement of the femoral tunnel by a depth gauge, the guide pin is inserted into the femoral tunnel. Then, the drill bit is manually introduced through the AM portal until reaching the anatomic position of the femoral ACL attachment.

The described surgical techniques and steps should be used to avoid intraoperative MFC injury during ACL reconstruction. The surgeon can use more than 1 technique to reduce the risk of MFC injury. MFC cartilage injury is a serious intraoperative complication. The described techniques reduce the risk of intraoperative articular cartilage damage to the MFC.

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