Arthroscopic Suture Fixation in Femoral-Sided Avulsion Fracture of Anterior Cruciate Ligament

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Abstract: A femoral-sided avulsion fracture of the anterior cruciate ligament (ACL) is a rare and challenging condition. Most reported cases have occurred in childhood or adolescence. Many techniques of ACL repair have been reported, and in recent years, techniques in arthroscopic surgery have been developed and have become ever more popular with orthopaedic surgeons. We created a technique of arthroscopic ACL repair with suture anchor fixation for a femoral-sided ACL avulsion fracture. This technique saves the natural ACL stump. It is available for cases in which creation of a tibial tunnel is not allowed. Moreover, it does not require a skin incision for fixation on the far femoral cortex and, therefore, does not require a second operation to remove the fixation device. The arthroscopic technique also has a good cosmetic outcome.

A femoral-sided avulsion fracture of the anterior cruciate ligament (ACL) is a rare and challenging condition. Most reported cases have occurred in childhood or adolescence. Many techniques of ACL repair have been reported. However, arthroscopic ACL reconstruction, after sacrificing the ACL stump, seems to be a more popular treatment technique. In some situations in which creation of a tibial tunnel is not allowed because of obstacles such as fixation devices, ACL reconstruction is not a proper treatment choice. Arthroscopic ACL repair is an alternate option for this situation. Moreover, arthroscopic ACL repair saves the natural ACL stump and no graft is needed. We describe arthroscopic ACL repair for a femoral-sided ACL avulsion fracture with a suture anchor technique.

Surgical Technique

A lateral tibial plateau fracture occurred in a 25-year-old man during a motorcycle accident. He was treated with open fixation with a plate and screws (Fig 1). Only 6 weeks later, he slipped and fell again. His knee was painful. He could not obtain full knee extension. We decided to examine his knee under arthroscopy.

The patient was positioned supine on the operative table. The lateral post controlled hip rotation, and the foot rested against a distal support that maintained the knee at 90° of flexion. A tourniquet is usually used if not clinically contraindicated. General arthroscopic examination was routinely carried out through the standard anterolateral portal and anteromedial portal.

The arthroscopic findings showed a femoral-sided avulsion fracture of the ACL (Video 1). ACL reconstruction could not be performed because of tibial-sided obstacles. We decided to repair the ACL with a suture anchor technique.

The anterolateral portal was used as a viewing portal. We tapped a pilot hole into a femoral crater. A double-loaded BioComposite suture anchor (Arthrex, Naples, FL) was inserted into the pilot hole (Fig 2). We created a high accessory anteromedial portal. The suture threads were kept through the high accessory anteromedial portal. We used a grasper holding the ACL stump tight through the high accessory anteromedial portal. A suture hook (Arthrex) was passed through the standard anteromedial portal. The ACL was hooked (Arthrex) was passed through the standard anteromedial portal. The ACL was hooked through the central part of the stump (Fig 3). The PDS thread (Johnson & Johnson, New Brunswick, NJ), which was already loaded into the suture hook, was advanced. The medial end of the PDS thread and 1 strand of anchor sutures were retrieved through the high accessory anteromedial portal. This strand was passed through the ACL stump with a shuttle-relay technique. Again, the...
A suture hook was passed through the ACL with the same technique to make a locking suture surrounding the stump (Figs 4 and 5). The other strand of anchor sutures underwent the same procedure. Knots were tied and secured, pulling the ACL stump into the femoral crater (Fig 6). A compression dressing was applied.

Active quadriceps exercises are allowed on the first postoperative day. The knee is fully extended in a hinged knee brace. Non-weight-bearing ambulation is restricted; after 6 weeks, partial to full weight-bearing ambulation and full knee motion are allowed. Jogging and running are started after 4 months. Six months postoperatively, our patient’s examination showed negative Lachman, anterior drawer, and pivot-shift test findings (Table 1).
Discussion

An avulsion fracture of the ACL is a rare knee injury, which is mostly reported in childhood or adolescence. An avulsion fracture of the tibial origin of the ACL is relatively more common. Only a few cases of femoral-sided avulsion fractures of the ACL were reported previously in the literature. Good results of both conservative and operative treatments were published. Corso and Whipple\(^1\) presented a case of avulsion of the femoral attachment of the ACL in a 3-year-old child. They arthroscopically showed that the avulsion fragment was reduced in the fully extended knee position. The knee was immobilized in extension in a long cast after reduction. Fibrous adhesions and some healing of the ACL were shown arthroscopically 7 weeks after the first operation.

Use of a pullout suture or wiring is the most reported fixation method for femoral-sided avulsion fractures of the ACL. Kawate et al.\(^2\) reported the case of a 3-year-old boy who presented with a femoral-sided osteochondral avulsion fracture of the ACL. This fracture was operatively treated with the medial parapatellar approach and fixation with pullout metal wiring and a button. The wire and button were removed 5 months after the first operation. No pain, instability, restriction of motion, or limitation of activity was reported in their 13-year follow-up. A few case reports of fixation with an open pullout suture technique have been published.\(^3\)\(^-\)\(^6\) The suture was not removed in all reports. Good to excellent results for pain, knee stability, range of motion, and level of activity were shown.

In recent years, arthroscopic surgery has become more advanced and more popular in many orthopaedic operations. Arthroscopic fixation of a femoral-sided avulsion fracture of the ACL was reported recently, in the past few years: Pai et al.\(^7\) reduced and fixed the fragment with a hooked Kirschner wire through an inside-out technique. The temporary Kirschner wire was removed 3 months after the first operation. They were concerned about developmental deformity if the permanent fixation device was passed across the physeal plates. The results showed excellent stability (negative Lachman test, pivot-shift test, and reverse pivot-shift test findings), full range of motion, and no limitation in sport activities. However,
all reported techniques of fixation require another skin incision to hang the suture or wire on the far femoral cortex. Moreover, a second operation is required to remove the metal button or wire.

Our technique can be considered an option for arthroscopic fixation of a femoral-sided avulsion fracture of the ACL in skeletally mature patients. This technique saves the natural ACL stump and is available for cases in which creation of a tibial tunnel is not allowed. The bone-to-bone healing achieved yields a stronger construct than tendon-to-bone healing. Moreover, the technique does not require a skin incision for fixation on the far femoral cortex, does not require a second operation to remove the fixation device, and has a good cosmetic outcome. However, above-the-knee immobilization is needed for 6 weeks until the healed repair is strong enough for motion exercise and full weight-bearing walking.

References


