ACL Reconstruction Using Hamstring Tendon Graft and Rigidfix

Seng Chamroeun, Eung Ha Kim, Soo Jae Yim, Kyoung Dae Min, Byung Sung Kim, Jae Ho Yoo, Yu Seok Seo

Department of Orthopedic Surgery, Kossamak Hospital, Phnom Penh, Cambodia, Department of Orthopedic Surgery, College of Medicine, Soonchunhyang University Bucheon, Korea

Abstract

The authors describe a technique for reconstructing the anterior cruciate ligament (ACL) using a hamstrings tendon graft for the management of anterior instability of the knee joint. The autogenous hamstring was used for the graft, which was fixed on the femoral side using Rigidfix and on the tibial side using an absorbable interference screw and a ligament staple. Twenty-five knees of 25 patients showed a good outcome after a short term follow-up evaluation. Femoral fixation with Rigidfix and tibial fixation and an absorbable interference screw ligament staple combined with an aggressive rehabilitation regimen can help stabilize the knee after an ACL reconstruction with a hamstring tendon.

Key words : Anterior cruciate ligament, Knee, Hamstring, Rigidfix

Introduction

There have been continuous improvements in techniques for reconstructing the anterior cruciate ligament (ACL). However, there is no ideal graft and fixation method. Several intra-articular substitutes for the ACL have been described, including autologous, heterologous, and synthetic grafts. A range of fixation methods have been developed and several experimental and clinical studies have demonstrated their validity. Unfortunately, some practical disadvantages have been reported using triple semitendinosus, and semitendinosus and gracilis tendons grafts. These include an incomplete graft of the femoral lateral cortex, interposition of soft tissue between the device and femoral cortex and ruptured connecting sutures. Their advantages and disadvantages have been described and fixation methods chosen have been evaluated. Another important and widely discussed point is the graft fixation method. This study examined the short term outcome after an ACL reconstruction using a hamstring tendon graft and femoral fixation by Rigidfix and tibial fixation with an absorbable interference screw and ligament staple.

Materials and Methods

Subjects

From January 2008 to June 2008, 25 knee joints from 25 patients underwent an ACL reconstruction with tendons of the medial flexor muscles of the knee joint (Semitendinosus,
Gracilis) fixed on the femur using a Rigidfix system and on the tibia using an absorbable interference screw and ligament staple. Twenty-five male patients aged 18 to 50 years (mean age: 34 years) were enrolled in this study. There were 15 right and 10 left knees. The exclusion criteria included acute tears (less than 1 months old), significant multiple ligament injuries, contralateral knee instability, and degenerative joint diseases. The patients were evaluated at the 7-months follow-up (range: 2 to 12 months) using the International Knee Documentation Committee (IKDC) form. Knee laxity was recorded pre- and postoperatively using a KT-2000 arthrometer. 

Both knees were tested and the anterior displacement was measured at 15, 20, and 30 lbs. The maximum manual translation and side-to-side differences were also recorded. Statistical analysis was carried out using a paired t-test.

**Diagnostic arthroscopy and graft preparation**

Diagnostic arthroscopy was performed to evaluate all the intra-articular structures and assess the torn ligament and associated pathology. To harvest the graft, an approximately 2 cm short vertical incision was made from 1.5 cm medial to the tibial tubercle and extending distally. The dissection was performed down through the subcutaneous tissue until the sartorius fascia was encountered. Palpation of the sartorial fascia was performed from the posterior to anterior to identify the underlying semitendinosus and gracilis tendons. The sartorial fascia was incised over the interval between the gracilis and semitendinosus tendons. Both tendons were identified individually and isolated. A blunt and sharp dissection was made to free the semitendinosus tendon from all associated attachments. A running baseball whipstitch of a No. 2 Ethibond suture was then made up and down the tendon for length of 1.5 cm. The tendon was then detached from its insertion. While holding tension on the sutures, a blunt dissection was performed around the tendon along its course proximally into the posteromedial theta to insure adequate access to the fascial bands before stripping the tendon in order to prevent premature transection of the tendon. The tendon was then harvested with a tendon stripper with the knee flexed and traction applied using grasping sutures. The tendon was then freed from its myotendinous junction. The gracilis tendon was harvested in a similar manner. Each tendon-muscle graft measuring at least 25 to 30 cm could be obtained. An assistant prepared the harvested tendon at the side table. The muscle remnants at the musculotendinous junction were removed. Each tendon end was sutured with a running baseball whipstitch of a No. 2 Ethibond suture. The four stranded tendon was then sutured together with a 3-0 Vicryl suture at 2 cm from the loop end.

**Tunnel preparation**

Under arthroscopy from the anterolateral portal, the disrupted ACL stump was first debrided to identify the tibial footprint of the ACL. On the femoral side, the ACL remnant was debrided to identify the posterior cortical margin of the lateral femoral condyle. The tibial guide was then placed through the anterior-medial portal and pointed to the posterior half and medial-lateral center of the native ACL tibial insertion. The tibial tunnel was created using a cannulated reamer with the appropriate diameter after placing a guide wire at a 50 degree angle. The incision used to harvest the hamstring tendon was just enough to provide an outer opening and further fixation. A guide pin was then placed through the tibial tunnel under the direction of the femoral guide instrument with a 7 mm offset. The preferred location of the femoral tunnel was
located at the center between the 10 and 11 o'clock position in the right knee (the 1 and 2 o'clock position in the left knee). A reamer was then used to produce a close-ended femoral tunnel, 35 mm in length. A Beath pin was passed through the tibial and femoral tunnels, and penetrated into the anterior cortex of the distal femur and out of the skin of the distal-lateral thigh. Under the arthroscopy, the length markers of the graft were checked to ensure a 35 mm long graft within the femoral tunnel. The tibial and femoral tunnels were established at the anatomical points of origin and the insertion of the ACL. Using the appropriate femoral guide, the Rigidfix guide-pins were inserted through two perforations from the outside to the inside of the tunnel (Fig. 1).

**Fig. 1.** Femoral fixation with Rigidfix system.

**Graft passage and fixation**

The graft was inserted from the tibia to femur where it was fixed with two Rigidfix pins. Pretension was carried out in situ. Tibial fixation was performed using an absorbable interference screw with a diameter equal to, or when needed, greater than that of the tunnel with the knee joint in extension (Fig. 2). Conventional joint stability tests were then carried out. A drainage tube was inserted and kept in place for 24 hours. The surgical wound was then closed, and brace-type immobilization was employed. A partial load was permitted 24 hours after hospital discharge. Isometric and flexion-extension exercises were carried out from the 4th postoperative day. The stitches were removed 10 days after surgery, and the patients were referred to specialized clinics for a rehabilitation program.

**Fig. 2.** Tibial fixation with bio-absorbable interference screw and additional ligament staple.

**Rehabilitation**

The initial aims of postoperative management are as follows: to decrease the pain, inflammation and swelling, rapidly restore full extension symmetric to the uninjured knee, reestablish quadriceps control and the range of motion, and restore normal gait. The surgical extremity was immobilized in a knee brace in full extension for the first week. Full weight-bearing was permitted as tolerated. The patient was instructed to participate in a progressive rehabilitation program that included both range-of-motion activities that emphasized the extension and quadriceps-strengthening exercises. Quadriceps isometric exercises, straight leg raising exercises, and the passive range of motion were initiated as early as possible. During the first month, the range of motion was restricted from 0 to 90°. The patients
were instructed in the performance of the closed kinetic chain exercise. At 6 weeks, the brace was unlocked with emphasis placed on establishing a normal gait. At 8 weeks, the range of motion was widened to complete flexion and extension. Hamstring strengthening exercises were begun. Quadriceps and hamstring muscle strength training were particularly emphasized according to a scheduled home rehabilitation program. The patient was scheduled to return to their normal activities of daily life at 3 months, with a return to light sports at 6 months. Pre-injury sports activities were permitted between 9 to 12 months.

Results

All patients were available for the evaluation. All examinations and results were evaluated by a single independent examiner who was not involved in the procedure. The average injury to surgery time ranged from 2 to 12 months (mean 7 months). Five patients (20%) underwent a partial medial meniscectomy, and three patients (12%) underwent a partial lateral meniscectomy. An "all-inside" suture of the posterior horn was performed in 3 patients (12%). The preoperative IKDC evaluation revealed 3 (12%), 3 (12%), 9 (36%) and 10 patients (40%) with grade A, B, C and D, respectively. At the final follow-up, 10 (40%) patients considered their reconstructed knee to be normal, and 14 patients (56%) rated their reconstructive knee as nearly normal. One patient rated their knee as abnormal. No patient reported their knee to be severely abnormal. One patient showed decreased flexion about 10 degrees but no deficit in extension was detected. The Lachman scores were +1 in 17 (68%) patients and +2 in 8 (32%) patients. Pivot shift distribution was +1 in 16 (64%) patients, +2 in 6 (24%), and +3 in 3 (12%) patients. Postoperatively, the endpoint Lachman test was noted in 15 (60%) patients. Increased excursion with the endpoint was observed in 9 patients (36%). A soft endpoint was noted in 1 patient. At the final follow-up, no patient had a grossly positive pivot shift, even though 1(4%) showed a +1 pivot shift. Preoperatively, utilizing the KT-2000, the anterior displacement in all patients was >5mm with a side-to-side difference of 6.18 mm (SD 3.69). At the final follow-up, the injured versus normal (I-N) side-to-side difference at the maximal manual loading was 1.64 (SD 2.05, p<0.001). The mean absolute displacement was 9.7 mm (SD 3.1) with a statistically significant difference (p<0.005). At the overall final IKDC evaluation, 9 (32%), 13 (52%), 3 (12%) and 0 patients were graded as A, B, C and D, respectively. Preoperatively, the Lysholm score was 46 (23-60, SD 4.0). All but one patient was rated as poor. The one patient was rated fair. The postoperative Lysholm score was 96 (81-100, SD 4.7). Seventeen patients (68%), 7(28%) and 1 patient(4%) were rated excellent, good and fair, respectively. The mean pre-injury Tegner score was 7 (5-9). After the injury and reconstruction, the mean Tegner score was 3.5 (0-7). Postoperatively, the mean Tegner score was 6.4 (2-9). There was one case with a superficial infection that was resolved with antibiotics.

Discussion

The optimal method for hamstring tendon graft and femoral fixation by Rigifix and tibial fixation with an absorbable interference screw and ligament staple is the most widely used and considered the gold standard. However, complications have been reported in the literature with this method, necessitating alternative methods of femoral fixation. The technique recommending the use of Rigifix for femoral fixation uses two pins across the graft and femoral tunnel while the Transfix system uses
only one pin and requires a longer training. This technique prevents the risk for fracture of the posterior cortical of the femur. However, in addition, one must take into account the decrease in the "windshield wiper effect" associated with the Endobutton system since the Rigidfix system fixes the femoral graft transversally and "in situ", thus preventing mobility between the graft end and the fixation system. We believe that the absorbable interference screw on tibia can lead to loosening of the set. Therefore, whenever possible, we use a screw of a greater diameter than that of the tibial tunnel. The success rate of surgery was similar to that reported in literature. Rehabilitation can be more aggressive due to less painful condition following surgery and less morbidity in the donor area. As with many other authors, we found no statistically significant difference between fixed with two pins of Rigidfix and clinical results. However, like most of the previous studies, this is only a short-term review of the clinical effects of fixed with two pins of Rigidfix. Further studies and longer follow-up should be done to establish the role of fixed with two pins of Rigidfix on the definitive fixation of the graft. Furthermore, fixed with two pins of Rigidfix have the cause with graft positioning and fixation in revision ACL surgery.

The present study showed that the use of Rigidfix for tendon fixation with no interface between elements in the femur led to excellent results, low rates of complications, good visualization of joint structures. We conclude that using femoral fixation with Rigidfix and tibial fixation with an absorbable interference screw and ligament staple combined with an aggressive rehabilitation program could contribute to stable knee after ACL reconstruction with hamstring tendon.

References
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