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Anterior cruciate ligament reconstruction using the Bio-TransFix femoral fixation device and anteromedial portal technique

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Abstract The cross-pin femoral fixation technique for soft tissue grafts is a popular option in anterior cruciate ligament (ACL) reconstruction. One of these devices is the Bio-TransFix (Arthrex Inc., Naples, FL, USA) which provides high fixation strength. According to the manufacturer, the femoral tunnel is created by placing the femoral aiming device through the tibial tunnel (transtibial technique). However, using this technique it is very difficult or even impossible to place the graft at the anatomical ACL attachment site at the "10 o'clock" position. In this report, we describe the use of the Bio-TransFix device with an anteromedial portal technique. Using this technique, the surgeon has more freedom to place the graft in an anatomical position, while combining the advantages of the excellent biomechanical properties of this device.

Keywords Anterior cruciate ligament · Reconstruction · Bio-TransFix · Anteromedial portal

Introduction

The use of hamstring grafts in anterior cruciate ligament (ACL) reconstruction has increased in popularity [5]. However, the strength of the fixation and not the strength of the graft is the weak point during the early postoperative period [3]. Cross-pin femoral fixation techniques which have been introduced recently provide high fixation strength and sufficient resistance against slippage in comparison to conventional interference screws, according to some biomechanical studies [1, 6, 9]. The Bio-TransFix femoral fixation device (Arthrex Inc., Naples, FL, USA) is a relatively new cross-pin bioabsorbable device composed of polylactic acid.

Placement of this transverse femoral pin is performed using the transtibial technique according to the manufacturer. Therefore, surgeons instructed to use this technique [8]. However, it has been demonstrated by Arnold et al. [2] that transtibial femoral-tunnel drilling does not reach the anatomical site of the ACL insertion at 10 o'clock. Usually with this technique, a position corresponding between the 11 and 12 o'clock positions could be reached. According to Loh et al. [7], placing the femoral tunnel at the 10 o'clock position could improve the rotatory knee stability compared with the 11 o'clock position.

In this report, the authors present an arthroscopic ACL reconstruction with hamstrings using the Bio-TransFix femoral device (Arthrex Inc.) and the anteromedial portal technique in an effort to improve graft placement and orientation.

Surgical technique

Graft harvesting is performed through a 2.5-cm longitudinal incision 3 cm medial and distal to the tibial tubercle, with the knee flexed to 90°. The sartorius fascia is incised along the course of the gracilis and semitendinosus. Both tendons are mobilized using blunt finger dissection. Once the tendons are free from their adhesions, they are harvested using a tendon stripper.

The graft is prepared on a back table by an assistant. Approximately 20-cm graft length is required. Each of the free ends of the grafts are sutured in a whipstitch fashion for a length of 30 mm and a methylene blue mark is made 25 mm from the proximal end of the graft. Graft diameter is determined using sizing tubes. A standard anterolateral portal is used for diagnostic arthroscopy and an anteromedial portal as a working portal. The ACL stump is debrided using arthroscopic scissors and a full radius shaver. A curette is used to perform a notchplasty and to debride the notch.

The tibial tunnel is created first. With the knee at 90° of flexion, the endoscopic aimer is inserted to the knee through the anteromedial portal and is adjusted to 45°. The ACL stump, the PCL, and the inner rim of the anterior horn of the lateral meniscus are used as landmarks to identify the optimal position. A guide pin is then drilled into the joint and a cannulated reamer equal to the graft diameter is used to create the tibial tunnel. An impactor is placed in the tibial tunnel to avoid fluid loss. Next, the femoral tunnel is prepared. The knee is placed in maximum flexion between 125° and 130°. The femoral guide with an appropriate offset (e.g., with an 8-mm graft a femoral guide with a 5-mm offset is used) is introduced into the joint through the anteromedial portal. With the aim of the femoral guide, a K-wire is then placed into the center of the anatomic insertion of the ACL at the 10 o'clock position for a right knee (Fig. 1). With the knee in full flexion, the K-wire is overdrilled with a reamer corresponding to the size of the graft diameter and to a depth of 35 mm (Fig. 2). Then the marking hook, with the same diameter as the femoral tunnel, is assembled with the TransFix femoral

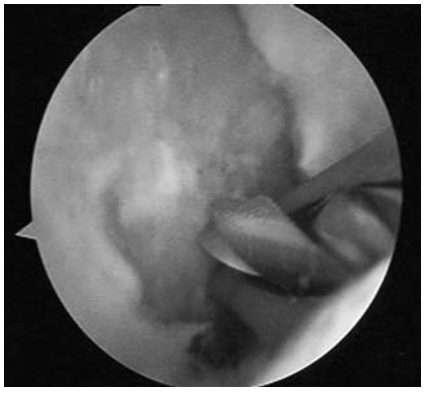

Fig. 1 Arthroscopic view of the femoral guide and K-wire placed in the 10 o'clock position (right knee) through the anteromedial portal

Fig. 2 Drilling of the femoral tunnel with the knee in maximum flexion through the anteromedial portal

Fig. 3 The TransFix femoral guide assembled with the hook is placed in the femoral tunnel. The 3-mm pin is drilled through the pin sleeve

Fig. 4 Postoperative sagittal MRI showing the femoral entry point of the Bio-TransFix femoral fixation device

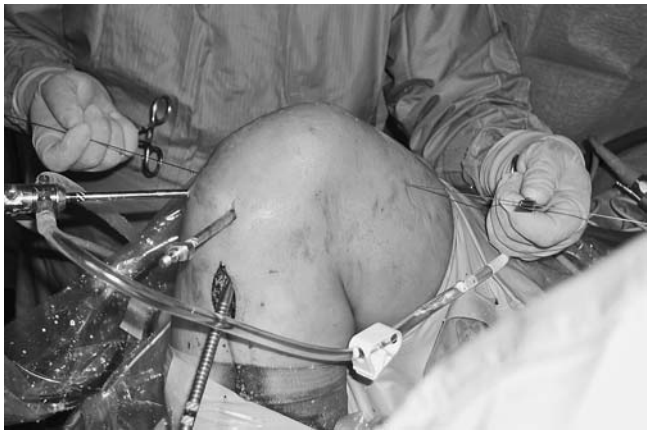

Fig. 5 The guidewire in place passed through the hook and exiting the femur medially

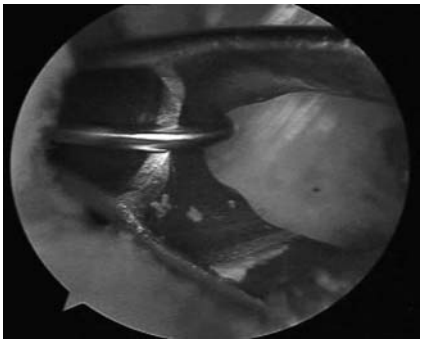

Fig. 6 Arthroscopic view of the hook exiting the femoral tunnel with the wire loop in it

Fig. 7 The wire loop is pulled with a grasper through the tibial tunnel

guide and the pin sleeve, and it is inserted into the femoral tunnel through the anteromedial portal (Fig. 3). Then, a 3-mm pin is drilled through the pin sleeve exiting the femur medially (Fig. 4). At this point, the TransFix

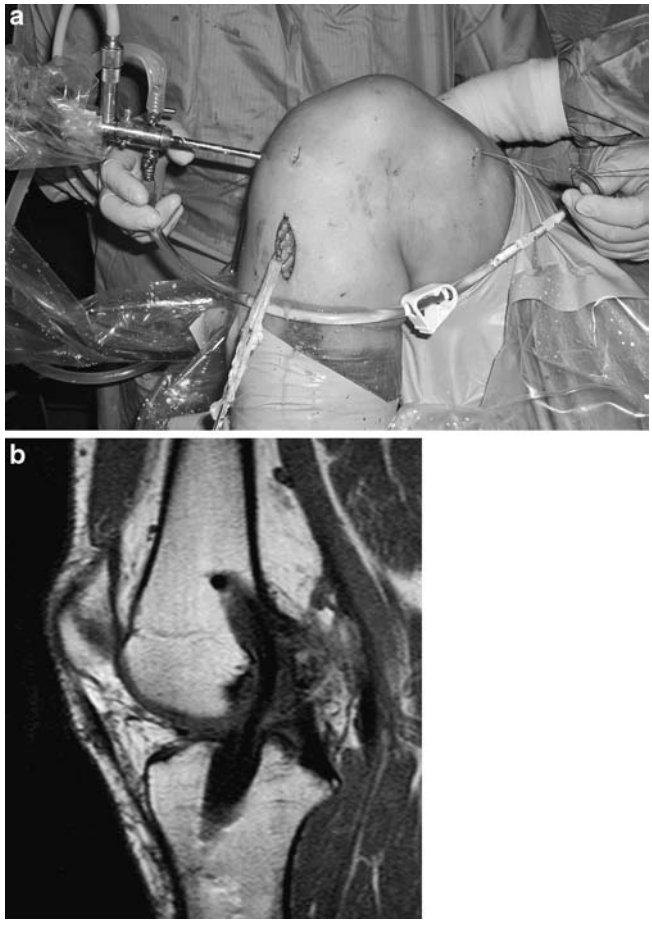

Fig. 8 **a** The graft is loaded into the wire loop. **b** Postoperative sagittal MRI showing the graft position

femoral guide and the pin sleeve are removed leaving the marking hook in place. Firm traction is placed on the hook to ensure that it is not ''dislocated'' from the femoral tunnel and the pin has passed through the opening of the hook. A cortical reamer with a depth stop that is placed over the pin is used to broach the cortex of the lateral femoral condyle and facilitating subsequent implant insertion. Next, the guide wire is placed into the guide pin slot. The guide pin is pulled from the medial site of the femur leaving the wire in place (Fig. 5). Under arthroscopic control, the hook is extracted slowly until the level of the tibial tunnel pulling the wire in it (Fig. 6). With a gentle oscillating motion, the wire is released from the hook leaving the wire into the joint. A grasper is then placed through the tibial tunnel to pull the wire out of the tibial tunnel (Fig. 7). The graft is loaded over the wire with the graft end lengths equalized (Fig. 8). Using large clamps on each end of the wire and pulling simultaneously both ends the graft is advanced into the tunnels. The wire should be pulled back and forth without difficulty to ensure that the graft is in the right

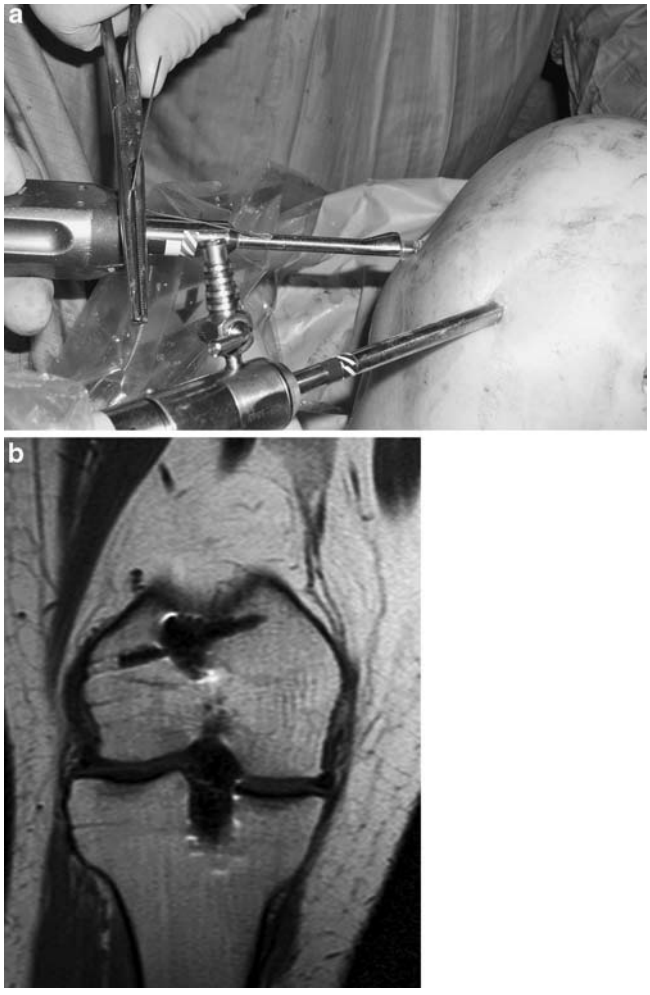

Fig. 9 **a** Insertion of the implant with the knee in maximum flexion. **b** Postoperative coronal MRI showing the position of the Bio-TransFix femoral fixation device. Note that tibial and femoral tunnels lie on different axes

depth in the femoral tunnel. Arthroscopic control should reveal that the methylene blue mark is exactly at the entrance of the femoral tunnel. Finally, the Bio-TransFix is inserted over the wire with the aid of a driver (Fig. 9). Tibial fixation is performed then according to the surgeon's preference.

Discussion

Many techniques have been used for the fixation of hamstring grafts in ACL reconstruction. It seems that the cross-pin femoral fixation techniques provide superior fixation strength compared to biodegradable interference screws and adequate fixation strength during the rehabilitation period [1, 6, 9]. Thus, this technique is the fixation of choice for many surgeons. The Bio-TransFix femoral device is an excellent choice because of its high biomechanical properties [1]. This technique places a pin across the femur traversing the femoral tunnel. The fixation strength and resistance to slippage of this device are higher than interference screws and other similar devices [1]. The two strands of the hamstring graft wrap 180° around the pin to create a quadrupled graft.

According to the technique described by the manufacturer and others [8], the Bio-TransFix pin has to be inserted through the tibial tunnel (transtibial technique). However, we are convinced from our experience and published data that it is very difficult or even impossible to reach the anatomical foot print of the ACL in the femur with the transtibial technique [2, 4].

Since we have performed all our ACL reconstructions with an anteromedial portal technique, we tried to do the same with the Bio-TransFix femoral device. Of course, we acknowledge that the anteromedial portal technique is more technically demanding than the transtibial technique. With deep flexion of the knee, the surgeon has little room for viewing with the arthroscope through the anterolateral portal, and working through the anteromedial portal. To overcome these problems, the surgeon has to remove all the soft tissues around the notch (synovium, fat pad) before deep knee flexion and then an assistant has to keep the knee stable in this position. Using the anteromedial portal technique and interference screws, one can create the femoral tunnel first in order to avoid fluid leakage. However, with the Bio-TransFix fixation, the tibial tunnel should be drilled first in order to pull the wire through it and load the graft into the wire. Finally, attention should be paid when the hook is extracted from the femoral tunnel (with the wire in it). The wire should be delivered at the level of the tibial tunnel. This ensures that the grasper will easily meet the wire into the joint. A hammer can be used to disimpact slowly the hook from the femoral tunnel, for this purpose.

We do not know if this method provides better clinical results in comparison to the transtibial technique. It would be interesting if future studies compare the two techniques to demonstrate if there are any clinical advantages using the anteromedial portal technique or not.

Therefore, for those surgeons who want to place the graft in a more horizontal and anatomical position and wish to use the Bio-TransFix femoral fixation device, we recommend the technique of anteromedial portal. Although it is more difficult than the transtibial technique, it is safe and effective and permits placement of the graft in the desired position. Using this technique, we have not noted any failures of fixation in over 30 procedures.

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