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PROSPECTIVE RANDOMIZED CLINICAL EVALUATION OF ANATOMICAL SINGLE BUNDLE ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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ABSTRACT This study tells us about the anatomy of the Anterior Cruciate Ligament, the biomechanical aspects of ACL reconstruction, review the outcomes of single bundle ACL reconstruction and present the current techniques for anatomic single bundle reconstruction. A critical evaluation of ACL reconstruction techniques has revealed that single-bundle grafts that were placed by conventional trans-tibial drilling do not provide adequate restraint to translational and rotatory forces. In some knees, this will affect function and possibly contribute to further chondral injuries.

KEYWORDS : ACL; anatomic; reconstruction; single bundle

INTRODUCTION

The ultimate goal of ACL reconstruction is the restoration of normal knee kinematics in patients with functionally unstable ACL deficient knees. It has been hypothesized that abnormal knee kinematics is one of the primary causes of the development of osteoarthritis (OA) after ACL reconstruction and from this it is hoped that anatomical ACL reconstruction will reduce the long-term incidence of OA.

Complete ACL rupture can lead to recurrent knee instability, meniscal tears, and articular cartilage degeneration. The ACL does not heal when torn and surgical reconstruction is the standard treatment[1,2]. Reconstruction of the ACL has become a commonly performed procedure, and good to excellent results have been reported. Conventional reconstruction techniques are mostly successful in limiting anterior tibial translation but may be insufficient in controlling combined rotatory loads of internal and valgus torque[3,4]. It has been well described in the literature that the ACL can be divided into 2 major functional bundles: the antero-medial (AM) bundle and the posterolateral (PL) bundle[5,6]. Bio-mechanical investigations have indicated that anatomic ACL double-bundle reconstruction restores knee stability closer to normal than conventional single-bundle ACL reconstruction[7,8,9,10.] On the other hand, some studies reported that there is no difference between single-bundle and double-bundle ACL reconstruction[1,11.] The aim of this study is to determine clinical result of Arthroscopic single-bundle reconstruction.

METHODS

From June 2016 to December 2018, we performed a prospective randomized clinical study to evaluate the results of these ACL reconstruction. Preoperatively, all patients had complete examination to exclude multiligamentous injuries and other pathologic changes. All patients underwent preoperative examination, including Lachman, anterior drawer, pivot-shift test. We examined the injured and the contralateral knees. All patients were evaluated objectively and subjectively. The objective International Knee Documentation Committee (IKDC) form was completed. All patients completed the questionnaires necessary to calculate the IKDC subjective score and Lysholm score. Standard radiographs and magnetic resonance imaging (MRI) had been obtained for all patients.

OPERATIVE

The knee was prepared and draped in the standard fashion, and arthroscopic portals were established. The anterolateral portal was placed a little above the inferior pole of the patella at the lateral border of the patellar tendon. The anteromedial portal was placed just below the inferior pole of the patella, approximately 1 cm medial to the medial edge of the patellar tendon. Finally, an accessory inferior medial portal was marked medial and distal to the inferomedial portal slightly above the meniscus and was established later in the procedure. The semitendinosus and gracilis tendons were harvested with a closed tendon stripper through a longitudinal anteromedial incision on the medial side of the proximal tibia, over the insertion of the pes anserinus. Graft preparation was initiated on the back table. Each graft was trimmed to the appropriate diameter. Before graft passage, an EndoButton CL (Smith and Nephew) was attached, with a loop length based on measurements of tunnel lengths. Before assessment of the ACL, any meniscal or chondral injuries were addressed. Next, the accessory medial portal was established using an 18-gauge spinal needle under direct visualization. This portal was essential to allow improved visualization of the lateral wall of the intercondylar notch and achieve correct placement of the PL femoral tunnel. Next, the rupture pattern of the AM and PL bundle was carefully evaluated using a thermal device. Special attention was given to the remaining fibres of each bundle, and the insertion sites of the AM and PL bundle were very carefully visualized through the lateral and medial portals. This was not always possible, especially in chronic cases. Then we visualized and identified the bony landmarks, especially the lateral intercondylar ridge and the lateral bifurcate ridge. Then we marked the location of the native femoral and tibial footprint, corresponding to their positions in the normal ACL.

Anatomic Single-Bundle Reconstruction

The procedure of anatomic single-bundle reconstruction was similar to anatomic double-bundle reconstruction. We addressed the femoral tunnel first and performed it through the accessory medial portal, but we placed the femoral tunnel in the centre of the marked insertion sites. The position of the femoral tunnel was between the target point of the AM bundle and PL bundle in the double- bundle ACL reconstruction. In chronic cases, we placed it below the lateral intercondylar ridge, at the lateral bifurcate ridge. If these bony landmarks could not be identified, we placed it in the lower third of the medial wall of the lateral femoral condyle. Next, attention was turned to the tibial tunnels. An ACL tibial tunnel director guide (DePuy Mitek) set at 55° was placed in the centre of the ACL tibial insertion site, based on anatomic landmarks and previous marking. The position of the director guide on the tibial cortex was 3 cm medial to the tibial tubercle (Figure 1). The graft was then passed and the EndoButton was flipped in the standard fashion for femoral fixation. The knee was cycled from 0° to 120° approximately 25 times for preconditioning of the graft. The graft

was fixed using a bio absorbable interference screw (DePuy Mitek) with the knee at full extension with a forced posterior drawer.

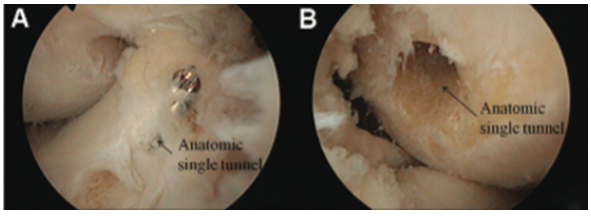

Figure. 1 Arthroscopic view of the left knee in 90° of flexion. (A) Lateral portal view of the anatomic single-bundle position in the middle of the anteromedial (AM) and posterolateral (PL) bundle insertion site. (B) Central portal view of the anatomic single-bundle position in the middle of the AM and PL bundle insertion site.

Figure 2. A central anatomic femoral tunnel viewed from the anterolateral portal will lie on the lateral wall of the notch and be directed superiorly.

REHABILITATION

Postoperative management followed our standard ACL protocol for all groups. Continuous passive motion stretching was initiated on the first postoperative day. Crutches were used for 1 week, but patients were allowed to bear weight as tolerated. Return to full activities was typically allowed at 9 months postoperatively.

FOLLOW-UP

In the first 2 hours after the surgery, an antero-posterior and lateral radiograph of the knee was performed. All follow-up examinations were performed by a blinded investigator who was not involved in the surgery. The initial and follow-up examinations were performed by the same observer. International Knee Documentation Committee subjective and Lysholm scores were used to evaluate the subjective outcomes. The skin incisions were identical for all 3 techniques, so the investigator did not know to which group the patients were assigned. The patients were not blinded because the surgeon informed them about details of the operative technique they had.

RESULTS

The average follow-up in this study was 9 months, ranging from 5 to 18 months. The results of last follow-up evaluation are outlined in Table 1.

TABLE 1

Scores	Anatomic Single Bundle Reconstruction (n=30)	
	Pre-Operative	Post-Operative
IKDC	67.7 14.0	90.6 6.4
Lysholm	73.6 12.8	91.8 4.3
DE, mean	0.6 1.1	
DF, mean	1.7 3.2	

DE, deficit of extensor, DF, deficit of flexion; IKDC, International Knee Documentation Committee

DISCUSSION

This study tells us about functional outcome of Single Bundle Anatomic ACL reconstruction. Identifying the anatomy of the ACL origin has been recognized as the key to anatomical ACL reconstruction for some time. Although the lateral intercondylar ridge and lateral bifurcate ridge have been described[12], they can be difficult to visualise[13]. Other techniques to determine the location of the ACL origin include intra-operative arthroscopic measurement and fluoroscopic imaging.

When the principles of anatomic graft placement are combined with independent drilling, single-bundle grafts can restore physiologic laxity to the knee[14].

CONCLUSION

A critical evaluation of ACL reconstruction techniques has revealed that single-bundle grafts placed by conventional transtibial drilling will not provide adequate restraint to translational and rotatory forces[15,16]. When the principles of anatomic graft placement are combined with independent drilling, single-bundle grafts can restore physiologic laxity to the knee. A thorough knowledge of the ACL insertions is necessary to place grafts correctly and an independent drilling method will require an anteromedial portal. The technique for anteromedial portal drilling requires various adjustments to permit knee flexion over 125 degrees when drilling. Grafts positioned in this fashion will tend to lengthen in extension and fixation may be accomplished with the knee in close to full extension.

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