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Outcome of Anterior Cruciate Ligament Reconstruction using Femoral Intrafix for a Single Tunnel Double Bundle Anterior Cruciate Ligament Reconstruction

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Abstract

Background: Single-tunnel double-bundle anterior cruciate ligament reconstruction (ACLR) with anatomical placement of hamstring tendon graft can closely restore the anterior knee instability when compared with single bundle reconstruction.

Aim: Evaluation of the clinical and functional outcomes of ACLR using femoral intra-fix and tibial interference screw.

Methods: This is a prospective study held on 40 patients who underwent autologous hamstring graft ACLR using femoral intra-fix and tibial interference screw. After a median follow up of one year the clinical (Lysholm score), functional outcome (International Knee Documentation Committee, IKDC) and Joint laxity (assessed with KT-1000 arthrometer - MEDmetric, San Diego, CA) were evaluated.

Results: As regard IKDC 36 patients (90%) had normal or nearly normal knees postoperatively in comparison to 100% had abnormal and severely abnormal knees pre-operatively (**P value < 0.001)**. The mean Lysholm score was higher in the postoperative follow up than preoperative (91.40±7.3 Vs 53.35± 13.55) with statistically significant (**P value < 0.001)**. The mean anterior translation of tibia improved from 7.55 mm preoperatively to 2.1 mm after one year of ACLR.

Conclusion: ACLR using femoral intra-fix and tibial interference screw provide secure graft fixation and allow early rehabilitation. The clinical and functional outcome of this fixation technique is rewarding.

Keywords: *ACL, Hamstring graft, Lysholm score, IKDC, Intrafix*

Introduction

The anterior cruciate ligament (ACL) consists of 2 major functional bundles, the antero-medial bundle (AMB) and the postero-lateral bundle (PLB).(1) The goal of anatomic double bundle (DB) ACL reconstruction (ACLR) is to provide a close restoration of the normal knee kinematics, function, and decrease the risk of degenerative osteoarthritis of the knee joint.(2) In anatomic DB reconstruction two tunnels in the tibia and in the femur are necessary to reconstruct both (AM) and (PL) bundles, which is difficult to impossible in narrow notches.(3) Most of the clinical studies comparing single-bundle (SB) to DB reconstruction do not present a fair comparison since often one or both surgical techniques were not performed anatomically. In addition, associated injuries such as chondral injuries, meniscus tears and osteoarthritic changes should be taken into account when conducting comparative clinical studies.(4)

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Materials and Methods

Patient's selection

This is a prospective study held on 40 patients aged (20-40) years operated from March 2016 to October 2018 for their ACL deficient knees with autologous hamstring graft fixed by femoral intrafix on the femoral side and interference screw on the tibial side. Patients with multi-ligamentous injury, infection, inflammatory or degenerative pathologies and previous history of ACLR on the same knee were excluded from the study. Institutional ethics committee permission was obtained and informed consent was taken from all patients. Preoperative evaluation include history, clinical examination, ligamentous laxity measurement using KT-1000 arthrometer, radiographs and magnetic resonance imaging of the knee joint were done. After complete clinical and radiological evaluation, patients were arthroscopically treated with ACLR using hamstring graft.

Surgical technique

The knee joint was accessed through three standard portals anteromedial (AM), anterolateral (AL) and accessory anteromedial (AAM). Meniscal injuries were addressed with partial resection. The harvested hamstring tendons (Gracilis and Semitendinosus) were prepared as tendons were folded in half over a single strand of #2 sutures to create two bundles. Each side was whip-stitched to 30 mm from fold. On the femoral side, the AM bundle was marked while the PL bundle left unmarked. The graft is whip-stitched on the tibial side; thickness and length of the graft were measured. (Fig.1a). A 45° micro-fracture awl was inserted through the AAM portal marking the centrum of the femoral foot print, which should be 2.5 mm plus the planned tunnel radius from the posterior articular cartilage. The knee was hyper-flexed to (110°-120°) allowing guide wire to move with the rotating condyle anteriorly, avoiding posterior wall blow out, now drilling the femoral tunnel using appropriate sized reamer. The depth should be 30-35 mm (Fig. 1b, c).

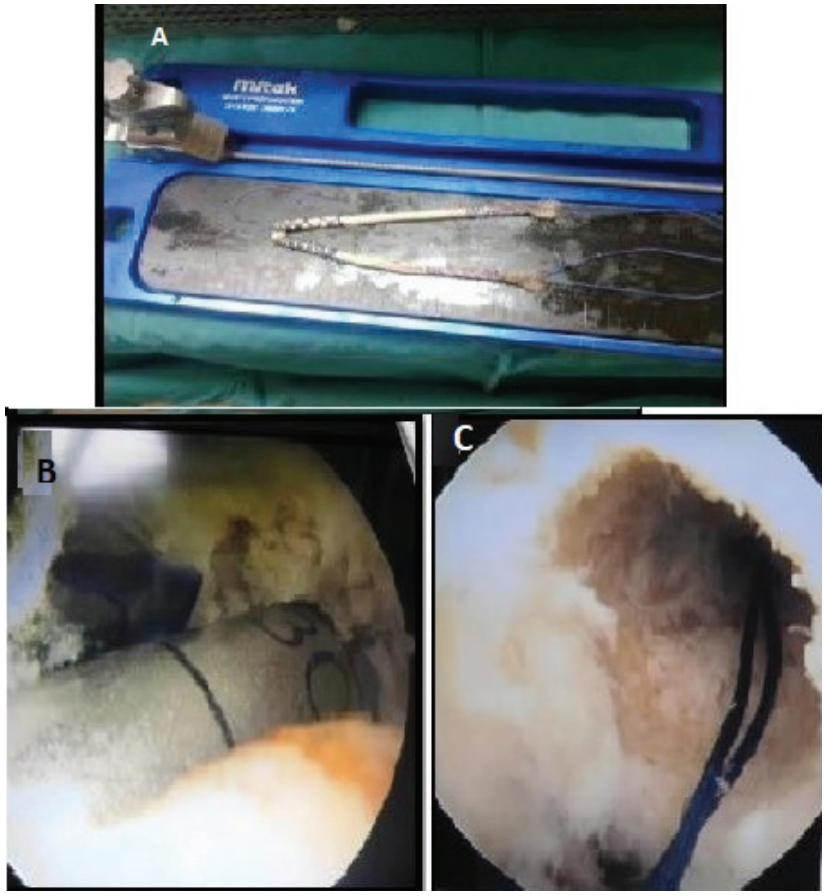

Fig 1. (a) Hamstring graft preparation.

(b) The femoral tunnel length 30mm. (c) intact posterior wall

Before advancing the graft into the femoral tunnel, the AM and PL bundles were rotated to the desired position (Fig.2a,b). A sheath trial of the same size of the graft was introduced via the AAM portal separating the AM & PL bundles (i.e. one strand posterior, the other inferior within the single tunnel), then rotate the sheath trial to orient its broader convex surface (laser marked) to an anterior distal position in the femoral tunnel and manually insert trial tip between graft bundles until snug.

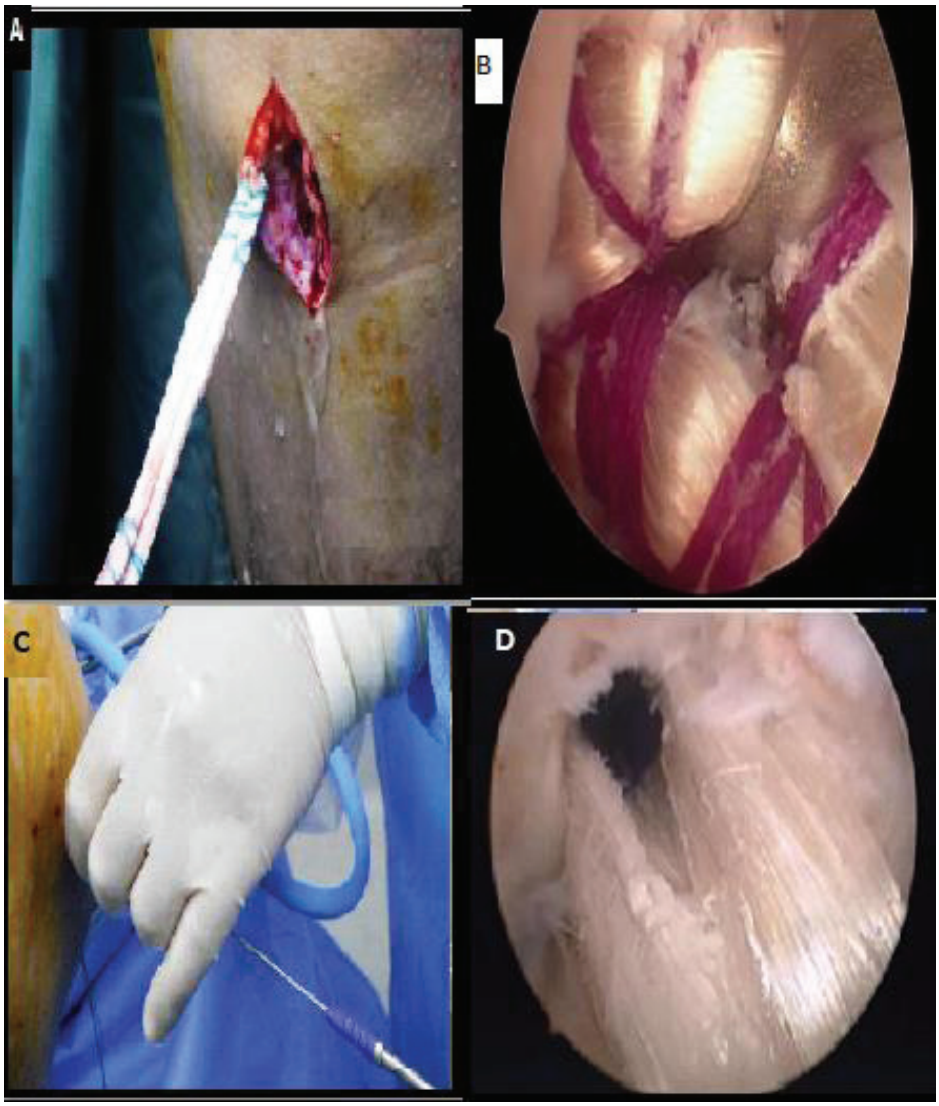

Fig2. (a) The AMB and PLB are rotated to the desired position. (b) Adjusting The graft position before inserting the guide wire, (c) Sheath Application, (d) The sheath is separating the two bundles.

Drive sheath over the guide wire between graft strands in the tunnel until it fully seated to a depth of 2mm-3mm into the tunnel as indicated by the laser marking on the rear shoulder of the inserter. The shoulder of the sheath inserter should be slightly recessed to prevent sheath extrusion during screw insertion (Fig.2c,d).The screw is next inserted over a guide wire into the sheath (Fig.3). Tension should be applied to both ends of the graft during screw insertion to prevent the graft from wrapping around the screw. If any material from the sheath has extruded during screw insertion, it is now removed. [8]

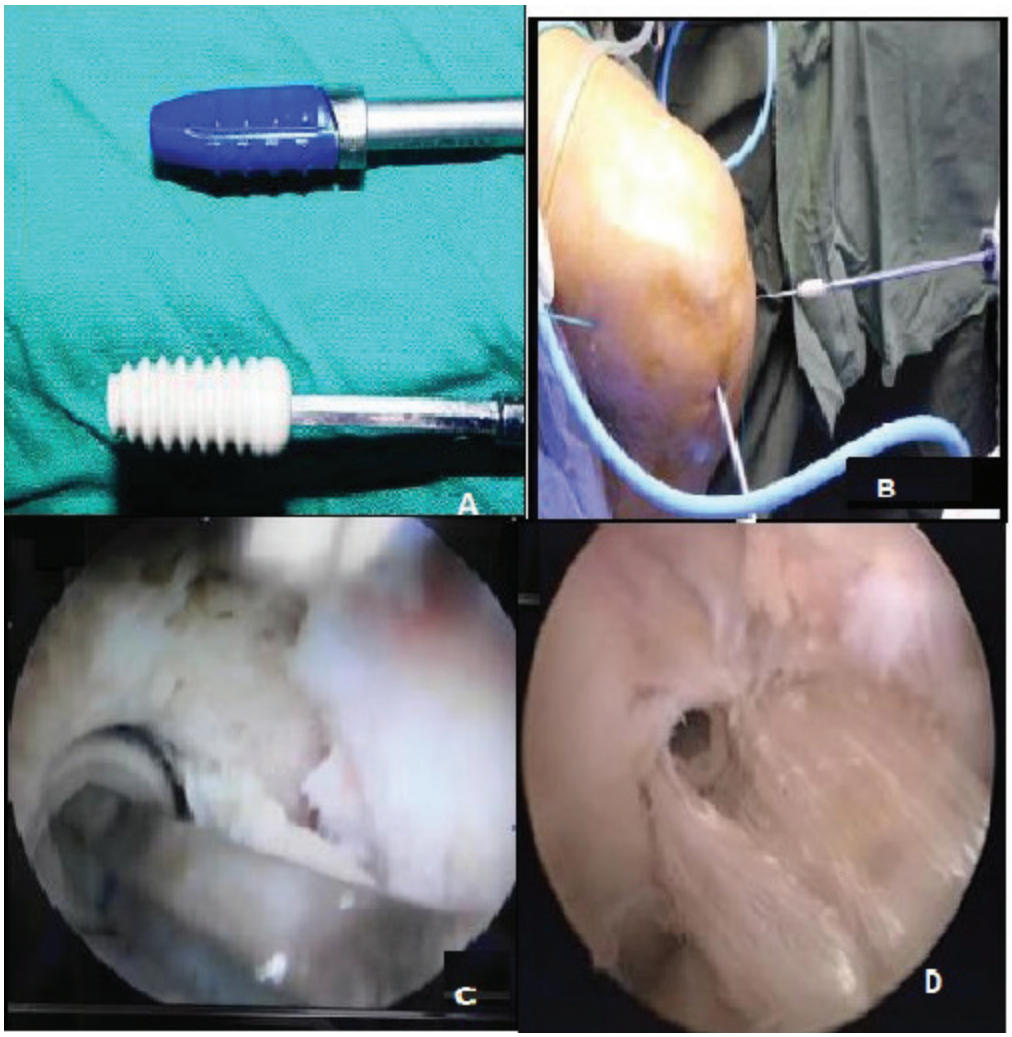

Figure 3: (a). Femoral intrafix screw and sheath, (b,c) Screw insertion, (d) Screw separating the two bundles.

Then tension is applied to Ethibond before interference screw is used to fix tibial side. Careful testing for full range of movement especially complete extension was done. Both Lachman and ADT tests were done.

Postoperative rehabilitation

First day postoperatively, patients were allowed to start partial weight bearing with crutches; knee flexion up to 90° is allowed and isometric quadriceps for six weeks [5]. Subjects were prescribed intense physical therapy for motion exercise, and to strengthen thigh muscles. Normally, full range of motion and weight bearing was achieved at 6-8 weeks of surgery. Patients were followed up in outpatient clinic at 14 days then monthly up to months, 6 months and finally every three months until one year. They were evaluated clinically (Lysholm score and IKDC examination form) and knee joint stability was measured using KT-1000 arthrometer at one year.

Statistical analysis: was performed using **SPSS software version 24**.

Results

The mean age of patients included in this study was 27.75 years (range 20-40 years). There were 38 males (95%) and 2 females (5%). Left side involvement was noticed in 17 patients (42.5%) and right side in 23 (57.5%) patients. There was no meniscal pathology in majority (52.5%) of the patients. In patients with meniscal tears, the medial meniscus (n = 11, 27.5%) was commonly involved than the lateral meniscus (n = 8, 22.5%). The mean operative time was (102± 21.4 minute, range 60-140 minutes).

34 patients (85%) had no post-operative limitation of motion compared to 6 patients (15%) who had post-operative limitation of range of motion either in extension or in flexion.

At the end of follow up; 90% of the patients had -ve Pivot shift while 10% have +ve test (three of them had only +1) one patient who had +3 Pivot shift postoperatively.

As regarding the IKDC examination form, preoperatively 55% of the patients (22 patients) had severely abnormal knee (class D) while 45% (18 patients) had abnormal knee (class C). Postoperatively according to IKDC examination form 60% of the patients had (24 patients) normal knee (class A), while 30% (12 patients) had nearly normal knee (class B), and only 10% (4 patients) had abnormal knee (class C) with statistical highly significance **(P- value <0.001).**

Lysholm score improved postoperative (Post-op) 91.40±7.3 Vs 53.35± 13.55 preoperative (Pre-op) which translated into statistically significant with **(P value < 0.001).**

Ligamentous laxity measured by KT-1000 showed significant improvement after ACLR. The mean anterior translation of tibia in the Pre-op. period was 7.53 mm and which improved to 2.1 mm after 1year of ACLR.

Thirty nine patients (97.5%) had no post-operative complications; one Patient (2.5%) had infection, and graft failure.

Discussion

The aim of ACLR is restoring normal knee anatomy, biomechanics and function. It was assumed that the clinical success of ACLR depends on correct positioning of the graft tunnel when performing singe bundle ACLR, However, many prospective series and meta-analyses conducted have shown that, despite correct tunnel placement, a significant number of patients experience persistent instability in the knee at follow-up especially in respect of rotational stability and also have abnormal IKDC scores in nearly one fifth of patients who had undergone single-bundle ACLR. [6]

Femoral intrafix ACL fixation system from DePuy Mitek, Inc. is designed to provide soft tissue femoral fixation for ACL reconstruction surgery using a single tunnel through an antero-medial approach. Femoral intrafix, with its unique patented polypropylene sheath and PEEK (Polyetheretherketone) screw (Figure3a) implant design offers more anatomic ACLR with improved femoral footprint placement and coverage, controlled antero-medial and posterolateral bundle positioning, protecting the graft from being violated during screw insertion, strong and stiff soft tissue aperture fixation. [7]

Regarding range of motion (ROM), 85% of patients had no post-operative limitation of motion in comparison with 5% that have postoperative limitation of extension due to inefficient rehabilitation and 10% had limitation in flexion (one patient had infection and graft failure, two patients had concomitant both menisci surgery, and one had mild loss of terminal flexion). The limitation of the ROM was greater in patients with concomitant meniscal surgery. This result was similar to **Ashish et al** [8] who had operated 30 patients with DB ACLR and had 13% limitation of range of motion.

Huang etal [9] results were better than this study regarding the ROM as h operated 25 patients with femoral intrafix but his follow up was longer and his final evaluation was done (12-18 months). Normal ROM of the involved knee is strongly associated with patient-reported outcome, reduced osteoarthritis, and greater quadriceps strength at long-term follow-up in patients after single bundle ACLR. [10]

In our study 90% of patients have –Ve Pivot shift test, and 10% of patients have + Ve pivot shift test. One of them (2.5%) had infection and graft failure, while 3 patients (7.5%) had postoperative laxity (+1) which was associated with positive ADT and Lachmann test this was similar to the study done by **Philippe et al** [11] who operated 33 patients with double bundle four tunnels ACLR technique and had +ve pivot shift test in 15% of patients. **Ricardo et al** [12] had operated 30 patients with SB anatomical ACLR technique and had +ve pivot shift in 23.3% which showed the superiority of this technique.

Regarding IKDC; 55% of the studied group had severely abnormal knee (D) and 45% had abnormal knee (C) preoperatively. Those findings were improved post-operatively as 60% of patients had normal knee (A), 30% of patients had nearly normal knee (B) and 10% had

abnormal knee (C) with a highly statistically significance (P value <0.001). Ninety percent (36 patients) cases had a normal or nearly normal knee (grade A + B objective IKDC) which was similar to DB ACLR by **Philippe et al** [11].

Our results were similar to **Ricardo et al.** [12]who had 30 patients underwent SB anatomical ACLR , 70% of patients had score normal knee (A), 20% had nearly normal knee (B), and 10% had abnormal knee (C).

Regarding Lysholm score :80% of patients had poor score and 20% had fair score preoperatively which improved postoperatively as 30% had excellent score, 50% good score, 10% had fair score, while 10% had poor score with statistically significant difference (P value <0.001). In the study done by **Järvelä et al.** [13] the Lysholm score for DB anatomical ACLR was 45% excellent score which was is better than our results. Also, the mean preoperative Lysholm score was 53.35 ± 13.55 which is less than the observations of **Järvelä et al** [13] **and Fujita et al.** [14] who reported a preoperative Lysholm score of 69 and, 67.4 respectively. This could be attributed to the long period between the injury and the operation; the instability and its associated secondary chondral damage due to delayed presentation may be the reason for a very low preoperative Lysholm score in these patients. The mean postoperative Lysholm score, of 91.40±7.3 was in close proximity with those reported by **Järvelä et al** [14] **and Asagumo et al.** [15] (96.8 ± 5.1) who used double bundle double tunnel technique in their study.

Our study results was better than the results observed by **Ubale et al.** [17] who operated on 30 patients with anatomical SB ACLR 49.5 ± 11.6 pre-operatively to 83.4 ± 9.5 postoperatively.

Conclusion

Single tunnel double bundle ACL reconstruction using femoral intrafix is a reliable technique for ACL reconstruction which can restore the AP stability and reduce the risk for rotational instability (improved IKDC examination form postoperatively with P-value <0.001 and –Ve pivot shift test) in comparison with other methods of fixation, but this technique is limited by long operative time, good bone quality and well trained surgeon with a good experience in ACL reconstruction.

Conflict of Interest : None (declared)

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