

Arthroscopic Anatomic Single Bundle Anterior Cruciate Ligament Reconstruction

Fahmy Samir Fahmy, Abd El Fatah Kotb, Hany Mokhtar El-Elesh, Adel Mohammad Salama

Orthopedic Surgery Department, Faculty of Medicine, Zagazig University.

Abstract

Background: Reconstruction of the anterior cruciate ligament (ACL) has become a commonly performed procedure. Biomechanical studies have demonstrated that conventional single-bundle ACL reconstruction techniques are only successful in limiting anterior tibial translation but less effective for restoring rotatory laxity.

Aim of the work: The purpose of this study was to report the results of anatomic single bundle (ACL) reconstruction by two anteromedial portals technique.

Material and Methods: This prospective study was conducted on thirty patients with complete ACL tear in Zagazig University in Sharqia between 2012 and 2014. All patients were treated by anatomic single bundle ACL reconstruction using two anteromedial portals. The patients were followed up for 24 months. The International Knee Documentation Committee (IKDC) and Lysholm scores were used for comparing the pre and postoperative results.

Results: At the final follow up, the Lysholm score was 29 patients (96.7%) had excellent and good results, while 1 patient (3.3%) had fair results with final postoperative mean (93.4±16.8). The IKDC score was 29 patients (96.7%) were normal(A) and near normal(B), while 1 patient(3.3%) was abnormal(C). The pivot shift and Lachman tests were negative in 27 patients(90%). The results are statistically significant.

Conclusion: Anatomic single bundle ACL reconstruction by two anteromedial portals is an effective surgical technique that restores the rotational stability with excellent clinical results.

Key words: Anterior cruciate ligament, Anteromedial portals, Rotational stability.

Introduction

Anterior Cruciate Ligament (ACL) rupture is one of the most frequent orthopedic sport injuries, with a yearly incidence of 35 in 100,000 (Yasuda et al., 2011).

Unlike many tendons and ligaments, a mid-substance (ACL) tear cannot heal and the manifestation is moderate to severe disability with "giving way" episodes in activities of daily living, especially during sport activities. Further, it can cause injuries to other soft tissues in the knee, particularly the menisci, and lead to early onset osteoarthritis of the knee (Savio et al., 2006).

Therefore, arthroscopic (ACL) reconstruction is one of the most often performed orthopedic surgeries. The goal of ACL reconstruction is to reproduce the functions of the native anterior cruciate ligament (Schreiber et al., 2010).

Suboptimum outcomes and arthritic changes in the knee joint after a long-term (ACL) reconstruction follow up are leading to a change in surgical technique from the traditional transtibial two portal technique to the anatomical single-bundle three portal technique, which more closely restores the native (ACL) anatomy (Van Eck et al., 2010).

Patients and Methods

This prospective study included thirty patients with ACL-deficient knees who underwent arthroscopic anatomic single bundle ACL reconstruction at Zagazig University Hospitals between 2012 and 2014. All reconstructions are done using quadrupled strands of semitendinosus and gracilis tendons auto grafts. In all cases, the femoral side is fixed using endobutton (Smith and Nephew) except one case interference screw is added to the end button, while the tibial side is fixed using bioabsorbable interference screw. Patients have multi ligament injury, chondral lesion; severe osteoarthritis and partial ACL injury are excluded from this study. The age limits in this study was between 16 and 43 years with a mean of (26± 6.7) years. The sex distribution was 28 males and 2 females. The occupation of the patients was 11 students, 2 housewives, 7 manual workers, one butcher, one driver, 6 farmers and 2 employers. The time from injury to the time of reconstruction ranges between (1.5-72) months with mean of (17.9± 20.2) months. Nineteen patients had their injury in the right knee (63.33%) while 11 patients had their injury in the left knee (36.7%). All patients were followed up for 24 months. In this study we use two scoring systems; the first is IKDC scoring system. The IKDC scoring system is used for objective assessment. The patients were graded as normal(A), near normal(B), abnormal(C) and severely abnormal(D). The second one is The Lysholm score, which is an 8-item (limp, support, locking, instability, pain, swelling, stair climbing and squatting) questionnaire. The total score is the sum of each response to the 8 items, of a possible score of 100 (100 = no symptoms or disability). The Lysholm score is used for subjective assessment. (Tegner Y, Lysholm J, 1985).

Operative Technique

In this study all reconstruction operations were performed under spinal anesthesia and all were performed under a well-padded thigh tourniquet. Examination under anesthesia before ACL reconstruction was done for all patients to ensure ACL deficiency by positive Lachman and Pivot shift tests. All patients received antibiotic 30 minutes before the operation; one gram ceftriaxone was given intravenously. Routine diagnostic arthroscopy was performed initially to ensure diagnosis and evaluate other pathological conditions. Any meniscal problems were treated before proceeding to reconstruction of ACL. Debridement of ACL stump was done leaving fibers that are not obstructive for possible vascular and cellular ingrowth and proprioceptive receptor. In this study our method using 2 anteromedial portals was performed for femoral tunnel placement. A standard anteromedial portal was created adjacent to the patellar tendon. Another anteromedial portal (far anteromedial portal) was established as distant as possible from the previous portal (- 2 cm from the medial border of the patellar tendon), using a needle at a site that allows for the use of a reamer without damaging the medial femoral condyle; thus avoiding complications that can be caused by interference with a reamer or an arthroscope. A standard anterolateral portal was created. The gracilis and semitendinosus tendons were harvested as an auto graft. This method allows for arthroscopic visualization of the medial wall of the lateral femoral condyle through the standard anteromedial portal with the knee in hyper flexion; hence, the anatomic ACL insertion site on the femur and the posterior cortical bone can be located

with ease. A guide pin was placed at the center of the ACL insertion site on the femur through the far anteromedial portal and a femoral tunnel was created using an endoscopic drill bit. A tibial tunnel was drilled with a guide pin placed at the center of the ACL insertion site on the tibia, taking care to preserve the remaining ACL tissue as much as possible. Then, a graft was passed through the femoral tunnel. The femoral side was fixed by endobutton CL while, the tibial side was fixed by bioabsorbable interference screw after cycling of the graft.

Post-operative rehabilitation regimen:

The postoperative rehabilitation protocol was the accelerated rehabilitation protocol of Shelbourne and Nitz, 1990. Joint flexion and extension were allowed starting from the day after the surgery. In patients who did not undergo meniscal repair procedure, partial weight bearing was performed for 2 weeks while wearing the ACL brace. After 2 weeks, full weight bearing was allowed. In patients who had meniscal repair, partial weight bearing was performed for 6 weeks and the brace was worn for 6 weeks. Jogging was allowed from 3 months after surgery. Sports activity was allowed from 6–9 months after surgery depending on the state of recovery.

Cases:

Case (8): Male patient 21 years old. He is student. His complaint was recurrent giving way of the left knee after twisting injury about 24 months before operation. No effusion as found with full ROM. Lachman test was +2 and pivot shift test was +2. X ray was normal. MRI showed intact medial and lateral menisci with ACL tear. One leg hop test was less than

50%. Lysholm score was 56. IKDC was grade D.

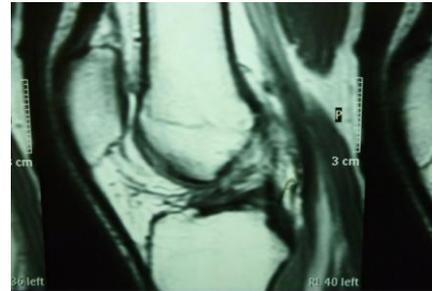


Figure (1): M.R.I showing abnormal ACL signal.

The ACL was reconstructed anatomically using quadrupled gracilis and semitendinosus auto graft fixed by endobutton on the femoral side and interference screw on the tibial side.



Figure (2): femoral tunnel drilling.



Figure (3): tibial tunnel drilling.

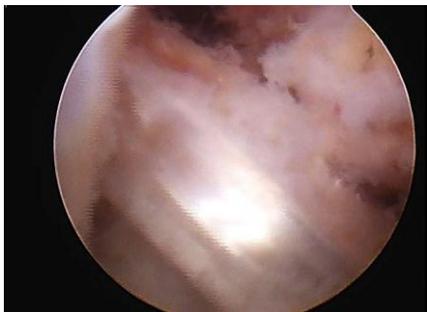


Figure (4): the final graft position.



Figure (5): postoperative x-ray showing the tunnels position.

Post-operative Complications:

Intraoperative lateral femoral cortex blow out was happened in one case (3.3%). Postoperative superficial wound infection at graft site was happened in one case (3.3%). Also, tourniquet neuropraxia was happened in one case (3.3%). Finally, postoperative neuropraxia of the saphenous nerve was happened in two cases (6.6%).

Statistical analysis:

The results were expressed as means \pm SD. The data obtained from the used double score system were analyzed statistically using paired T test. P values less than 0.05 were considered significant.

Results

Evaluation of ACL injury and associated injuries:

(1) Site of injury:

Nineteen patients had their ACL injury in the left knee (63.3%), while eleven patients had their ACL injury in the right knee (36.7%).

(2) Mechanism of injury:

Fifteen patients (50%) in this study were injured while participating in sports, five patients (16.7%) were injured due to traffic accident, five patients (16.7%) were injured at work and five patients (16.7%) were injured during daily activity.

(3) Associated meniscal injury:

Meniscal injuries identified and treated before or during the operation were documented in twenty patients (66.6%). Seventeen patients (56.7%) had a medial meniscus injury, while

three patients (10%) had a lateral meniscus injury. Two patients of the 20 treated with subtotal meniscectomy, seventeen patients of the 20 treated with partial meniscectomy and one patient treated by medial meniscal repair.

(4) Time interval before surgery:

The time interval before surgery in this study was between 1.5 and 72 months with a mean of 17.9 ± 20.2 months.

(5) Previous knee surgery:

Six patients (20%) of this study had previous knee surgery. Five patients of the six had previous diagnostic arthroscopy and one patient had a previous ACL reconstruction surgery.

Assessment of the results of surgery

1) - Assessment using IKDC Scoring System

The 2000 IKDC knee examination form was used for objective evaluation. Before surgery, 15 patients had abnormal IKDC grade (C) and 15 patients had severely abnormal grade (D). After surgery, 26 patients had normal IKDC grade (A), 3 patients had nearly normal grade (B) and only one patient had abnormal grade (C).

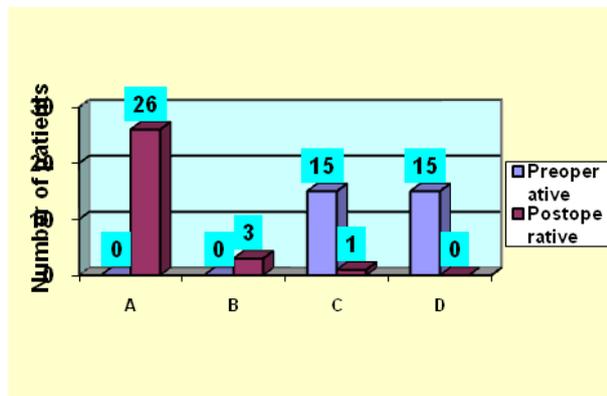


Figure (6): The final results of IKDC Score system

2)-The Lysholm score:

It is an 8-item (limp, support, locking, instability, pain, swelling, stair climbing and squatting) questionnaire. The total score is the sum of each response to the 8 items, of a possible score of 100 (100 = no symptoms or disability).

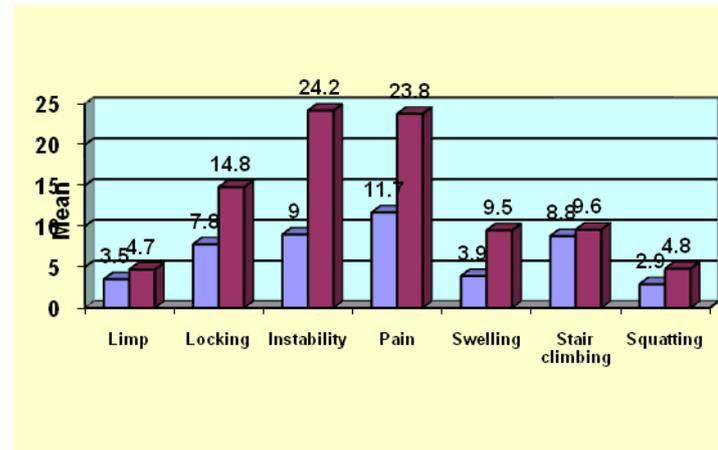


Figure (7): pre and post-operative means of the Lysholm score items

3) - Instability tests

Before surgery, 18 patients had Lachman test +2 and 12 patients had Lachman test +3. After surgery, 27 patients (90%) had normal test and 3 patients (10%) had +1 Lachman test. Before surgery, 2 patients had +1 pivot shift test, 16 patients had +2 pivot shift and 12 patients had +3 pivot shift. After surgery, 27 patients (90%) had normal pivot shift and 3 patients (10%) had +1 pivot shift.

Discussion:

In this prospective study, thirty patients who had complete ACL injury underwent

anatomic single bundle ACL reconstruction using quadrupled strands of gracilis and semitendinosus tendon auto grafts using 3-portal technique. The graft was fixed by endobutton CL (smith and nephew) at the femoral side and bioabsorbable interference screw at the tibial side in all cases except one case femoral interference screw was added to the end button. The age limit was between 16-43 years with a mean (26 ± 6.7), sex distribution was 28 males (93.3%) and 2 females (6.7%). The affected side was 19 (63.3%) in the left knee and 11 (36.7%) in the right knee. There were 20 patients (66.6%) having meniscal injury, 17 patients had medial meniscus (56.6%), while 3 patients had lateral meniscus tear (10%). The main cause of injury was sport injuries (50%). The patients were followed up for 24 months using Lysholm, IKDC score and X-ray. The IKDC final preoperative score was 15 patients having grade C (50%) and 15 patients (50%) having grade D, while the final score postoperatively was 26 patients (86.7%) being grade A, 3 patients (10%) being grade B and one patient (3.3%) being grade C. The pivot shift test preoperatively was one patient (3.3%) being grade I, 16 patients (53.3%) being grade II and 12 patients (40%) being grade III, while postoperatively, 27 patients (90%) were grade 0 and 3 patients (10%) were grade I. Lachman test preoperatively was 18 patients (60%) being grade II and 12 patients (40%) being grade III, while postoperatively, 27 patients (90%) were grade 0 and 3 patients (10%) were grade I. In our study we also use Lysholm score system : The results for the score have shown significant improvement of the **Limp** as it was found that the mean for preoperative was **3.5 (SD ± 0.9)** show improvement postoperative mean **4.7(SD**

± 0.7); also for **Locking Sensation** In The Knee from preoperative mean **7.8 (SD ± 4.3)** to postoperative mean **14.8 (SD ± 0.9)** ; also for **swelling** from preoperative mean **3.9 (SD ± 2.7)** to postoperative mean **9.5(SD ± 1.4)** ; also for **Giving Way Sensation From The Knee (Instability)** from preoperative mean **9 (SD ± 3.7)** to postoperative mean **24.2 (SD ± 2.3)** ; also for **Climbing Stairs** from preoperative mean **8.8 (SD ± 1.9)** to postoperative mean **9.6 (SD ± 1.2)** ; also for **Squatting** from preoperative mean **2.9 (SD ± 1.1)** to postoperative mean **4.8 (SD ± 0.4)** ,and for comparison between **pre and post total mean for lysholm score** show improvement from preoperative **53(SD ± 13)** to postoperative **93.4(SD ± 16.8)** . The final results of lysholm score were 9 patients had fair results (30%) and 21 patients had poor results (70%) pre-operative. while postoperatively, 21 patients had excellent results (70%), 8 patients had good results (26.7%) and one patient had fair results (3.3%).

In a prospective study by **Kim et al. (2011)**, 33 patients who had complete ACL tear were treated by anatomic single bundle ACL reconstruction, the mean age was 29.8 (17-58 years), sex distribution was 25 males (75.7%) and 8 females (24.3%). The results of their study were that Lysholm final score postoperatively, 19 patients (57.6%) had excellent score, 12 patients (36.4%) had good results, one patient (3%) had fair results and one patient (3%) had poor results with postoperative mean of 88.3. The postoperative IKDC was 2 patient (69.7%) having grade A, 9 patients (27.3%) having grade B and one patient (3%) having grade C. The final pivot shift test was that 30 patients (90%) were grade 0, 2 patients (6%)

were grade I and one patient (3%) was grade II. The final Lachman test was that 28 patients (84.8%) were grade 0, 4 patients (12.1%) were grade I and one patient (3%) was grade II.

In a study by **Alentorn-Geli et al. (2010)**, 26 patients who had ACL tear were treated by anatomic single bundle ACL reconstruction using antero-medial portal technique, they had the following results: The postoperative mean of Lysholm score was 99.3 ± 2.3 , the final IKDC grade was 26 patients having grade (A/B), the number of patients with negative pivot shift was 19 patients (73.1%) and the patients with negative Lachman test were 21 patients (80.7%).

In a study by **Sohn et al. (2014)**, 20 patients with ACL injury were treated by anatomic single bundle reconstruction using anteromedial portal technique had the following results: All the patients had excellent and good Lysholm score was postoperative mean of 88.6. The pivot shift test at the end of the follow-up period was 18 patients (90%) were grade 0 and 2 patients (10%) were grade I.

In another prospective study by **Hussein et al. (2012)**, 30 patients were treated by anatomic single bundle reconstruction using the anteromedial portal technique having the following results: The mean postoperative Lysholm score was 93.5 ± 3.3 . The IKDC final grade was that 26 patients (86.7%) were grade A and 4 patients (13.3%) were grade B. The postoperative pivot shift test was that 27 patients (90%) were grade 0, 2 patients (6.6%) were grade I and one patient (3.3%) was grade II.

Studies, including the current study, have shown that ACL reconstruction using the

anteromedial portal technique allows for anatomic reconstruction of the ACL and is effective for restoring anterior stability and rotational stability.

Summary and Conclusion

Anatomical position and coronal obliquity of the ACL graft are important for restoration of the rotational stability and maintenance of the knee joint functions in the long term. In the previously commonly used transtibial technique, the position of the femoral tunnel was determined by the tibial tunnel, rendering the anatomical reconstruction difficult. ACL reconstruction using 2 anteromedial portals can be effective for reproducing the anatomy of the ACL and obtaining good clinical results, because the technique allows for a better field of view and more obliquity of the reconstructed ACL compared to the transtibial technique.

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إعادة بناء الرباط الصليبي الأمامي تشريحياً بحزمة مفردة بواسطة منظار الركبة

فهمي سمير فهمي ، عبد الفتاح قطب اسماعيل والي، هاني محمد مختار القلش، عادل محمد سلامة

قسم جراحة العظام - كلية الطب البشرى - جامعة الزقازيق

يعد قطع الرباط الصليبي الأمامي لمفصل الركبة من الإصابات المتكررة والشائعة في مجال جراحة العظام، حيث تصل نسبة حدوثه إلى 35 لكل 100000 شخص سنوياً.

فعند حدوث قطع بالرباط الصليبي الأمامي للركبة ينتج عن ذلك عدم قدرة على ممارسة النشاط اليومي وخاصة ممارسة الرياضة. بخلاف ذلك يمكن أن يسبب إصابة لغضاريف الركبة مع حدوث خشونة مبكرة للمريض.

لذلك فإن إعادة بناء الرباط الصليبي الأمامي بواسطة منظار الركبة يعد من الجراحات الشهيرة والهامة، فالهدف من إعادة بنائه هو إعادة الوظيفة الأصلية للرباط الصليبي الأمامي لمفصل الركبة.

لقد أدت النتائج غير المثلى وحدثت خشونة بمفصل الركبة على المدى البعيد بعد إعادة بناء الرباط الصليبي الأمامي بالطريقة التقليدية لتغيير التقنية إلى إعادة بناء الرباط الصليبي الأمامي تشريحياً عن طريق ثلاثة مداخل لمنظار الركبة.

الهدف من العمل

إعادة الثبات الدوراني والإزاحي لمفصل الركبة في المرضى الذين يعانون من قطع بالرباط الصليبي الأمامي عن طريق إعادة بنائه تشريحياً بحزمة مفردة بواسطة منظار الركبة وتقييمه إكلينيكياً عن طريق اختبارى (لاخمان) و(بيفوت) .

طرق والمواد المستخدمة

: سيتم إجراء الدراسة علي ثلاثون حالة منطبقه عليهم الشروط الأتية

- **مقاييس إدراج الحالات في عينة البحث:** المرضى الذين يعانون من قطع كامل بالرباط الصليبي الأمامي للركبة وأيضاً المرضى الذين يعانون من قطع بالرباط الصليبي الأمامي مع قطع مصاحب بالغضروف الهلالي للركبة.

- **مقاييس استبعاد الحالات من عينة البحث :** المرضى الذين يعانون من قطع بأربطة أخرى بمفصل الركبة، الإصابات الغضروفية لسطح المفصل، مرضى خشونة الركبة والمرضى الذين يعانون من التهاب صديدي بمفصل الركبة.

إكلينيكياً: - باستخدام الأشعة السينية و الرنين المغناطيسى - سيتم تقييم المرضى قبل إجراء الجراحة كالأتي

النتائج و المضاعفات

عدم الثبات بمفصل الركبة هي الشكوى الرئيسية للمريض قبل الجراحة و إعادة الثبات لمفصل الركبة هو الهدف من اجراء التقنية.

المضاعفات تمثلت في الاحمرار السطحي للجرح او الارتشاح الدموي للمفصل او تيبس بالمفصل ما بعد الجراحه

الملخص و الاستنتاج

ان إعادة بناء الرباط الصليبي الأمامي بحزمة احادية بواسطة المنظار هي الطريقة المثلى لاعادة الثبات الدوراني لمفصل الركبة.