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ORIGINAL ARTICLE

Clinical Outcome of Combined Anterolateral Ligament and Anterior Cruciate Ligament Reconstruction in Anterior Cruciate Ligament Deficient Knee

Mohamed Ibrahim Hosseini[1*], Mohamed Safwat Mostafa Shalaby[1], Mohamed Saeed ElAttar[1], Hossam Fathi Mahmmoud[1].

[1] *Orthopedic Surgery Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt*

Corresponding author:
Mohamed Ibrahim Hosseini
Orthopedic Surgery Department, Faculty of Medicine, Zagazig University, Zagazig, Egypt
E.mail : malhoseiny22@gmail.com

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ABSTRACT

Background: Recent advances in understanding the rotational instability of the knee in addition to well described anterolateral ligament (ALL) have led to an increased interest in augmentation of the anterior cruciate ligament Reconstruction (ACLR) by extra articular method.
Aim of this study is to assess the functional and clinical outcome of combined ALL and ACL reconstruction in ACL deficient knees.

Methods: A prospective study, held between January 2018 and July 2019 where Twelve patients included with either: chronic ACL lesion, grade III positive pivot shift test, revision surgery, Segond fracture and operated with arthroscopic anatomic single bundle ACL reconstruction associated with ALL reconstruction using modified Lemaire technique of extra-articular tenodesis. Patients were evaluated pre- and postoperative clinically using Lysholm score form.

Results: at a mean follow-up of 7.25 ± 1.91 months, clinical evaluation showed statistically significant improvement, with excellent control of post-operative rotational instability and PST and good functional results

Conclusions: Extra articular tenodesis using modified Lemaire technique is a simple method for reconstruction of ALL and preventing ALRI which could occur after isolated ACLR. When indicated combined ALL and ACL reconstruction shows good functional results and excellent results in preventing postoperative residual pivot shift phenomenon and residual instabilities with no specific complication noted.

Key words; ACL reconstruction; Extraarticular tenodesis; anterolateral ligament; ALL

INTRODUCTION

Anterior Cruciate Ligament (ACL) rupture is one of the most frequent orthopedic sport injuries. Unlike many other ligaments, ACL tears usually fail to heal and patients will suffer from moderate to severe disability with "giving way" episodes, Further, it can cause injuries to other soft tissues in the knee, particularly the menisci, predisposing to early onset knee osteoarthritis [1] The goal of ACLR is to reproduce the functions of flexion angles and preventing anterior tibial translation. So, a patient with surgically reconstructed ACL may still have a positive pivot-shift sign [3].

A residual pivot shift test may be observed in approximately 5%- 15% of patient after isolated ACL reconstruction. With exclusion of graft failure, untreated concomitant ALL tear is the main contributor to postoperative knee laxity [3].

The conventional intra-articular ACLR is typically successful at reducing anterior tibial translation but ACLR cannot regain the native knee biomechanics with regard to ALRI which could affect patient outcome. Failure rates as high as 25 % have been reported with a rate between the native knee. Current techniques in ACL surgery have been associated with satisfactory long-term results in the majority of the patients; however, unsatisfactory outcome regarding residual rotational instability that may persist after surgery [2].

Recent biomechanical studies emphasized the role of ALL as an important primary stabilizer of internal rotation of the tibia at high knee

3.5 % and 7 % residual rotational instability after ACLR and return to perjury of sports level is about 60%. Role of the anterolateral structures in rotational control and their contribution in the variation in clinical laxity seen in the ACL deficient knee are now well defined. So, repair or reconstruction of these structures could be considered more "anatomical" than intraarticular ACLR alone [4-6].

The extra-articular reconstruction was historically performed without concomitant intra-articular ACL as a sole mean to compensate ACL, however results were generally poor it shows good control of PST. Introduction of all – arthroscopic ACLR was favored over these more invasive non anatomical techniques [5].

LET was found to reduce the forces seen in an ACL graft by 43 % beside the load sharing effect between intra-articular and extra-articular reconstructions it reduces internal rotation of the tibia and give better control of ALRI as the native knee [7].

LET using modified Lemaire technique, where in short terms, 8cmm ITB graft left attached to

Gerdy tubercle pass deep to FCL to be inserted posterior and proximal to FCL femoral origin while the leg held in neutral position and in 60º flexion, is our preferred technique for extraarticular augmentation as FCL act as a pulley that maintain the graft orientation more in line with the joint for most of the flexion range. This may help in maintaining the graft at a relatively isometric position and also in a mechanically advantageous vector to resist rotation [8].

METHODS

Research design: A prospective clinical trial conducted during the period of January 2018 to July 2019.

Sample size: Twelve patients with ACL-deficient knee were admitted and operated with arthroscopic anatomic single bundle ACL reconstruction associated with ALL reconstruction using modified Lemaire technique of extra-articular tenodesis at the arthroscopic unit of the orthopedic department of Zagazig University Hospitals and followed up for 6-12 (average 7.25) months.

Inclusion criteria: Chronic ACL lesion more than 6 months, grade II or III positive pivot shift test, revision ACL surgery and/or Second fracture and avulsion of Gerdy tubercle.

Exclusion criteria: Skeletal prematurity, arthritic knee, malalignment of lower limbs and/or infection.

Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

The demographic data (Table 1) and The clinical data of the patients fulfilling the inclusion criteria has been evaluated as follows; History has been taken from the patient, including the date of the injury; Full history has been taken to define the type and mechanism of trauma.Physical examination has been documented including ROM, drawer, lachman, PSTs, MacMurrays's test for menisci lesion and stress tests for collateral integrity.

The patients had the following radiological examinations: An antero-posterior (AP) and lateral views Xray and Magnetic resonance imaging (MRI). Pre-operative routine lab investigations**:** complete blood count, random blood glucose level, bleeding profile and liver and kidney function tests was done**,** Lysholm knee score was used for evaluation pre- and postoperatively (Table 2).

Surgical technique: All reconstruction procedures 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.

Routine diagnostic arthroscopy was performed initially to ensure diagnosis. Any meniscal problems were treated before proceeding to reconstruction of ACL. ACL Complete tear was confirmed through AL portal scope and reconstructed anatomically using quadruple strands of gracilis and semitendinosus autograft fixed by endobutton on the femoral side and interference screw on the tibial side.

After ACLR in surgeons preferred technique anatomical land marks for addition LET using Modified Lemaire technique were identified (ITB, Gerdy tubercle, fibular head) while the knee is flexed 90º (Fig.1a). A 5 cm skin incision is performed 2 cm proximal to the Gerdy tubercle and extending5 cm proximally and slightly curved posterior, parallel to the ITB fibers (Fig.1b). After Subcutaneous dissection, the anterior and posterior borders of ITB is visualized. A 10 mm width × 80 mm length rectangular stripe is sharply harvested, leaving its distal insertion attached to the Gerdy tubercle (Fig. 1c, d).

Then, FCL is identified running from the lateral femoral epicondyle to the fibular head while knee is flexed 90º. FCL is incised on its anterior and posterior borders, and a small pulley is undermined (Fig 2.a). After whip stitched in the ordinary manner, The ITB graft is passed *under the FCL* using a curved clamp (Fig 2. b).

A guide wire is inserted just posterior and proximal to FCL femoral origin with caution not to interfere with the ACL femoral tunnel, better with its pull out suture being visible, without violation of the medial cortex, a cannulated drill is used along the wire to create the tunnel for the interference screw.

The graft is then pulled to the newly formed tunnel, with the knee in 60º flexion and the foot in neutral position, repeated cycling and tightening of the graft is made followed by introduction of the appropriate sized interference screw (Fig 3. a). Meticulous irrigation after good haemostasis especially for the vessels beneath the ITB to avoid postoperative haematoma. final image is shown (fig 3 b,c). Closure of the wounds on drain after deflation of the tourniquet

Postoperatively, all patients followed the accelerated rehabilitation program. Rehabilitation protocol is six stages protocol. All patients were followed up for at least 6 months.

Statistical analysis: Collected data were coded, entered and analyzed using Microsoft Office Excel (2013). date was then imported into Statistical Package for the Social Sciences (SPSS) version 20.2 .Baseline characteristics of the study population were presented as frequencies and percentages in qualitative date while quantitative Results were expressed as means ±SD (standard deviation). The data obtained from twelve patients according to lysholm scoring systems, pivot shift and and lachman tests were analyzed by using paired t-test.

RESULTS

Before surgery, all patients (100%) had lysholm score poor results with preoperative mean of 51.92 ± 5.70. After surgery, seven patients (58%) had good results, four patients (33%) had excellent results, and one patient (8%) had a fair result, with a postoperative mean of 92.33 ± 5.07 **(**fig 4 a,b).

Before surgery, six patients (50%) had Lachman test +3, five patients (42%) had Lachman test +2, and one patient (8%) had Lachman test +1. After surgery, all patients (100%) had normal test. On the other hand, before surgery, eight patients (67%) had +3 pivot shift test and four patients (33%) had +2 pivot shift. After surgery, nine patients (75%) had normal pivot shift and three patients (25%) had +1 pivot shift (Fig 5 a,b). Five patients (41%)

experienced postoperative complications. Effusion was detected in two patients, Infection in one patient. Hematoma was found in one patient. Saphenous nerve neuropraxia was found in one patient.

As described by knee society score, patient satisfaction was measure by a single question post operatively as: currently, how satisfied are you with your knee function while performing light household activities? Six patients (50%) reported that they were satisfied; three patients (25%) reported that they were very satisfied, and three patients (25%) reported that they were neutral

Table 1: Demographics of the patients and injury

	Number /Range	Mean
Age (years)	(17-38)	(28.92 ± 6.14)
Sex		
Male	10	(83%)
Female	2	(17%)
Side		
Right	8	(70%)
Left	4	(30%)
Mechanism		
indirect	11	(91.66%)
direct	1	(8.33%)
chronicity		
Subacute 6ws-3ms	3	(25%)
Chronic >6m	9	(75 %)
Time till operated(months)	(3-44)	(25.75 ± 14.68)
Previous knee surgery	0	0
Associated injuries		
Meniscal lesion	4 (3 MM,1 LM)	(33%)

MM= medial meniscus, LM= lateral meniscus

Table 2: Lysholm scoring system

Limp (5 points)	**None=5 Slight or periodically=3 Severe or constant= 0**		
Support (15 points)	None=5 Limp =2 Weight bearing impossible =0		
Locking (15 points)	No locking =15 Catching sensation=10 Occasional locking=6 Frequent=2 Locked joint at examination =0		
Instability (25 points)	Never=25 Rare during exertion=20 Frequent during exertion=15 Occasionally in daily activity=10 Frequent in daily activity=5 With every step=0		
Pain (25points)	None=25 slight During severe exertion=20 marker during severe exertion=15 marked on or after walking 2 kilometers or more=10 marked on or after walking less than 2 kilometers=5 constant=0		
Swelling (10 points)	None=10 On severe exertion=6 On slight exertion=2 Constant =0		
Stair climbing (10 points)	No problem=10 slightly impaired =6 Step by step =2 Impossible =0		
Squatting (15 points)	No problem=10 slightly impaired =6 up to 90 degree =2 Impossible =0		
Total count			
Results			
Excellent :91-100	Good: 84-90	Fair:65-83	Poor: 64 or less

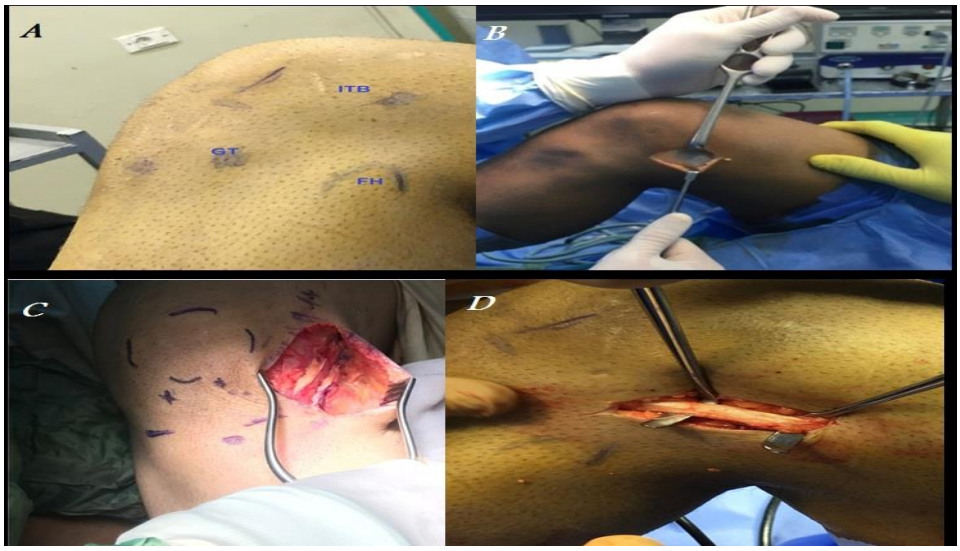

Figure 1: A anatomical landmark of LET and skin incision (GT gerdy tubercle, FH fibular head, ITB iliotibial band), B ITB identification, C and D ITB graft harvesting.

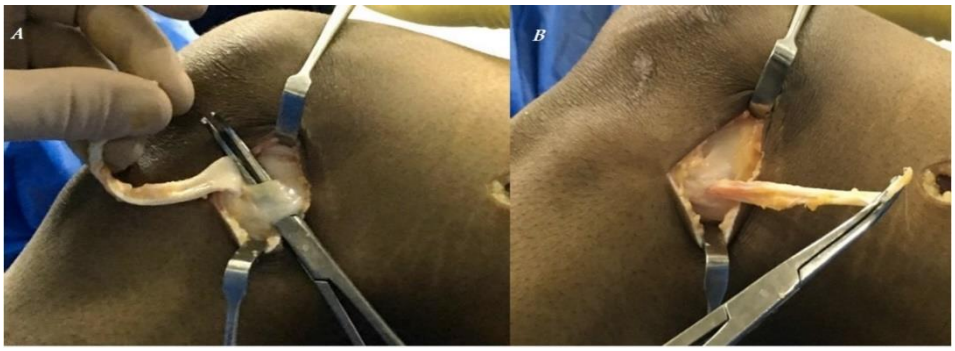

Figure 2: graft passing under the FCL**, (**A) a small bulley is undermined at anterior and posterior border of the FCL, (B) the ITB graft passing under the FCL.

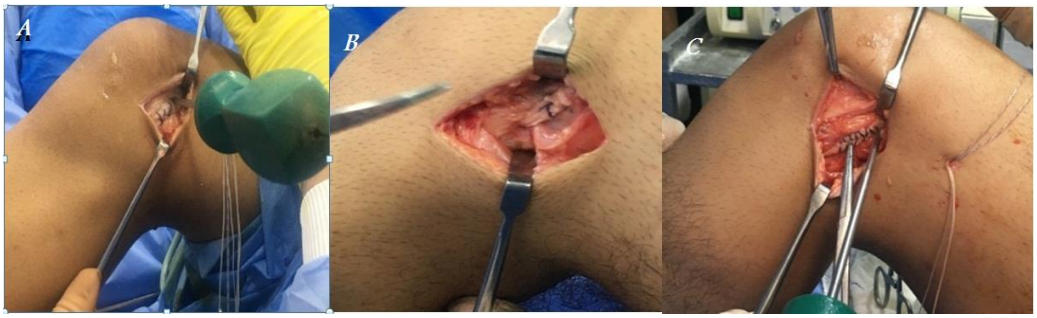

Figure 3: A fixation by interference screw posterior and proximal to FCL origin, final image after fixation of the graft B graft passing under FCL pulley, C graft fixed to the lateral femoral condyle.

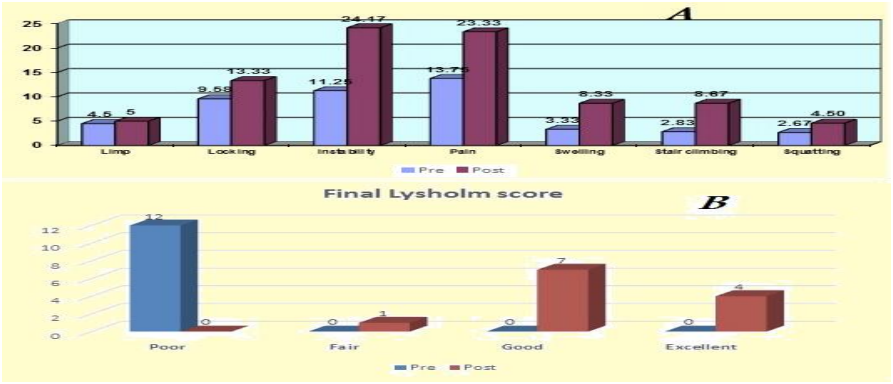

Figure 4: A: the mean of pre- and post-operative scores of the Lysholm score items. B: individual Pre- and post-operative scores of the Lysholm scale items

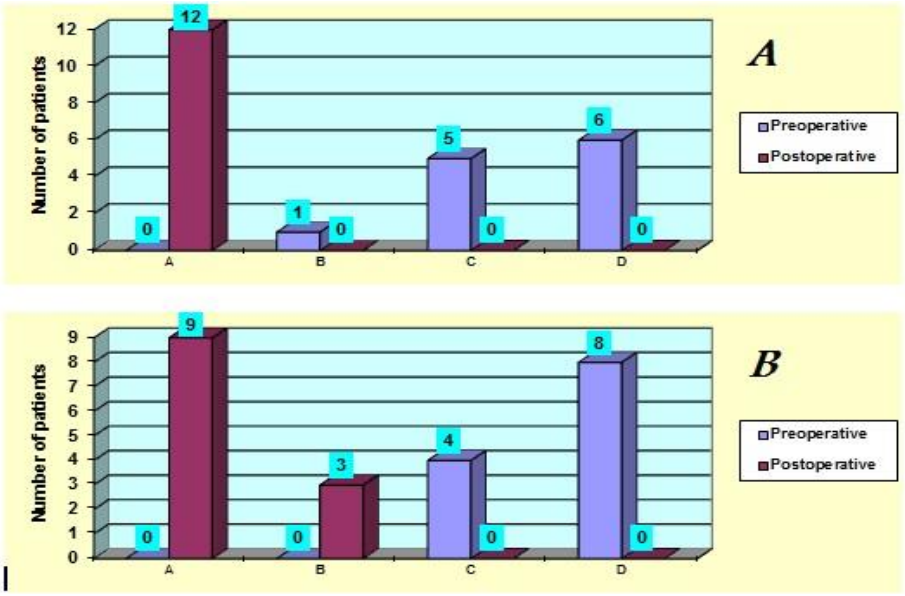

Figure 5: A: Pre- and post-operative Lachman test. B: Pre- and post-operative pivot shift test.

DISCUSSION

Many authors have studied the structure firstly described in 1870 by Paul Segond with well-established literature about its anatomy, radiology, function, value in controlling ALRI, limiting the pivot shift phenomenon and biomechanical properties with a better lever arm than intraarticular ACL to resist rotational laxity. [4, 9,10]

The most important finding in this study is that combined ALL and ACL reconstruction in ACL deficient knee showed good to excellent results regarding functional outcome and excellent results in preventing residual rotational laxity and pivot shift phenomenon with the technique chosen.

The main limitation of short term follows up period is that arthritis changes could not be detected in addition to other complication as failure, pathological laxity and revision. No recent long term studies are available for ACLR associated with LET; however, Branch et al. conducted a cohort study with at least 9 years' interval postoperatively where they reported better control of internal rotation with LET [11].

Modified Lemaire technique used with the graft passing under the FCL to be inserted posterior and proximal to FCL femoral origin using interference screw similar to Dejour et al. [12], Branch et al. [13] who used modified Lemaire technique but with gracilis graft and BTB for ACLR and Trichine et al. [14] who twisted the ITB graft 180º instead of passing the graft under FCL. However, Valada.et al., Guzzini et al. [15] used Arnold and cocker modification of Macintosh technique for LET.

Regarding our results, patients were satisfied or highly satisfied with the post-operative results, Lachman test dropped to normal for all our patients postoperatively while PST grade I reported only in 3 patients postoperatively and the

remaining showed negative test. The mean Lysholm score has raised from 51.92 ± 5.70 to 92.33 ± 5.07.

These values are comparable to Guzzini et al.[15] who reported that only 2 patients were PST grade I postoperatively while the rest were negative; on the other hand, the Lachman test was normalized for all the patients. They also reported that postoperative lysholm score increased to 91 ± 2.3 in addition to 100% return to previous sport level. However, our results were inferior to valada et al. [14] who reported rise of the mean post-operative lysholm score to 95.8±3.99 and the PST dropped to normal in 22 patients and grade I in five, this excellent results could be attributed to using of a different technique, selection of athlete patients with early reconstruction, less meniscal damage and highly motivated patients.

On the other hand, our results were superior to Imbert et al. who conducted a multicentric study over 478 patients with average follow-up of 6.8 years. They reported no detectable pivot shift in 83% of patients; while 12.8% of patient had a smooth glide with Lysholm score raised to 91.3 ± 9.61. This may be due to smaller sample size and shorter follow up in our study.

Postoperative complications included transient saphenous neuropraxia in one patient, haematoma over the lateral incision in one patient, infection on medial incision in another which subsided after debridement and post-operative effusion in two patients which subsided within two months.

While Valada et al. [14] and Guzzini et al. [15] reported no complication in their studies, Imbert et al. [16] reported 6,7% reoperation due to complication other than meniscal injury as haematoma, superficial infection, joint infection and Cyclops lesion, however these complications are not LET-specific and comparable to isolated ACLR. They also reported limitation on internal tibial rotation in 11% of patients in 20◦flexion and 13.7% in 90◦flexion without patient's complaint about it.

Hewison et al. [17] and Rezende et al. [18] concluded in their met analytic studies that association of ACLR with extraarticular procedures gave better controlling of PST and ALRI when compared to isolated ACLR while this improvement could not have been translated into difference in the functional score. Regarding revision ACLR, Trojani et al. [19] reported that the pivot shift was better controlled with a lower failure rate in the extra-articular procedure but still with no improvement of the functional score.

In addition to short term follow up, limitation of this study include small sample size with restrictive inclusion criteria. Another drawback is the design of the study, with no control group, limitation and additional value of the additional technique over the traditional one could not be determined.

CONCLUSIONS

In conclusion Extra articular tenodesis using modified Lemaire technique is a simple method for reconstruction of ALL and preventing ALRI which could occur after isolated ACLR.

Combined ALL and ACL reconstruction in patients with high pivot shift, chronic tear, Segond fracture or revision surgery shows good functional results and excellent results in preventing postoperative residual pivot shift phenomenon and residual instabilities with no specific complication noted.

Conflict of interest: None of the authors declare that they have any conflict of interest related to this work.

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