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Functional outcome of arthroscopic single bundle anatomical anterior cruciate ligament reconstruction using quadrupled semitendinosus tendon autograft: A prospective study

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Abstract

Background: Functional Outcome was studied at one year following anatomical reconstruction of anterior cruciate ligament using quadrupled semitendinosus tendon autograft in patients who had presented with symptomatic torn anterior cruciate ligament.

Methods: Thirty skeletally mature patients with anterior cruciate ligament tear confirmed by Lachman Test, with or without concomitant meniscal injury underwent Arthroscopic anterior cruciate ligament reconstruction using quadrupled semitendinosus tendon autograft, provided that they were permitted to undergo rehabilitation for six months post operatively. Single surgeon performed all surgeries and functional outcome was assessed periodically till one year followup.

Results: In our study of 30 patients with minimum one year follow-up, the IKDC score was normal in 70%, near normal in 23.3% and abnormal in 6.6%. 21 patients were very satisfied and rest 7 patients were satisfied as per SQ scoring. Before surgery affected leg hop test had mean of 42.36 with SD 10.19 and it increased postoperatively to 76 with SD of 19.93 which is statistically significant ($p < 0.001$). Limb Symmetry Index scores significantly increased to mean \pm SD of 82.01 ± 7.25 postoperatively from mean \pm SD of 45.88 ± 6.94 preoperatively. Lachman upto grade one laxity observed in 56.67% patients but with hard end point, which is the reason of success of surgery.

Conclusion: The functional outcome of arthroscopic single bundle anatomical anterior cruciate ligament reconstruction with quadrupled semitendinosus tendon autograft is excellent to good (93%).

Keywords: Arthroscopy ACL reconstruction, Anatomical ACL reconstruction, Semitendinosus Graft for ACL

Introduction

Ruptures of anterior cruciate ligament (ACL) are among the most common ligamentous injuries. There is scarcely any other ligament in the human body that has been the subject of more professional interferences and publications [1]. While widely investigated, the anterior cruciate ligament is still a highly persistent area of study [2].

Deficiency of anterior cruciate ligament is a common disorder which can lead to changes in lifestyle [3]. A tear of the ACL with resultant instability of the knee is indeed a major cause of disability and is not readily tolerated, particularly by an athlete [4]. Thus, patients who have symptoms related to ACL deficiency, may consider ligament reconstruction as a means of stabilizing the tibiofemoral joint and restoring high level function of the knee joint.

Graft sources include most commonly autograft (patellar tendon, hamstring tendon, quadriceps tendon) and synthetic ligaments, allograft or cadaveric tissue sources still in trial. Intra-articular ACL reconstruction using autografts is the gold standard for the foreseeable future. All autologous grafts have donor site morbidity. Many studies have demonstrated that hamstring grafts have fewer problems with anterior knee pain, quadriceps muscle deficits, loss of extension compared with BPTB autografts [5].

David J. Biau, *et al* performed a meta-analysis to provide qualitative data to ascertain whether bone-patellar tendon-bone graft or hamstring graft provided superior knee function as determined by final overall IKDC evaluation and return to pre injury level of activity.

They found no difference in the final number of patients restoring to full activity after hamstring tendon graft and bone-patellar tendon-bone graft reconstruction [6].

Our study is designed to analyze the postoperative outcome of arthroscopic anatomical ACL reconstruction with quadrupled semitendinosus tendon autograft fixed in femoral tunnel using ACL tightrope (endobutton) and in the tibial tunnel using suture disc.

Material and Methods

A prospective study of 30 patients was conducted, who underwent Arthroscopic Anatomical ACL reconstruction using quadrupled semitendinosus autograft during the period of September 2014 to May 2015 and they were followed up till May 2016. The data was collected using a pre-designed, pre-structured proforma

Inclusion criteria: All skeletally mature patients with ACL tear diagnosed by Lachman Test, with or without concomitant meniscal injury that required repair were included in study.

Exclusion criteria: Skeletally immature patients; patients with osteoarthritis of knee joint; ACL avulsion injuries; concomitant PCL, MCL, LCL, PLC (posterolateral corner) injuries requiring surgery; associated fractures; associated pathology of other joints of lower limb; revision ACL reconstruction patients.

Timing of surgery: In all acute cases of ACL injury, patients were treated with long knee brace for three weeks following which ACL reconstruction was planned. During that period patient received optimum preoperative physiotherapy exercises.

Surgical Technique

Initial Diagnostic arthroscopy: Performed via anteromedial and anterolateral ports and meniscal injuries were managed. Accessory medial port was used if required.

Graft Harvesting: Semitendinosus graft through standard antero-medial incision was taken.

Graft preparation: A quadrupled semitendinosus graft was prepared using double krackow stitch at the free end with ethibond no2 and graft tensioned on the graft board.

Tunnel preparation: Anatomical tunnel preparation was done aiming at the centre of AC, footprints using intercondylar ridge, bifurcate ridge as reference points for femoral site and medial tibial spine, anterior horn of lateral meniscus for tibial site. The femoral tunnel length to be reamed was measured with a depth gauge and then calculated according to the length of the graft material.

Graft fixation: ACL tightrope with endobutton at the femoral site and suture disc at the tibial site was used to fix the graft.



A

Results

Majority of our patients were males (72.4%), belonging to the age group 20-35year (72.4%), and with competitive lifestyle like army trainers, athletes etc. (43.33%). However, there was no much difference in the side affected of the patients as 53.33% were injured in right side and 46.67% were injured on left knee.

Giving way sensation and click were the major complaints in 25 (83.3%) patients followed by pain seen in 22(73.3%) patients. All the patients were examined with Lachman,

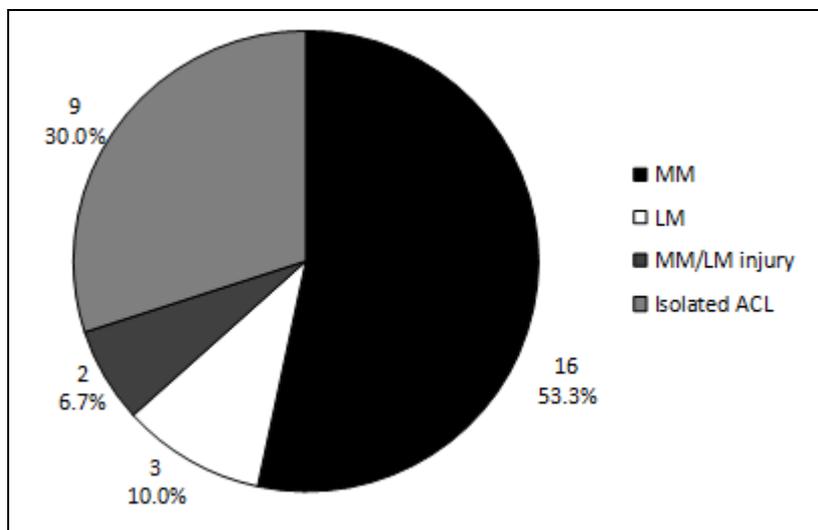
anterior drawer and pivot shift tests in OPD and under anesthesia prior to surgery. In OPD, 15 (50.0%) patients had grade 3 and 13 (43.3%) patients had grade 4 Lachman while rest 2(6.7%) patients were Lachman negative. Under anaesthesia, the grade 4 Lachman increased to 22(73.3%) patients and the rest were grade 3 except 2 patients being grade 2. Pivot shift test was positive in 16 (53.3%) patients in OPD but the same when done under anesthesia was positive in 28(93.3%) patients. (Table.1)

Table 1: Distribution of patients according to presenting symptoms and clinical evaluation

Characteristics	Number (N)	Percentage (%)
Presenting Symptoms		
Pain	22	73.3
Swelling	16	53.3
Giving way	25	83.3
Locking	10	33.3
Clicking	25	83.3
Clinical Evaluation of laxity in OPD and under Anesthesia		
OPD Lachman Test	28	93.3
Under anesthesia Lachman Test	30	100
OPD Anterior Drawer Test	27	90.3
Under anesthesia Anterior Drawer Test	29	96.7
OPD Pivot Test	16	53.3
Under anesthesia Pivot Test	28	93.3

Medial meniscus tear was the most common associated lesion in ACL injuries (53.3%) revealed on performing diagnostic arthroscopy prior to ACL reconstruction. Isolated ACL tears were seen in 9(30.0%) patients and 3 (10.0%) patients has

associated lateral meniscus tear. Both medial and lateral meniscuses were injured in 2(6.7%) patients which was least common. (Graph 1)



Graph 1: Associated injuries with ACL tear

After ACL reconstruction using a semitendinosus tendon, post-operative condition of the patient with minimum 1 year follow-up was assessed using International Knee Documentaion Committee (IKDC), Lysholm Gillquist Scoring (LGS) and Subjective Questionnaire (SQ) scoring. Majority of patients (70.0%) were classified as ‘Normal’,

‘Excellent’, ‘Very satisfied’ as per IKDC, LGS, SQ scoring and 23.3% of patients were classified as ‘Near Normal’, ‘Good’ as per IKDC, LGS scoring whereas 30.0% were classified into ‘Satisfied’ category according to SQ scoring system. (Table 2) However, age, gender and mode of injury were not statistically associated with IKDC and LGS scores.

Table 2: Post-operative outcome scoring of patients

Scoring Method	Number (N)	Percentage (%)
IKDC Scoring		
Normal	21	70.0
Near Normal	7	23.3
Abnormal	2	6.7
LGS Scoring Method		
Excellent	21	70.0
Good	7	23.3
Fair	2	6.7
Poor	0	0.0
SQ Scoring Method		
Very satisfied	21	70.0
Satisfied	9	30.0
Not satisfied	0	0.0

All patients performed the hop test at 6 months follow up. Before surgery, affected leg hop test had mean of 42.36 with

SD 10.19 which increased postoperatively to 76.0 with SD of 19.93 and it was statistically significant (p<0.001). (Table 3)

Table 3: Evaluation of Single Hop Test

Single Hop test (cms)	Normal side	Affected side	At the end of 24 weeks (postoperative)	Significance test		
				Normal side-Affected side	Normal side-At the end of 24 weeks (postoperative)	Affected side –at the end of 24 weeks (postoperative)
Min-Max	58.0-140	23.0-70.0	38.0-115.0			
Mean \pm SD	93.43 \pm 22.79	42.36 \pm 10.19	76.80 \pm 19.93	<0.001**	<0.001**	<0.001**

*statistically significant

The mean limb symmetry index (LSI) of single hop test was 45.88 preoperative which increased to 82.01 at 6 months. When LSI was calculated according to age, gender and mode of injury distribution preoperatively and postoperatively the improvement was statistically significant irrespective of age, gender and mode of injury. (Table 4)

Table 4: Evaluation of LSI Score

	Pre-op (%)	Post-op (%)
Min-Max	30.76-57.31	65.21-91.76
Mean \pm SD	45.88 \pm 6.94	82.01 \pm 7.25
Inference	LSI score significantly increased postoperatively with $t=20.902$; $p<0.001$ **	

*statistically significant

Discussion

Anterior cruciate ligament reconstruction has become the standard care for ACL injuries in the active patients. The hamstring tendon grafts, specifically quadrupled semitendinosus tendon is excellent choice given their low harvest morbidity, biomechanical properties and minimal complications. Graft fixation is of major concern for the successful outcome of ACL reconstruction which is readily achieved by the tightrope (endobutton) on femoral side and suture disc at the tibial side with their excellent pullout strength which is further strengthened by graft to bone healing. Though all the patients were aged between 18-50years, most of them fall in the age group 20-35year, conveying the message that ACL injuries are common in young adults. Highly male dominance (28 out of 30) may be related to their frequent involvement in sports, outdoor and strenuous activities. Right knee was injured in 16 patients and the rest 14 sustained left knee ACL tear shows that there was not much difference in lateralization of the injury. There was increase in grades of Lachman and Pivot test when performed under anaesthesia than when compared to performed in OPD. So, Lachman under anaesthesia is as good as diagnostic arthroscopy, performed prior to surgery in detecting ACL tears.

Juri T. Kartus *et al* [7]. In their study showed that patients with concomitant partial meniscectomy had more pain, swelling, laxity and greater loss of motion than those without meniscectomy. They also had worse classification according to the IKDC scoring, lower LGS scoring.

In present study, patients with concomitant partial meniscectomy have lower IKDC OR LGS scoring as compared with isolated ACL injuries. In our two cases of ACL rupture with displaced bucket handle of medial meniscus (which was found on initial diagnostic arthroscopy) we could find that the clinical examination which was done in OPD had given an absent anterior drawer, pivot shift and near normal Lachman test, but when the same was done under anaesthesia, it had turned Lachman positive of just grade 2+ while pivot shift remained negative. So if the history strongly suggests an ACL injury and examination reveals a near stable knee, then the dual pathology of bucket handle medial

meniscus and ACL rupture should be suspected. In our study, we used semitendinosus tendon autograft only to reconstruct near anatomical ACL without sacrificing gracilis tendon to produce equally good results as that of with semitendinosus and gracilis use. This technique of ACL reconstruction using single bundle quadrupled fold semitendinosus tendon autograft with tight rope gives excellent results with little morbidity and low reoperation rates.

Vernon J. Cooley *et al* [8]. In their study concluded that ACL reconstruction using quadrupled fold semitendinosus tendon autograft provides excellent clinical outcome, patients maintain preinjury activity without episodes of reinjury. About 85% of the patients according to IKDC scoring fall into normal to near normal in their study as compared to more than 90% normal to near normal in our study. In this study, we used tight rope (Endobutton) for femoral fixation and suture disc for tibial fixation. Leo Chan *et al* [5]. Reported that the technique of ACL reconstruction using quadrupled fold semitendinosus tendon autograft for ACL reconstruction using the Endobutton for femoral fixation has been used for over ten years with no known instance of fixation failure.

K Button and others [9]. In 2005, evaluated the outcome of anterior cruciate ligament reconstruction with semitendinosus tendon autograft with same rehabilitation protocol in 48 patients with average follow-up of 20weeks, and found the IKDC score normal or near normal in 92% of cases. In our study of 30 patients of minimum 1 year follow-up the IKDC score normal in 70%, near normal in 23.3% and abnormal in 6.6%. 21 patients were very satisfied and rest 7 patients satisfied as per SQ scoring. No patient was dissatisfied. This was probably due to the fact that most of the patients were keen on normal day to day activities than return to sports.

Andrea Reid *et al*, in March 2007, published their results of a series of hop tests on 42 patients, 15-45 years of age who had undergone ACL reconstruction [38], the mean limb symmetry index in above study was calculated at the 22nd postoperative week against at 24 weeks postoperative in our study. The mean values of above study were all above 85%. In our study, the mean value is around 82%. This could be due to some patients; especially the ones with a poorer outcome had much lower limb symmetry indices which was skewing the mean to the lower side. Moreover, many patients were quite apprehensive in performing the hop test, thereby increasing the disparity between the normal and the operated limb scores. Time period elapsed between the injury and the ACL reconstruction ranged from 1½ months to 2 years with a mean value of 5.8 months. The duration of surgery ranged from 90 minutes to 135 minutes with a mean of 109.6 minutes. 2 patients had pain at the graft donor site. 3 patients had numbness over graft donor site which improved later. 17 patients (56.67%) had laxity of up to grade 1. In spite of this, Lachman test was hard end and it is the reason for the success of the surgery; 4 patients had terminal restriction movements thus resulting in decreased postoperative scores, which improved over time.

In our study, 83.33% of the patients were complaint with the physiotherapy regimen. Once the day to day activities of

walking, squatting and climbing stairs returned, after following patients according to Wilk et a rehabilitation protocol during immediate post-operative and follow up period, it was observed that adherence to physiotherapy gradually waned in most of the patients.

Conclusion

This study was conducted on 30 patients suffering from ACL deficiency in the age group of 19-48 years. Instability of knee in the form of giving way is main complaint evaluated by Lachman test and confirmed by arthroscopy. The functional outcome of arthroscopic near anatomical anterior cruciate ligament reconstruction with single bundle quadrupled semitendinosus tendon autograft is excellent to good (93%) with mild laxity at the end of one year. However, larger studies with longer follow up are required to convince whether these methods are better than conventional techniques.

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