

RESEARCH ARTICLE

Comparative Analysis of Arthroscopic Tight Rope ACL Reconstruction Using four Strand Isolated Semitendinosus Graft and Quadrupled Combined Hamstring Graft

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Abstract

Background: Arthroscopic ACL reconstruction using hamstring autograft is a quite a popular surgical procedure. But there is a conflict regarding the use of isolated semitendinosus graft or a combined hamstring graft. We did a comparative analysis of the functional outcome after ACL reconstruction performed with four strand semitendinosus graft and a combined hamstring graft over tightrope.

Methods: Two groups of 30 patients each with similar demographic profiles, presenting with symptoms of instability after chronic ACL tear were included. A standard single bundle arthroscopic ACL reconstruction was performed by using four-strand semitendinosus graft in Group A and combined hamstring graft in Group B patients. Clinical and functional outcome analysis was done using quantitative anterior tibial translation measurement and Lysholm score.

Results: The mean age of subjects in group A was 29 years and in Group B was 28 years. The semitendinosus graft length was insufficient in 13.33% cases in group A. The improvement in Lysholm score and the decrease in the tibial translation were comparable in both the groups at one year of follow-up. No added comorbidities were noted in additional removal of gracilis tendon in group B patients.

Conclusion: Isolated semitendinosus four-strand autograft can be used for arthroscopic single bundle ACL reconstruction when adequate graft length is obtained. However, one should not be hesitant in additional removal of gracilis tendon when needed. In terms of functional outcome and patient satisfaction, both the graft configurations stand the same.

Level of evidence: I

Keywords: Combined Hamstring graft, Four-strand semitendinosus, Single bundle ACL reconstruction

Introduction

Anterior cruciate ligament (ACL) reconstruction is the most widely performed arthroscopic procedure worldwide. A variety of graft options are available including bone patellar tendon autograft,

hamstring autograft and allografts. The ideal graft used should be easy to harvest, with no donor site morbidity and with adequate load to failure strength (1). Allografts run the risk of re-tear, allogenic

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reactions and possible transmission of communicable diseases. Additionally, these are also not easily available in developing nations and they prove to be costly in terms of maintaining a proper tissue bank with adequate storage facilities. Thus, autografts are more popular among the arthroscopy surgeons all over the world (2,3).

Bone patellar tendon autograft has the maximum stiffness among the available autograft options, but its use has declined in the past few years due to increased incidence of postoperative knee pain, weakened extensor mechanism and pain in kneeling position (4). Currently hamstring autografts are usually preferred, but still there are a lot of discrepancies regarding the preparation technique and graft preference among sports medicine specialists.

Quite frequently, the question arises as to whether a single hamstring tendon is enough or two hamstring tendons should be used for ACL reconstruction. The advocates of the former thought suggest that harvesting two hamstring tendons decreases the knee flexion and internal rotation strength in the post-operative period and also adds to increased donor site morbidity (5-7).

We did a comparative analysis of functional outcome after arthroscopic ACL reconstruction using four strand isolated semitendinosus and quadrupled combined hamstring graft performed in the same center, by the same surgeon.

Materials and Methods

A total of 60 symptomatic patients in the age group of 15-50 years with complete ACL tear were divided into two groups of 30 each. All the cases were randomized using simple random sampling method and the operating surgeon was blinded from the sampling procedure. Each group was subjected to clinical tests (Anterior drawer, Lachman and pivot shift) for ACL tear and an MRI of the involved knee was done to document a complete tear of the ligament.

Group A (30 patients) was operated with four strand semitendinosus graft and group B (30 patients) was operated with combined hamstring graft. An oblique incision was used in both the groups for graft retrieval on the antero-medial aspect of tibia as there are less chances of damage to the infrapatellar branch of saphenous nerve with this incision (8). After carefully incising the sartorius fascia in an oblique fashion parallel to the direction of the pes tendons, semitendinosus and gracilis were hooked and released from all the tendinous ramifications. The tibial site attachment was severed as close to the bone as possible in group A patients so as to gain maximum possible length of the isolated semitendinosus and optimum precaution was observed not to damage the additional conjoint tendon during this maneuver (9).

In group A, graft preparation was done with stitching the semitendinosus graft ends and folding it in four strand quadrupled fashion while in group B semitendinosus and gracilis graft was loaded over the tightrope by symmetrically folding it over the loops [Figure 1-4] (10). Then standard knee arthroscopy portals were



Figure 1. Preparation of isolated semitendinosus graft for group A.

used and a single bundle tight rope ACL reconstruction was performed in both the groups. Postoperatively, both the groups were put on same rehabilitation protocol with isometric quadriceps exercises and walking with



Figure 2. Final four-strand semitendinosus graft.



Figure 3. Combined semitendinosus and gracilis graft preparation for group B.

crutches and knee brace for initial two weeks. Gradually, normal gait pattern without crutches and knee brace was encouraged in the 3rd week and non-contact sports were allowed only after at least 4 months.

The outcome evaluation was done using Anterior tibial translation measured by using a rollimeter [AIRCAS] and Lysholm scoring done pre-operatively and one year post-operatively (11). The rollimeter is a simple portable arthrometer used to quantify the tibial displacement when the examiner translates the tibia anteriorly with manual force in 90 degrees of knee flexion. It is comparable to KT-1000 in terms of diagnosing the ACL deficient knees [Figure 5] (12).

Statistical Analysis

Data analysis was done using SPSS version 21. For quantitative data like Lysholm score and anterior tibial translation, mean and standard deviation were calculated and preoperative values were compared with postoperative follow up findings using paired T-test. $Pvalue < .05$ was considered statistically significant. Qualitative data like clinical examination findings (anterior drawer, lachman and pivot shift tests) was expressed as proportions.



Figure 5. AIRCAST Rollimeter.



Figure 4. Final combined hamstring graft loaded over tightrope.

Ethical Statement

A valid ethical clearance was obtained from the ethical committee of the institution for the purpose of this study.

Results

Both the groups had 28 male and 2 female patients. The mean age of Group A was 29 years (youngest= 17 years, oldest= 46 years) and of Group B was 28 years (youngest =18 years, oldest= 46 years). The mean time lapse between injury and surgery was 7.6 months in Group A and 6.46 months in Group B. Associated medial meniscus injury was found in 36.7% cases in group A and 23.33% cases in group B.

The average semitendinosus graft length in group A was 289mm (Four strand average length=72.27mm) and average diameter of the graft was 7.53mm. Four out of 30 patients in group A had a graft length of less than 280mm, so interference screw fixation was practically not possible, instead a suture disc was used over antero-medial cortex of tibia to achieve fixation. While in group B, the average length of combined quadrupled hamstring graft was 127.73 mm and the average diameter was 7.5 mm. The mean femoral tunnel length in group A was 41.33mm and in group B was 39.5 mm. Mean tourniquet time was 55.2 min for group A and 53.77 min for group B.

Anterior drawer test and Lachman test were recorded positive (grade 1) in 11 patients in Group A and in 7 patients in Group B in post-operative period while the pivot shift test was recorded negative in all the patients of the both the groups postoperatively.

Anterior tibial translation measured in 90° of knee flexion improved in both the groups and a similar improvement was noted in the Lysholm Score [Table 1].

The average Lysholm score in four patients of group A with suture disc fixation on the tibial side improved from 51 to 77 and the average tibial translation decreased from 11.5 to 4.25 mm at one year follow-up [Table 2]. These patients were also subjected to same rehabilitation protocol as other study patients.

Table 1. Anterior tibial translation measured in 90° of knee flexion

	Group A		Group B	
	Preoperative	Postoperative	Preoperative	Postoperative
Positive Anterior Drawer test	30 patients	11 patients (grade 1)	30 patients	7 patients (grade 1)
Positive Lachman test	30 patients	11 patients (grade 1)	30 patients	7 patients (grade 1)
Positive pivot shift test	30 patients	0 patients	30 patients	0 patients
Mean anterior tibial translation measured in 90° of knee flexion	11.2mm	3.5mm (<i>P value</i> = <.0005)	10.8mm	3.63mm (<i>P value</i> = <.0005)
Mean Lysholm Score	49.8	93.23(<i>P value</i> = <.005)	47.53	97.45 (<i>P value</i> = <.01)

Table 2. The average Lysholm score in four patients of group A

	Preoperative Lysholm Score	Postoperative Lysholm Score	Preoperative Rollimeter Reading (in mm)	Postoperative Rollimeter Reading (in mm)
Subject 1	50	78	12	5
Subject 2	42	77	14	4
Subject 3	54	75	10	3
Subject 4	58	78	10	5
Average	51	77	11.5	4.25

Discussion

Anterior cruciate ligament of the knee is quite commonly injured in younger population especially in athletes. The usual mechanism of injury is non-contact pivoting, with the foot firmly planted on the ground and valgus or rotatory stress acting on the knee. The most common mode of injury that we came across was due to road traffic accidents in both our study groups, with the person riding on a bike. It was then closely followed by sports related injuries (13).

Usually a prompt diagnosis of ACL tear is hard to reach immediately after trauma, as there is significant hemarthrosis and it is extremely painful for the patient to undergo a complete physical examination. Once the pain subsides and patient starts walking without any support, an expert is consulted for instability. Clinical examination is the key to reach the diagnosis but an MRI scan is advisable to document complete tear of the ligament and associated injuries. Once the tear has been acknowledged, there should be no further delay in reconstruction as there is increased susceptibility of medial meniscus injury and progressive cartilage wear (14,15).

Hamstrings autografts are being widely used in ACL reconstruction for quite sometime now. It is relatively easy to obtain and prepare, has adequate stiffness and good healing and viability. It surely has overtaken bone patellar tendon and is now the commonly used graft for ACL reconstruction. An increased incidence of knee discomfort, patella-femoral problems and increase in the areas of decreased skin sensitivity are the commonly reported problems with bone patellar tendon graft (16). There is a long list of methods of hamstring graft

harvesting depending upon the incision being used (oblique or vertical or medial popliteal) and tibial site fixation (extracortical or interference fixation or tibial attachment preserving) (17). We used a short 2-3cm medial oblique incision to retrieve the graft using a closed tendon stripper after careful detachment of the tendon from tibial insertion.

An isolated semitendinosus graft in four-strand configuration has often been popularized by various authors in terms of its adequacy for single bundle ACL reconstruction. We noted almost similar improvement in Lysholm score and quantitative anterior tibial translation with the use of isolated Semi-T graft as compared to combined hamstring graft. But, the length of the semitendinosus graft is often inadequate for it to be used in a four-strand fashion (18). The minimum quadrupled graft length required for a single bundle surgery is 7cm, for which the tendon length should be at least 28cm. In our study, 13.33% patients (4 out of 30) did not have adequate length of the harvested tendon in isolated Semi-T group. Consequently, a compromise had to be done in tibial fixation of the graft (19).

It is well known that the free hamstring graft undergoes necrosis, then revascularization happens and there is formation of fibro-cartilage at the graft tunnel interface (20). Usually, the tibial side is the weakest link in incidence of graft failure (21,22,23). So, when inadequate graft length jeopardizes tibial site fixation, the chances of early graft failure are also increased substantially.

Gracilis is an important muscle in the medial hamstrings group. It primarily acts as a hip adductor, but also assists in knee flexion and has a stabilizing role in knee internal

rotation (24). So, it is frequently argued that using it as a graft might lead to decrease in knee flexion strength in the post-operative period. We did not come across any complaint from patients regarding weakness of knee flexion in group B patients. The power of knee flexion measured as per MRC grading in group B patients was comparable to that of group A patients. Also, the surgical time was similar in both the groups suggesting that there is no significant additional morbidity in terms of blood loss during gracilis retrieval.

The results of our study seem to be reliable as the demographic factors in terms of study population were similar in both the groups (age group, sex ratio). The timing from injury to surgery, the method of graft harvesting, average femoral tunnel length (comparable in both the groups) and post-operative rehabilitation protocol were also the same and the fact that all the patients were operated by the same surgeon in the same setup prove that confounding factors were kept to the minimum.

Hamstring autografts provide optimum result in single bundle arthroscopic ACL reconstruction. Semitendinosus tendon alone can be used as a suitable graft option, but it is not always that adequate length of the tendon is obtained. So, instead of compromising on the fixation method, gracilis should be used in combination of semitendinosus in cases of shorter graft lengths. In terms of functional outcome, there is not much difference in the use of both the configurations. There is no delay in rehabilitation of patients following the use of both the

tendons as compared to a single tendon.

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