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A study on surgical management of anterior cruciate ligament injuries by arthroscopic reconstruction using semitendinosus and gracilis tendon

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Abstract

Background and Objectives: The unprecedented growth and development in the past decade of our country saw rapid growth and urbanization resulted in change in life style of the people and also increase in the sports and other occupational related activities by the individuals. This has led to the increased accidental injuries to the knee joint, a major contributing factor to Anterior Cruciate Ligament (ACL) injury. Arthroscopic ACL reconstruction using quadrupled semitendinosus and gracilis tendon autograft with using endobutton for femoral tunnel fixation and in the tibial tunnel with hybrid fixation using suture disc and anchored with a cancellous screw and washer or interferential screw is a relatively new technique. We have undertaken this study to analyze the postoperative outcome in our experience with this procedure.

Methods: This was a prospective study of consecutive patients with ACL injury who underwent Arthroscopic ACL reconstruction in our institution using quadrupled semitendinosus and gracilis tendon autograft. Postoperatively, all patients were initiated on the same rehabilitation protocol. All patients were followed up for four to six months period at regular intervals using IKDC, LGS scoring systems and a subjective questionnaire. Functional assessment with hop test was done.

Results: About 92% of the patients had a favourable outcome as per three scoring systems. All three scoring system had a very high correlation as evidenced by the Kendal-tau values ranging x from 0.464 to 0.923. Statistically, this was found to be highly significant (p value- 0.000 – 0.001). Using IKDC scoring, the results were normal in 14, nearly normal in 10 and abnormal 1. 4 patient (16%) presented with anterior knee pain. Sensory loss was noted in 3 patients (12%) at the end of 6 months following surgery. Swelling was present in 4 patients (16%).None were having any infection and FFD.

Conclusion: We conclude that the functional outcome of arthroscopic anterior cruciate ligament reconstruction using quadrupled semitendinosus and gracilis tendon autograft is excellent to good (92%). With proper patient selection and physiotherapy regimen, full occupational and recreational activities can be expected for most of the patients within four to six months of the procedure.

Keywords: Anterior cruciate ligament, arthroscopic, semitendinosus, gracilis tendon autograft

Introduction

Arthroscopic-assisted reconstruction of the anterior cruciate ligament (ACL) using hamstring grafts is a well-known and widely accepted surgical procedure [1]. The use of hamstring tendon autograft has been perceived to have less post-operative morbidities [2].

Anterior Cruciate Ligament (ACL) injury is the most controversial ligamentous injury and has been studied extensively all over the world in the past 20 yrs. The Anterior Cruciate Ligament is the weaker of the two cruciate ligaments and therefore its injuries are more common than the PCL [3].

The ACL is an important restraint to anterior tibial translation and tibial rotation and contributes to the overall stability of the knee [4-6]. If an ACL insufficiency remains untreated, meniscal tear and cartilaginous damage of the joint may secondarily occur [7, 8]. Therefore, ACL reconstruction is generally recommended for active younger people to restore joint stability and prevent secondary arthritis [9].

Anterior knee instability associated with rupture of the ACL is a disabling clinically and the ACL has a poor capacity for intrinsic repair. Thus patients, who have knee symptoms related to ACL deficiency, may consider ligament reconstruction as a means of stabilizing the tibio-femoral joint and restoring high level function of the knee joint.

Arthroscopically assisted Anterior Cruciate Ligament Reconstruction has the advantage of being minimally invasive, accurate graft placement, less disturbance of normal tissue resulting in quicker recovery and rehabilitation, minimal hospital stay and very less infection rate.

There is fair evidence that patients reconstructed with hamstring graft report less morbidity than those reconstructed with bone-patellar tendon- bone graft. Hamstring graft reconstruction is also not without challenges. It may pose hamstring weakness following ACL reconstruction and the fixation in the tunnel can be longer with respect to bone-patellar tendon [10].

The present study is designed to analyse the postoperative outcome of arthroscopic ACL reconstruction with quadrupled semitendinosus and gracilis tendon autograft fixed in femoral tunnel using endobutton and in the tibial tunnel using interference screws. The measurement of ACL laxity is clinically important from the preventive diagnosis of knee injury standpoint as well as for comparison of pre and post-surgical reconstruction and conservative treatment. Generalized articular laxity can also be a risk factor for a number of skeletal muscle injuries [11].

Aim and Objectives

1. To study the functional outcome of arthroscopic anterior cruciate ligament reconstruction using semitendinosus and gracilis tendon autograft.
2. To study the complications following arthroscopic anterior cruciate ligament Reconstruction using STG autograft.
3. To assess the morbidity following arthroscopic ACL reconstruction using the hamstring grafts.

Methodology

This was a prospective study of 25 consecutive patients who underwent arthroscopic ACL reconstruction using quadrupled STG tendon autograft during the study period, September 2018 to September 2020, in Department of Orthopedics, Medici Institute of Medical Sciences, Ghanpur, Hyderabad.

Data was collected according to a proforma. Ethical committee clearance was obtained.

Inclusion criteria

1. All skeletally mature patients with ACL tear confirmed by Lachman test, Anterior Drawer test, and the pivot shift test. The diagnosis is reconfirmed with MRI and diagnostic arthroscopy were included in the study,
2. Patients willing to undergo post-operative ACL rehabilitation protocol after reconstruction.
3. No history of previous ligament reconstruction.
4. Healthy contra-lateral knee.

Exclusion criteria

1. Patients with ACL avulsion injury.
2. Anterior cruciate ligament tear with Concomitant posterior cruciate ligament, collateral ligament injuries requiring surgery or posterolateral corner injury.
3. Anterior cruciate ligament tear associated with the bony injury around the knee.
4. Patients undergoing revision ACL reconstruction.
5. Concurrent musculoskeletal condition, eg, back, hip, or ankle injury on either extremity.

Initial Arthroscopy

The patient receives the intravenous antibiotics pre-operatively. After induction of anaesthesia, the patient is positioned supine

with the operative leg in a leg holder and tourniquet on the upper thigh.

Diagnostic arthroscopy is performed through an anteromedial and anterolateral portals.

Integrity of ACL, PCL meniscus cartilage cover over the tibial and femoral condyle and Patella is inspected and any chondral or meniscal procedures are performed at this time. A minimal soft-tissue notch plasty is performed for visualization purposes only.



Fig 1: Patient positioning

Make a 4-cm incision anteromedially on the tibia starting approximately 4 cm distal to the joint line and 3 cm medial to the tibial tuberosity. Expose the pesanserinus insertion with subcutaneous dissection. Palpate the upper and lower borders of the sartorius tendon, and identify the palpable gracilis and semitendinosus tendons 3 to 4 cm medial to the tendinous insertion.

Make a short incision in line with the upper border of the gracilis tendon, and carry the incision just through the first layer, taking care not to injure the underlying medial collateral ligament.

With Metzenbaum scissors, carry the dissection proximally up the thigh. Stay in the same plane, and maintain adequate exposure by using properly placed retractors. With a curved haemostat, dissect the gracilis and semitendinosus tendons from the surrounding soft tissues about 3 cm medial to their insertion onto the tibia.

Postoperative management

All patients were initiated on postoperative ACL Protocol (adapted from Wilk *et al.*) on postoperative day 1.

On the operative day, after patient recovers from anaesthesia, patient is taught to do foot and ankle pump movements. The next day patient was taught static quadriceps exercises. On the 2nd postoperative day, active knee bending with gradual increase of 10-20 degrees of flexion/ day was started. On the 3rd post-operative day, assisted SLRT, abduction and adduction exercises of thigh and hamstring strengthening exercises were started.

By the end of 1st week, patient will be able to walk full weight bearing with long knee brace. Sutures are removed on the 10th post-operative day and patient is discharged with the advice to continue exercises as per the protocol given to them in the form of a booklet.

Patients were advised to wear long knee brace for 2 months to protect the knees from getting injured. Patients were followed up every month for the first 6 months and the progresses are assessed. Patients are subject to single hop test at 4th, 5th and 6th month of post-operative period and at the end of 6 month, the patients are subjected to IKDC, Lysholm Scoring and the subjective questionnaire.



Fig 2: Post-operative X-ray



Fig 3: Graft passage and fixation



Fig 4: Tibial side fixation by biointerference screw

Results

Table 1: Age Distribution

Age in Years	Number	Percentage
20 to 25	07	28
26 to 30	08	32
31 to 35	08	32
36 to 40	01	04
41 to 45	03	12
46 to 50	00	00
Total	25	100

The mean age in our study was 33.68 years. The youngest patient was 21yrs and the oldest patient was 45 years old. The maximum number of patients were in the age group of 26 to 35 years followed by the age group of 20 to 25 yrs (28%).

Table 2: Sex Distribution

Sex Distribution	Number	Percentage
Male	21	84
Female	4	16
Total	25	100

In our series of 25 patients, 21 patients (84%) were males and 4 patient (16%) female, (Male Predominance). It may be because of the involvement of males in outdoor activities like sports, farming and road traffic accidents.

Table 3: Side Injured

	Frequency	Percentage
Left	11	44
Right	14	56
Total	25	100

Right knee was injured in 14 patients (56%) and left knee was injured in 11 patients (44%).

Table 4: Dominant Side Affected

	Frequency	Percentage
Left	03	12
Right	14	56
Total	17	68

About 56% of injury occurred in the dominant side of affected patients.

Table 5: Mode of Injury

	Frequency	Percentage
Sports	5	20
RTA	8	32
Fall/Activities of Daily Living	12	48
Total	25	100

- Most of the ACL tears were caused by either occupational or while doing activities of daily living like slip and fall while walking/ climbing down stairs. Twisting of the knee was noted in most of the
- Patients followed by twisting in flexion (48%).
- Next common cause is road traffic accidents (about 32%). Some patients (20%) got injured Sports activities like football, kabaddi and athletics like jumping, police physical training, etc.

Table 6: Nature of Occupation

	Frequency	Percentage
Sedentary	12	48
Forming	08	32
Competitive	05	20
Total	100	100

Majority of the patients (48%) got injured while attending their activities of daily living and were usually leading sedentary life style. Next major group is from farming community in our study (32%) followed by competitive sports (20%).

Table 7: Signs and symptoms before surgery

	Yes	Percentage
Pain	15	60
Swelling	12	48
Instability/Giving Away	25	100
Locking	12	56
Clicking	21	84

All patients presented with complaints of giving way of the knee. 84% of the patients were able to appreciate the clicking of knee. 48% cases were having swelling and 60% cases presented with complaint of pain. 56% gave history of locking of knee which was correlated with associated injuries in the knee.

Table 8: Frequency of Associated Injuries on MRI

	Yes		No	
	Number	Percentage	Number	Percentage
MMIM	02	8	23	92
LMIM	01	4	24	96
MCLIM	0	0	25	100
LCLIM	0	0	25	100
ACLIM	25	100	0	0
PCLIM	0	0	25	100

Medial meniscal tear was the detected in about 2 patients by MRI followed by lateral meniscus in one. There was no collateral ligament and /or PCL injury.

Table 9: Results of associated injuries on arthroscopy

	Frequency	Percentage
MM	03	12
LM	01	04
PCL	00	00
Isolated ACL	21	84
Total	25	100

Diagnostic arthroscopy prior to ACL reconstruction confirms the medial meniscal tear in 03 patients (12%) cases and lateral meniscal tear in 1 (4%) patients. The rest of the cases (84%) were isolated ACL injuries. There was no PCL injury in our study.

Table 10: Post – Op Complications

Graft Site Morbidity	Yes		No	
	Number	Percentage	Number	Percentage
Pain	04	16	21	96
Swelling	05	20	20	80
Superficial Infection	0	0	25	100
Deep infection	0	0	25	100
Numbness	03	12	22	88
Laxity	02	08	23	92
Click	0	0	25	100
FFD	0	0	25	100

4 patients (13.33%) had pain at the graft site at the end of 6 months. Postoperative periods were uneventful with no cases of infections. Grade I laxity at the end of 6 months is noted in 2 patients but with hard end point. Numbness is noted in 03 patients.

Table 11: Range of movement

	N	Minimum	Maximum
Roma	25	0 -60	0 -80
Rom6	25	0 -90	0 -140

At the time of admission, 6 patients were having ROM of 60 degrees, 13 patients with ROM of 70 degrees and 6 were having around 80 degrees.

About 56% of the patients attained movements ranging from minimum of 90 degree to maximum of 140 degrees and about 40% of them up to 130 degrees at the end of 6 months.

Table 12: Post – Op Outcome: IKDC Scoring System

	Frequency	Percentage
Normal	14	56
Nearly Normal	10	40
Abnormal	1	4

Most of the patients graded their postoperative recovery as normal (56%) and 40% as nearly normal whereas 1patients (4%) graded recovery as abnormal according to IKDC score. The abnormal group included patient who was not complaint with regular ACL rehabilitation protocol.

Table 13: Post-Operative Outcome—SQ

	Frequency	Percentage
Very Satisfied	17	68
Satisfied	07	28
Not Satisfied	01	04
Total	25	100

With the regular follow up and at the end of 6 months, 68% patients graded their recovery as very satisfied and the remaining 28% were satisfied with the outcome except one.

Table 14: Post–Operative LGS Scoring System

	Frequency	Percentage
Excellent	15	60
Good	08	32
Fair	02	08
Total	25	100

Around 60% of the patients reported outcome as excellent and with scores above 85 and 32% reported as good with score of 84-74 respectively according to LGS scale. 2 patients (08%) scored >65 and <73 and were grouped as fair outcome.

Table 15: Single Leg HOP Test

Limb Symmetry Index	Minimum	Maximum	Mean
Pre-Operative	22.72	57.14	44.35
Post-Operative	66.36	93.33	83.50

Limb symmetry index was calculated by the percentage of affected limb over the normal limb. The preoperative index ranges from 22.72 to 57.14 with a mean of 44.355. Post operatively the index improved to a mean of 85.503 ranging from 66.36 to 93.33.

Table 16: Physiotherapy Compliance

Physiotherapy	Frequency	Percentage
Complaint	23	92
Non complaint	02	08
Total	25	100

92% of the patients were complaint with the post-operative rehabilitation protocol. The percentage was higher initially but with the improvement in the daily life activities, the patients gradually decreased their physiotherapy intensity and thus the

final non compliancy was 08%.

Table 17: Return to Pre Injury Level of Activity

	Yes		No	
	Number	Percentage	Number	Percentage
Return To Pre Injury Level Of Activity	23	92	02	08

About 23 of 25 (92%) of the patients were able to return to their pre injury level of activities including their previous occupation, farming and to competitive sports. 2 patients (8%) were not satisfied with physiotherapy regimen and these patients were noncompliant to the protocol.

Table 18: Comparison of IKDC and LGS

LGS	IKDC			
	Normal	Nearly Normal	Abnormal	Total
Excellent	12 81.81%	03 30%	00 00%	15 100%
Good	02 18.18%	06 60%	00 00%	08 100%
Fair	00 00%	01 10%	01 100%	02 100%
Total	14 100%	10 100%	01 100%	25 100%

Discussion

Arthroscopic ACL reconstruction is performed to restore the functional stability in ACL deficient knees and restore the normal kinetics of the knee. Increasing number of ACL reconstruction surgeries have been performed and there is an increasing expectation of patients to speedy recovery and more rapid return to activities of daily living, work and study.

Long term outcomes and post-op morbidity following arthroscopic ACL reconstruction depends on graft selection, surgical technique, experience of the surgeon and rehabilitation protocol for 6 months during immediate post-operative and follow up period.

This is a prospective study to assess the surgical outcome following arthroscopic ACL reconstruction using the quadruple stranded hamstring graft.

Although there are many potential graft choices from which to choose for ACL reconstruction, hamstring autografts have over the past decade become increasingly more popular. Several studies have shown that quadrupled-strand hamstring tendon ACL reconstructions have higher strength, stiffness, and cross-sectional area compared with patellar tendon grafts.

In our study 21 male and 4 female patients underwent ACL reconstruction using quadrupled STG tendon autograft and all these patients underwent graft fixation using endobutton in the femoral tunnel and hybrid fixation with suture disc and an anchoring interferential screw within the tibial tunnel.

All aged between 21 and 50 years of age. The side of injury was distributed accordingly –56% [14 patients] to right knee while 44% [11 patients] injured their left knee.

A statistical trend towards a better outcome in all three scoring systems was seen with injury to the dominant lower limb but this was not significant.

Arthroscopic ACL reconstruction was done as an in-patient procedure in all patients under spinal anaesthesia.

In 2009, Brown^[12] and others studied the incidence of sex and limb differences in anterior cruciate ligament injury and stated that even though females are prone for injury, due their less exposure to strenuous environment makes the incidence of males more than females. They also concluded that limb differences have no influence either during injury or in the recovery period.

Once the day to day activities of walking, squatting and

climbing stairs returned, after following according to Wilk *et al.*, rehabilitation protocol for 6 months during immediate post-operative and follow up period, it was observed that adherence to physiotherapy gradually waned in most of the patients.

Vassilios S Nikolaou *et al.*, in June 2008, after a retrospective analysis of MRI efficiency in diagnosing internal lesions of the knee, reported that the accuracy for tears to the medial, lateral meniscus, anterior and posterior cruciate ligaments and articular cartilage was 81%, 77%, 86%, 98% and 60% respectively^[13]. They found that the clinical examination had significant lower reliability in the detection of these injuries and concluded that MRI is very helpful in diagnosing meniscal and cruciate ligament injuries.

Various studies by different authors shows that arthroscopy still remains the gold standard for definitive diagnosis. In our study, clinical evaluation of the patients for instability was an essential component. Lachman test and Pivot shift test was more specific in diagnosing ACL injury which were further confirmed by MRI and later by arthroscopy, unlike anterior drawer test which in most of the patients was inconclusive as no correlation between pre-operative and examination under anaesthesia.

According to the ACL rehabilitation Protocol by Evans^[14], in order to return to sports following ACL surgery, one should have quadriceps strength of at least 80% of the normal leg and hamstring strength of at least 80% of the normal leg.

According to Bizzini and others^[15, 16] criteria to return to sports include strength of the hamstrings and quadriceps at least of 85% compared to the contra lateral side and when the patients tolerate sports specific activities. In our study, hamstring and quadriceps strengths were restored to satisfactory levels when compared to normal leg suggesting that the isometric strengths were restored.

In the LGS system 15 patients (60%) had an excellent outcome, 8 patients (32%) had well and 2 patients (08%) had a fair outcome. Quite similarly, 17 patients (68%) were very satisfied as per the subjective questionnaire and 7 patients (32%) were satisfied. One patient was not satisfied. This was probably due to the fact that most of the patients were keen on normal day to day activities than return to sports. All three scoring systems had a very high correlation as evidenced by the Kendal-tau values ranging from 0.647 to 0.923. Statistically, this was found to be highly significant [p value 0.000-0.0001]. 92% of the patients were able to return to the preinjury level of activities of daily living.

All patients performed the hop test in the postoperative four to six months period. The mean limb symmetry index of the single hop test was 85.50. These values gradually reduced when the outcome became poorer on the three scoring systems. Statistically the hop test was more of a trend with regards to IKDC and LGS, whereas it was significant with SQ.

Time period elapsed between the injury and the ACL reconstruction ranged from 2 months to 13 with a mean value of 6.8 months. The duration of surgery ranged from 95 minutes to 120 minutes with a mean of 102.5 minutes. 4 patients (16%) had pain at the graft donor site. 3 patients (12%) had numbness around the graft donor site which gradually resolved completely. Most of the patients 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. None had superficial skin infection.

Gulick TD^[17] and others in 2002 studied on 57 patients and concluded that 84% of their patients returned to pre injury level of function. In our study 92% patients returned to their previous level of function with 92% of the patients complaint with the physiotherapy regimen.

Conclusion

This study was conducted on 25 patients suffering from ACL deficiency in the age group of 21 - 50 years. All patients had instability of knee in the form of giving way evaluated by Lachman test and confirmed by MRI and arthroscopy. The functional outcome of anterior cruciate ligament reconstruction with quadrupled STG tendon autograft is excellent to good (92%) with mild laxity at the end of 6 months.

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Conflict of Interest

None

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