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Original Article

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Surgical Management of Anterior Cruciate Ligament Injuries by Arthroscopic Reconstruction Using Semitendinosus and Gracilis Tendon

Dr. Purushothama K[1]; Dr. Krishnamurthy[2]; Dr. Archit Verma[3]

[1] HOD department of orthopaedics, Dr. B.R Ambedkar Medical College
[2] Assistant professor, Dr. B.R Ambedkar Medical
[3] Resident, Dept. Of orthopaedics, Dr. B.R Ambedkar Medical

ABSTRACT

Background: Anterior cruciate ligament (ACL) and meniscal injuries pose significant challenges for individuals of all age groups. Arthroscopic reconstruction, utilizing hamstring tendon autografts, has emerged as an effective approach for restoring knee function and reducing morbidity. The aim of this study was to assess the functional outcome of combined arthroscopic reconstruction for ACL injuries using semitendinosus and gracilis autografts.

Materials and Methods: A total of 20 patients with ACL tears were enrolled in this study. All patients underwent arthroscopic ACL reconstruction using hamstring tendon autografts. The functional outcomes were evaluated using the International Knee Documentation 2000 Score (IKDC) and Lysholm Knee Scoring Scale. Data analysis was conducted using the IBM SPSS software, employing the chi-square test.

Results: Our findings demonstrate that arthroscopic anterior cruciate ligament reconstruction using hamstring autografts yields excellent to good functional outcomes in 80% of patients. Through careful patient selection and adherence to a comprehensive physiotherapy protocol, most patients can expect to regain full occupational and recreational activities within four to six months following the procedure.

Key Words: *Anterior cruciate ligament, International Knee Documentation Score, Lysholm Knee Score, Hamstring autograft (semitendinosus and gracilis).*

***Corresponding Author**
Dr. Archit Verma
Resident, Dept. Of orthopaedics, Dr. B.R Ambedkar Medical

INTRODUCTION

The knee joint frequently suffers from injuries, with the Anterior Cruciate Ligament (ACL) representing the most prevalent ligament that necessitates surgical intervention [1]. Today's fast-paced lifestyle, characterized by vehicular accidents and sports-related activities, has resulted in a rise in knee ligament injuries. Serving as a critical pivot point, the ACL ensures functional congruence and stability of the knee, working in conjunction with other ligaments, muscles, the capsule, and bone [2, 3]. The ACL's primary role is to stabilize the knee, aiding in counteracting anterior translation [4], as well as offering resistance against rotational and valgus stress. ACL tears that lead to anterior knee instability are a significant clinical issue, particularly due to the ligament's limited intrinsic repair capability. Therefore, patients exhibiting symptoms of ACL deficiency often need to undergo ligament reconstruction to stabilize the knee joint and enhance its functionality.

Various studies have explored successful ACL reconstruction techniques, utilizing autografts (from bone patellar tendon, hamstring tendon, quadriceps tendon) and allografts (derived from patellar tendon, hamstring tendon, tibialis anterior, achilles tendons) [5]. Multiple Anterior Cruciate Ligament Reconstruction (ACLR) methodologies have been described to date, ranging from open to arthroscopic techniques [6]. Among these, the Bone patellar tendon bone (BPTB) graft has been most widely employed in ACL reconstruction. However, the ensuing challenges—problems with the knee's extensor mechanism, motion loss, patella infra, patellar fracture, and persistent anterior knee pain—have encouraged surgeons to explore other graft materials. The hamstring graft has thus emerged as an alternative autograft material, offering fewer complications related to the extensor mechanism in ACLR.

The development of a successful arthroscope in 1954 opened up numerous possibilities for treating knee injuries [7].

Since 1982, ACLR has primarily been conducted arthroscopically. This approach offers the advantages of minimal invasiveness, precise graft placement, less disruption to normal tissue (thereby facilitating faster wound healing and rehabilitation), shorter hospital stays, and a significantly reduced infection rate.

The use of hamstring tendon in ACLR has grown in popularity among patients with symptomatic instability, often yielding successful outcomes [8]. The cells in a hamstring tendon graft are likely to survive intra-articular implantation, whereas those in a BPTB graft may not. The quadrupled hamstring tendon graft initially draws nourishment from the synovial fluid.

Although there are numerous fixation devices available for the quadrupled hamstring tendon graft, only a few offer strength and stiffness superior to that of a BPTB graft with interference screw fixation. Regardless of the autograft type, aggressive rehabilitation is safe as long as strong, stiff fixation methods are utilized. A meta-analysis conducted by Biau et al., in 2007 failed to identify a difference in patients returning to full activity following either a hamstring tendon graft or BPTB graft reconstruction [9].

Evidence suggests that patients undergoing reconstruction with a hamstring graft report less morbidity than those reconstructed with a BPTB graft. The debate continues regarding the stability improvement between a BPTB graft and a four-strand hamstring graft for most patients. Our study aims to analyze the outcome of arthroscopic ACLR with semitendinosus and gracilis graft.

AIM:

To evaluate the functional outcome of combined arthroscopic reconstruction of anterior cruciate ligament injuries using Semitendinosus and gracilis autograft.

MATERIALS AND METHODS

Study Design and Participants

This prospective study was conducted on 20 patients at the Department of Orthopaedics, Dr. B.R Ambedkar Medical College and Hospital over an 18-month period from January 2021 to June 2022. The study involved patients who had undergone Arthroscopic Anterior Cruciate Ligament (ACL) reconstruction using Semitendinosus and Gracilis autografts.

Inclusion and Exclusion Criteria

Patients aged 15 to 50 years, with an ACL tear confirmed by multiple diagnostic tests and MRI, were included. Exclusions were patients unwilling to participate, immunocompromised individuals, pregnant and lactating mothers, those with ACL tear of less than 3 weeks, or ACL tear associated with other ligament injuries or bony injury around the knee.

Data Collection Procedure

A detailed history was obtained, and preoperative investigations were performed, including various blood tests, urine routine, chest X-ray, ECG, and imaging of the affected knee.

Implants and Instrumentation

The implants required were Endobutton with loop and Interference screws. Instrumentation involved a TV/Monitor, Arthroscopy Camera system, Light source, Shaver System, specialized knee arthroscopic instruments, ACL reconstruction instruments, and a Pneumatic Tourniquet.

Surgical Technique

The procedure included initial arthroscopy, graft harvest and preparation, tibial and femoral tunnel preparation, graft passage and fixation, and wound closure. The surgical technique was visualized through various figures.

Postoperative Management and Evaluation

Postoperatively, all patients followed a prescribed ACL rehabilitation protocol starting from day 1. Patients were assessed at 6 weeks, 3 months, 6 months, and 1 year for clinical tests, range of movements, and subjected to International Knee Documentation Committee (IKDC) scoring and Lysholm knee scoring scale questionnaire.

Rehabilitation Protocol

The rehabilitation protocol included four phases, starting from 1 to 2 weeks post-operation and continued beyond three months. Activities like ankle-toe movements, straight leg raising, static quadriceps, knee bending, walking with crutch, static cycling, slow jogging, and swimming were prescribed according to the phases. Some activities were prohibited during the recovery period.

Data Analysis Plan:

The data collected for this study was analyzed using the IBM SPSS software. The statistical analysis focused on evaluating the functional outcomes of arthroscopic anterior cruciate ligament (ACL) reconstruction using hamstring autografts.

First, descriptive statistics such as means, standard deviations, and frequencies were calculated to summarize the demographic and clinical characteristics of the study participants.

To assess the functional outcomes, two scoring scales were utilized: the International Knee Documentation 2000 Score (IKDC) and the Lysholm Knee Scoring Scale. The scores obtained from these scales were tabulated and analyzed.

Next, the chi-square test was employed to examine the association between the type of graft (semitendinosus and gracilis autograft) and the functional outcomes. This analysis aimed to determine if there were any significant differences in the functional outcomes based on the graft type used.

The significance level was set at $p < 0.05$ to determine statistical significance.

Overall, the data analysis aimed to provide insights into the functional outcome of arthroscopic ACL reconstruction using hamstring autografts and to determine if any differences existed based on the type of graft employed.

Results

Twenty cases of arthroscopic ACL reconstruction were regularly followed for an average period of 18 months in Dr. B.R Ambedkar Medical College.

Table 1: Age distribution

Age(years)	Patients	percentage
20 - 25 years	7	35%
26 - 30 years	4	20%
30 - 35 years	6	30%
36 - 40 years	3	15%
	20	100%

Most of the patients (35%) were in the age group of 20 to 25 years followed by 30% in the age group of 30 to 35 years.

Table 2: Sex distribution

Gender	Number of patients	percentage
Male	17	85%
Female	3	15%
Total	20	100

Of the 20 patients included in our study, 17 (85%) were Male patients and 3 (15%) were female.

Table 3: Side involvement

SIDE	NUMBER OF PATIENTS	PERCENTAGE
RIGHT	11	55%
LEFT	9	45%
TOTAL	20	100%

In this study, the right side was more commonly injured (55%) than the left side (45%)

Table 4: Mode of Injury

MODE OF INJURY	NUMBER OF PATIENTS	PERCENTAGE
RTA	12	60%
sports	4	20%
others	4	20%
	20	100%

The most common mode of injury in our study was Road Traffic Accidents (60%) followed by sports (20%). The other modes of injury in our study were self fall and kick by bull.

Table 5: Duration between injury and surgery

Duration	Patients	Percentage
up to 3 months	6	30%
4 - 6 months	8	40%
7 - 9 months	1	5%
10 - 12 months	2	10%

In our study, most of the patients (40%) presented 4 to 6 months after injury.

Table 6: Symptom at presentation

SYMPTOM AT PRESENTATION	NO. OF PATIENTS	PERCENTAGE
knee pain	8	40%
instability	6	30%
locking	3	15%
knee pain and instability	3	15%
	20	100%

The most common symptom at presentation was knee pain (40%) followed by instability (30%).
Both knee pain and instability were present in 15% of patients.

Table 7: Sports causing ACL injury

SPORTS	NUMBER OF PATIENTS	PERCENTAGE
Kabaddi	3	75%
Football	1	25%

In this study, Kabaddi was the most common sport causing injury to the Anterior Cruciate Ligament.

Table 8: Associated Meniscal injuries

S.No	Associated injuries	No. of cases	Percentage
1	Isolated ACL tear	5	25%
2	medial meniscus tear	11	55%
3	lateral meniscus tear	1	5%
4	medial and lateral meniscus Tear	3	15%

In our study, there was associated meniscal injury in 75 % of patients. The most commonly injured was medial meniscus (55%) followed by injury to both medial and lateral menisci (15%). Isolated ACL tear was present in 5 patients (25%).

Table 9: Lysholm Knee score

S.NO	RESULTS	NO. OF CASES	PERCENTAGE
1	Excellent	9	45%
2	Good	8	40%
3	Fair	3	15%
4	Poor	0	0

9 patients (45%) had excellent functional outcome while 8 patients (40%) had good outcome. The remaining 3 patients (15%) had a fair outcome according to Lysholm knee score.

Table 10: IKDC subjective score

	Preop Mean (standard deviation)	Post op Mean (standard deviation	P value
IKDC subjective score	50.86 (10.45)	87.66 (6.98)	0.00001

The mean pre-op IKDC subjective score was 50.86 while the mean post op score was 87.66. There was significant improvement in post op IKDC score when compared with pre op score ($p<0.05$).

DISCUSSION

The escalating frequency of Road Traffic Accidents and involvement in sports activities has led to a surge in the number of ACL reconstructions. Arthroscopic reconstruction of the injured ACL is recognized as the gold standard, and is now one of the most performed procedures in orthopaedics. This popularity has led to substantial research focus and interest in the outcomes of ACL reconstruction.

One of the primary debates in the field pertains to the choice of graft. Options range from bone patellar tendon bone grafts and hamstring autografts to quadriceps tendons, synthetic grafts, and allografts. Among these, bone patellar tendon bone graft and hamstring graft are most commonly utilized. Bone patellar tendon bone grafts have the advantage of a high ultimate tensile load (approximately 2300 N) and rigid fixation due to the bony ends. However, the use of hamstring grafts has been on the rise, thanks to decreased surgical site morbidity, reduced incidence of patellofemoral adhesions and anterior knee pain. Despite the semitendinosus tendon having only 75% and gracilis 49% of the strength of native ACL, the quadrupled semitendinosus or semitendinosus-gracilis possess a tensile load of around 4108 N[9].

The aim of our study was to evaluate the functional outcome of arthroscopic anatomical single bundle ACL reconstruction using quadrupled hamstring autograft, performed on a group of 21 patients at the Coimbatore Medical College and Hospital. One patient was lost to follow-up, and the most common injury cause was Road Traffic Accidents, followed by sports injuries. The most common cause of ACL tear among sports injuries was Kabaddi. The study showed a male predominance, with males comprising 85% of the patients. Most patients belonged to the age group of 20 – 25 years (35%) and 40% underwent ACL reconstruction 4 to 6 months post-injury.

Associated meniscal injuries were seen in 75% of the patients, with the medial meniscus being the most commonly injured. These findings are consistent with D.W Lewis et al.'s study[9], which stated that meniscal injuries did not affect the final outcome.

Our study revealed that the functional outcome of ACL reconstruction using the quadrupled hamstring autograft is on par with the studies of D Choudhary et al. 2005[10], Jomha et al. 1999[11], Railey et al. 2004[12], Mahir et al. 2005[13] and Ashok Kumar et al.2016[14], as reflected by the comparable average Lysholm and IKDC scores. There

was a significant improvement in post-operative IKDC score compared to pre-operative score.

Furthermore, our study reported no significant patellofemoral pain, akin to Railey et al.'s findings[12]. As for tibial translation, our study echoed Agiletti et al.'s results[15], with 85% of patients having eliminated anterior tibial translation at a mean of 17 months post-operatively. The remaining 15% of patients (three) exhibited a 1+ Lachman test at the follow-up examination, although the laxity did not correlate with the functional scores.

In conclusion, our study supports the notion that arthroscopic ACL reconstruction with a quadrupled hamstring autograft provides a stable knee with minimal complications and good to excellent functional outcome (80%) with mild laxity at the end of 6 months. It's an optimal treatment choice for anterior cruciate ligament injured knees, reducing postoperative morbidity and enabling early rehabilitation.

CONCLUSION

The study undertaken affirms that Anterior Cruciate Ligament (ACL) injuries primarily affect younger individuals, predominantly males. This conclusion aligns with our observation and understanding of the higher participation rate of males in vigorous physical activities and contact sports, which are common precursors to such injuries.

Our study found that the predominant symptom leading patients to seek medical attention was the 'giving way' of the knee. This observation underscores the functional impairment and instability caused by ACL injuries. It is noteworthy that the medial meniscus was the most commonly associated injury. This suggests that a comprehensive approach is needed during diagnosis to identify any associated injuries which, if left untreated, could compromise patient recovery and functional outcomes.

The instability of the knee in patients was confirmed by the positive Lachman test, a reliable indicator of ACL tears, substantiated further by arthroscopy. This consistency between clinical examination and arthroscopic findings reaffirms the reliability of clinical examination techniques in the assessment and diagnosis of ACL injuries.

Arthroscopic ACL reconstruction utilizing the hamstring autograft was demonstrated to be an effective surgical intervention for ACL injuries. The choice of the hamstring graft offered a robust and flexible graft option, shown to reintegrate well with the surrounding knee anatomy, thus facilitating excellent functional outcomes.

Minimal postoperative complications were associated with the use of hamstring autografts in ACL reconstruction, further strengthening the case for its usage. The low complication rates underscore the safety of this procedure when performed by trained professionals, following careful patient selection and meticulous surgical technique.

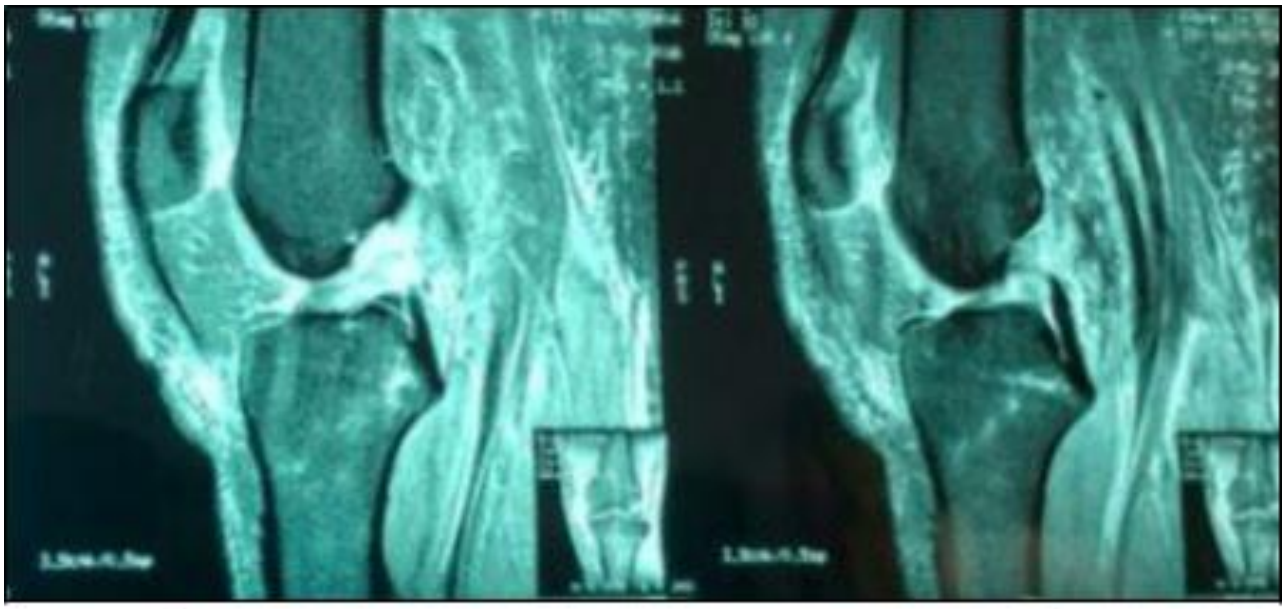
ACL reconstruction with the hamstring autograft was shown to reduce postoperative morbidity, facilitating a quicker recovery and return to daily activities and sports. This is a crucial aspect of treatment, particularly for younger individuals who are keen to regain their pre-injury activity levels.

Our findings indicate an excellent to good functional outcome in 80% of the patients at the end of six months post-surgery, despite mild laxity noted in some cases. The high rate of satisfactory outcomes emphasizes the effectiveness of the procedure in restoring knee function. Moreover, the mild laxity observed did not seem to affect the overall functionality and stability of the knee significantly.

In conclusion, our study contributes to the body of evidence supporting the use of arthroscopic ACL reconstruction with a hamstring autograft. The procedure is shown to be safe, with minimal complications, excellent functional outcomes, and a faster return to normal activities. Further research could delve into longer-term follow-ups to assess the durability of these repairs and the impact of these surgeries on the patient's quality of life.

CASE ILLUSTRATIONS

Case 1

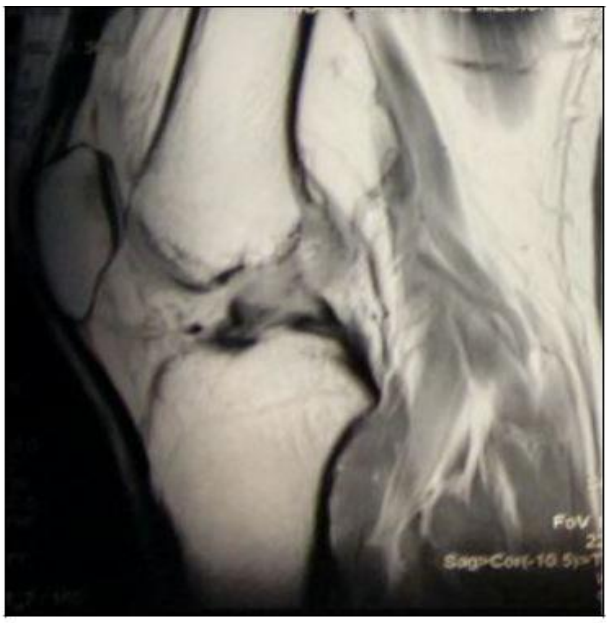


Pre op MRI showing ACL tear with intact PCL in sagittal section

Post op X – ray showing endobutton used for graft fixation on the tibial and femoral sides

Clinical picture Showing full range of knee movement without extension lag at 18 months follow up
Clinical picture Showing the patient's ability to squat without Difficulty

Case 2



Pre op MRI showing ACL deficient knee in sagittal section

Post op X – ray showing endobutton used for graft fixation on femoral side and interference screw on tibial side

Clinical picture showing painless full range of knee movements without extension lag at 1 year follow up

Clinical picture showing the patient's ability to sit cross legged without difficulty

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