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Comparative Study of Peroneus Longus Tendon Versus Hamstring Tendon Graft in Arthroscopic Reconstruction of Anterior Cruciate Ligament

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KEYWORDS
Anterior cruciate ligament, ACL reconstruction, peroneus longus tendon, hamstring tendon, IKDC score, Lysholm score, functional outcome, autograft.

ABSTRACT:

Background: Anterior cruciate ligament (ACL) injuries are among the most common sports-related knee injuries. Various autografts are used for ACL reconstruction, with semitendinosus (hamstring) tendon being widely preferred. However, the peroneus longus tendon (PLT) has recently emerged as a promising alternative due to its favorable biomechanical properties and minimal donor site morbidity.

Objectives: To compare the functional outcomes of ACL reconstruction using peroneus longus tendon versus hamstring tendon autografts.

Materials and Methods: This prospective clinical study was conducted at B.L.D.E. (Deemed to be University), Shri B.M. Patil Medical College, Vijayapura, Karnataka, from January 2023 to January 2025. A total of 24 patients with ACL rupture were equally divided into two groups: Group 1 (n=12) received semitendinosus grafts, and Group 2 (n=12) received peroneus longus grafts. Functional outcomes were assessed using the International Knee Documentation Committee (IKDC) subjective score and the Lysholm knee scoring scale preoperatively and at 6 months postoperatively.

Results: Both groups showed significant improvement in IKDC and Lysholm scores postoperatively. At 6 months, mean Lysholm scores were 97.00 ± 4.16 (Group 1) and 98.50 ± 2.36 (Group 2), and mean IKDC scores were 94.38 ± 3.37 (Group 1) and 95.66 ± 2.49 (Group 2). No significant complications, including ankle instability, were reported in the PLT group.

Conclusion: ACL reconstruction using peroneus longus tendon autograft provides comparable functional outcomes to hamstring tendon grafts, with minimal donor site morbidity. PLT is a viable alternative, particularly when hamstring grafts are inadequate or unavailable.

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INTRODUCTION

Anterior cruciate ligament (ACL) injuries are among the most common knee ligament injuries, particularly affecting young and active individuals participating in pivoting sports or high-demand physical activity [1,2]. The ACL plays a critical role in maintaining knee stability by preventing anterior tibial translation and rotational instability [3]. When injured, the functional impairment often necessitates surgical intervention, especially in active individuals who require restoration of pre-injury activity levels.

Arthroscopic ACL reconstruction is the gold standard treatment for ACL tears, with a variety of autograft options available, including hamstring tendons (semitendinosus and gracilis), bone-patellar tendon-bone (BPTB), quadriceps tendon, and more recently, the peroneus longus tendon (PLT) [4]. The ideal graft should provide adequate strength, biological integration, and minimal donor site morbidity while maintaining joint biomechanics [5].

Hamstring tendons, especially the semitendinosus, have been widely used for ACL reconstruction due to their favorable biomechanical properties, minimal anterior knee pain, and relatively easy harvesting technique [6]. However, concerns have been raised regarding variable graft diameter, delayed integration, and reduced knee flexor strength postoperatively [7].

The peroneus longus tendon has emerged as a promising alternative graft choice in recent years. It offers sufficient length and diameter, good tensile strength, and lesser donor site morbidity, making it a suitable candidate for ACL reconstruction [8,9]. Several biomechanical studies have suggested that PLT may provide comparable strength and stability to traditional hamstring autografts [10].

Despite its potential, limited clinical data are available comparing the functional outcomes and complication rates between peroneus longus tendon and hamstring tendon grafts in ACL reconstruction. Therefore, this study aims to compare the functional outcomes, rehabilitation progress, and complication rates of arthroscopic ACL reconstruction using either semitendinosus hamstring tendon or peroneus longus tendon autografts in a tertiary care setting.

This comparison is particularly relevant in expanding graft options for surgeons and patients, potentially leading to better individualized graft selection based on anatomical and functional considerations.

MATERIALS AND METHODS

Study Design and Setting

A prospective clinical study was conducted at the Department of Orthopaedics, B.L.D.E (Deemed to be University) Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka, India, from January 2023 to January 2025. The study aimed to evaluate functional outcomes following anterior cruciate ligament (ACL) reconstruction using either semitendinosus tendon or peroneus longus tendon grafts.

Sample Size and Sampling

Based on previous data indicating a mean ± SD graft diameter of 8.71 ± 0.4 mm for peroneus longus and 7.65 ± 0.6 mm for hamstring grafts, and assuming a significance level of 5% and power of 99%, the calculated minimum sample size was 12 patients per group (total n = 24). Equal group allocation was done using purposive sampling.

Participants

A total of 24 patients with ACL rupture confirmed both clinically and radiologically were included. Of these, 21 were male and 3 were female; 14 had right-sided ACL injuries, and 10 had left-sided injuries. The follow-up period ranged from a minimum of 6 months to a maximum of 21 months.

Inclusion Criteria

- Age between 18–45 years.
- ACL rupture confirmed clinically and by MRI.
- Patients with associated meniscal injuries managed with repair.

Exclusion Criteria

- ACL ruptures requiring meniscectomy.

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- Multiligamentous knee injuries.
- Neurovascular injuries around the knee.
- Polytrauma patients.
- Medically unfit patients for surgery.
- History of ligament reconstruction in the contralateral knee.

Clinical Evaluation and Diagnosis

Patients presenting with knee pain and instability following trauma were assessed through detailed clinical examination. The following tests were employed:

- For ACL integrity: Lachman's test, Anterior Drawer test, and Pivot Shift test.
- For associated injuries:
    - Menisci: Apley's Grind test and McMurray's test.
    - Collateral ligaments: Varus and Valgus stress tests.
    - Posterior cruciate ligament: Posterior Drawer test.

All patients underwent radiological evaluation with standard anteroposterior and lateral X-rays. MRI was performed in all cases to confirm the diagnosis and assess associated injuries.

Pre-operative Workup and Consent

Routine blood investigations (CBC, RBS), chest X-ray, and ECG were done. A thorough pre-anesthetic evaluation was completed. Patients were educated about their diagnosis, surgical procedure, possible complications, and rehabilitation. Informed written consent was obtained from all participants.

Pre-operative Rehabilitation

- Baseline knee range of motion (ROM) and muscle strength were recorded.
- Patients were instructed in static and dynamic quadriceps exercises.
- The postoperative rehabilitation protocol was explained.

Operative Procedure

All patients underwent spinal or epidural anesthesia. With the patient in a supine position and the affected knee flexed to 90°, standard anterolateral and anteromedial arthroscopic portals were established. A diagnostic arthroscopy was performed to confirm ACL rupture and assess associated intra-articular pathologies. Meniscal tears, if present, were managed with repair.

Graft Harvesting

- Semitendinosus tendon graft: Harvested via an oblique incision medial to the tibial tuberosity. Muscle fibers were cleared, and the tendon was quadrupled and sized.
- Peroneus longus graft: Harvested from the ipsilateral leg using a posterolateral approach. Care was taken to identify and preserve surrounding neurovascular structures.

Femoral Tunnel Preparation

With the knee in 120° flexion, the femoral tunnel was created using an offset aimer through the anteromedial portal. The tunnel was reamed over a guide wire to the appropriate graft size.

Tibial Tunnel Preparation

Using a tibial aimer set at 55°, the tibial tunnel was created with the exit point slightly posterior to the anterior horn of the lateral meniscus. The tunnel was reamed to the size of the graft.

Graft Passage and Fixation

A quadrupled graft was attached to an adjustable loop Endobutton for femoral fixation and passed through the tunnels. Approximately 20 mm of graft was inserted into the femoral tunnel. The tibial side was fixed using an interference screw and a backup suture disc with the knee in 10° flexion. Proper graft tensioning was confirmed under arthroscopic visualization. The portals and incisions were closed in layers, and a sterile dressing was applied.

Postoperative Care and Rehabilitation

Patients received IV antibiotics for three days postoperatively. Incisions were inspected on postoperative days 2 and 7, and sutures were

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removed on day 12. Rehabilitation, including range of motion and strengthening exercises, was initiated after suture removal. A knee brace was used for immobilization during the early postoperative period.

Follow-up and Outcome Assessment

Postoperative radiographs (anteroposterior and lateral views) were obtained to assess tunnel placement and implant position. Functional outcomes were evaluated using the International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form and the Lysholm Knee Scoring Scale at 6 weeks, 3 months, 6 months, and 1 year.

- IKDC Score: A percentage-based score derived from subjective patient responses, with 100% indicating normal knee function.
- Lysholm Score: Evaluated based on 8 parameters including pain, instability, and function; categorized as excellent, good, fair, or poor.

Statistical Analysis

Data were recorded in Microsoft Excel and analyzed using SPSS version 20.0. Results were expressed as mean ± standard deviation (SD), frequencies, and percentages.

- An independent t-test was used to compare normally distributed continuous variables.
- Mann–Whitney U test was applied for non-normally distributed variables.
- The chi-square test was used for categorical variables. A p-value < 0.05 was considered statistically significant. All statistical tests were two-tailed.

RESULTS AND OBSERVATIONS;

Twenty four cases of arthroscopic ACL reconstruction with semitendinosus and peroneus longus autograft were followed up regularly for a period of 24 months and 12 months minimum in B. L. D. E (DEEMED TO BE UNIVERSITY) Shri B.M Patil Medical College, Hospital and Research Centre, Vijayapura (from August 2023 to January 2025)."

Table; 1 Age Distribution:

AGE	FREQUENCY	PERCENTAGE
<20	1	5%
20-29	10	40%
30-39	10	40%
40+	3	15%
TOTAL	24	100.0

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Table 2 Sex distribution:

SEX	FREQUENCY	PERCENTAGE
MALE	20	91
FEMALE	4	9
TOTAL	24	100.0

Table 3 Side of injury:

SIDE	FREQUENCY	PERCENTAGE
LEFT	10	41.67%
RIGHT	14	58.33%
TOTAL	24	100%

Table; 4 Mode of injury:

MODE OF INJURY	FREQUENCY	PERCENTAGE
RTA	14	58.33%
SELF FALL FROM STAIRS	4	16.67%
SPORTS	6	25.00%
TOTAL	24	100%

Table; 5 Meniscal injury:

SIDE	FREQUENCY	PERCENTAGE
MEDIAL	6	21
LATERAL	3	9
NONE	16	70
TOTAL	24	100.0

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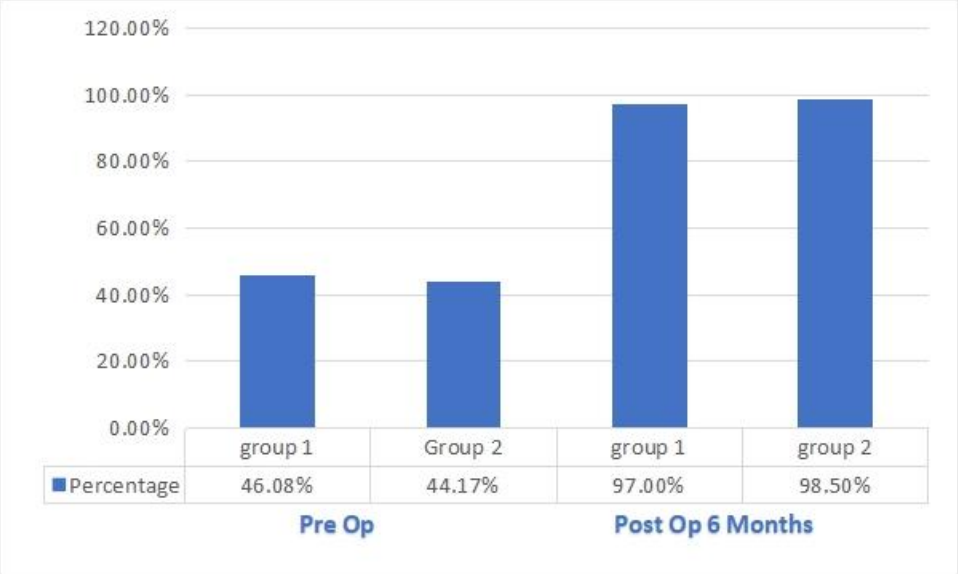
Table 6: Group-wise Descriptive Statistics

Parameter	Group	N	Mean	Standard Deviation (SD)
Age (years)	1	12	29.92	8.17
	2	12	30.17	7.10
Injury to Surgery Time (months)	1	12	3.08	2.27
	2	12	5.25	6.82
Lysholm Score – Preoperative	1	12	46.08	5.70
	2	12	44.17	5.36
Lysholm Score – Postoperative (6 months)	1	12	97.00	4.16
	2	12	98.50	2.36
IKDC Score – Preoperative (%)	1	12	44.36	5.74
	2	12	46.50	9.00
IKDC Score – Postoperative (6 months, %)	1	12	94.38	3.37
	2	12	95.66	2.49



Figure; 1 LYSHOLM score comparison

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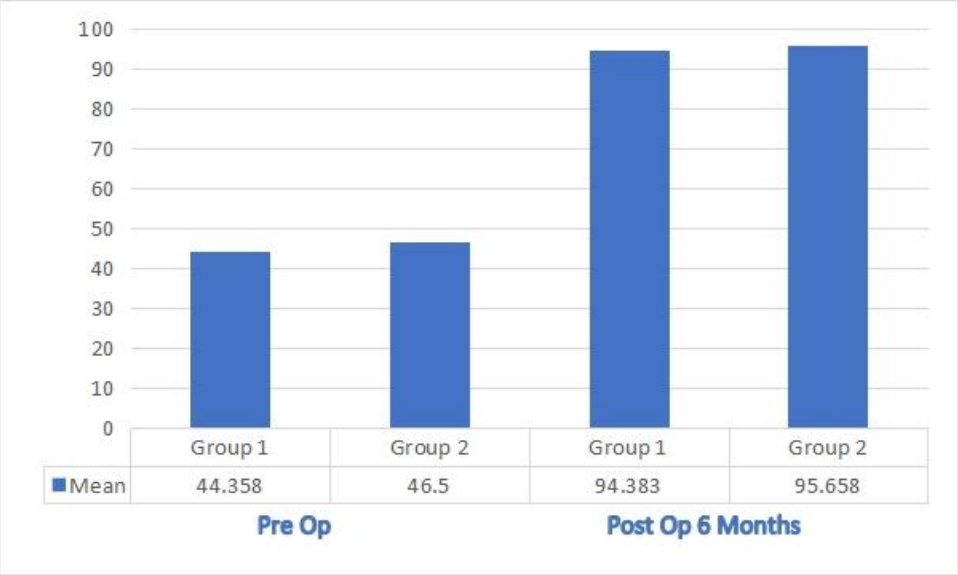

Figure 2: IKDC score comparison

IKDC scores showed significant differences at pre op and 6 months postoperatively.

Table 7 POSTOPERATIVE REHABILITATION

Phase	Duration	Activities
1	0-14 Days	• Quadriceps strengthening (static, dynamic) • Straight leg raises • Patellar mobilization (superior-inferior) • Ankle pumps • Gradual increase in range of motion (up to 90°) • Partial weight-bearing with crutches
2	2-10 Weeks	• Gradual increase in range of motion (up to 120°) • Discontinuation of crutches • Progressive quadriceps strengthening • Therapist-assisted extension (90-40°)

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		• Introduction of lunges
3	3-4 Months	• Knee extension exercises (high reps/low weight) • Isokinetic quadriceps exercises • Slow and controlled drills for lateral sports
4	4-5 Months	• Jogging and jump rope exercises (if no effusion, full ROM, and stable knee)
5	5-8 Months	• Sports-specific drills (cutting, figure-of-eight) • Agility testing
6	> 8 Months	• Full return to sports (contingent on achieving 0-130° ROM, 90% hamstring strength, and 85% quadriceps strength) • Completion of sports-specific agility training • Continuation of exercises (3 times/week)

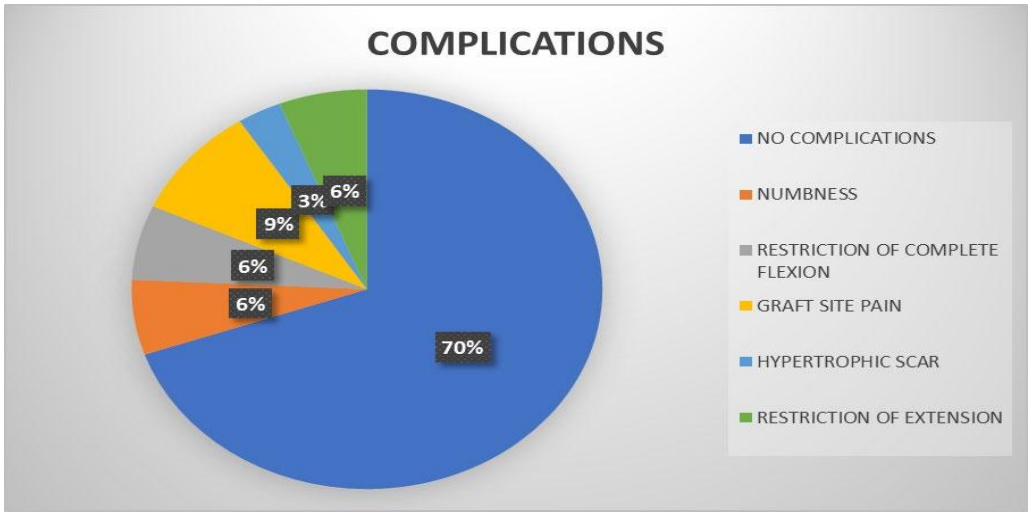

Figure 3: Complications

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DISCUSSION

The reconstruction of the anterior cruciate ligament (ACL) using autografts is a cornerstone in restoring knee stability and function, especially in active individuals. The present study compared the clinical and functional outcomes of two autograft options—peroneus longus tendon (PLT) and semitendinosus hamstring tendon (HT)—in arthroscopic ACL reconstruction. Our findings revealed that both grafts demonstrated excellent postoperative outcomes in terms of IKDC and Lysholm scores at the 6-month follow-up, with no statistically significant differences between the groups.

Graft Selection and Functional Outcome

Semitendinosus hamstring grafts have traditionally been preferred for ACL reconstruction due to their ease of harvest, low donor site morbidity, and favorable biomechanical properties [1]. However, hamstring harvesting can result in decreased knee flexor strength and potential injury to nearby structures like the saphenous nerve [2].

The peroneus longus tendon has gained attention recently due to its adequate length and diameter, tensile strength, and relatively minimal impact on ankle stability and function [3]. Biomechanical studies have demonstrated that PLT has tensile properties comparable to or exceeding those of hamstring grafts, making it a viable alternative [4,5]. Our study findings corroborate these results, with mean postoperative IKDC and Lysholm scores being slightly higher in the PLT group compared to the HT group, although the differences were not statistically significant.

Postoperative Rehabilitation and Recovery

All patients underwent a standardized rehabilitation protocol postoperatively, which played a vital role in functional recovery. Early quadriceps activation, protected weight-bearing, and progressive range-of-motion exercises ensured restoration of strength and mobility. The mean Lysholm score at 6 months was 97.00 in the hamstring group and 98.50 in the PLT group, aligning with previous studies reporting excellent outcomes with either graft [6,7].

Donor Site Morbidity

An essential consideration in graft selection is the associated donor site morbidity. Hamstring graft harvest may cause persistent weakness in knee flexion, whereas peroneus longus harvesting raises concerns about potential eversion weakness or ankle instability. However, recent literature and electromyographic studies suggest that peroneus brevis compensates adequately for eversion, minimizing functional deficits after PLT harvesting [8]. In our study, no patients reported subjective ankle instability or difficulty with gait, consistent with other clinical series [9].

Injury-to-Surgery Timing

Interestingly, the average injury-to-surgery duration was longer in the PLT group (5.25 months) than in the hamstring group (3.08 months), though this difference was not statistically significant. Delayed surgery has been linked to increased meniscal and chondral damage [10]; however, in this study, both groups had similar intra-articular findings and outcomes, suggesting that timely rehabilitation and surgical planning mitigate the impact of delay.

Meniscal Injuries and Associated Findings

A total of 9 patients had associated meniscal injuries, most commonly medial. Literature suggests that meniscal preservation through repair during ACL reconstruction promotes long-term joint preservation and enhances functional recovery [11]. All meniscal tears in our cohort were repaired, contributing to the high postoperative functional scores across both groups.

Limitations

This study has some limitations. The sample size was small (n=24), potentially underpowering the ability to detect small but clinically relevant differences. The follow-up duration, although adequate for short-term assessment, may not capture graft failure or late-onset complications. Additionally, the subjective nature of functional scores (IKDC, Lysholm) may introduce bias, although these are validated tools widely used in ACL outcome studies.

Clinical Implications

The findings of this study reinforce that peroneus longus tendon is a viable alternative to hamstring

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autograft in ACL reconstruction, with comparable functional outcomes, minimal complications, and no significant donor site morbidity. This could be particularly valuable in cases where hamstring tendons are unavailable, previously harvested, or insufficient in diameter.

CONCLUSION

This prospective comparative study demonstrates that both peroneus longus tendon (PLT) and semitendinosus hamstring tendon (HT) grafts yield excellent functional outcomes in arthroscopic anterior cruciate ligament (ACL) reconstruction. At the 6-month postoperative follow-up, no statistically significant differences were observed in IKDC or Lysholm scores between the two groups, indicating comparable efficacy in restoring knee stability and function.

The peroneus longus tendon graft offers a reliable alternative to the traditional hamstring graft, with minimal donor site morbidity, sufficient graft diameter, and favorable biomechanical strength. Importantly, no subjective ankle instability or complications related to PLT harvest were noted, further supporting its clinical viability.

Given its potential advantages, the PLT graft can be considered especially useful in cases where hamstring tendons are inadequate, previously harvested, or contraindicated. However, larger studies with longer follow-up durations are recommended to validate these findings and assess long-term graft integrity and knee function.

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