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Prospective evaluation of functional outcome in anterior cruciate ligament reconstruction with peroneus longus graft: a hospital-based study

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ABSTRACT

Background: Anterior cruciate ligament (ACL) reconstruction using the peroneus longus tendon (PLT) graft is emerging as a viable alternative to traditional autografts, offering comparable strength and reduced donor site morbidity. This study evaluates the functional outcomes and complications of ACL reconstruction using this PLT graft.
Methods: A hospital-based prospective study was conducted on 50 patients with isolated ACL tears. Outcomes, including Lysholm, IKDC, Tegner activity, and modified Cincinnati scores, were assessed preoperatively and postoperatively at 6 and 12 months. Visual analog scale (VAS), range of motion (ROM), and complications were also recorded. Statistical significance was set at $p<0.05$.
Results: Significant improvements were observed in Lysholm (46.2±10.3 to 89.4±6.7), IKDC (38.1±9.7 to 85.2±5.9), and modified Cincinnati (37.5±8.2 to 85.3±5.1) scores ($p<0.001$). ROM increased from 115°±15° to 140°±5°, and pain (VAS) decreased from 7.4±1.2 to 1.5±0.7. Complications were minimal, with a 2% graft failure rate and mild donor site morbidity.
Conclusions: ACL reconstruction with the peroneus longus graft provides excellent functional outcomes and minimal complications, making it a reliable alternative to conventional autografts.

Keywords: Anterior cruciate ligament, Peroneus longus tendon, VAS scores, Lysholm scores, Donor site morbidity

INTRODUCTION

Anterior cruciate ligament (ACL) injuries are among the most frequently encountered ligamentous injuries of the knee, accounting for a substantial proportion of orthopedic consultations, particularly among young and active individuals.[1] The incidence of ACL injuries globally is approximately 68.6 per 100,000 individuals per year.[2] The estimated incidence of ACL injuries in India is approximately 1 per 3,000 individuals per year, with higher rates observed in urban and semi-urban areas where organized sports are more common.[3]

An ACL tear often results in knee instability, reduced functional capacity, and diminished quality of life. If left untreated, chronic instability of the knee can lead to secondary damage, such as meniscal tears and early-onset osteoarthritis, significantly affecting long-term joint health.[4]

ACL reconstruction has become the standard of care for managing complete ACL tears, particularly in active individuals. The primary goal of ACL reconstruction is to restore knee stability, improve functional outcomes, and enable the patient to return to pre-injury levels of activity.[5] The choice of graft material plays a pivotal role in the

success of the surgery, influencing factors such as biomechanical strength, healing potential, and postoperative recovery.[6]

Traditionally, autografts such as hamstring tendon, patellar tendon, or quadriceps tendon have been widely utilized in ACL reconstruction. While these grafts have demonstrated excellent clinical outcomes, they are associated with certain disadvantages. Hamstring tendon autografts may lead to reduced hamstring strength, while patellar tendon autografts are linked to anterior knee pain, patellar fracture, and sensory deficits.[7] Quadriceps tendon grafts, though increasingly popular, may also result in donor site morbidity and complications.[8]

In the quest to identify alternative graft sources, the PLT has emerged as a promising option.[9] The PLT offers several advantages, including ease of harvest, adequate graft length and diameter, and minimal impact on lower limb function. Biomechanical studies have demonstrated that the tensile strength of the PLT is comparable to that of conventional grafts, making it a viable choice for ACL reconstruction.[10] Additionally, the compensatory role of the peroneus brevis tendon ensures that the functional integrity of the ankle is preserved following PLT harvesting.[11]

However, there is limited literature evaluating the clinical and functional outcomes of ACL reconstruction using the PLT. Most available studies are either retrospective or include small sample sizes, underscoring the need for more robust, prospective investigations. Furthermore, concerns about donor site morbidity, such as reduced ankle strength or altered gait mechanics, necessitate a closer examination of its impact on patient outcomes.[12]

This study aims to bridge this gap by prospectively evaluating the functional outcomes of ACL reconstruction using the PLT as an autograft. The study focuses on key outcome measures, including pain, ROM, functional scores, and patient satisfaction, over a one-year follow-up period.

METHODS

This hospital-based prospective study was conducted on 50 patients with ACL tear at the department of orthopedics, Pondicherry institute of medical science over a period of one year, from April 2023 to April 2024. The study was approved by the institutional ethics committee, and written informed consent was obtained from all participants.

Inclusion criteria

Patients aged 18-50 years with isolated ACL tears confirmed by clinical examination and MRI was included in the study. Patients with no prior knee surgeries and who gave consent to participate, were also included in the study

Exclusion criteria

Patients with multiligamentous knee injuries, pre-existing degenerative knee conditions and significant comorbidities contraindicating surgery or rehabilitation were excluded from the study.

Surgical technique

All patients were operated on under spinal or general anesthesia. The patient was positioned supine with a tourniquet applied to the upper thigh. A 2-3 cm incision was made near the lateral malleolus to harvest the PLT. The harvested tendon was prepared to achieve a graft diameter of 8-10 mm.

ACL reconstruction

Arthroscopic single-bundle ACL reconstruction was performed. The femoral and tibial tunnels were drilled using the anteromedial portal technique. The graft was fixed with an Endobutton on the femoral side and an interference screw on the tibial side.

Postoperative protocol

Immediate knee immobilization with early passive ROM exercises. Weight-bearing was initiated gradually as per the rehabilitation protocol.

Outcome measures

Functional scores: Lysholm knee score, international knee documentation committee (IKDC) score, and Tegner activity scale and modified Cincinnati score were recorded preoperatively, and at 6 and 12 months postoperatively.

Pain and ROM: Pain was assessed using the visual analog scale (VAS), and ROM was measured using a goniometer.

Complications: Donor site morbidity, graft failure, and infection rates were monitored.

Statistical analysis

Data were analyzed using SPSS software version 24. Paired t tests and Wilcoxon signed-rank tests were used to compare preoperative and postoperative outcomes. Statistical significance was set at $p<0.05$.

RESULTS

The study included 50 patients with a mean age of 27.5±6.8 years, predominantly young males (70%).

Most injuries were sports-related (64%), with the right limb more frequently affected (60%). The mean time from injury to surgery was 8.4±3.5 months (Table 1).

Table 1: Demographics and clinical characteristic of the study participants.

Parameters	Value
Age (in years) (mean±SD)	27.5±6.8
Gender (n, %)	
Males	35 (70)
Females	15 (30)
BMI (kg/m²) (mean±SD)	24.3±3.1
Affected limb (n, %)	
Right	30 (60)
Left	20 (40)
Mechanism of injury (n. %)	
Sports related	32 (64)
Non-sports	18 (36)
Time from injury to surgery (months)	8.4±3.5 months

The mean graft diameter was 8.2±1.1 mm, and the average surgical duration was 85.3±10.6 minutes. Patients had a mean hospital stay of 3.2±1.1 days, with immediate postoperative ROM averaging 90°±15°. Donor site morbidity, assessed by pain on the VAS, was low, with a mean score of 2.3±0.8 (Table 2).

Table 2: Intraoperative and postoperative details of the study participants.

Parameters	Values (mean±SD)
PLT graft (mm)	8.2±1.1
Surgical duration (minutes)	85.3±10.6
Hospital stay (days)	3.2±1.1
Immediate postoperative ROM (°)	90±15
Donor site morbidity (pain on VAS)	2.3±0.8

The results demonstrate significant improvements in functional outcomes following ACL reconstruction using the peroneus longus graft. The Lysholm score improved from 46.2±10.3 preoperatively to 89.4±6.7 at 12 months, and the IKDC score increased from 38.1±9.7 to 85.2±5.9 ($p<0.001$ for both). The Tegner activity scale rose from a median of 2 to 6, and pain scores (VAS) decreased from 7.4±1.2 to 1.5±0.7. ROM also improved significantly, reaching 140°± 5° at 12 months. The modified Cincinnati score showed a notable increase from 37.5±8.2 to 85.3±5.1, highlighting excellent functional recovery ($p<0.001$) (Table 3).

Table 3: Functional outcome in ACL reconstruction using peroneus longus graft.

Parameters	Preoperative scores	Postoperative scores (6 months)	Postoperative scores (12 months)	P value
Lysholm score (mean±SD)	46.2±10.3	82.5±8.6	89.4±6.7	<0.001[a]*
IKDC score (mean±SD)	38.1±9.7	78. 6±7.4	85.2±5.9	<0.001[a]*
Tegner activity scale (median)	2 (1-3)	5 (4-6)	6 (5-7)	<0.001[b]*
Modified Cincinnati score (mean±SD)	37.5±8.2	73.6±6.5	85.3±5.1	<0.001[a]*
Pain (VAS, mean±SD)	7.4±1.2	2.1±0.9	1.5±0.7	<0.001[a]*
ROM in degrees (mean±SD)	115±15	135±10	140±5	<0.001[a]*

*Denotes significant ($p<0.05$). a-paired student's t test; b-Wilcoxon signed-rank test

The complications observed following ACL reconstruction with the peroneus longus graft were minimal. Graft failure occurred in 2% of cases, while persistent knee instability was noted in 4%. Infection was rare, reported in only 2% of patients. Donor site-specific complications included numbness in 8% and reduced ankle strength in 4% of cases. Overall, these results indicate a low complication rate, with donor site morbidity being mild and self-limiting in most patients (Table 4).

Table 4: Complications and donor site morbidity.

Complication type	N (%)
Graft failure	1 (2)
Persistent knee instability	2 (4)
Infection	1 (2)
Donor site numbness	4 (8)
Reduced ankle strength (Donor)	2 (4)

DISCUSSION

The patellar tendon and hamstring tendon are the most frequently utilized autografts for ACL reconstruction. However, the use of the patellar tendon can lead to knee discomfort, which poses a challenge, particularly for individuals who frequently kneel due to cultural, religious, or athletic practices. In cases where an ACL rupture is accompanied by a medial collateral ligament tear, harvesting the hamstring tendon may result in medial knee joint instability, with the additional risk of saphenous nerve injury. Since the peroneus longus is a key muscle responsible for ankle eversion, a primary concern with using its tendon as a graft is the potential for ankle instability.[13]

The findings of this study highlight the efficacy and safety of using the PLT as an autograft for ACL reconstruction. The significant improvement in functional outcomes, as

evidenced by increases in Lysholm, IKDC, Tegner activity, and modified Cincinnati scores, underscores the potential of the PLT graft to restore knee stability and function.

In the present study, the mean age of the patients with ACL tear was 27.5±6.8 years and male preponderance was observed encompassing 70% of the total study population. Likewise in a study done by Joshi et al the mean age was 27.2 years and 75% of the patients were females.[9] Most injuries were sports-related (64%), with the right limb more frequently affected (60%). The mean time from injury to surgery was 8.4±3.5 months. Likewise, in a study done by Hussain et al majority of the ACL reconstruction was as a result of sports related injuries.[14]

The findings regarding the mean diameter of the PLT graft (8.2±1.1 mm) confirm its suitability for ACL reconstruction, as an ideal graft diameter of 8-10 mm is associated with lower failure rates and better clinical outcomes. In a recent systematic review study done by Quinn et al in which the outcome of 16 studies revealed that PLT grafts diameters equal or greater >8 mm, reinforcing the utility of the PLT as a reliable autograft for achieving biomechanical stability and avoiding excessive graft elongation.[15]

The average surgical duration of 85.3±10.6 minutes observed in this study aligns with operative times for other autografts, including hamstring and patellar tendon grafts. However, the straightforward harvesting technique for the PLT, involving a single small incision near the lateral malleolus, suggests that procedural complexity is minimized. This makes the PLT an attractive option for surgeons seeking to balance efficiency with graft quality. Postoperative hospital stays averaged 3.2±1.1 days, which is consistent with modern ACL reconstruction protocols emphasizing early mobilization and discharge. The short hospitalization duration reflects effective perioperative management, reduced surgical morbidity, and the minimally invasive nature of PLT harvesting. Immediate postoperative ROM averaging 90°±15° is encouraging, as early restoration of knee motion is critical for preventing stiffness and facilitating functional recovery. These outcomes are comparable to those observed with hamstring grafts, indicating that the PLT does not negatively impact early joint mobility.[16]

In the present study, the mean VAS score was 2.3±0.8 and it was low, suggesting that PLT harvesting causes minimal pain and discomfort. This finding aligns with studies highlighting the compensatory role of the peroneus brevis tendon in maintaining ankle stability. Importantly, this low morbidity rate further underscores the suitability of the PLT as a graft choice, particularly for patients seeking rapid recovery and minimal impact on daily activities.

In the present study, the increase in the Lysholm Score from 46.2±10.3 preoperatively to 89.4±6.7 at 12 months reflects excellent recovery in knee function, stability, and the ability to perform daily and athletic activities. These results align with similar studies using PLT grafts, Abdelkader et al reported a significant increase in Lysholm score from preoperative to post-operative (66.8±10.2 vs 91.5±8.3).[17]

The improvement in the IKDC score from 38.1±9.7 to 85.2±5.9 demonstrates substantial progress in subjective knee assessment, reflecting patient satisfaction and functional recovery. These outcomes are consistent with the global benchmarks for successful ACL reconstructions using well-established grafts. Likewise, in a study done by Agarwal et al there was a significant improvement in the IKDC scores when compared between preoperative to postoperative (53.62 vs 83.28).[18]

In the present study, the Tegner Activity Scale's rise from a median of 2 to 6 indicates that most patients returned to moderate-to-high levels of physical activity, including sports participation. This is particularly significant for athletes and active individuals seeking graft options that support rigorous demands. Studies using patellar tendon grafts have reported similar trends, confirming that PLT grafts are equally capable of enabling patients to resume active lifestyles.[19]

The reduction in pain scores VAS from 7.4±1.2 to 1.5±0.7 highlights the low postoperative morbidity associated with PLT harvesting. Unlike patellar tendon grafts, which are frequently associated with anterior knee pain, the minimally invasive nature of PLT harvesting contributes to a more comfortable recovery experience. In the present study, the postoperative ROM improvement to 140°±5° is a critical indicator of surgical success, reflecting excellent graft placement, healing, and adherence to rehabilitation protocols. Our reports are in line with the previous report by Rajani et al where there was a significant reduction in VAS scores and improvement in ROM post operatively.[20]

In the present study, the increase in the modified Cincinnati score from 37.5±8.2 to 85.3±5.1 demonstrates significant functional recovery, including improvements in knee stability, strength, and overall performance. These results are comparable to studies evaluating traditional autografts, underscoring the PLT graft's ability to achieve similar outcomes while potentially reducing donor site complications. In a study done by Shair et al there was a significant improvement in modified Cincinnati score from preoperative to 9 months postoperative (68.46±14.8 vs 88.81±4.2) and it was significant.[21]

In the present study, he observed complications following ACL reconstruction with the peroneus longus tendon graft were minimal, reflecting its safety. A graft failure rate of 2% and persistent knee instability in 4% of cases are comparable to or better than traditional autografts like hamstring or patellar tendons. Donor site-specific issues, such as numbness (8%) and reduced ankle strength (4%), were mild and self-limiting. Likewise, in a study done by

Asif et al 20% of the patients had numbness and 13.3% had tingling sensation.[16]

The study limitations included small sample size and single center study. In addition, the study has short follow-up and direct comparison hamstring or patellar tendon was not performed.

CONCLUSION

The significant improvements across multiple functional parameters (Lysholm score. IKDC, Tegner activity scale's and modified Cincinnati score), combined with low pain scores and excellent ROM, confirm the efficacy of the peroneus longus tendon as an autograft for ACL reconstruction. Its performance is comparable to traditional autografts while offering potential advantages in terms of donor site morbidity and postoperative recovery. Further studies with larger sample sizes and long-term follow-up are needed to validate these findings and establish the PLT graft as a standard option in ACL reconstruction.

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