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# Evaluation of Donor Ankle Function after Harvesting Peroneus Longus Tendon Graft for Primary Anterior Cruciate Ligament Reconstruction

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**KEYWORDS**

Anterior cruciate ligament, ACL reconstruction, peroneus longus tendon graft, donor site morbidity, ankle function, AOFAS score, FADI score.

**ABSTRACT:**

Background: Selection of an appropriate autograft for anterior cruciate ligament reconstruction (ACLR) remains important, as commonly used grafts may be associated with donor site morbidity. The peroneus longus tendon has recently emerged as a potential alternative graft; however, concerns persist regarding postoperative ankle function following tendon harvest.

Aim: To evaluate donor ankle function after harvesting the peroneus longus tendon graft in patients undergoing primary ACL reconstruction.

Materials and Methods: This prospective cohort study was conducted in the Department of Orthopaedics at the Integral Institute of Medical Sciences and Research, Lucknow, over a period of 18 months. Sixty patients aged 18–50 years with primary ACL tear confirmed clinically and by MRI underwent arthroscopic ACL reconstruction using a peroneus longus tendon autograft. Donor ankle function was assessed at 6 weeks, 3 months, and 6 months postoperatively using the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score and the Foot and Ankle Disability Index (FADI). Data were analysed using SPSS software and compared using a paired t-test, with $p < 0.05$ considered statistically significant.

Results: The mean age of patients was 28.4 ± 6.72 years, with male predominance (90%). Mean FADI score improved significantly from 67.33 ± 3.38 at 6 weeks to 98.17 ± 1.81 at 6 months ($p < 0.001$). Mean AOFAS score increased from 68.65 ± 3.41 to 98.27 ± 1.53 over the same period ($p < 0.001$). Transient hypoesthesia was observed in 11.7% of patients and minor donor site morbidity in 3.3%, while no ankle instability or permanent nerve injury was recorded.

Conclusion: Peroneus longus tendon autograft for ACL reconstruction provides excellent donor ankle functional outcomes with minimal complications. The graft appears to be a safe and reliable alternative to traditional graft options, with preservation of ankle stability and near-normal function by 6 months postoperatively.

## INTRODUCTION

Anterior cruciate ligament (ACL) injury is one of the most common ligamentous injuries of the knee joint, particularly affecting young and physically active individuals. It frequently occurs during pivoting, cutting, or deceleration movements and is commonly associated with sports such as football, basketball, and

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kabaddi. The ACL plays a crucial role in maintaining anteroposterior and rotational stability of the knee; therefore, untreated ACL deficiency may lead to recurrent instability, meniscal injury, chondral damage, and early onset osteoarthritis of the knee joint. Surgical reconstruction is generally recommended in symptomatic patients to restore knee stability and enable return to pre-injury functional activity levels.[1–3]

Over the years, several graft options have been used for ACL reconstruction (ACLR), including bone–patellar tendon–bone (BPTB) autograft, hamstring tendon autograft, quadriceps tendon graft, allografts, and synthetic grafts. Although BPTB graft has long been considered the gold standard due to excellent fixation and stability, it is associated with significant donor site morbidity, anterior knee pain, kneeling pain, patellar fracture, and extensor mechanism complications. Hamstring tendon grafts are widely used because of lower anterior knee pain and good functional outcomes; however, they may lead to hamstring weakness, saphenous nerve irritation, and tunnel widening.[4–6]

In recent years, the peroneus longus tendon has gained attention as an alternative autograft for ACL reconstruction. The peroneus longus tendon provides adequate length and diameter, favorable biomechanical strength, and ease of harvest. Biomechanical studies have demonstrated that the tensile strength and stiffness of the peroneus longus tendon are comparable to those of hamstring tendons, making it a reliable graft choice. Additionally, harvesting the tendon avoids anterior knee complications and preserves the extensor mechanism.[7–9]

Despite these advantages, concerns persist regarding donor site morbidity, particularly the functional status of the ankle and foot after harvesting the peroneus longus tendon. The peroneus longus muscle plays an important role in plantar flexion of the first ray, eversion of the foot, and stabilization of the medial longitudinal arch. Removal of the tendon theoretically may lead to ankle instability, weakness in eversion, altered gait, and functional impairment. Therefore, evaluation of postoperative ankle function is essential before widespread adoption of this graft.[10–12]

Various clinical scoring systems have been used to assess ankle function following graft harvest. The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score is a clinician-based scale that evaluates pain, function, and alignment, whereas the Foot and Ankle Disability Index (FADI) is a patient-reported outcome measure assessing functional limitations during activities of daily living and sports. These validated tools provide a comprehensive assessment of donor ankle morbidity and help determine the safety of using the peroneus longus tendon as an autograft.[13–15]

Previous clinical studies have reported satisfactory knee stability and minimal donor site complications following ACL reconstruction with peroneus longus graft. However, data on donor ankle function remain limited, and regional population-based studies are scarce. Hence, the present study was undertaken to evaluate donor ankle function after harvesting the peroneus longus tendon graft for primary ACL reconstruction using objective and subjective functional outcome scores.

## MATERIALS AND METHODS

### Study Design and Setting

This prospective cohort study was conducted in the Department of Orthopaedics at the Integral Institute of Medical Sciences and Research (IIMSR), Lucknow, Uttar Pradesh, India. The study was carried out over a period of eighteen months after obtaining approval from the Institutional Ethics Committee (IEC).

### Study Population

Adult patients presenting to the Orthopedics outpatient department (OPD) or emergency services with a diagnosis of primary anterior cruciate ligament (ACL) tear were screened. Diagnosis was established clinically and confirmed radiologically using magnetic resonance imaging (MRI). Eligible patients underwent arthroscopic ACL reconstruction (ACLR) using a peroneus longus tendon graft (PLTG).

### Sample Size

A total of 60 patients were included in the study. Sample size was calculated using the standard prevalence-based formula described by Daniel (1999), assuming a prevalence (p) of 14.9% for ACL rupture, a confidence level of 95% (Z = 1.96), an allowable error (d) of 10%, and a 20% non-response rate. The final calculated sample size was 60.

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**Inclusion Criteria**

1. Postoperative patients after ACL reconstruction using the peroneus longus tendon graft.
2. Age between 18 and 50 years.
3. Cooperative patients willing to follow a structured rehabilitation protocol.
4. Bilaterally healthy ankle joint before surgery.

**Exclusion Criteria**

1. Patients unwilling to participate in the study.
2. Presence of arthritis of the spine, pelvis, or lower limb.
3. Multiligament injury of the knee joint.
4. Any fracture around the knee or ankle joint.

**Preoperative Evaluation**

Written informed consent was obtained from each participant prior to inclusion. Baseline demographic data were recorded. Height and weight were measured and body mass index (BMI) was calculated. Time elapsed since injury was documented.

All patients underwent the following investigations:

- Complete blood count, random blood sugar, serum creatinine, liver function tests, thyroid profile, HIV, HBsAg, and HCV
- Urine routine examination (albumin, sugar, microscopy)
- Magnetic resonance imaging (MRI) of the knee
- Electrocardiogram (ECG) to assess cardiac status

Following MRI confirmation, patients were counselled regarding operative management. Diagnostic arthroscopy was performed intraoperatively to confirm the ACL tear.

**Surgical Procedure**

The peroneus longus tendon graft was harvested from the ipsilateral limb and prepared. Arthroscopically guided femoral and tibial tunnels were created. The graft was passed through the tunnels and fixed proximally using an endobutton and distally with a bioscrew.

**Post-operative Rehabilitation Protocol**

- Knee immobilization with a static knee brace was applied immediately after surgery.
- Early mobilization with closed-chain exercises up to 90° and partial weight bearing was initiated on the first postoperative day as tolerated.
- Sutures were removed at 2 weeks.
- Active quadriceps strengthening exercises were started between 2–4 weeks.
- Static cycling and wall-slide exercises were initiated after 4 weeks with full weight bearing using a walker.

**Outcome Assessment**

Donor ankle functional outcomes were assessed using the following validated scoring systems at 6 weeks, 3 months, and 6 months after ACL reconstruction:

**1. AOFAS Ankle-Hindfoot Score**

The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scale is a clinician-administered instrument evaluating pain (40 points), function (50 points), and alignment (10 points). The total score ranges from 0 to 100, where higher scores indicate better ankle function.

**2. Foot and Ankle Disability Index (FADI)**

The Foot and Ankle Disability Index (FADI) is a self-reported questionnaire assessing functional limitation associated with foot and ankle disorders. It contains 26 items assessing activities of daily living and 8 sport-related items. Each item is graded on a 5-point Likert scale and converted to percentage values, with 100% indicating normal function.

**Complications Monitored**

The following complications were recorded during follow-up:

- Hypoaesthesia near the donor site
- Donor site infection

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- Nerve injury
- Ankle instability

Complications occurring before the first follow-up visit were categorized as transient complications.

**Ethical Considerations**

The study protocol, data collection tools, consent forms, and patient information sheets were reviewed and approved by the Institutional Ethics Committee of IIMSR, Lucknow. Written informed consent was obtained from all participants after explaining the procedure, risks, and benefits in the local language. Participant confidentiality was strictly maintained by assigning unique patient identification numbers (PIDs), and all records were stored securely.

**Data Collection**

Data were collected using a semi-structured proforma. Each participant's details were recorded individually and later digitized using Microsoft Excel 2023.

**Statistical Analysis**

Data analysis was performed using IBM SPSS (latest version).

- Qualitative variables were expressed as frequencies and percentages.
- Continuous variables were expressed as mean ± standard deviation.
- Paired t-test was used to compare outcomes at different follow-up intervals. A p-value < 0.05 was considered statistically significant.

**RESULT AND OBSERVATIONS;**

The present study was carried out to evaluate the donor's ankle function after harvesting the peroneus longus tendon graft for primary anterior cruciate ligament reconstruction. For this purpose, a total of 60 patients fulfilling the eligibility criteria were enrolled in the study. Table 1 shows the distribution of cases according to age.

**RESULT AND OBSERVATIONS;**

**Table 1: Age-wise Distribution of Study Population (n=60)**

| SN | Age Group | Number of cases | Percentage |
|---|---|---|---|
| 1. | 18-20 Years | 5 | 8.3 |
| 2. | 21-25 Years | 20 | 33.3 |
| 3. | 26-30 Years | 15 | 25.0 |
| 4. | 31-35 Years | 11 | 18.3 |
| 5. | 36-40 Years | 7 | 11.7 |
| 6. | >40 Years | 2 | 3.3 |
| Mean age±SD (Range) in years<br>Median [Interquartile age] | | 28.40±6.72 (18-46)<br>27.5 [23, 32] | |

**Table 2: Sex Profile of Study Population**

| SN | Sex Profile | Number of cases | Percentage |
|---|---|---|---|
| 1. | Male | 54 | 90.0 |
| 2. | Female | 6 | 10.0 |
| Sex ratio (M:F) | | 9 | |

**Table 3: Distribution of Study Population according to BMI status**

| SN | BMI | Number of cases | Percentage |
|---|---|---|---|
| 1. | 18.5-24.9 kg/m² | 41 | 68.3 |
| 2. | 25.0-29.9 kg/m² | 19 | 31.7 |
| Mean BMI±SD (Range) kg/m² | | 23.76±2.24 (19.5-28.3) | |

**Table 4: Distribution of Study Population according to Time Since Injury**

| SN | Time since injury | Number of cases | Percentage |
|---|---|---|---|
| 1. | ≤6 months | 32 | 53.3 |
| 2. | 6-12 months | 17 | 28.3 |
| 3. | 12-24 months | 11 | 18.3 |

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**Table 5: FADI at different follow-up intervals**

| SN | Follow-up interval | Mean | SD | Change as compared to first follow-up | | | Statistical significance of change (Paired 't'-test) | |
|---|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | % | 't' | 'p' |
| 1. | 6 weeks (First FU) | 67.33 | 3.38 | - | - | - | - | - |
| 2. | 3 months (Second FU) | 85.58 | 3.96 | 18.95 | 5.17 | 28.1 | 28.36 | <0.001 |
| 3. | 6 months (Third FU) | 98.17 | 1.81 | 30.53 | 3.74 | 45.3 | 63.25 | <0.001 |

**Table 6: AOFAS at different follow-up intervals**

| SN | Follow-up interval | Mean | SD | Change as compared to first follow-up | | | Statistical significance of change (Paired 't'-test) | |
|---|---|---|---|---|---|---|---|---|
| | | | | Mean | SD | % | 't' | 'p' |
| 1. | 6 weeks (First FU) | 68.65 | 3.41 | - | - | - | - | - |
| 2. | 3 months (Second FU) | 86.55 | 2.54 | 17.90 | 3.76 | 26.1 | 36.89 | <0.001 |
| 3. | 6 months (Third FU) | 98.27 | 1.53 | 29.62 | 3.15 | 43.1 | 72.78 | <0.001 |

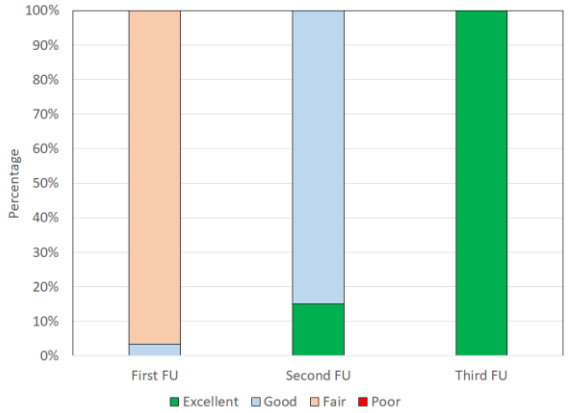


**Fig. 1: Functional Status at different follow-up intervals as per categories of AOFAS**

**Table 7: Transient Complications**

| SN | Complication | Number of cases | Percentage |
|---|---|---|---|
| 1. | Hypesthesia | 7 | 11.7 |
| 2. | Donor site morbidity | 2 | 3.3 |
| 3. | Nerve injury | 0 | 0 |
| 4. | Ankle instability | 0 | 0 |

## DISCUSSION

The present prospective cohort study evaluated donor ankle function after harvesting the peroneus longus

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tendon graft (PLTG) for primary anterior cruciate ligament reconstruction (ACLR). The principal finding of the study was that ankle function progressively improved over time, with near-normal function achieved at 6 months follow-up, and only minimal transient donor-site complications.

In the present study, the majority of patients were young adults with a mean age of 28.4 ± 6.72 years, and 58.3% of the patients were below 30 years of age. ACL injury predominantly affects young and active individuals because of high participation in sports and physically demanding activities. Griffin et al. and Beynnon et al. also reported that ACL rupture commonly occurs in the second and third decades of life, particularly among athletes and recreational sports participants.[1],[2] The male predominance observed in our study (90%) is also consistent with regional participation patterns in contact sports such as football and field sports in developing countries, as noted in previous epidemiological studies.[16]

Body mass index (BMI) analysis in our study showed that most patients had normal BMI (68.3%), while 31.7% were overweight. Increased BMI has been associated with greater mechanical stress across the knee joint and higher risk of ligamentous injuries as well as poorer functional recovery. Studies have demonstrated that excessive body weight contributes to abnormal knee biomechanics and delayed rehabilitation following ACL injury.[17],[18]

Time since injury revealed that more than half of the patients presented within 6 months of injury. Early reconstruction is beneficial because delayed ACL reconstruction may lead to secondary meniscal tears and chondral damage due to recurrent instability episodes. Fithian et al. and Dunn et al. reported that untreated ACL deficiency significantly increases the risk of secondary intra-articular pathology and early degenerative changes.[19],[20]

The major objective of the present study was to evaluate ankle function after peroneus longus graft harvest. The Foot and Ankle Disability Index (FADI) score improved significantly from 67.33 ± 3.38 at 6 weeks to 98.17 ± 1.81 at 6 months ($p < 0.001$). Similarly, the AOFAS ankle-hindfoot score improved from 68.65 ± 3.41 to 98.27 ± 1.53 ($p < 0.001$). These findings indicate substantial functional recovery of the donor ankle over time. Comparable results were reported by Rhatomy et al., who found excellent ankle function following ACLR with peroneus longus graft and no long-term functional deficit.[8] Shi et al. also demonstrated progressive improvement in ankle scores with near-normal function at final follow-up.[12]

Biomechanically, the peroneus longus contributes to eversion and stabilisation of the first ray; however, compensation occurs through the peroneus brevis muscle and surrounding musculature. Otis et al. showed that the peroneus brevis muscle is capable of maintaining lateral ankle stability after harvesting the peroneus longus tendon.[10] Clinical studies have further confirmed that removal of the tendon does not significantly affect gait mechanics or balance in the long term.[21],[22] This explains the progressive improvement in functional scores observed in our study.

Transient complications were minimal in our patients. Hypoesthesia was observed in 11.7% of patients, donor-site morbidity in 3.3%, and no cases of ankle instability or nerve injury were noted. Similar complication rates have been reported by Kerimoğlu et al. and other authors, who observed only temporary sensory disturbance without permanent ankle dysfunction.[7],[23] The absence of ankle instability in our study supports the safety of peroneus longus tendon harvest.

Traditional grafts such as bone–patellar tendon–bone and hamstring tendon are associated with donor site complications, including anterior knee pain, kneeling pain, hamstring weakness, and sensory disturbances. Freedman et al. and Kartus et al. reported significant anterior knee pain and kneeling discomfort following patellar tendon graft harvest.[4],[5] Hamstring grafts may also result in decreased knee flexion strength and saphenous nerve irritation.[6] Compared with these grafts, the peroneus longus tendon provides adequate graft diameter and tensile strength with minimal morbidity at the donor site.[9]

Overall, our findings suggest that the peroneus longus tendon is a reliable autograft option for ACL reconstruction, providing excellent functional recovery of the ankle while avoiding complications associated with traditional graft sources. The progressive improvement in both clinician-based (AOFAS) and patient-reported (FADI) outcome scores supports the safety and effectiveness of this graft.

## CONCLUSION

In this prospective cohort study of 60 patients undergoing primary ACL reconstruction using a

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peroneus longus tendon autograft, donor ankle function showed significant and consistent improvement at successive follow-ups. Both FADI and AOFAS scores increased markedly from the 6-week assessment to 6 months, reaching near-normal functional levels. Only minor transient complications, mainly localized hypoesthesia, were observed, and no cases of ankle instability or permanent nerve injury occurred.

These findings indicate that harvesting the peroneus longus tendon does not produce clinically significant functional impairment of the donor ankle and provides a dependable graft option for ACL reconstruction. Larger studies with longer follow-up are recommended to confirm long-term safety and functional outcomes.

We are grateful to all the patients who participated in the research for their cooperation and trust. Special thanks to the medical and technical staff for their assistance in data collection and patient care. MCN: IU/R&D/2026-MCN0004342

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