

## Research Article

# Functional Outcomes of Anterior Cruciate Ligament Reconstruction Using Autogenous Semitendinosus Versus Peroneus Longus Tendon Grafts: A Prospective Comparative Study

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**Abstract:** **Introduction:** Anterior cruciate ligament (ACL) reconstruction is the standard treatment for symptomatic ACL rupture in active individuals. Although semitendinosus tendon autografts are widely used, concerns regarding graft diameter, donor-site morbidity, and postoperative muscle weakness have encouraged exploration of alternative graft sources such as the peroneus longus tendon. Comparative evidence regarding short-term functional outcomes and donor-site morbidity remains limited. **Aim** To compare the functional outcomes of ACL reconstruction using autogenous semitendinosus tendon and peroneus longus tendon grafts. **Materials and Methods** A prospective comparative study was conducted in the Department of Orthopaedics, Pt. J.N.M. Medical College and Dr. B.R.A.M. Hospital, Raipur. Thirty patients with complete ACL rupture were enrolled and allocated into two groups: semitendinosus tendon graft (ST group, n=15) and peroneus longus tendon graft (PL group, n=15). Functional outcomes were assessed using the International Knee Documentation Committee (IKDC) score, Visual Analog Scale (VAS), and American Orthopaedic Foot and Ankle Society (AOFAS) score. Donor-site morbidity, thigh circumference changes, knee stability tests, graft characteristics, and postoperative complications were evaluated over a 6-month follow-up period. **Results:** The mean graft diameter was significantly greater in the PL group than the ST group ( $8.60 \pm 0.51$  mm vs  $8.07 \pm 0.59$  mm;  $p=0.0004$ ). Graft length was also significantly greater in the PL group ( $9.16 \pm 2.1$  cm vs  $7.37 \pm 2.3$  cm;  $p=0.0026$ ). At one month, the PL group demonstrated significantly lower VAS scores ( $2.10 \pm 0.54$  vs  $2.58 \pm 0.60$ ;  $p=0.034$ ) and higher IKDC scores ( $56.76 \pm 5.41$  vs  $51.80 \pm 1.74$ ;  $p=0.005$ ). However, no significant differences were observed in IKDC, VAS, or AOFAS scores at 6 months. Both groups achieved satisfactory knee stability and comparable complication profiles. **Conclusion** Peroneus longus tendon autografts provided larger graft dimensions and superior early postoperative recovery compared with semitendinosus grafts. However, both grafts produced comparable functional outcomes, knee stability, and donor-site morbidity at final follow-up.

**Keywords:** Anterior cruciate ligament, ACL reconstruction, Peroneus longus tendon, Semitendinosus tendon, IKDC score, VAS, score, AOFAS score

## INTRODUCTION

Anterior cruciate ligament (ACL) injury is one of the most common ligamentous injuries affecting the knee joint and is particularly prevalent among young, physically active individuals involved in sports and high-demand occupational activities. ACL deficiency results in recurrent instability, impaired functional performance, reduced activity levels, and an increased risk of secondary meniscal injury and early osteoarthritis if left untreated [1–4]. The incidence of ACL rupture has continued to rise globally with increasing participation in recreational and competitive sports.

ACL reconstruction remains the preferred treatment for symptomatic instability and aims to restore normal knee biomechanics, improve function, and facilitate return to preinjury activity levels [5]. The success of reconstruction depends upon several factors, including

surgical technique, rehabilitation protocol, tunnel positioning, fixation method, and graft selection. Among these factors, graft choice continues to be one of the most debated aspects of ACL surgery.

Autologous grafts remain the most commonly utilized graft source because of their biological compatibility, superior incorporation, and lower risk of disease transmission compared with allografts [6,7]. Traditionally, bone-patellar tendon-bone and hamstring tendon grafts have been widely employed. Semitendinosus tendon grafts have gained popularity owing to reduced anterior knee pain, smaller incisions, and acceptable biomechanical properties [8,9]. However, concerns remain regarding hamstring weakness, donor-site morbidity, and variability in graft diameter, which may influence graft survival and functional recovery [10,11].

The peroneus longus tendon has recently emerged as a potential alternative autograft. Biomechanical studies have demonstrated adequate tensile strength and graft dimensions, while clinical investigations have reported satisfactory functional outcomes with minimal donor-site complications [12–15]. Several recent comparative studies and systematic reviews have suggested that peroneus longus grafts may provide larger graft diameters and lower donor-site morbidity than hamstring grafts while maintaining equivalent knee function [16–19].

Despite increasing interest in peroneus longus tendon grafts, evidence comparing short-term functional recovery and donor-site outcomes with semitendinosus grafts remains limited. Most available studies focus on long-term outcomes, whereas early postoperative recovery plays a critical role in rehabilitation and return to activity. Therefore, the present prospective comparative study was undertaken to evaluate functional outcomes, donor-site morbidity, graft characteristics, knee stability, and postoperative complications following ACL reconstruction using semitendinosus and peroneus longus tendon autografts.

The aim of this study was to compare functional outcomes of anterior cruciate ligament reconstruction using autogenous semitendinosus and peroneus longus tendon grafts.

## MATERIALS AND METHODS

### Study Design and Setting

This prospective comparative observational study was conducted in the Department of Orthopaedics, Pt. Jawahar Lal Nehru Memorial Medical College and Dr. Bhim Rao Ambedkar Memorial Hospital, Raipur, Chhattisgarh, India, after obtaining approval from the Institutional Ethics Committee and Institutional Scientific Committee.

### Study Population and Sample Size

A total of 30 patients with complete anterior cruciate ligament rupture fulfilling the eligibility criteria were enrolled. Patients undergoing ACL reconstruction using semitendinosus tendon autograft were included in the Semitendinosus (ST) group (n=15), whereas those undergoing reconstruction using peroneus longus tendon autograft were included in the Peroneus Longus (PL) group (n=15).

## RESULTS

### Baseline Characteristics

Thirty patients with complete ACL rupture were included in the study and underwent arthroscopic ACL reconstruction using either semitendinosus tendon autograft (ST group, n=15) or peroneus longus tendon autograft (PL group, n=15). The mechanism of injury was comparable between groups. Sports-related injuries were the predominant cause in the ST group (53.3%), whereas road traffic accidents were more common in the PL group (60%). The mean trauma-to-surgery interval was 4.8 months in the ST group and 3.7 months in the PL group, indicating earlier surgical intervention in the PL cohort. No clinically meaningful baseline differences were observed between groups.

### Inclusion Criteria

Patients with complete ACL rupture who were clinically and radiologically diagnosed and planned for arthroscopic ACL reconstruction were included in the study.

### Exclusion Criteria

Patients with associated ligament injuries requiring additional reconstruction, previous knee surgery, active infection, severe osteoarthritis, revision ACL reconstruction, or conditions affecting rehabilitation were excluded according to the protocol.

### Surgical Technique

All patients underwent arthroscopic single-bundle ACL reconstruction. In the ST group, semitendinosus tendon autografts were harvested and prepared as quadrupled grafts. In the PL group, peroneus longus tendon autografts were harvested and prepared as tripled grafts. Standard arthroscopic tunnel preparation and fixation techniques were used in both groups.

### Outcome Measures

Patients were evaluated preoperatively and postoperatively at 1 month, 3 months, and 6 months using:

- International Knee Documentation Committee (IKDC) score
- Visual Analog Scale (VAS) score
- American Orthopaedic Foot and Ankle Society (AOFAS) score
- Thigh circumference assessment
- Knee stability tests (Lachman, Anterior Drawer, and Pivot Shift tests)
- Graft diameter and graft length
- Postoperative complications

The primary outcome measure was functional assessment using IKDC score. Secondary outcomes included pain assessment, donor-site morbidity, ankle function, graft characteristics, knee stability, and complications.

### Statistical Analysis

Data were analyzed using appropriate statistical methods. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequencies and percentages. Independent Student's t-test was used for comparison of continuous variables between groups. Fisher's exact test was applied for categorical variables where appropriate. A p-value  $<0.05$  was considered statistically significant.

**Table 1. Mechanism of Injury and Trauma-to-Surgery Interval**

Variable	Semitendinosus (n=15)	Peroneus Longus (n=15)
Sports Injury	8 (53.3%)	6 (40.0%)
Road Traffic Accident	7 (46.6%)	9 (60.0%)
Mean Trauma-to-Surgery Interval (months)	4.8	3.7

**Graft Characteristics**

Peroneus longus tendon grafts demonstrated significantly superior graft dimensions compared with semitendinosus tendon grafts. The mean graft diameter was significantly larger in the PL group ( $8.60 \pm 0.51$  mm) than in the ST group ( $8.07 \pm 0.59$  mm;  $p=0.0004$ ). Similarly, graft length was significantly greater in the PL group ( $9.16 \pm 2.1$  cm) compared with the ST group ( $7.37 \pm 2.3$  cm;  $p=0.0026$ ). These findings suggest that peroneus longus tendon harvesting consistently provides larger grafts suitable for ACL reconstruction.

**Table 2. Comparison of Graft Characteristics**

Parameter	Semitendinosus	Peroneus Longus	p-value
Graft Diameter (mm)	$8.07 \pm 0.59$	$8.60 \pm 0.51$	0.0004
Graft Length (cm)	$7.37 \pm 2.3$	$9.16 \pm 2.1$	0.0026

**Pain Assessment (VAS Score)**

Both groups exhibited progressive reduction in pain during follow-up. At one month, the PL group demonstrated significantly lower pain scores compared with the ST group ( $2.10 \pm 0.54$  vs  $2.58 \pm 0.60$ ;  $p=0.034$ ), indicating superior early postoperative recovery. However, by three and six months, pain scores improved substantially in both groups and the differences were no longer statistically significant. These findings suggest that although peroneus longus grafts may provide better early pain control, long-term pain outcomes are comparable.

**Table 3. Comparison of VAS Scores**

Follow-up	Peroneus Longus	Semitendinosus	p-value
Preoperative	$4.52 \pm 0.68$	$4.63 \pm 0.72$	0.65
1 Month	$2.10 \pm 0.54$	$2.58 \pm 0.60$	0.034
3 Months	$1.30 \pm 0.58$	$1.55 \pm 0.49$	0.21
6 Months	$0.82 \pm 0.66$	$1.10 \pm 0.68$	0.19

**Functional Outcome (IKDC Score)**

Functional recovery improved progressively in both groups following ACL reconstruction. At one month, the PL group achieved significantly higher IKDC scores than the ST group ( $56.76 \pm 5.41$  vs  $51.80 \pm 1.74$ ;  $p=0.005$ ), indicating faster early functional recovery. However, this difference diminished with time, and by six months both groups demonstrated comparable IKDC scores ( $p=0.56$ ). Thus, while peroneus longus grafts may accelerate early rehabilitation, both grafts provide equivalent medium-term functional outcomes.

**Table 4. Comparison of IKDC Scores**

Follow-up	Peroneus Longus	Semitendinosus	p-value
Preoperative	$42.60 \pm 5.20$	$41.80 \pm 4.90$	0.67
1 Month	$56.76 \pm 5.41$	$51.80 \pm 1.74$	0.005
3 Months	$63.63 \pm 6.88$	$60.07 \pm 3.20$	0.08
6 Months	$80.20 \pm 10.19$	$82.13 \pm 7.13$	0.56

**Donor-Site Functional Outcome (AOFAS Score)**

Assessment of ankle function revealed excellent recovery in both groups. At one month, AOFAS scores were slightly lower in the PL group ( $96.93 \pm 5.32$ ) than in the ST group ( $100 \pm 0$ ), reaching statistical significance ( $p=0.02$ ). However, this difference resolved during subsequent follow-up, and by six months both groups achieved complete functional recovery with identical AOFAS scores. These findings indicate minimal long-term ankle morbidity following peroneus longus tendon harvesting.

**Table 5. Comparison of AOFAS Scores**

Follow-up	Peroneus Longus	Semitendinosus	p-value
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Preoperative	100 ± 0	100 ± 0	NS
1 Month	96.93 ± 5.32	100 ± 0	0.02
3 Months	98.67 ± 3.52	100 ± 0	0.10
6 Months	100 ± 0	100 ± 0	NS

### Donor-Site Morbidity

Thigh muscle wasting was more frequently observed in the semitendinosus group than in the peroneus longus group. Eight patients (53.3%) in the ST group developed quadriceps/thigh muscle wasting compared with four patients (26.7%) in the PL group. Although this difference did not achieve statistical significance ( $p=0.136$ ), the findings suggest a trend toward lower donor-site morbidity following peroneus longus tendon harvesting.

**Table 6. Comparison of Thigh Muscle Wasting**

Variable	Semitendinosus (n=15)	Peroneus Longus (n=15)	p-value
Thigh Muscle Wasting	8 (53.3%)	4 (26.7%)	0.136

### Knee Stability Outcomes

Postoperative knee stability improved substantially in both groups. Clinical assessment using standard stability tests demonstrated satisfactory restoration of anterior and rotational stability after reconstruction. No statistically significant differences were observed between groups ( $p>0.05$ ), indicating that both semitendinosus and peroneus longus tendon grafts provide equivalent restoration of knee stability.

**Table 7. Comparison of Postoperative Knee Stability**

Outcome	Semitendinosus	Peroneus Longus	p-value
Overall Knee Stability Outcome	Improved	Improved	>0.05

### Delayed Postoperative Complications

Delayed postoperative complications were generally uncommon in both groups. Anterior knee pain, quadriceps hypotrophy, and persistent paraesthesia were numerically more frequent in the ST group. However, none of these differences reached statistical significance. No superficial graft-site infections were observed in either group. These findings indicate comparable long-term safety profiles for both graft options, although semitendinosus graft harvesting may be associated with relatively greater donor-site morbidity.

**Table 8. Comparison of Delayed (>6 Months) Postoperative Complications**

Complication	Semitendinosus (n=15)	Peroneus Longus (n=15)	p-value
Anterior Knee Pain	4 (26.7%)	1 (6.7%)	0.330
Quadriceps Hypotrophy	8 (53.3%)	4 (26.7%)	0.136
Superficial Graft Site Infection	0 (0.0%)	0 (0.0%)	—
Persistent Paraesthesia	1 (6.7%)	0 (0.0%)	1.000

### Key Results Summary

- Peroneus longus grafts produced significantly larger graft diameter and length ( $p=0.0004$  and  $p=0.0026$ , respectively).
- Early postoperative outcomes favored the peroneus longus group, with significantly lower VAS scores ( $p=0.034$ ) and higher IKDC scores ( $p=0.005$ ) at one month.
- At six months, IKDC, VAS, and AOFAS scores were comparable between groups.
- Thigh muscle wasting occurred more frequently in the semitendinosus group (53.3% vs 26.7%).
- Knee stability and overall complication rates were comparable between groups.



**FIGURE 1: Surgical incision mark for st graft**



**FIGURE 2: Incision mark for pl graft**

## DISCUSSION

Anterior cruciate ligament (ACL) reconstruction remains the standard treatment for symptomatic ACL insufficiency in young and physically active individuals. Selection of an appropriate graft continues to be one of the most debated aspects of ACL surgery because graft characteristics may influence biomechanical stability, donor-site morbidity, rehabilitation, and functional recovery. The present prospective comparative study evaluated the clinical outcomes of ACL reconstruction using semitendinosus tendon and peroneus longus tendon autografts.

### Baseline Characteristics and Injury Profile

The baseline characteristics and injury patterns were comparable between the two study groups, minimizing the likelihood of confounding during outcome assessment. Sports injuries and road traffic accidents represented the major mechanisms of injury, which is consistent with the epidemiological trends reported in contemporary ACL literature. ACL injuries predominantly affect young active populations and frequently result from pivoting sports or high-energy trauma [2–4]. Similar injury patterns were reported by Ambulgekar et al. [13] in their comparative evaluation of semitendinosus and peroneus longus grafts.

### Graft Characteristics

A major finding of the present study was the significantly larger graft diameter and graft length obtained with the peroneus longus tendon. The mean graft diameter was  $8.60 \pm 0.51$  mm in the PL group compared with  $8.07 \pm 0.59$  mm in the ST group ( $p=0.0004$ ). Similarly, graft length was significantly greater in the PL group ( $9.16 \pm 2.1$  cm vs  $7.37 \pm 2.3$  cm;  $p=0.0026$ ).

These findings are clinically important because graft diameter has been identified as an important predictor of graft survival following ACL reconstruction. Magnussen et al. demonstrated that hamstring grafts measuring less than 8 mm were associated with a significantly increased risk of graft failure [11]. Therefore, the larger graft dimensions observed in the present study may provide a potential biomechanical advantage for peroneus longus grafts.

The present findings are consistent with those reported by Ambulgekar et al. [13], Keyhani et al. [14], and Acharya et al. [20], all of whom observed significantly greater graft diameters in patients undergoing ACL reconstruction using peroneus longus tendon autografts. A recent systematic review and meta-analysis by Kumar et al. [15] further confirmed that peroneus longus tendon grafts consistently provide larger graft dimensions compared with hamstring tendon grafts. Biomechanical

evidence from Rudy et al. [12] also demonstrated favourable tensile properties of the peroneus longus tendon, supporting its suitability as an ACL graft.

### **Pain Outcomes**

Postoperative pain improved significantly in both groups during follow-up. However, patients in the peroneus longus group demonstrated significantly lower VAS scores at one month ( $2.10 \pm 0.54$  vs  $2.58 \pm 0.60$ ;  $p=0.034$ ), indicating superior early postoperative recovery.

These findings are comparable with those reported by Agarwal et al. [18], who observed lower early postoperative pain scores among patients reconstructed using peroneus longus tendon grafts. Similarly, Dwidmuthé et al. [19] reported favourable early postoperative comfort and rehabilitation in patients receiving peroneus longus grafts.

The reduced pain observed in the PL group may be attributable to preservation of the hamstring musculature and avoidance of donor-site morbidity around the knee. However, by six months both groups achieved comparable pain scores, indicating that graft selection does not significantly influence long-term pain outcomes.

### **Functional Outcome (IKDC Score)**

Functional improvement occurred progressively in both groups throughout follow-up. The PL group demonstrated significantly better IKDC scores at one month ( $56.76 \pm 5.41$  vs  $51.80 \pm 1.74$ ;  $p=0.005$ ), suggesting faster early functional recovery. However, the difference disappeared at later follow-up, and both groups achieved similar IKDC scores at six months.

The findings of the present study are in agreement with those reported by Acharya et al. [20], who demonstrated equivalent final IKDC outcomes between hamstring and peroneus longus grafts despite differences during early rehabilitation. Similar observations were reported by Keyhani et al. [14], Dwidmuthé et al. [19], and Sari and Kose [23], who found no significant difference in long-term functional outcomes between the two graft sources. A recent systematic review by Park et al. [25] concluded that peroneus longus and hamstring tendon autografts provide comparable functional outcomes after ACL reconstruction. Therefore, while peroneus longus grafts may facilitate faster early rehabilitation, both grafts ultimately achieve equivalent restoration of knee function.

### **Donor-Site Morbidity and AOFAS Outcomes**

One of the primary concerns associated with peroneus longus tendon harvest is the possibility of postoperative ankle dysfunction. In the present study, AOFAS scores were slightly lower in the PL group at one month ( $96.93 \pm 5.32$  vs 100;  $p=0.02$ ). However, this difference

resolved by subsequent follow-up, and both groups achieved identical scores at six months.

These findings indicate that peroneus longus tendon harvest may result in a transient reduction in ankle function but does not cause clinically significant long-term impairment. Similar findings were reported by Song et al. [16], who demonstrated preservation of ankle function following peroneus longus tendon harvesting. Rhatomy et al. [17] further reported no significant long-term impairment of ankle eversion strength or first-ray plantar flexion after graft harvest.

Acharya et al. [20] and Singh et al. [21] likewise demonstrated excellent ankle function and minimal donor-site morbidity following peroneus longus tendon harvest. The present findings therefore support the growing body of evidence suggesting that peroneus longus tendon harvesting is safe and does not result in clinically relevant long-term ankle disability.

### **Knee Stability Outcomes**

Restoration of knee stability represents the principal objective of ACL reconstruction. In the present study, both groups demonstrated satisfactory improvement in postoperative knee stability, with no significant intergroup differences.

Comparable findings have been reported by Agarwal et al. [18], Dwidmuthé et al. [19], and Gök et al. [24], who observed equivalent postoperative Lachman, Anterior Drawer, and Pivot Shift outcomes in patients reconstructed using either hamstring or peroneus longus tendon grafts. These findings may be explained by the favourable biomechanical properties of the peroneus longus tendon, which have been shown to provide adequate strength and stiffness for ligament reconstruction [12].

The comparable stability outcomes observed in the present study suggest that both graft options effectively restore knee biomechanics and provide satisfactory functional stability.

### **Postoperative Complications**

The incidence of postoperative complications was low in both groups. Although anterior knee pain, quadriceps hypotrophy, and paraesthesia occurred more frequently in the semitendinosus group, none of these differences achieved statistical significance.

Anterior knee pain occurred in 26.7% of patients in the ST group compared with 6.7% in the PL group, while quadriceps hypotrophy was observed in 53.3% and 26.7% of patients, respectively. Similar trends have been reported by Agarwal et al. [18], Ambulgekar et al. [13], and Kumar et al. [15], who reported reduced donor-site morbidity among peroneus longus graft recipients.

The lower incidence of donor-site complications in the PL group may be related to preservation of hamstring function and reduced disruption of structures around the knee joint. Preservation of hamstring integrity may facilitate more rapid rehabilitation and maintenance of muscular balance around the knee.

Overall, the present findings indicate that both grafts are safe and effective options for ACL reconstruction, although peroneus longus tendon grafts may offer a modest advantage with respect to donor-site morbidity.

### Clinical Implications

The present study demonstrated that peroneus longus tendon grafts provide significantly larger graft dimensions, superior early postoperative pain relief, and faster early functional recovery while maintaining equivalent final functional outcomes, knee stability, and ankle function. These findings support the use of peroneus longus tendon autografts as a reliable alternative to semitendinosus tendon grafts, particularly in patients with small hamstring tendons or when larger graft dimensions are desired.

### Strengths and Limitations

The strengths of the present study include its prospective design, direct comparison of two autograft sources, uniform rehabilitation protocol, and assessment of both knee and donor-site outcomes. However, limitations include the relatively small sample size, single-centre design, and short follow-up duration of six months. Larger multicentric studies with longer follow-up are necessary to evaluate long-term graft survival and functional outcomes.

## CONCLUSION

The present prospective comparative study demonstrated that both semitendinosus and peroneus longus tendon autografts provide satisfactory outcomes following arthroscopic ACL reconstruction. Peroneus longus tendon grafts produced significantly greater graft diameter and graft length than semitendinosus grafts, potentially offering biomechanical advantages during reconstruction.

Patients reconstructed using peroneus longus grafts experienced superior early postoperative pain relief and faster functional recovery, as evidenced by significantly better VAS and IKDC scores at one month. However, these advantages diminished over time, and both groups achieved comparable IKDC, VAS, and AOFAS scores by six months. Restoration of knee stability was similar between groups, and complication rates were low in both cohorts.

The study further demonstrated that harvesting the peroneus longus tendon did not result in clinically significant long-term ankle dysfunction, supporting its safety as an alternative autograft source. Although some

complications were numerically more frequent in the semitendinosus group, no statistically significant differences were observed.

Based on these findings, the peroneus longus tendon may be considered a reliable and effective alternative to the semitendinosus tendon for ACL reconstruction, particularly when larger graft dimensions are desired or when preservation of hamstring integrity is advantageous.

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