



**Peroneus Longus Tendon Autograft for Anterior Cruciate Ligament Reconstruction:  
A Comprehensive Statistical and Outcome-Based Clinical Analysis**

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**Abstract**

*Anterior cruciate ligament (ACL) reconstruction remains a critical intervention for restoring knee stability and preventing long-term degenerative changes following ligament rupture. While hamstring tendon (HT) and bone–patellar tendon–bone (BPTB) grafts are widely used, emerging evidence supports the peroneus longus tendon (PLT) as a viable and potentially superior alternative. This study synthesizes data from randomized controlled trials, prospective comparative studies, and meta-analyses involving >1,500 patients, evaluating graft diameter, functional outcomes, knee stability, donor-site morbidity, and rehabilitation parameters. Statistical analysis demonstrates that PLT autografts provide significantly larger graft diameters ( $p < 0.001$ ), comparable or superior IKDC and Lysholm scores, and negligible donor-site morbidity, with ankle function preserved (AOFAS >95 in >90% cases). These findings position PLT as a biomechanically sound and clinically advantageous graft choice in ACL reconstruction.*

**Introduction**

Anterior cruciate ligament injuries represent a significant proportion of knee pathologies encountered in orthopedic practice, particularly among young and physically active individuals(1). Epidemiological data indicate that ACL injuries account for nearly 30–50% of all ligamentous knee injuries, with an increasing incidence due to the rising participation in high-demand sports activities. Surgical reconstruction remains the gold standard for restoring joint stability, improving functional outcomes, and preventing early osteoarthritic changes. However, graft selection continues to be a subject of considerable debate, as it directly influences surgical success, rehabilitation, and long-term outcomes(2).

Traditionally, hamstring tendon and bone–patellar tendon–bone grafts have been widely utilized, yet both present notable limitations. Hamstring grafts are associated with variability in graft diameter and postoperative muscle weakness, while patellar tendon grafts often result in anterior knee pain and donor-site complications(3). In this context, the peroneus longus tendon has emerged as a promising alternative, owing to its favorable biomechanical characteristics, consistent morphology, and minimal impact on lower limb function. The present article aims to provide an in-depth statistical and clinical evaluation of PLT grafts, focusing on their efficacy, safety, and comparative performance against established graft options(4).

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## Materials and Methods

The present analysis integrates data from six randomized controlled trials, eight prospective comparative studies, and three systematic reviews with meta-analysis, encompassing a total sample size of approximately 1,528 patients undergoing ACL reconstruction (5). The studies included in this synthesis evaluated outcomes such as graft diameter, functional knee scores including the International Knee Documentation Committee (IKDC) and Lysholm scores, objective stability measurements using KT-1000 arthrometry, and donor-site morbidity assessed through ankle-specific scoring systems such as the American Orthopaedic Foot and Ankle Society (AOFAS) score and the Foot and Ankle Disability Index (FADI)(6).

Continuous variables were expressed as mean values with standard deviations, and statistical significance was determined using p-values, with a threshold of less than 0.05 considered significant. Comparative analyses were performed to evaluate differences between PLT and HT graft groups, and pooled effect sizes were derived where applicable to provide a comprehensive statistical perspective (7).

## Biomechanical and Morphological Analysis

The biomechanical strength of the graft plays a critical role in determining the success of ACL reconstruction. The peroneus longus tendon demonstrates an ultimate tensile strength ranging from approximately 4,000 to 4,500 Newtons, which is significantly higher than that of the native ACL, estimated at around 2,200 Newtons. When compared to hamstring grafts, which exhibit tensile strengths in the range of 3,800 to 4,100 Newtons, the PLT shows comparable or slightly superior biomechanical properties. This indicates that the PLT is capable of withstanding physiological loads effectively and provides sufficient strength for ligament reconstruction (8).

An important morphological advantage of the PLT is its consistent and larger graft diameter. Across multiple studies, the mean diameter of PLT grafts was reported as  $8.56 \pm 0.93$  mm, compared to  $7.44 \pm 0.60$  mm for hamstring grafts, with the difference being highly statistically significant ( $p < 0.001$ ). This finding is clinically relevant, as grafts with diameters less than 8 mm have been associated with higher rates of graft failure and revision surgery. Therefore, the consistently larger diameter of the PLT contributes to improved structural integrity and long-term durability of the reconstructed ligament.

**Graft Diameter (Critical Determinant of Success)**

Study	PLT Diameter (mm)	HT Diameter (mm)	p-value
Gök et al.	8.7 ± 0.8	7.5 ± 0.6	<0.001
Singh et al.	8.5 ± 0.9	7.3 ± 0.7	<0.001
Meta-analysis (pooled)	8.56 ± 0.93	7.44 ± 0.60	<0.001

Statistical Interpretation:

A graft diameter  $\geq 8$  mm reduces failure risk by up to 43%, placing PLT at a clear advantage.

**Functional Outcomes**

Functional recovery following ACL reconstruction is typically assessed using validated scoring systems such as the IKDC and Lysholm scores. Analysis of pooled data indicates that patients receiving PLT grafts demonstrate slightly superior early functional outcomes compared to those receiving hamstring grafts. At six months postoperatively, the mean IKDC score in the PLT group was approximately  $82.4 \pm 5.2$ , compared to  $80.1 \pm 6.0$  in the HT group, with the difference reaching statistical significance ( $p = 0.04$ ). At twelve months, the PLT group continued to show higher scores, with a mean of  $90.6 \pm 4.1$  versus  $88.7 \pm 4.8$  in the HT group ( $p = 0.03$ ). However, by twenty-four months, the difference between the groups was no longer statistically significant, indicating comparable long-term outcomes(9).

A similar trend was observed in Lysholm scores, where a higher proportion of patients in the PLT group achieved excellent outcomes. Approximately 78–85% of patients in the PLT group reported scores above 90, compared to 72–80% in the HT group. These findings suggest that while both grafts provide satisfactory long-term results, the PLT may offer a slight advantage in early functional recovery.

**IKDC Score Comparison**

Time Interval	PLT (Mean ± SD)	HT (Mean ± SD)	p-value
6 months	82.4 ± 5.2	80.1 ± 6.0	0.04
12 months	90.6 ± 4.1	88.7 ± 4.8	0.03
24 months	93.8 ± 3.2	92.5 ± 3.6	0.08

Early superiority with PLT; long-term outcomes statistically equivalent

### Lysholm Score Analysis

Outcome	PLT (%)	HT (%)
Excellent (>90)	78–85%	72–80%
Good (84–90)	10–15%	12–18%
Fair/Poor	<5%	5–8%

PLT shows higher proportion of excellent outcomes

### Knee Stability and Objective Assessment

Objective evaluation of knee stability using KT-1000 arthrometry revealed no significant differences between the PLT and HT groups. The mean anterior tibial translation was reported as  $1.8 \pm 0.9$  mm in the PLT group and  $2.0 \pm 1.1$  mm in the HT group, with a p-value of 0.12, indicating statistical equivalence. Clinical tests such as the Lachman and pivot-shift tests further supported these findings, with negative results observed in over 90% of patients in both groups. These results confirm that PLT grafts provide comparable mechanical stability to traditional grafts(10).

### KT-1000 Arthrometer Findings

Mean anterior tibial translation difference:

PLT:  $1.8 \pm 0.9$  mm

HT:  $2.0 \pm 1.1$  mm

p = 0.12 (not significant)

### Clinical Stability Tests

Negative Lachman test:

PLT: 91–94%

HT: 89–92%

Indicates statistical equivalence in stability

## Donor-Site Morbidity and Ankle Function

One of the primary concerns associated with the use of the peroneus longus tendon is the potential impact on ankle function. However, extensive statistical analysis demonstrates that donor-site morbidity is minimal. The mean AOFAS scores in patients undergoing PLT harvest ranged from 95 to 97, indicating excellent ankle function. Similarly, FADI scores were reported to be between 93 and 96, suggesting no significant impairment in daily activities.

### Ankle Functional Scores

Parameter	Mean Score	Interpretation
AOFAS	95–97	Excellent
FADI	93–96	No functional limitation

A meta-analysis involving over 1,000 patients found no statistically significant differences in ankle strength or gait patterns following PLT harvest, with a p-value of 0.67. Furthermore, any reduction in muscle strength was reported to be less than 5%, which is considered clinically insignificant(11). These findings strongly support the safety of PLT harvest and alleviate concerns regarding functional compromise at the donor site.

## Rehabilitation and Recovery

Rehabilitation outcomes are a critical determinant of patient satisfaction and return to activity. Patients undergoing ACL reconstruction with PLT grafts have been shown to achieve faster recovery compared to those with hamstring grafts. The average time to return to sports was reported to be approximately 5.5 to 6 months in the PLT group, compared to 6 to 7 months in the HT group. Additionally, patients in the PLT group exhibited lower pain scores and reduced muscle hypotrophy, contributing to a more efficient rehabilitation process.

### Rehabilitation and Recovery Metrics

Parameter	PLT	HT	Significance
Return to sports	5.5–6 months	6–7 months	Faster
Muscle hypotrophy	Minimal	Moderate	Significant
Pain score (VAS)	Lower	Higher	$p < 0.05$

PLT demonstrates faster and smoother rehabilitation

## Complications and Failure Rates

The incidence of complications and graft failure is an important consideration in graft selection. Data analysis indicates that the failure rates for PLT grafts range from 2.1% to 3.5%, compared to 3.8% to 5.2% for hamstring grafts. Although these differences are not always statistically significant, the trend suggests a lower risk of failure with PLT grafts. Infection rates were low and comparable between groups, and reoperation rates were slightly lower in the PLT group(12).

### Complication and Failure Rates

Complication	PLT (%)	HT (%)
Graft failure	2.1–3.5	3.8–5.2
Infection	<1	<1
Reoperation	2.5	3.9

Trend toward lower failure rates in PLT, though not always statistically significant

## Discussion

The findings of this comprehensive analysis demonstrate that the peroneus longus tendon autograft offers several distinct advantages over traditional graft options. The most significant of these is the consistently larger graft diameter, which has been strongly correlated with reduced failure rates and improved biomechanical stability. Additionally, the preservation of hamstring and quadriceps function provides a functional advantage, particularly in athletes and individuals requiring high levels of physical performance.

The absence of significant donor-site morbidity further enhances the appeal of the PLT graft. Contrary to earlier concerns, the available evidence indicates that harvesting the peroneus longus tendon does not compromise ankle stability or function. This is supported by robust statistical data and long-term follow-up studies.

## Conclusion

The peroneus longus tendon autograft represents a statistically validated and clinically effective option for ACL reconstruction. Its superior graft diameter, comparable functional outcomes, minimal donor-site morbidity, and favorable rehabilitation profile position it as a strong alternative to traditional grafts. The accumulating body of evidence suggests that the PLT is not merely an alternative but a potential first-line

graft choice, particularly in patients where optimal biomechanical strength and rapid recovery are essential. As surgical techniques continue to evolve, the peroneus longus tendon is poised to play an increasingly prominent role in the future of ligament reconstruction.

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