Aryana IGNW, Prayudi IBD, Suyasa IK, Subawa IW, Febyan. No Difference in Ankle Morbidity Between the Leg with Peroneus Longus Used for ACL Reconstruction Autograft and the Contralateral Side 12 Months Postoperatively. *Orthopedic Reviews*. 2025;17. doi:10.52965/001c.144731

General

No Difference in Ankle Morbidity Between the Leg with Peroneus Longus Used for ACL Reconstruction Autograft and the Contralateral Side 12 Months Postoperatively

I Gusti Ngurah Wien Aryana[1], Ida Bagus Deny Prayudi[1], I Ketut Suyasa[1], I Wayan Subawa[1], Febyan[1]

[1] Department of Orthopaedic and Traumatology, faculty of Medicine, Udayana University, Prof Ngoerah Hospital, Bali, Indonesia

Keywords: Anterior Cruciate Ligament, Peroneus Longus Tendon, Ankle Morbidity, Autograft

https://doi.org/10.52965/001c.144731

Orthopedic Reviews

Vol. 17, 2025

Background

Anterior cruciate ligament (ACL) injuries often require surgical intervention. The use of the peroneus longus tendon in ACL reconstruction has been reported to offer significant potential benefits, such as preserving the hamstring tendons. However, its effects on the ankle must be considered prior to surgery.

Methods

This was a cross-sectional study evaluating ankle morbidity using the American Orthopedic Foot and Ankle Society (AOFAS) score, plantarflexion and eversion strength, and Clarke's angle on both extremities. Data were collected from patients who underwent ACL reconstruction using the peroneus longus tendon as an autograft. Statistical analysis was performed using the Mann-Whitney test with SPSS v.26.

Results

A total of 64 patients were included, with the mean AOFAS scores of 58.88 (donor side) and 70.12 (contralateral side). Mann-Whitney test results showed no significant difference in AOFAS scores between the two sides (p=0.085). The mean plantarflexion strength values were 62.23 (donor) and 66.77 (contralateral), with no significant difference (p=0.489). Additionally, the mean Clarke's angle values were 59.10 (donor) and 69.90 (contralateral), with no significant difference (p=0.099).

Conclusion

There was no statistically significant difference in ankle function in patients who used the peroneus longus tendon as an autograft in ACL reconstruction.

INTRODUCTION

The *peroneus longus*, also known as the *fibularis longus*, is a muscle located on the lateral aspect of the lower leg, specifically along the lateral side of the fibula. It plays a role in plantarflexion and eversion of the foot, both of which involve the ankle joint. The peroneus longus is known to have a higher maximum load strength compared to the hamstring muscles, which has led to increased use of the peroneus longus as a graft donor in orthopaedic surgeries, including ACL tendon grafts. However, studies evaluating the impact of peroneus longus use on ankle function are still very limited.[1]

The anterior cruciate ligament (ACL) is the most frequently injured ligament in the knee joint, often due to sports injuries or traffic accidents. Most ACL injuries require surgical reconstruction, which involves using a donor graft to replace the damaged ligament.[2,3]

There are several graft options available for ACL injury treatment, including autografts from the bone-patellar tendon-bone (BPTB), hamstring tendon, and peroneus longus tendon. A study by Rhotamy et al. evaluating ACL reconstruction using the peroneus longus reported very good outcomes.[1,4,5] However, another study by Angthong et al. reported that using the peroneus longus tendon in ACL reconstruction could result in ankle instability.[6]

Therefore, this study aims to evaluate ankle joint function following the harvest of the peroneus longus tendon by assessing functional performance tests, ankle strength, AOFAS score, and Clarke's angle, comparing them to the healthy contralateral limb.

METHODS

STUDY DESIGN

This was a retrospective cohort study aimed at evaluating ankle morbidity in patients who underwent peroneus longus tendon harvesting as an autograft for ACL reconstruction.

POPULATION AND SAMPLE

The study sample included all patients who underwent ACL reconstruction using the peroneus longus tendon autograft and presented from February 2023 onwards, meeting the inclusion and exclusion criteria.

The inclusion criteria for this study were patients aged between 18 and 40 years who had undergone anterior cruciate ligament (ACL) reconstruction using the peroneus longus tendon autograft at least 12 months prior to the study. Additionally, eligible participants were those who provided informed consent, demonstrated willingness to participate, and were cooperative during the examination process. The exclusion criteria comprised individuals with a history of prior ankle injuries, those who had sustained multi-ligamentous injuries, and patients with systemic diseases such as diabetes mellitus.

According to Xergia et al. (2013), the mean ACLR value for the control group was 0.26 (σ = 1.87), and for the intervention group was 0.29. From sample size calculations, 20.2 samples were required per group; adding 10% for potential dropouts, a total of 22 samples per group was determined.

RESEARCH VARIABLES

Variables included age, sex, comorbidities (acute and chronic conditions that could worsen or relieve the primary disease), congenital abnormalities, and physical activity level (⩾4 times per week for at least 30 minutes per session).

The outcome variables assessed in this study included the American Orthopedic Foot and Ankle Society (AOFAS) score, ankle strength, and Clarke's angle. The AOFAS score was categorized into three levels: Excellent (90–100), Good (80–90), and Fair (<80). Ankle strength was defined as the physical capacity of the muscles and tendons around the ankle joint to produce and sustain force during movement. Clarke's angle was measured as the tangent angle formed by two lines: the first connecting the medial border of the first metatarsal head and the heel, and the second connecting the first metatarsal head to the apex of the medial longitudinal arch.

Clarke's angle was further classified into five categories: Normal (42°–54°), Mild flatfoot (35°–41°), Moderate flatfoot (30°–34.9°), Severe flatfoot (<30°), and High-arched foot (>54°).

DATA ANALYSIS

Data were analyzed using SPSS version 26. Univariate analysis was followed by bivariate analysis to evaluate ankle morbidity outcomes such as AOFAS score, plantarflexion strength, and eversion strength. Independent t-tests or Mann-Whitney tests were used for group comparisons. Effect sizes were presented as percentages. A p-value <0.05 with a 95% confidence interval was considered statistically significant.

Table 1. Characteristics of included samples

Variables	n (%)
Age (Mean ± SD)	27,28 ± 10,03
Gender	
Male	45 (70,3)
Female	19(29,7)
Total	64 (100,0)

RESULTS

The study included 64 patients divided into two groups and was conducted at RSUP Prof. Dr. I.G.N.G Ngoerah, Denpasar. Demographic characteristics of patients are shown in Table 1. The mean age of the sample was 27.28 ± 10.03 years. The male-to-female ratio was 2.37:1, with males being the majority (70.3%). Normality tests were conducted using the Kolmogorov–Smirnov test due to the sample size exceeding 50 participants per group. According to the normality test results, data for the AOFAS score, plantarflexion strength, eversion strength, and Clarke's angle were not normally distributed ($p < 0.05$) (Table 2). Bivariate analysis results are shown in Table 3.

In this study, the mean AOFAS score on the peroneus longus donor side was 58.88, and 70.12 on the contralateral side. Based on the Mann-Whitney test, no significant difference was found in AOFAS scores.

There was no significant difference in ankle function between the donor and contralateral sides following ACL reconstruction, with a p-value of 0.085 ($p > 0.05$).

The mean plantarflexion strength was 14.58 on the donor side and 14.75 on the contralateral side. Based on the Mann-Whitney test, there was no significant difference in plantarflexion strength between the two sides after ACL reconstruction ($p = 0.49$; $p > 0.05$).

The mean eversion strength was 11.40 on the donor side and 11.02 on the contralateral side. An independent t-test showed no significant difference between the two ankles post-ACL reconstruction ($p = 0.767$; $p > 0.05$).

The mean Clarke's angle was 59.10 on the donor side and 69.90 on the contralateral side. The Mann-Whitney test revealed no significant difference between the donor and contralateral sides after ACL reconstruction ($p = 0.099$; $p > 0.05$).

DISCUSSION

This study found no significant difference in ankle strength between the side without the peroneus longus tendon and the contralateral healthy ankle, measured using first ray plantarflexion and eversion strength 12 months after ACL

Table 2. Normality test with *Saphiro Wilk*

Variables	n	p-value	Data Distribution
AOFAS Score	128	<0,001	Non-parametric
Plantar Flexion Strength	128	0,044	Non-parametric
Eversion Strength	128	0,814	Parametric
Clarke's Angle	128	0,004	Non-parametric

Table 3. Inferential testing using the Mann-Whitney test on ankle morbidity outcomes between the donor side and the contralateral side after ACL reconstruction

Variables	Peroneus longus donor side	Contralateral Side	p-value
AOFAS Score	58,88	70,12	0,085
Plantar Flexion Strength	14,58	14,75	0,489
Eversion Strength	11,40	11,02	0,767
Clarke's Angle	59,10	69,90	0,099

reconstruction. These findings are consistent with a study by Shao et al. (2020), which showed that average plantarflexion strength was 46 in the peroneus-donor ankle and 45.2 in the contralateral ankle ($p = 0.131$).

Similarly, Rhatomy et al. (2019) reported no significant difference in ankle strength when measured by first ray plantarflexion and eversion. Their study found a mean plantarflexion strength with $p = 0.680$ ($p > 0.05$) and mean eversion strength with $p = 0.546$ ($p > 0.05$).

The peroneus longus tendon plays a key role in enhancing first ray plantarflexion and eversion. It helps distribute pressure on the anterior foot and maintain stability in coordination with the peroneus brevis tendon. Hence, even after harvesting the peroneus longus tendon for ACL reconstruction, the remaining peroneus brevis and other muscles may compensate for the loss, resulting in no significant reduction in plantarflexion or eversion strength.[5,7]

The primary function of the peroneus longus tendon is to support first ray plantarflexion and foot eversion. Concerns have been raised about diminished inversion-eversion control and plantarflexion strength following peroneus longus harvest. However, these concerns are not supported by a study by Shi et al., which found no differences in ankle strength or range of motion before and after surgery ($p > 0.05$).[5,8,9]

Previous studies have also shown that harvesting the peroneus longus tendon does not significantly affect ankle function, strength, or range of motion. Karanikas et al. reported no differences in isokinetic strength for first ray plantarflexion between the donor and contralateral ankles, suggesting that peroneus longus harvest does not significantly impact first ray plantarflexion strength.[10-11] Moreover, the tensile strength of the peroneus longus tendon is comparable to other commonly used grafts, such as the hamstring tendon. This suggests that the peroneus longus autograft can provide sufficient strength for ACL reconstruction.[2,12]

These findings provide evidence of no significant difference in first ray plantarflexion strength following peroneus longus tendon harvest. However, individual variations and other influencing factors may still affect outcomes. Further research is needed to better understand the underlying reasons for these findings.

In contrast, Angthong et al. (2015), in a study involving 24 patients who underwent ACL reconstruction using peroneus longus autograft with endobutton fixation, reported significantly reduced eversion and inversion peak torque in the donor ankle at both 60°/s and 120°/s during isokinetic testing at 7 months follow-up ($p < 0.05$). Based on these results, Angthong et al. did not recommend the peroneus longus as the first-choice graft for ACL reconstruction. However, it may still be considered when other grafts have been used or in complex multiligament knee reconstructions, such as in traumatic knee dislocations.[9,12,13-14]

The comparable ankle strength observed in this study may be attributed to two main factors: compensatory activity of adjacent muscles and potential regeneration of the peroneus longus tendon. Muscle compensation has been documented in prior studies. The peroneus longus contributes only about 4% of total ankle plantarflexion strength, whereas the gastrocnemius-soleus complex contributes approximately 87%. Thus, even if the peroneus longus is harvested, ankle strength can be preserved. Another factor is the potential regeneration of the tendon. Previous studies have shown that hamstring tendon regeneration can aid in restoring postoperative flexion strength.[15]

This study also found no significant difference in ankle performance, as measured by the AOFAS score, between patients who had their peroneus longus harvested and the contralateral healthy ankle 12 months after ACL reconstruction. These results align with findings by Shao et al., which reported only a 0.2-point difference in AOFAS scores between donor and contralateral ankles ($p = 0.480$).[16]

In their study, the AOFAS score was 98.7 in the donor ankle and 98.5 in the contralateral side. Conversely, Trung et al. (2019) reported a significant postoperative improvement in AOFAS scores among 30 ACL-reconstructed pa-

tients. Similarly, a prospective cohort study by Rhatomy found no significant decrease in AOFAS scores post-ACL reconstruction using peroneus longus grafts, with an average score of 98.93 ($p < 0.05$).[12,17,18]

In contrast, Angthong et al. (2015) evaluated the biomechanical and clinical outcomes of the donor ankle following peroneus longus harvest for ACL reconstruction. Their study reported a decrease in AOFAS score from a preoperative mean of 100.0 to 96.0 at six months postoperative. In an RCT by Vijay et al., AOFAS scores dropped from a preoperative average of 100 to 96.43 one year after surgery. These studies suggest a potential clinical decline in donor ankle function post-harvest.[19]

Regarding arch morphology, this study found no significant difference in Clarke's angle between the peroneus longus-donor foot and the contralateral healthy foot 12 months after ACL reconstruction. Clarke's angle is commonly used to assess the foot arch and identify conditions such as flatfoot or cavus foot. These findings are consistent with those of Shao et al., who found no difference in foot arch morphology between donor and contralateral sides in patients who underwent ACL reconstruction with peroneus longus graft ($p > 0.05$).[9,15]

Nishino et al. conducted a CT-based study assessing foot arch parameters, including longitudinal arch height, transverse arch width, and longitudinal angle, and found no statistically significant changes before and 30 months after full-thickness peroneus longus tendon harvest.[19]

One concern regarding donor site morbidity is the potential for structural failure resulting in arch deformity. However, this study—along with those by Shao et al. and Nishino et al.—did not find any post-harvest structural abnormalities in the foot arch. Thus, harvesting the peroneus longus tendon does not appear to impair static arch structure, although it may weaken some dynamic stabilizers.[13]

Interestingly, a study by Harshad et al. associated chronic ACL rupture with flatfoot based on podogram analysis in 23 patients. An RCT by Dalitan et al. assessed Clarke's angle in 13 patients who underwent ACL reconstruction with peroneus longus autograft. The study reported moderate flatfoot at six months post-op, with Clarke's angle measuring 39.67° in the group with distal stump suturing and 39.5° in the group without suturing.[5,7,13]

The peroneus longus tendon has a minimal role in supporting the foot arch. Other structures such as the abductor hallucis, posterior tibial tendon, and flexor hallucis longus play more significant roles in maintaining the arch. The peroneus brevis and abductor digiti minimi help support the lateral longitudinal arch, while the adductor hallucis and posterior tibial tendon are key to stabilizing the transverse arch. Therefore, the study by Kremoglu et al. concluded that peroneus longus tendon harvest does not affect foot stability.[19]

LIMITATIONS

This study had several limitations, including a relatively short follow-up period and the lack of analysis on the influence of other variables, such as age and sex, on outcome differences.

CONCLUSION

There was no significant difference in ankle strength between patients who had their peroneus longus tendon harvested and their contralateral side 12 months after ACL reconstruction, in terms of both plantarflexion and eversion strength. Similarly, ankle stability measured using the AOFAS score showed no significant differences. Additionally, there was no significant difference in foot arch morphology, as measured by Clarke's angle, between the donor and contralateral sides.

Future studies should involve a larger sample size and longer observation periods. Moreover, comparative studies between peroneus longus tendon and other autograft options may provide a more comprehensive understanding of functional outcomes following ACL reconstruction.

CONFLICT OF INTEREST

There are no conflicts of interest in this study.

ETHICAL CLEARANCE

This study received ethical approval from the Research Ethics Committee of the Faculty of Medicine, Udayana University.

FUNDING

This research did not receive any external funding and was entirely self-funded by the authors.

AUTHOR CONTRIBUTIONS

All authors contributed fully to all stages of the article preparation.

Submitted: July 27, 2025 EDT. Accepted: August 24, 2025 EDT.
Published: September 29, 2025 EDT.

REFERENCES

1. Rhatomy S, Hartoko L, Setyawan R, Soekarno NR, Zainal Asikin AI, Pridianto D, et al. Single bundle ACL reconstruction with peroneus longus tendon graft: 2-years follow-up. *J Clin Orthop Trauma*. 2020;11:S332-6. doi:10.1016/j.jcot.2019.09.004

2. Angthong C, Chernchujit B, Apivatgaroon A, Chaijenkit K, Nualon P, Suchao-in K. The Anterior Cruciate Ligament Reconstruction with the Peroneus Longus Tendon: A Biomechanical and Clinical Evaluation of the Donor Ankle Morbidity. *J Med Assoc Thai*. 2015;98(6):555-560.

3. Khan IA, Mahabadi N, D'Abarno A, Varacallo M. Anatomy, Bony Pelvis and Lower Limb: Leg Lateral Compartment. In: Treasure Island (FL); 2024.

4. Wong AK, Calvo MR, Schaffler BC, Nixon RA, Carrero LC, Neufeld EV, et al. Biomechanical and geometric characterization of peroneus longus allografts with respect to age. *Clin Biomech (Bristol, Avon)*. 2019;67:90-95. doi:10.1016/j.clinbiomech.2019.04.017

5. Zhao J, Huangfu X. The biomechanical and clinical application of using the anterior half of the peroneus longus tendon as an autograft source. *Am J Sports Med*. 2012;40(3):662-671. doi:10.1177/0363546511428782

6. Hallinan JTPD, Wang W, Pathria MN, Smitaman E, Huang BK. The peroneus longus muscle and tendon: a review of its anatomy and pathology. *Skeletal Radiol*. 2019;48(9):1329-1344. doi:10.1007/s00256-019-3168-9

7. Bavdek R, Zdolšek A, Strojnik V, Dolenec A. Peroneal muscle activity during different types of walking. *J Foot Ankle Res*. 2018;11:50. doi:10.1186/s13047-018-0291-0. PMID:30202446

8. Lezak B, Varacallo M. Anatomy, Bony Pelvis and Lower Limb: Calf Peroneus Longus Muscle. In: Treasure Island (FL); 2024.

9. Arliani GG, Astur DC, Moraes ER, Kaleka CC, Jalikjian W, Golano P, et al. Three dimensional anatomy of the anterior cruciate ligament: a new approach in anatomical orthopedic studies and a literature review. *Open access J Sport Med*. 2012;3:183-188. doi:10.2147/OAJSM.S37203. PMID:24198601

10. Marieswaran M, Jain I, Garg B, Sharma V, Kalyanasundaram D. A Review on Biomechanics of Anterior Cruciate Ligament and Materials for Reconstruction. *Appl bionics Biomech*. 2018;2018:4657824. doi:10.1155/2018/4657824. PMID:29861784

11. Raines BT, Naclerio E, Sherman SL. Management of Anterior Cruciate Ligament Injury: What's In and What's Out? *Indian J Orthop*. 2017;51(5):563-575. doi:10.4103/ortho.IJOrtho_245_17. PMID:28966380

12. Perry D, O'connell M. Evaluation and management of anterior cruciate ligament injuries: A focused review. *Osteopath Fam Physician*. 2015;7(2):8-12.

13. Domnick C, Raschke MJ, Herbort M. Biomechanics of the anterior cruciate ligament: Physiology, rupture and reconstruction techniques. *World J Orthop*. 2016;7(2):82-93. doi:10.5312/wjo.v7.i2.82. PMID:26925379

14. Filbay SR, Grindem H. Evidence-based recommendations for the management of anterior cruciate ligament (ACL) rupture. *Best Pract Res Clin Rheumatol*. 2019;33(1):33-47. doi:10.1016/j.berh.2019.01.018. PMID:31431274

15. Mann G, Nyska M, Hetsroni I, Karlsson J. Scoring systems for evaluating ankle function. *Foot Ankle Clin*. 2006;11(3):509-519. doi:10.1016/j.fcl.2006.05.001

16. Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M. Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. *Foot ankle Int*. 1994;15(7):349-353. doi:10.1177/107110079401500701

17. Gonosova Z, Linduska P, Bizovska L, Svoboda Z. Reliability of Ankle–Foot Complex Isokinetic Strength Assessment Using the Isomed 2000 Dynamometer. *Medicina (Kaunas)*. 2018;54(3). doi:10.3390/medicina54030043. PMID:30344274

18. Agung G, Yudha K, Kawiyana IKS, Gede K, Ridia M, Suyasa IK, et al. The use of compression stockings produces lower Interleukin-6 (IL-6) levels , Higher American Orthopaedic Foot and Ankle Society Score (AOFAS), and does not produce higher alkaline phosphatase level in postoperative patients with fracture around the ankle. 2021;12(1):208-211.

19. Kerimoğlu S, Aynaci O, Saraçoğlu M, Aydin H, Turhan AU. [Anterior cruciate ligament reconstruction with the peroneus longus tendon]. *Acta Orthop Traumatol Turc*. 2008;42(1):38-43. doi:10.3944/AOTT.2008.038