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Donor-Site Ankle Function Following Full-Thickness Peroneus Longus Tendon Harvest for Primary Anterior Cruciate Ligament Reconstruction: A Prospective Case Series

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Abstract

Background: Autograft selection in anterior cruciate ligament (ACL) reconstruction remains a critical determinant of postoperative stability and donor-site morbidity. While bone–patellar tendon–bone and hamstring grafts are widely used, alternative grafts such as the peroneus longus (PL) tendon have gained attention due to favorable biomechanical properties. However, concerns persist regarding potential ankle dysfunction following PL harvesting. ***Methods:*** This prospective case series included 26 patients who underwent primary ACL reconstruction using ipsilateral full-thickness peroneus longus tendon autograft between 2017 and 2021. Donor-site ankle function was assessed preoperatively and at three weeks, two months, and six months postoperatively using the American Orthopaedic Foot and Ankle Society (AOFAS) score, Foot and Ankle Disability Index (FADI), St. Pierre score, and Karlsson-Peterson scoring system. ***Results:*** Twenty-four patients completed six-month follow-up. A transient decline in ankle functional scores was observed at three weeks postoperatively (mean AOFAS: 95; FADI: 93; Karlsson-Peterson: 95), followed by progressive improvement at two months. By six months, all functional scores returned to baseline values (mean AOFAS: 100; FADI: 100; Karlsson-Peterson: 100; St. Pierre: 0). No persistent ankle instability, strength deficit, or major donor-site complications were identified. ***Conclusion:*** Full-thickness peroneus longus tendon autograft for ACL reconstruction is associated with minimal and transient donor-site morbidity, with complete functional recovery by six months. The PL tendon represents a safe and effective alternative autograft option for primary ACL reconstruction.

Keywords: Anterior cruciate ligament; Peroneus longus tendon; Autograft; Donor-site morbidity; Ankle function.

INTRODUCTION

Anterior cruciate ligament (ACL) injury represents one of the most common ligamentous injuries of the knee, particularly among young and athletic populations, and is associated with significant functional impairment and healthcare burden[1]. Epidemiological studies demonstrate a substantial incidence of ACL injuries globally, with increasing rates observed in physically active individuals[2,3]. Restoration of knee stability through surgical reconstruction is frequently required to enable return to sport and prevent secondary joint degeneration.

Graft selection remains a critical determinant of surgical success. Historically, bone–patellar tendon–bone (BPTB) and hamstring tendon autografts have been considered the gold standard options for primary ACL reconstruction[4,5]. Meta-analyses comparing these grafts have demonstrated comparable stability outcomes but distinct complication profiles[6]. While BPTB grafts offer reliable bone-to-bone healing, donor-site complications such as anterior knee pain and kneeling discomfort are frequently reported[7]. Conversely, hamstring tendon harvest may lead to postoperative flexor weakness and potential deficits in knee flexion strength[8].

In addition to morbidity concerns, graft diameter and biomechanical properties significantly influence long-term outcomes. Studies have shown that smaller graft size and younger patient age are associated with increased revision risk[9]. Biomechanical comparisons have demonstrated that hamstring and patellar tendon grafts possess strong tensile characteristics suitable for ACL reconstruction[10]. Furthermore, appropriate graft tensioning protocols have been shown to influence postoperative stability and functional outcomes[11], emphasizing the importance of graft quality and surgical precision.

Given these considerations, alternative autografts have been explored to minimize donor-site morbidity while preserving mechanical integrity. The peroneus longus (PL) tendon has emerged as a promising option due to its adequate length, favorable tensile strength, and predictable graft diameter[12,13]. Clinical investigations suggest that PL autograft may provide comparable or even superior functional outcomes compared to traditional hamstring grafts[14]. Additionally, studies evaluating graft diameter prediction have highlighted the reliability of the PL tendon in achieving adequate thickness for single-bundle ACL reconstruction[15].

Despite its advantages, concerns remain regarding donor-site morbidity following PL harvesting. The peroneus longus tendon plays an essential role in ankle eversion, first ray plantarflexion, and maintenance of the transverse arch[16]. Functional assessment studies evaluating ankle strength and eversion capacity after PL harvest have generally demonstrated minimal long-term impairment[17]. Moreover, donor-site morbidity analyses following peroneal tendon procedures indicate acceptable functional outcomes when surgical technique preserves synergistic function with the peroneus brevis tendon[18,19].

Precise anatomical understanding and radiographic identification of knee structures are also essential for accurate tunnel placement and graft positioning during ACL reconstruction[20], further emphasizing the importance of comprehensive surgical planning when introducing alternative graft sources.

Therefore, this study aims to evaluate the functional outcome of the donor ankle following full-thickness peroneus longus tendon harvesting for primary ACL reconstruction using validated foot and ankle scoring systems at defined postoperative intervals.

MATERIALS AND METHODS

Study Design and Setting

This prospective case series was conducted between January 2017 and December 2021 at a tertiary care orthopedic center. The study aimed to evaluate donor-site morbidity following ipsilateral full-thickness peroneus longus tendon harvesting for primary anterior cruciate ligament (ACL) reconstruction.

Study Population

A total of 26 consecutive patients diagnosed with complete ACL rupture and scheduled for primary ACL reconstruction were included in the study. Diagnosis was established based on clinical examination and confirmed with magnetic resonance imaging (MRI). Eligible participants were between 18 and 45 years of age and were undergoing primary ACL reconstruction. All patients provided informed consent prior to participation.

Patients with previous surgery on the affected knee, multiligamentous knee injuries, associated fractures around the knee or ankle, pre-existing ankle instability or deformity, or systemic inflammatory diseases were excluded from the study. During follow-up, two patients were lost after the two-month postoperative assessment and were therefore excluded from the six-month evaluation. Final analysis at six months included 24 patients.

Surgical Technique

All procedures were performed under spinal or general anesthesia with the patient positioned supine. A longitudinal skin incision approximately 2 cm proximal to the lateral malleolus was made over the posterolateral aspect of the fibula. The peroneus longus (PL) and peroneus brevis (PB) tendons were identified carefully. The PL tendon, located posterior and slightly deeper than the PB tendon, was isolated with meticulous dissection to avoid injury to surrounding structures.

The distal end of the PL tendon was sutured and transected. A tendon stripper was then advanced proximally to harvest the full-thickness PL tendon. Following graft retrieval, the distal stump of the PL tendon was sutured to the peroneus brevis tendon to preserve eversion function and maintain ankle stability.

The harvested tendon was prepared according to standard ACL graft preparation techniques. Arthroscopic single-bundle ACL reconstruction was performed with appropriate femoral and tibial tunnel placement. Graft fixation was achieved using interference screw fixation on both the femoral and tibial sides.

Postoperative Rehabilitation Protocol

All patients followed a standardized postoperative rehabilitation protocol. Quadriceps activation exercises were initiated immediately after surgery. Gradual range of motion exercises were commenced on the first postoperative day. Partial weight bearing with assistive support was advised for the first two weeks, followed by progressive strengthening exercises. Return to sports specific training was generally permitted between four and six months postoperatively, depending on functional recovery.

Outcome Measures

Donor-site ankle function was assessed preoperatively and at three weeks, two months, and six months postoperatively. Functional evaluation was performed using validated scoring systems including the American Orthopaedic Foot and Ankle Society (AOFAS) score, the Foot and Ankle Disability Index (FADI), the St. Pierre scoring system, and the Karlsson-Peterson scoring system. These instruments assess parameters such as pain, functional capacity, stability, and activity limitation.

Statistical Analysis

Data were analyzed using descriptive statistical methods. Continuous variables were expressed as mean values. Changes in functional scores across the different follow-up intervals were compared descriptively to observe trends in recovery. Given the observational design and relatively small sample size, no inferential statistical testing was performed.

All patients provided written informed consent for participation and for the use of anonymized clinical data for publication purposes. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. The surgical technique for peroneus longus tendon harvesting is illustrated in Figures 1–4.

Figure 1: Intraoperative identification and exposure of the peroneus longus tendon through a posterolateral ankle incision prior to graft harvesting.

Figure 2: Harvesting of the full-thickness peroneus longus tendon using a tendon stripper, with preservation of surrounding structures.

Figure 3: Post-harvest closure of the donor-site incision following suturing of the distal stump of the peroneus longus tendon to the peroneus brevis tendon.

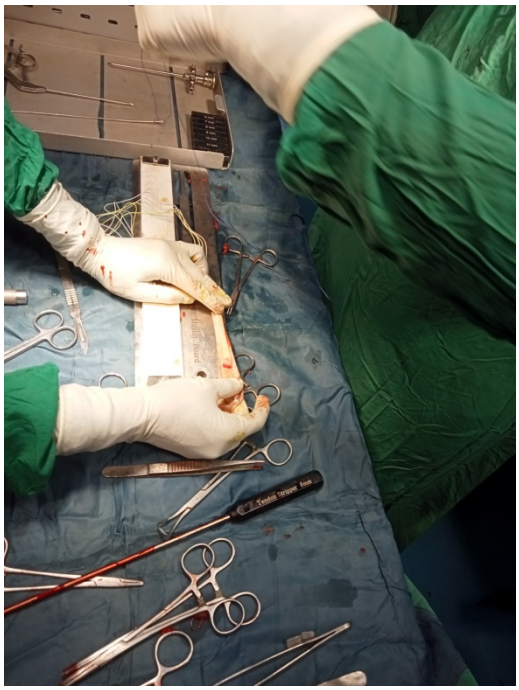

Figure 4: Harvested peroneus longus tendon graft prepared on the surgical table prior to anterior cruciate ligament reconstruction.

RESULTS

Patient Characteristics

A total of 26 patients underwent primary anterior cruciate ligament reconstruction using ipsilateral full-thickness peroneus longus tendon autograft during the study period. Two patients were lost to follow-up after the two-month postoperative assessment. Therefore, 24 patients completed the full six-month follow-up and were included in the final analysis.

The study population consisted predominantly of young, physically active individuals within the age group of 18–45 years. All patients had isolated complete ACL rupture confirmed clinically and radiologically. No intraoperative complications related to graft harvesting were reported.

Functional Outcome Assessment

Ankle function at the donor site was evaluated preoperatively and at three weeks, two months, and six months postoperatively using the American Orthopaedic Foot and Ankle Society (AOFAS) score, Foot and Ankle Disability Index (FADI), St. Pierre score, and Karlsson-Peterson scoring system.

AOFAS Score

The mean preoperative AOFAS score was 100, indicating normal ankle function prior to graft harvesting. At three weeks postoperatively, the mean score decreased to 95, demonstrating a transient reduction in ankle function during the early recovery phase. At two months, the mean score improved to 97. By six months postoperatively, the mean AOFAS score returned to 100, indicating complete functional recovery comparable to baseline levels.

FADI Score

The mean preoperative FADI score was 100. At three weeks postoperatively, the mean score decreased to 93, reflecting early postoperative discomfort and functional limitation. At two months, improvement was observed with a mean score of 96. At six months, the mean FADI score returned to 100, suggesting full restoration of ankle functional capacity.

St. Pierre Score

The mean preoperative St. Pierre score was 0, indicating absence of instability or dysfunction. At three weeks postoperatively, the mean score increased to 4, representing mild early postoperative symptoms. At two months, the mean score decreased to 2. At six months, the mean score returned to 0, consistent with resolution of donor-site morbidity.

Karlsson-Peterson Score

The mean preoperative Karlsson-Peterson score was 100. At three weeks, the mean score decreased to 95. At two months, improvement was observed with a mean score of 97. At six months, the score returned to 100, indicating recovery to preoperative functional status.

Temporal Functional Trend Analysis

Across all four scoring systems, a consistent temporal pattern was observed. There was a mild but measurable decline in ankle function during the early postoperative period (three weeks), followed by progressive improvement at two months, and complete recovery by six months.

The greatest relative decline was observed at the three-week interval, with mean reductions of 5% (AOFAS), 7% (FADI), and 5% (Karlsson-Peterson), while St. Pierre score demonstrated transient increase consistent with mild early instability symptoms. However, none of the patients demonstrated persistent ankle instability or functional limitation at final follow-up.

Donor-Site Morbidity and Complications

Two patients (8.3%) reported mild ankle instability during the first three postoperative months. Both cases resolved with rehabilitation, and no instability was observed at six months. No cases of peroneal nerve injury, tendon rupture, chronic lateral ankle instability, or persistent weakness in eversion were identified during follow-up.

No reoperations or graft-related ankle complications were recorded.

DISCUSSION

Anterior cruciate ligament (ACL) reconstruction aims to restore knee stability while minimizing donor-site morbidity. Given the high incidence of ACL injuries worldwide[1] and the growing demand for optimal graft selection[2,3], identifying a graft that balances mechanical strength with minimal functional compromise remains essential.

Historically, bone–patellar tendon–bone (BPTB) and hamstring autografts have been the most widely used graft options[4,5]. Meta-analyses have demonstrated comparable stability outcomes between these grafts, although differences in donor-site morbidity profiles are well documented[6]. BPTB grafts are associated with anterior knee pain and kneeling discomfort[6], whereas hamstring harvest may lead to persistent flexor weakness and altered biomechanics[7,8]. Furthermore, graft diameter has been identified as a critical predictor of revision risk, particularly in younger populations[9]. These considerations have prompted investigation into alternative graft sources capable of providing reliable mechanical properties while limiting morbidity.

Biomechanical studies comparing peroneus longus (PL) tendon with hamstring tendons have demonstrated comparable tensile strength and structural integrity[10]. Additionally, appropriate graft tensioning protocols remain crucial for postoperative stability regardless of graft type[11]. In this context, the PL tendon offers several theoretical advantages, including predictable diameter and adequate length for single-bundle reconstruction[12].

Clinical investigations have increasingly supported the PL tendon as a viable alternative autograft. Shi et al.[13] reported that PL autograft is safe and effective in ACL reconstruction, demonstrating satisfactory functional outcomes without significant ankle impairment. Similarly, Rhatomy et al.[14] suggested that PL autograft may provide clinical outcomes comparable or superior to hamstring grafts in selected patients. Setyawan et al.[15] further demonstrated successful use of PL tendon in posterior cruciate ligament reconstruction with favorable long-term results, reinforcing its biomechanical reliability.

Despite encouraging results, concerns regarding donor-site morbidity persist due to the anatomical role of the PL tendon in ankle eversion, first ray plantarflexion, and arch stabilization[16]. Functional strength evaluation studies assessing eversion and plantarflexion following PL harvest have generally reported minimal long-term deficits[17]. Angthong et al.[18] demonstrated that ankle function, as measured by validated scoring systems, returned to baseline after PL tendon harvesting. These findings align closely with the results of the present study.

In our series, a transient decline in ankle functional scores was observed at three weeks postoperatively across all assessment tools. However, progressive improvement was documented at two months, and complete restoration of function was achieved at six months. This temporal pattern mirrors previously published observations suggesting that early postoperative symptoms are self-limiting and responsive to rehabilitation[13],[18].

Importantly, no persistent ankle instability, peroneal nerve injury, tendon rupture, or chronic weakness was observed in our cohort. Although two patients reported mild early instability, symptoms resolved with rehabilitation. These findings support the hypothesis that compensatory mechanisms particularly preserved function of the peroneus brevis tendon may mitigate long-term functional compromise[16],[17].

When compared with traditional graft-related morbidity such as anterior knee pain (associated with BPTB grafts)[6] or hamstring strength deficits[8], the donor-site morbidity observed with PL harvesting appears clinically minimal. Moreover, given the established association between inadequate graft diameter and revision risk[9], the predictable size of the PL tendon may offer an additional advantage in selected populations.

The anatomical precision required for optimal tunnel placement during ACL reconstruction remains critical to clinical success[20]. While graft source is important, surgical technique and accurate radiographic identification of knee structures contribute significantly to postoperative stability and long-term outcomes.

Clinical Implications

The findings of this study suggest that full-thickness peroneus longus tendon harvesting is associated with only transient and clinically insignificant donor-site morbidity. Given its biomechanical strength, adequate diameter, and minimal long-term ankle impairment, the PL tendon represents a viable alternative autograft option, particularly in cases where hamstring graft size is insufficient or patellar tendon harvest is contraindicated.

Limitations

Several limitations should be acknowledged. First, the sample size was relatively small, limiting statistical power. Second, the follow-up duration was limited to six months, preventing evaluation of long-term ankle biomechanics. Third, objective strength testing such as isokinetic dynamometry and gait analysis was not performed. Future studies incorporating larger cohorts, randomized comparisons with hamstring autografts, and long-term follow-up are warranted to further validate these findings.

CONCLUSION

Full-thickness peroneus longus tendon autograft for primary anterior cruciate ligament reconstruction demonstrates excellent short-term donor-site outcomes, with only transient early postoperative ankle functional decline and complete recovery by six months. No persistent instability, strength deficit, or significant complications were observed. Given its favorable biomechanical properties, predictable graft diameter, and minimal long-term ankle morbidity, the peroneus longus tendon represents a safe and effective alternative to traditional autograft options. Larger studies with extended follow-up are recommended to further validate its long-term functional and biomechanical outcomes.

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