Short-Term Clinical Outcome of ACL Reconstruction Using Peroneal Longus Tendon Auto Graft

Abstract

Background: The anterior cruciate ligament (ACL) reconstruction is one of the most frequent surgeries on the adult knee. Auto grafts are essential for providing knee stability while minimizing donor site morbidity. The peroneus longus tendon may be an alternative auto graft for ACL reconstruction. This study aimed to evaluate the short-term clinical outcomes and donor site morbidity of ACL reconstruction using the peroneus longus tendon.

Methods: This cross-sectional study was conducted on patients with an ACL tear, who underwent arthroscopic reconstruction using the peroneal longus tendon. The knee functional outcomes were investigated based on the Lysholm and IKDC scores at preoperative and end of at least one year after the procedure. The follow-up period was at least one year, and the graft diameter was measured intra-operatively. In addition, the American Orthopaedic Foot and Ankle Score (AOFAS), the Foot & Ankle Disability Index (FADI), and ankle range of motion were applied to evaluate ankle donor site morbidities.

Results: A total of 50 patients (47 men and three women) were followed up for at least one year with a mean age of 24.2 years (17 to 50 years old). The mean follow-up time was 19 months (12-24 months). The mean diameter of the peroneal longus auto graft was 8.22 ± 0.5 mm (7-9 mm). The AOFAS, FADI and ankle range of motion indicated no obvious ankle joint dysfunction.

Conclusion: According to the results, arthroscopic anterior cruciate ligament reconstruction with the peroneal longus tendon is be a safe and effective auto graft source.

Keywords: Anterior cruciate ligament reconstruction, Tendons, Arthroscopy, Auto grafts, Tendon injuries

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Introduction

Arthroscopic reconstruction of ACL is recognized as the standard treatment for restoring knee stability and joint function after an ACL tear. The use of auto graft is the best option in ACL reconstruction surgery due to its proper tissue compatibility, fast healing, lack of contamination, and low cost of treatment. Currently, various auto graft options are utilized for ACL reconstruction, which can be called tendon-bone-bone-patella (BPTB), hamstring tendon, and quadriceps tendon and have advantages and disadvantages. An appropriate alternate auto graft can reduce surgical time, resection side effects, and postoperative pain [1-4]. An ideal auto graft should have the right size and sufficient strength and be easily removed with minimal complications. In addition, factors such as availability, patient activity level, and lifestyle should be considered in preoperative auto graft selection [5]. PLT auto graft is commonly used in some surgeries such as deltoid ligament reconstruction in patients with flat feet and internal patella femoral ligament reconstruction [6]. Some studies have reported the utilization of the PLT in ACL reconstruction as the first choice with good clinical outcomes and minimal damage to the graft donor site [7-10]. However, other studies have not found these results due to the damage to the graft donation site [11]. Even though there are numerous articles about the different methods and outcomes of ACL reconstruction, there is no consensus about the best method.

This study aimed to evaluate the short-term results of ACL reconstruction by the longus peroneal tendon and investigate the functional outcome and complications of the donor area with a minimum follow-up period of one year after ACL reconstruction surgery. According to the study hypothesis, the peroneal longus auto graft can be used as a suitable alternative auto graft when it shows an acceptable clinical result and no serious side effects in the donor area.

Methods

This cross-sectional-descriptive study was conducted from March 2019 to April 2022 in Poursina and Ghaem hospitals of Rasht, Iran, on all patients with ACL tear subjected to primary anterior cruciate ligament reconstruction surgery using the PLT, following the inclusion and exclusion criteria and using a full-count and goal-oriented sampling method. The inclusion criteria were age 17 to 50 with ACL tear requiring surgery. The exclusion criteria included simultaneous cartilaginous lesions greater than grade III requiring intervention, multiple knee ligament injuries, previous ankle and knee surgery, ACL re-surgery, hyper mobility and ligament laxity, history of ankle joint ligament damage or peroneal nerve damage, and history of ankle fractures. The patient's medical history, physical clinical examinations such as the Lachman test, pivot shift test and MRI were used to diagnose an ACL tear.

The surgical method was fully explained to all patients participating in this study, and the informed consent form was read and signed by the patient. Surgical procedures were performed on all patients by the same surgical team.

Surgical method

The patient was placed in the supine position under spinal or general anesthesia, and a tourniquet was tied on the thigh using standard anterior portals. Initially, a diagnostic arthroscopy was performed to confirm the ACL tear and check the menisci and articular cartilage. Then, the PLT was removed from the leg on the same side. The PLT was harvested through a 2-3 cm longitudinal skin incision, 1 cm posterior, and 1 cm superior to the external malleolus. The distal part of the PLT was connected to the peroneus brevis tendon with end-to-side sutures with 0.2 vicryl thread. The PLT was separated up to about 5 cm distal to the fibula head using a tendon stripper to prevent injury to the peroneal nerve (Figure 1).

The tendon was folded longitudinally in half to obtain a 2-stranded auto graft in the form of a loop (Figure 2). Then, the inter condylar notch was cleared of fibrotic tissue to facilitate visualization while preparing the tunnels, but some of the remaining fibers of the ACL were kept as a reference for tunnel placement. In the next stage, the femoral and tibial tunnels were prepared anatomically. The tendon was passed through the channels and fixed after digging the tunnels with the help of a button (XO Button®, Conmed©, USA) on the femoral side and an absorbable screw (Bioscrew®, Conmed©, USA) on the tibial side. Other joint operations such as suture passage and meniscus repair or partial meniscectomy were performed if necessary.

Rehabilitation

The patients were discharged from the hospital one day after surgery and after setting up partial weight bearing with a knee immobilizer. All patients were rehabilitated with a standard protocol after ACL reconstruction. Knee extension and ankle pump exercises were started immediately after the surgery, and the partial weight bearing and motion range of 0 to 90 degrees were allowed for the first two weeks. Full flexion was achieved within 5 to 6 weeks, and the full weight-bearing exercise was allowed for at least 3 to 4 weeks after surgery. Running was allowed after 3–4 months, and return to sports activity was permitted after passing functional outcome tests at nine months postoperatively. This test included knee joint stability evaluation based on anterior drawer, Lachman, and single-leg hop tests, as well as muscle strength examination, and knee motion range. A simultaneous meniscus repair took 5-6 weeks for full weight bearing and 6-8 weeks for a full range of motion after surgery.

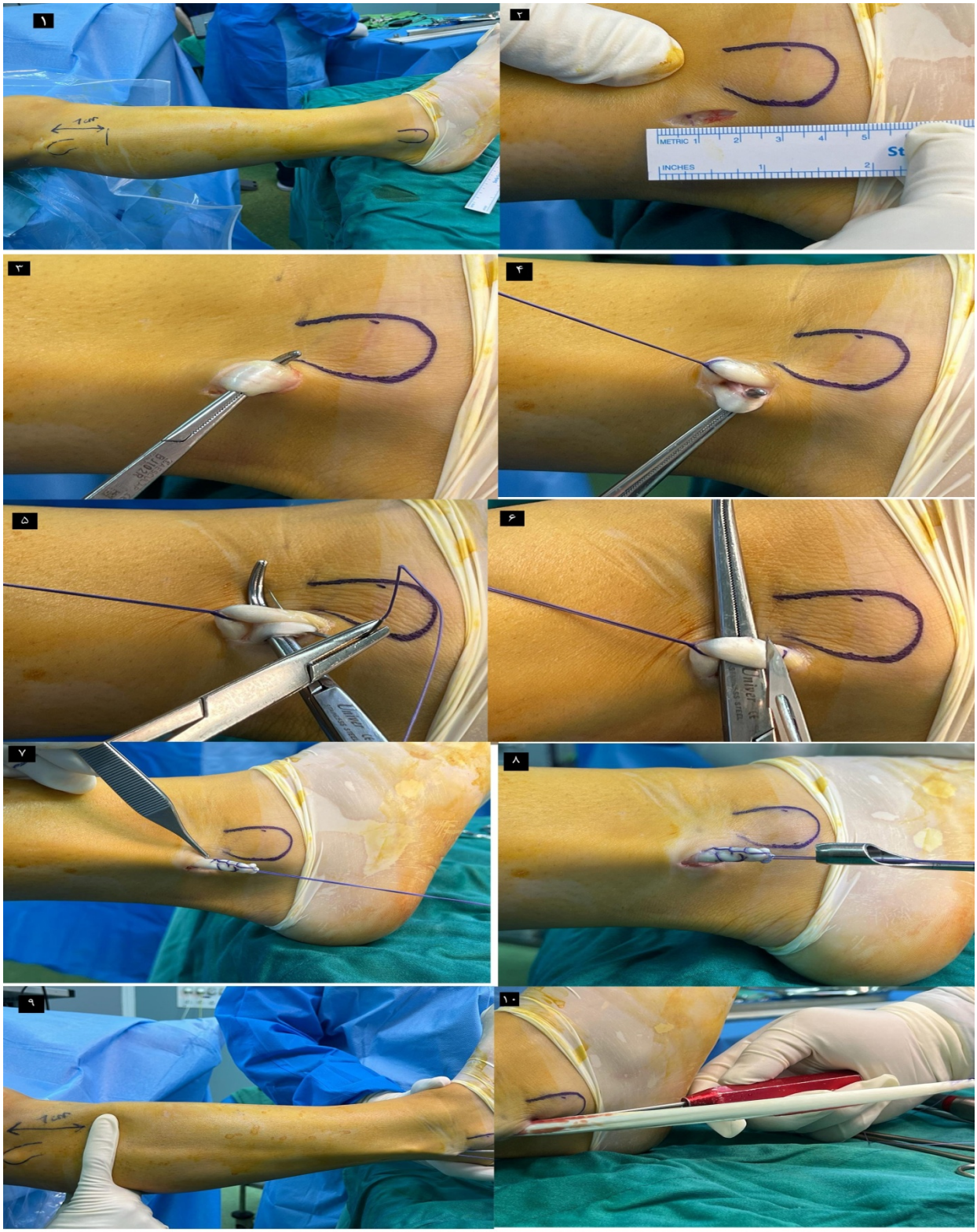

Figure 1: The steps of removing the longus peroneal tendon: 1) Marking on the skin. 2) The size and location of the graft. 3) Finding the tadon peroneal longus. 4) Finding the peroneal tendon of Bruis. 5) Suturing the ends of the peroneal longus and peroneal brevis tendons. 6) Freeing the posterior distal peroneal longus. 7) Suturing the decital end of peroneal longus. 8) Using a tendon stripper. 9) Limiting the stripper by hand to prevent potential damage to the peroneal nerve. 10) Final pulled out tendon.

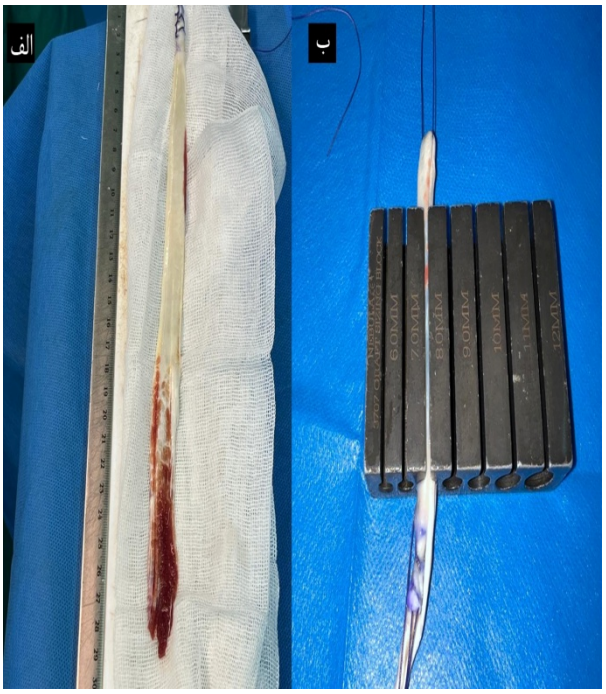

Figure 2: Preparation and measurement of peroneal longus graft diameter: a) Removed tendon 26 mm long. b) Measuring the diameter of the removed tendon 8 mm

Postoperative evaluation

The postoperative evaluation was performed at least one year later so that the patients have enough time to complete the rehabilitation protocol, return to sports activities, and each peak of their performance after an ACL injury. All patients were examined by an orthopaedic surgeon, and the results of direct clinical examinations and interviews were recorded in the patients' files at each time. Postoperative evaluation included clinical evaluation, as well as Lysholm and IKDC scores. The functional ankle score through AOFAS (American orthopaedic foot and ankle score), FADI scale (the foot and ankle disability index), and ankle range of motion were used to evaluate the complications of the ankle donor area.

The data were analyzed using SPSS Software Version 24. After collecting information, frequency tables and statistical indicators such as mean and standard deviation were used to describe the data. The Chi-square test or Fisher's exact test was utilized to compare the data, and $P < 0.05$ was considered a significant level.

Results

In this study, 50 patients (47 men and three women) with an average age of 24.2 years (17 to 50 years) were followed up for at least one year. The average follow-up time of the patients was 19 months (12-24 months).The average diameter of the two-stranded peroneal longus auto graft was 8.22 ± 0.5 (7-9 mm). The clinical results showed that 49 patients experienced significant improvement in functional results and IKDC and Lysholm clinical scores after ACL reconstruction ($P < 0.001$) (Table 1). None of the patients were professional athletes, and 34 patients were able to participate in their sports training an average of nine months after surgery. There was no infection at the graft removal site and movement limitation in the ankle joint.

Lachman test and Pivot-shift test were used to evaluate knee laxity and stability. Any positive Lachman grade III or pivot-shift tests were defined as a failure. One patient had +1 to +2 anteroposterior laxity (mild to moderate laxity), and one other patient suffered re-tear.

The side effects of donor site morbidity and ankle joint function:

AOFAS, FADI, and objective measurements of the ankle range of motion scales were used to evaluate the complications of the tendon harvest site. None of the patients experienced ankle joint dysfunction or difficulty in usual (non-professional) sports activities due to peroneal longus auto graft transmission.

No difference was observed between the AOFAS scale before and after the operation. The average AOFAS score for the donor ankle before and after the operation were 96.2±0.8 and 93.4±1.7 (100-84) (scores 90-100 is excellent, 80-89 is good, 70-79 is moderate, and below 70 is weak), respectively. In addition, there was no significant difference in the FADI score between the donor and the contra lateral side ($P < 0.0001$). The mean FADI score was 92.7±0.5 (94-102) on the donor and 98.9±0.6 on the contra lateral side. No significant difference was observed in ankle ROM for all movements of the donor area compared to the contra lateral side (Table 2).

Table 1. Functional results after ACL reconstruction using the PLT

P-value	*Score change (percent)*	*Last follow-up*	*Preoperative*	
<%001	37/3 (%67)	92/5±9/8	55/2±2/4	*IKDC*
<%001	31/6 (%49)	95/1±6/2	63/5±11/2	Lysholm

Table 2. Ankle range of motion in patients undergoing ACL reconstruction surgery using PLT

P-value	*Contra lateral side*	*Peroneus longus harvested*	*Motion (degree)*
n. s %826	23/8±6/1	23/5±7/6	Dorsi flexion
n. s %575	57/4±2/1	56/8±7/2	Plantar flexion
n. s %325	30±5/1	29±4/5	Inversion
n. s %453	22/8±4/7	21/7±9/2	Eversion

There was no pain or complaints of ankle joint weakness, neurovascular complications, or any other discomfort in the ankle donor area. One patient complained of mild pressure pain and dysesthesia at the PLT removal site, which improved after one month. One another patient also had mild wound discharge from an ankle incision during the first three weeks, which was treated with daily dressing changes and oral antibiotics.

Discussion

PLT seems to be a suitable auto graft for anterior cruciate ligament reconstruction, given the functional results of ACL reconstruction, lack of dysfunction at the graft removal site, rapid knee extension, and low pain in the medial and posterior region of the knee in patients undergoing ACL reconstruction. ACL reconstruction using the PLT provided good functional results; avoided potential complications of the auto graft harvested from the knee, and had no short-term detrimental effect on the ankle joint.

Generally, the PLT has an appropriate size, and the biomechanical evaluations of its characteristics have indicated its sufficient strength to reconstruct the anterior cruciate ligament of the knee [1, 12, 13]. Rudi et al. found no significant difference between the tensile strength of the PLT and the hamstring in a biomechanical study [10]. Wiradiputra et al. stated that the PLT could be considered the first-choice graft option in ACL reconstruction surgery due to the lack of significant postoperative complications related to biomechanical problems in the ankle donor area [14].

The auto graft diameter significantly affected the re-tear rate and the need for revision surgery [12]. Snaebjornsson et al. conducted a large cohort study and reported that an increase of 0.5 mm in the auto graft diameter decreases the probability of revision surgery by 0.86 times [15]. Recent studies have shown that a graft diameter less than 8 mm is not acceptable [16-18]. In this study, the average diameter of the PLT was more than 8 mm. A diameter of less than 8 mm was achieved in the two-layered tendon only in two patients. The tendon became 3-layered in two patients, reached a diameter of 9 mm (about 9 cm), and was fixed to both sides of the femur and tibia with absorbable screws. Patients with weight less than 55 kg, height less than 150

cm, thigh circumference less than 37 cm, and body mass index less than 18 are considered at high risk of failed hamstring reconstruction surgery [19]. Kihani et al. in a comparative study concluded that PLT auto graft could be a suitable auto graft for ACL reconstruction due to its strength, larger graft diameter, and prevention of potential complications of hamstring auto graft obtained from the knee area. The PLT diameter was larger than the hamstring tendon, and the tears percentage was almost the same in the hamstring group, which may indicate lower stability of the PLT graft than the hamstring tendon graft [20]. In this study, only one case of tendon tear was observed during the first year after surgery, and this patient had not completed the course of physical therapy and muscle strengthening.
Generally, the torque decreases in the evertor and invertors muscles of the ankle, function decreases, and ankle stability are mentioned as possible complications of the donor area after the removal of the PLT [21]. This study found no significant pain at the donor site or complications near the external ankle after harvesting the PLT. No significant difference was observed in ankle ROM, including the angles of flexion/extension, inversion/deviation, and rotation at the donor site compared to the contra lateral ankle. Rathomy et al. reported that the effect of PLT auto graft on foot and ankle function was minimal, and the ankle deviation and plantar flexion strength of the donor site were like the contra lateral side [22]. On the other hand, Bi et al. did not want to completely remove the longus peroneal tendon due to irreversible functional disorders [19].
One the limitations of this study was the relatively short follow-up time, which made it impossible to assess clinical efficacy or long-term complications. Therefore, the results may not be generalized to a wider population due to the small sample size. Thus, more accurate double-blind randomized controlled trials, scientific design, and larger sample sizes are recommended for more accurate evaluations.

Conclusion

According to the results, PLT auto graft can be a proper auto graft for anterior cruciate ligament reconstruction surgery due to its strength, larger graft diameter, and satisfactory ankle performance. Therefore, this graft seems appropriate in patients with medial collateral ligament injuries along with ACL tear or in people who cannot access the hamstring grip due to scarring in the medial area of the knee. More studies are needed to ensure the absence of ankle dysfunction in professional athletes despite studies on ankle stability after the removal of this graft.

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