International Journal of Orthopaedics Research
www.orthopaedicsjournal.in
E-ISSN: 2663-0923, P-ISSN: 2663-0915
Received: 28-02-2023, Accepted: 15-03-2023, Published: 30-03-2023
Volume 5, Issue 1, 2023, Page No. 25-28

# Functional outcome of anterior cruciate ligament reconstruction using peroneal longus with semitendinosus graft

**Dr. Dhaval Bhatia[1], Dr. Arvind Hadiya[1*], Dr. Vaishvi Bhatia[2], Dr. Atit Kantawala[1]**
[1] Orthopaedic Consultant, Anand Orthopaedic Hospital Anand, Gujarat, India
[2] MBBS Student, GMERS Medical College and Civil Hospital, Sola, Ahmedabad, Gujarat, India

**Abstract**
**Introduction:** There are many graft options available for anterior cruciate ligament reconstruction. Because of the shorter length and unpredictability of graft size the hamstring graft the peroneus longus tendon could be a good option for anterior cruciate ligament reconstruction. Peroneus longus tendon provides thicker, longer and stiff graft and it had promising results in anterior cruciate ligament reconstruction. Peroneus graft harvesting doesn't affect ankle functions.
**Aim & objectives:** To evaluate the functional outcome of ACL reconstruction using peroneus longus and semitendinosus graft and effect on ankle morbidity and ankle function.
**Materials & methods:** This was a retrospective study that included 50 patients of anterior cruciate ligament injury treated with anterior cruciate ligament reconstruction with peroneus longus tendon graft with semitendinosus graft. Results were assessed by physical examinations. At follow-up Lysholm scores were calculated. For ankle function American Orthopaedic Foot and Ankle Society (AOFAS) score and The Foot and Ankle Disability Index (FADI) was evaluated. Ankle muscle power assessment was done as per Medical Research Council (MRC) grades.
**Results:** This study includes 50. The average thickness of semitendinosus and peroneus longus tendon coupled grafts was 9.3 mm. The average Lysholm score was 93.5 (range 80-100). Among all patients 74% patients had an excellent Lysholm score, 20% had a good score and 6% had a fair score. The average FADI score was 134.8 (range 120-136). The average AOFAS score was 97.7 (range 95-100).
**Conclusion:** Peroneus longus tendon graft had promising results in ACL reconstruction with advantages in form of easy to harvest, thicker and stiff graft, longer graft length, no muscle wasting with no effect on ankle plantarflexion, eversion and on ankle stability with good functional outcome so it can be coupled with hamstring graft for better stable ACL reconstruction.

**Keywords:** anterior cruciate ligament reconstruction, peroneal longus, semitendinosus, mstring, ankle morbidity hamstring, ankle morbidity

## Introduction

Anterior cruciate ligament (ACL) injury is one of the most common ligament injuries occurring in the knee. Gera SK reported 6 ACL injuries per 100 patients in their study [1]. The anterior cruciate ligament prevents the tibia from sliding out in front of the femur and it provides rotational stability to the knee. There -fore its reconstruction is necessary. There are many graft options available for ACL reconstruction with all options having its own pros and cons. The Bone-Patellar Tendon-Bone (BPTB) was most commonly used graft previously because of its better bone to bone healing potential and rapid incorporation of graft but it leads to anterior knee pain, risk of patellar fracture, shorter length of graft, weak tensile strength than native ACL [2]. On the other side hamstring graft is easy to harvest with minimal complications but an unpredictable graft size is an issue with it [3]. Sometimes shorter length hamstring tendon graft has difficulty for tibial interference fixation. Therefore some surgeons use the anterior half or full thickness peroneal longus tendon as a graft choice. Biomechanically the ultimate tensile strength of native ACL was 1725 N while the ultimate tensile strength of peroneus longus tendon ranged from 2500 N. Rudy *et al* reported in their study that difference in tensile strength between the peroneus longus tendon (446.1 N ± 233.2 N) and a four-strand hamstring tendon (405.8 N ± 202.9 N) with the same cross-sectional area showed no significant difference [4]. Some Surgeons used peroneus longus tendon graft in other conditions like deltoid ligament reconstruction, medial patellofemoral ligament reconstruction, spring ligament reconstruction [5, 6, 7]. The reason behind is due to the synergistic function of the peroneus longus and peroneus brevis as peroneus brevis is a more effective evertor of the ankle [8]. The aim and objective of our study is to evaluate the functional outcome of ACL reconstruction using semitendinosus and peroneus longus tendon graft and effect on ankle morbidity and ankle function.

## Materials and method

This is a retrospective study conducted at our institute from 2017 to 2019. We had selected 50 patients. Patients with age more than 18 years, without multiligament injury or associated meniscal injuries were included. Patients with multiligament injury, ACL avulsion, meniscal injuries, age less than 18 years, age more than 40 years, revision ACL tear were excluded. All ACL tears were diagnosed by clinical examination and magnetic resonance imaging (MRI). All surgeries were performed by the same single orthopaedic surgeon. All surgeries were performed in supine position.
Surgeries were done arthroscopically. First we harvested the peroneus longus tendon graft by putting a 2 cm incision over the posterior border of the lateral malleolus. Retinaculum over the peroneal tendon was incised and the

tendon was exposed. Graft was pulled forward using a clamp and distal cut was made with a knife and free part of graft was grasped with Allis clamp. The release of the peroneus longus tendon was performed by tendon stripper and graft was harvested. The remaining distal end of the peroneal longus tendon was end to end sutured with peroneus brevis tendon with ankle in neutral position.

**Fig 1:** putting a 2 cm incision over the posterior border of the lateral malleolus

**Fig 2:** Retinaculum over the peroneal tendon was incised and the tendon was exposed. Graft was pulled forward using a clamp

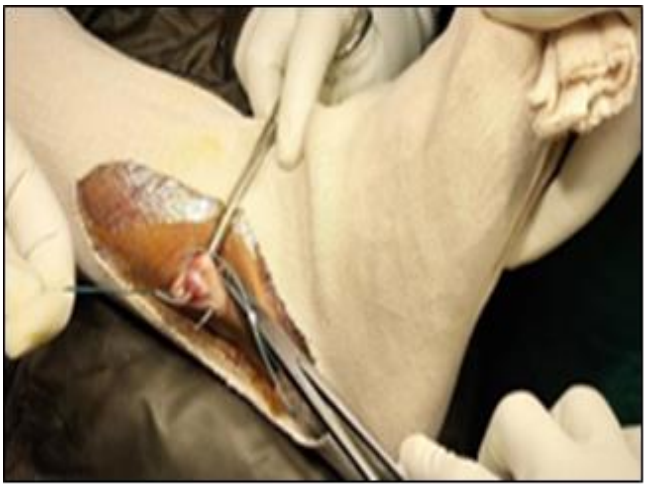

**Fig 3:** Distal end of peroneus longus graft sutured with peroneus brevis tendon with ankle keep in neutral

**Fig 4:** cut was made with a knife and free part of graft was grasped with Allis clamp. The release of the peroneus longus tendon was performed by tendon stripper and graft was harvested.

For harvesting semitendinosus graft 3 cm vertical incision was put over insertion of Pes anserine. The distal end of semitendinosus tendon was pulled out with curved clamp and graft was harvested.

Both the grafts were cleaned up from muscle fibres. Both grafts were coupled and both ends were sutured by using Ethibond 2 No. This coupled graft was again folded and a standard four strand graft was prepared. This augmented graft was pre-tensioned before implantation. After preparing the tibial and femoral tunnel the graft was passed in the tunnel and from the femoral end of the graft was fixed with an end button and the tibial end of the graft was fixed with biodegradable interference screw.

Intraoperative Pivot shift test was performed in all cases. Patients were discharged on postoperative day 2 with knee brace. Sutures removed on 14th day. Knee extension exercise was started immediately post-surgery and knee flexion up to 90 degree was targeted until 4week post-surgery.

Follow up was done at 1 month, 6 months, 1 year and at 3 years post-surgery. At that time functional outcome was evaluated by using Lysholm score. For the ankle donor site morbidity American Orthopaedic Foot and Ankle Society (AOFAS) score and The Foot and Ankle Disability Index (FADI) was evaluated.

**Results**

This study includes 50 patients of which 33 male (66%) and 17 female (34%). The most common mode of injury was fall (62%, 31 cases) followed by Road Traffic Accidents (32% 16 cases) and sports related injuries (6%, 3 cases). The right side (60%, 30 cases) is more involved in our study compared to the left side (40%, 20 cases). The age ranges from 18 years to 40 years with an average of 28 years. The average thickness of 4 strand coupled grafts of semitendinosus and peroneus longus tendon was 9.3 mm and average length was 12.5 cm. Intraoperative Pivot shift test was found negative. 5 patients had a graft size of 10 mm. All these patients were required wall pasty to avoid graft impingement. At 3 yr follow up pivot shift test still found negative. The average Lysholm score was 93.5 (range 80-100). Among all patients 74% patients had an excellent Lysholm score, 20% had a good score and 6% had a fair score. The average FADI score was 134.8 (range 120-136). The average AOFAS score was 97.7 (range 95-100). At every follow up the donor site foot and ankle muscle power assessment was done as per Medical Research Council (MRC) grades. On donor site ankle for flexion/extension, rotation movements and dorsiflexion/plantarflexion the MRC grading was 5.

**Fig 5:** At 3 yr. follow up patient had full ankle plantar flexion and dorsiflexion.

## Discussion

ACL reconstruction is nowadays routinely performed surgery and many graft options available for that but the hamstring graft is most widely used. But there are a lot of variations in hamstring graft thickness. The minimum 7 mm cross section diameter is required for ACL graft which may be difficult with hamstring graft alone. The average diameter of the normal ACL is 7-12 mm (9) so the minimum thickness of graft is 7 mm recommended (10). We need an additional source of graft for special circumstances where the hamstring tendon's thickness is less than 7 mm because of technical errors of removing tendons or even due to normal variations in the diameters of hamstring tendons [11, 12]. The thicker graft will be more-stiffer and stronger. The diameter of the graft can affect its biomechanical properties. (13). Mariscalco et a l (14) found significant positive correlation between 1 mm increase in graft diameter, with higher Knee injury and Osteoarthritis Outcome Score (KOOS) score and International Knee Documentation Committee (IKDC) score, and also higher revision rate with graft size of less than 8mm. Therefore, we coupled peroneus longus tendon graft with semitendinosus graft. A reduction in thigh circumference was noted with hamstring tendon graft which may result in a quadriceps-hamstring imbalance and reduce dynamic knee stability (15). Biomechanically tensile strength of four stranded semitendinosus graft (4090N) and double stranded peroneus longus tendon (4268N) are more or less comparable and they are superior to the tensile strength of the ACL (2160N) (16). Safety *et al* (17) founded in their study that there was a significant difference in graft diameter between the hamstring and peroneus longus tendons, with a mean difference of 0.6 mm in favour of the peroneus graft. The main function of peroneus longus tendon is to evert the foot and plantar flex the 1st ray. Peroneus longus tendon and peroneus brevis tendon are considered synergistic structures for ankle plantar flexion and eversion. The peroneus brevis tendon inserts on the fifth metatarsal, while the peroneus longus tendon inserts on the first metatarsal. The peroneus brevis tendon is more effective than the peroneus longus tendon in rotating the navicular externally and the calcaneus into valgus (8), to provide the eversion moment necessary to balance the opposing inversion moments. Only the proximal portion of peroneus longus tendon above the level of the lateral malleolus is harvested and the distal portion is then sutured to the peroneus brevis tendon, which may preserve some peroneus longus tendon functions. Additionally, tendon-like tissues have been observed in the normal peroneus longus tendon position, especially in young patients, upon long follow-up of ACL reconstruction (18). The peroneus longus tendon has minimal effect on maintenance of the arch of the foot. Medial longitudinal arch is maintained by abductor hallucis tendon, tibialis posterior tendon, and flexor pollicis longus while lateral longitudinal arch is maintained by peroneus brevis, and abductor digiti minimi and the foot transverse arch is maintained by the posterior tibial tendon and adductor pollicis. Therefore, the stability of the foot is not much affected by using peroneus longus tendon graft. Sholahuddin *et al* (19) concluded in his study that at donor site an ankle eversion and first ray plantarflexion strength were similar to those at the contralateral normal healthy site, with no donor site morbidity. That suggests that the peroneus longus tendon has promising results in ACL reconstruction.

The surgical harvest time is less for the peroneus longus tendon than hamstring tendon. The other advantage is there is no fibrous connection between the peroneus longus tendon and the nearby structures. The peroneus longus tendon harvesting should be stopped at the level of 5 cm below the fibular head to avoid injury to the deep peroneal nerve. The tendon stripper should be kept parallel and superficial to the fibula to avoid injury to the superficial peroneal nerve (20).

In our study 37 patients had excellent, 10 patients had good and only 3 patients had fair Lysholm Score. No patient had ankle dysfunction related to peroneus longus tendon graft. No patient had gait disturbance. Angthong *et al*. noticed ankle donor site morbidity using the peroneus longus tendon, including reduced peak torque eversion and inversion, decreased ankle function. We evaluated the ankle function by AOFAS and FADI score. The average AOFAS score was 97.7 and average FADI score was 134.8 which were very good results. These results were very satisfactory due to intact peroneus brevis tendon. Kerimoglu *et al* (21) assessed 29 patients of acl reconstruction using full thickness peroneal longus tendon graft. At 5 yr follow up the mean Lysholm score was 83.7. In his study no patient experienced ankle donor site morbidity. Cao HB *et al* (22) in his study of 35 cases of ACL reconstruction with peroneal tendon graft reported average Lysholm score was 97.2 and average AOFAS score was 96.3. No patients had parenthesis or numbness around the ankle joint.

There is an MRI study of the cross-section of the intercondylar notch that has shown that the intact native ACL is thin and elongated and fits snugly between the lateral edge of the PCL and the medial edge of the lateral femoral condyle [23]. The use of a soft tissue ACL graft that is rounder and larger in a cross-sectional area than the intact ACL requires widening the notch until the space between the lateral femoral condyle and posterior cruciate ligament exceeds the width of the graft by 1 mm. In our study 3 patients required wall pasty to avoid graft impingement.

**Conclusion**

Peroneus longus tendon graft had promising results in ACL reconstruction with advantages in form of easy to harvest, thicker and stiff graft, longer graft length, no muscle wasting with no effect on ankle plantarflexion, eversion and on ankle stability with good functional outcome so it can be coupled with hamstring graft for better stable ACL reconstruction.

**Reference**


1. Gera SK, Pilar A, Saji MJ, Amaravathi RS. Epidemiology of Anterior Cruciate Ligament Injuries – A Hospital-Based Cross-Sectional Study | Journal of Karnataka Orthopaedic Association,2021:9 (1):30-35.
2. Adam F, Pape D, Schiel K, Steimer O, Kohn D, Rupp S Biomechanical properties of patellar and hamstring graft tibial fixation techniques in anterior cruciate ligament reconstruction. Am J Sports Med,2004:32:71-78
3. Tashiro T, Kurosawa H, Kawakami A, Hikita A, Fukui N. Influence of medial hamstring tendon harvest on knee flexor strength after anterior cruciate ligament reconstruction. A detailed evaluation with comparison of single- and double-tendon harvest. Am J Sports Med,2003:31:522-9.
4. Rudy ME, Phatama KY. Tensile strength comparison between peroneus longus and hamstring tendons: a biomechanical study. Int J Surg Open,2017:9:41-44.
5. Ellis SJ, Williams BR, Wagshul AD, Pavlov H, Deland JT. Deltoid ligament reconstruction with peroneus longus autograft in flatfoot deformity. Foot Ankle Int,2010:31:781-789
6. Williams BR, Ellis SJ, Deyer TW, Pavlov H, Deland JT. Reconstruction of the spring ligament using a peroneus longus autograft tendon transfer. Foot Ankle Int,2010:31:567-577.
7. Xu C, Zhao J, Xie G. Medial patella-femoral ligament reconstruction using the anterior half of the peroneus longus tendon as a combined procedure for recurrent patellar instability. Asia Pac J Sport Med Arthrosc Rehabil Technol.2016:4:21-26
8. Otis JC, Deland JT, Lee S, Gordon J. Peroneus brevis is a more effective evertor than peroneus longus. Foot Ankle Int,2004:25:242-246
9. Petersen W, Zantop T. Anatomy of the anterior cruciate ligament with regard to its two bundles Clin Orthop Relat Res,2007:454:35-47
10. Mardani-Kivi M, Karimi-Mobarakeh M, Mirbolook A. "Predicting the hamstring tendon diameter using anthropometric parameters," Arch Bone Jt Surg,2016:4 (4):314-317.
11. de Jong SN, van Caspel DR, van Haeff MJ, Saris DB. Functional assessment and muscle strength before and after reconstruction of chronic anterior cruciate ligament lesions. Arthroscopy,2007:23:21-8.
12. Moisala AS, Jarvela T, Kannus P, Jarvinen M. Muscle strength evaluations after ACL reconstruction. Int J Sports Med,2007:28:868-72
13. Papastergiou SG, Konstantinidis GA, Natsis K, Papathanasiou E, Koukoulias N, Papadopoulos AG. Adequacy of semitendinosus tendon alone for anterior cruciate ligament reconstruction graft and prediction of hamstring graft size by evaluating simple anthropometric parameters. Anatomy research international, 2012, 424158
14. Mariscalco MW, Flanigan DC, Mitchell J, *et al*. The influence of hamstring autograft size on patient-reported outcomes and risk of revision after anterior cruciate ligament reconstruction: a multicenter orthopaedic outcomes network (MOON) cohort study. Arthrosc J Arthrosc Relat Surg,2013:29 (12):1948e1953.
15. Thomas AC, Wojtys EM, Brandon C, Palmieri-Smith RM. Muscle atrophy contributes to quadriceps weakness after anterior cruciate ligament reconstruction. J Sci Med Sport,2016:19:7-11.
16. Kumar PM, Shevte I, Phalak M, Nair A, Parth. Arthroscopic anterior cruciate ligament reconstruction with semitendinosus graft versus peroneus longus tendon graft. Int J Res Orthop,2020:6:386-92.
17. Sasetyo Dadang Rona, Rhatom, Sholahuddin, Pontoh, Ludwig. Peroneus longus tendon: The promising graft for anterior cruciate ligament reconstruction surgery. Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology, 2017:9:25.
18. Shao X, Shi LL, Bluman EM, Wang S, Xu X, Chen X, Wang J. Satisfactory functional and MRI outcomes at the foot and ankle following harvesting of full thickness peroneus longus tendon graft. Bone Jt J,2020:102:205-211
19. Rhatomy, Sholahuddin *et al*. "Eversion and First Ray Plantarflexion Muscle Strength in Anterior Cruciate Ligament Reconstruction Using a Peroneus Longus Tendon Graft." Orthopaedic journal of sports medicine,2019:7:9:2325967119872462.
20. 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,2012:40:662-671.
21. Kerimoğlu S, Aynaci O, Saraçoğlu M, Aydin H, Turhan AU. Peroneus longus tendonu ile ön çapraz bağ rekonstrüksiyonu [Anterior cruciate ligament reconstruction with the peroneus longus tendon]. Acta Orthop Traumatol Turc,2008:42 (1):38-43.
22. Cao HB, Liang J, Xin JY. Treatment of anterior cruciate ligament injury with peroneus longus tendon. Zhonghua Yi Xue Za Zhi,2012:18;92 (35):2460-2
23. Fujimoto E, Sumen Y, Deie M, *et al.* Anterior cruciate ligament graft impingement against the posterior cruciate ligament: diagnosis using MRI plus three-dimensional reconstruction software. Magn Reson Imaging,2004:22:1125-1129.