ACL Reconstruction with Peroneus Longus Autograft Using Endobutton & Bioabsorbable Interference Screw and Brace Free Rehabilitation

Ali Raza Hashmi,[1] Sher Afgan,[2] Adeel Hamid,[3] Atif Aslam,[4] Jawad Asghar,[4] Ahmed Shams Nasir,[5] Muhammad Moaz Bin Khalid,[6] Muhammad Ibrahim[7]

Abstract

Objective: To assess the functional outcome of arthroscopic anterior cruciate ligament (ACL) reconstruction with Peroneus longus tendon autografts using endobutton and interference screw at one-year follow-up post-operatively and brace-free rehabilitation.

Material and Methods: A prospective study included 53 patients with clinical and radiological ACL deficiency. Arthroscopic ACL reconstruction was performed using Peroneus Longus double bundle autografts with subsequent brace-free rehabilitation. Pre- and postoperative assessment at one-year follow-up utilized the International Knee Documentation Committee (IKDC) score. Graft length and diameter were measured perioperatively, and donor site morbidity was evaluated using The American Orthopedic Foot and Ankle Score (AOFAS).

Results: The study included 51 (94.4%) males and 2 (3.7%) females, mean age 27.3±7.2 years. Majority were left-sided procedures (64.8%). Peroneus Longus graft mean length and diameter were 116.8±5.3mm and 8.2±0.2mm respectively. At one-year follow-up, ankle joint movement at the graft site was preserved (mean AOFAS 98±0.8). There was a significant improvement in IKDC score postoperatively ($p < 0.05$).

Conclusions: ACL reconstruction with Peroneus longus autograft offers knee stability and facilitates early rehabilitation. Utilizing endobutton and bioabsorbable interference screw fixation supports graft strength until sufficient graft-to-bone healing occurs. Patients regain pre-injury activity levels, including stair climbing, sitting cross-legged, and squatting without difficulty.

Keywords: Anterior cruciate ligament, ACL Reconstruction, Peroneus longus.

How to cite: *Hashmi AR, Afgan S, Hamid A, Aslam A, Asghar J, Nasir AS, Khalid MMB, Ibrahim M. ACL Reconstruction with Peroneus Longus Autograft Using Endobutton & Bioabsorbable Interference Screw and Brace Free Rehabilitation. Esculapio - JSIMS 2023;20(01): 48-53.*

DOI: https://doi.org/10.51273/esc24.251320110

Introduction

Injury to the Anterior Cruciate Ligament (ACL) is a common and the most prevalent injury resulting from sports related trauma.[1,2] ACL injury if not addressed, can lead to instability of the knee, meniscal injuries or degenerative changes in the knee joint. The attending consultants have long been in search of alternate methods and substitute grafts for the reconstruction of ACL (ACLR). The objective of ACLR is to restore stable knee biomechanics as well as to provide rehabilitation for sports and routine activities. Surgeons have adopted various different techniques for ACLR. Thus, with changing concepts, newer and safe alternative graft options have been in use recently.[3] Various studies have documented the Peroneus longus (PL) as an auto-graft that has sufficient biomechanical properties safe enough to be used in ACLR without having any major biomechanical and kinematic effects on the functions of foot and ankle from which it was harvested.[4,5] Amongst the different choices of auto grafts available, Semitendinosus

1,2,4,6. Department of Orthopedic Surgery Unit -1, Services Hospital, Lahore
3. Department of Orthopedic Surgery, Lahore General Hospital
5. Pediatric Orthopedic Surgery, Children Hospital, Lahore

Correspondence:
Dr. Muhammad Moaz Bin Khalid, *Resident Orthopaedic Surgery, Department of Orthopaedic Unit 1, SIMS Hospital, Lahore, Pakistan.*
E-mail. muhammadmoazbinkhalid@yahoo.com

Submission Date: 12-02-2023
1st Revision Date: 17-02-2024
Acceptance Date: 05-03-2024

and Gracilis (Hamstring), and the bone patella bone tendon grafts are already being used for ACLR with good functional outcome. Despite the available variety of auto graft options, controversy still exists regarding the most suitable graft for ACLR.[6,7] The usage of PL tendon autograft however, is a recent advancement in the management of ACL injuries.[7,8] Among its benefits are good strength and the ease of harvest. The mean thickness of PL auto graft nearly matches that of native ACL. But only a few studies are available regarding the donor site morbidity following the harvest. This study was carried out to investigate functional outcome, biomechanical stability, along with donor site morbidity of harvesting the PL graft for ACLR.

Material and Methods

Following the approval from the Institutional Review Board, this study was done on 53 patients admitted through Out Patient Department with Clinical and Radiological deficiency of ACL in the Orthopedic Surgery Department of a tertiary care Hospital, Lahore from May 2019 to June 2022. Following the informed consent, detailed history and clinical examinations were performed, including the knee stability tests, the Anterior and posterior Drawer test, Pivot Shift and the Lachman Test. Patients were evaluated with radiographs of the knee and findings were confirmed by Magnetic Resonance imaging (MRI).

Patients aged between 16-45 years with primary injuries to the ACL on MRI and complete ACL tear confirmations on diagnostic arthroscopy were included in this study. Those Aged greater than 45 years with evidence of bi-compartmental and tri-compartmental OA of knee, multi-ligamentous injury, Associated MCL injury, Fractures around the knee, Presence of Pathological condition in the affected limb were not included in the study.

A total of fifty-three patients were included in the study of ACL injury. Prior to the surgery, patients were treated elsewhere with a knee immobilizer. Pre-operatively the International Knee Documentation Committee (IKDC) was used to evaluate the functional status of the injured knee. Physiotherapy was started to improve the strength of quadriceps muscle and to decrease the joint effusion. All patients presented to the Out Patient Department six months after the sustaining ACL injury. Under spinal anesthesia, the patient was positioned in supine position for the surgery. Intravenous antibiotic was given 5 minutes before the inflation of the tourniquet which was placed on the thigh in all cases. A single 3cm long longitudinal incision was given almost 4-5 cm proximal to the tip of lateral malleolus (Fig-1).

After the subcutaneous tissues, deep fascia was incised and Peroneus Longus and Peroneus Brevis tendons were identified. Using the artery forceps or Kelly the PL was separated from peroneus brevis (PB) muscle. The tendons were then stitched with each other distally using Coated VICRYL® (Polyglactin 910) No.1 Suture. The peroneus longus tendon just proximal to distal unification of both tendons was sutured with VICRYL® (Polyglactin 910) No.1 Suture and cut sharply with the knife and extracted with the help of a tendon stripper approximately 5cm from fibular head taking care not to injury the common peroneal nerve. The mean length of graft was 116.8±5.3mm. The graft was folded on itself to constitute a double bundle graft. To determine the precise diameter of the graft for passage through the femoral and tibial tunnels (Figure 3), cylindrical sizers were used whereby the tendons were passed through it. The mean diameter was measured 8.2±0.2mm on average. The harvested tendon was placed on the tendon board and pre-tensioning was performed following which the endobutton was applied to one end. Wound closure was done using absorbable subcutaneous 2/0 VICRYL® (Polyglactin 910) Suture and interrupted 2/0 PROLENE® (Polypropylene) suture was used to close the skin incisions.

Figure 1. 3 cm incision and identification of PL Tendon

Figure 2: *Tenodesis of PL to PB and Harvested PL Tendon*

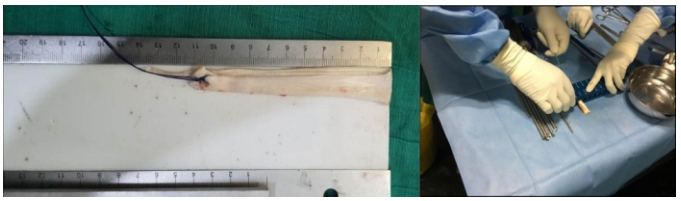

Figure 3: *Measuring PL tendon.*

Standard arthroscopic approach was used to place the portals for the intra-articular examination. An awl was carefully positioned onto the posteromedial aspect of the lateral femoral condyle just distal to residual ridge 8-10mm above inferior articular surface to mark the location for femoral tunnel. Guide wire was passed through the marked position over which reamers of adequate sizes were used for the femoral tunnel. The knee was flexed up-to about 70 to 80º, then using the anteromedial portal the tip of the tibial drill guide was placed with 45 to 55 degrees angulation of the guide wire. Guide wire was then drilled through the medial side of tibia to emerge under vision from the articular surface of tibia at the footprint of the native ACL. Cannulated reamers were then used to make the tibial tunnel with diameter the size of the harvested graft. The graft was then passed through the tunnel under arthroscopic vision up to the markings labeled on the graft. Once the endobutton had flipped across the lateral femoral condyle the knee joint was then flexed and extended through full range to ensure firm setting of the graft in its position. Bio-absorbable screw was placed and tightened at the tibial tunnel until satisfactory purchase was achieved while keeping the knee in 40-60 degree of flexion. Post operatively graft tension is checked by performing anterior drawer and Lachmann`s test. In case of slackness further tensioning on graft is made on the femoral side by further tightening the tight rope. Patients were prescribed antibiotics and analgesics post-operatively. Knee immobilizer was given to all patients at the end of surgery. Post-operative radiographs were done to ensure proper endobutton position over the lateral condyle of femur and the position of the bio-absorbable interference screw.

Follow Up and Assessment

On the first postoperative day, active and passive range of motion exercises of knee and ankle were initiated. Knee was inspected on day four postoperatively to assess the surgical wound, effusion, overlying skin condition. Patients were discharged on oral antibiotics and analgesics and were given the rehabilitation protocol to continue exercises at home. Patients were called for follow-up on day 10 for removal of the skin stitches and were advised to continue the Knee immobilizer for one month. Post-operative rehabilitation protocol was divided into three-phases. Phase I – This was the initial recovery phase and comprised the first two weeks. In the first week patients were advised to elevate the operated leg. Cold therapy in the form of ice packs was applied immediately after surgery and used for at least 20 minutes every other hour for 24-48 hours. In the second week patients were advised to weight bear by putting 50% of the body weight through the operative leg. Phase II - Two to six weeks after surgery, progression to full weight bearing without crutches was recommended and closed kinematic chain (CKC) exercises were started. Straight leg raise exercises were recommended. Knee immobilizer was discontinued after 04 weeks of surgery.

Phase III - Six weeks to three months after Surgery, walking, leg curls, leg presses, cycling were advised. Following the third month postoperatively walking, jogging, light running, leg raising were advised. Postoperative knee function was evaluated by the International Knee Documentation Committee (IKDC) and for the assessment of donor ankle function The American Orthopedic Foot and Ankle Score (AOFAS) was used at one-year follow-up. Paired Sample t-test was used to calculate the significance between the mean IKDC pre and post operatively at one-year post-operatively.

Results

Of the total of 53 patients, 51 (94.4%) were males and 2(3.7%) females with mean age of 27.3±7.2. Eighteen (33.3%) patients were operated on the right side and 35(64.8%) on the left. Forty-one (75.9%) patients had injury as a result of direct trauma due to road traffic accident, whereas 10 (18.5%) patients presented following sports injury and 2(3.7%) patients presented secondary to indirect trauma to the knee. All patients were operated on more than 06 months after injury. Peroneus Longus graft mean length and diameter was 116.8±5.3 mm and 8.2±0.2mm respectively (Table 1). Pre-operatively, the Lachman test was reported positive in 52 cases (96.3%) and negative in 1 case (1.9%). Post operatively Lachman test was normal in 52 cases (96.3%), whereas 1 patient (1.9%) had 1+ laxity (Table 2). Preoperatively Pivot shift was found positive in 32 subjects (59.3%) and negative in 21 (38.9%) but postoperatively 53 patients (100%) showed negative pivot shift test. (Table 2). The functional outcome of the knee was evaluated by IKDC score at one-year follow-up. Pre-opera-

tive IKDC score was 29.21±1.3 and post-operatively 93.40±1.3 at one year post-operatively. There was a significant improvement in the IKDC score at one-year operative (p-value <0.05). The range of motion of the knee joint was fully intact at the end of one-year follow up. The foot and ankle functions at the donor site were grossly preserved at one-year follow-up, with mean AOFAS of 98±0.8. (Table 3).

Table 1: *Patient Demographics*

Characteristics	Mean	SD	Min	Max	N (%)
Age	27.3	7.2	16	45	
Sex					
Male					51 (94.4)
Female					2 (3.7)
Injury Mechanism					
RTA					41 (75.9)
Sports					10 (18.5)
Other					2 (3.7)
Side on injury					
Right					18 (33.3)
Left					35 (64.8)
Graft Length	116.8	5.3	110	130	
Graft Thickness	8.2	0.2	8	9	

Table 2: *Lachman & Pivot Shift test preoperative vs post-operative.*

Lachman test grade	Preoperative	Postoperative
Negative	01	52
1+	19	01
2+	30	00
3+	03	00
Pivot shift test	**Preoperative**	**Postoperative**
Negative	21	53
Positive	32	00

Table 3: *Functional Outcome*

Functional Outcome	Mean	SD	Min	Max	*p- value*
Pre- IKDC	29.2	1.3	27	31	
Post- IKDC	93.4	1.3	91.0	96	<0.05
AOFAS	98.0	0.8	96.0	99.0	

Discussion

Our results showed favorable outcomes following ACLR using PL double-bundle Autograft one year post-operatively. There have been multiple previous studies demonstrating the functional outcome using other grafts such as the Hamstring tendon, Bone patellar-bone tendon (BPTB) and the synthetic grafts each having their merits and demerits.

The Bone-patellar-tendon-bone graft is to date still considered the gold standard for ACLR, owing to its relative ease of harvest, bigger size, better strength and good bone to bone healing.[9] A ten-year clinical study of ACLR using BPTB press-fit fixation, showed the subjects to have stable knees and high participation in contact sports such as soccer.[10] Thus, the choice of graft for ACL in high demand sports players is the BPTB. The demerits of this graft are difficulty in harvesting of graft in patients with osteoporotic bone, anterior knee pain following the harvest, numbness around knee, quadriceps weakness, iatrogenic fracture of patella and donor site morbidity. This makes it a less favorable choice in patients with occupation requiring frequent kneeling. In a study by Muller et al. there was donor site discomfort in 57% of the patients undergoing ACLR using the BPTB graft[11] where as Kartus et al. showed that 65% of their patients had difficulties with knee walking at 2 years post-operatively.[12] In contrast, these complications are avoided when using the PL autograft, with the added benefit of showing similar and comparable functional outcomes. In a local study in 2022,[13] the outcomes between PL and BPTB grafts for ACLR in 30 patients were compared and the results showed comparable functional outcome of both techniques with less operative time for the PL due to shorter harvesting time. The study also showed greater average diameter of 8.4mm of PL graft in contrast to 8.1mm of the BPTB graft. Studies have shown that there is a positive correlation between 1 mm increase in graft diameter and higher IKDC score.[14] Hamstrings tendon (HT) is also a popular choice for an autograft among the surgeons performing ACLR.[15] Following its harvest from the knee, it carries potentially the same disadvantages as those of BPTB and Quadriceps tendon including knee laxity and quadriceps-hamstring imbalance. When comparing the tensile strength of four strand HT with PL graft of same cross-section, Rudy et al. reported no significant difference (405.8 N ±202.9 N vs 446.1 N ± 233.2 N).[16] A systematic review and meta-analysis comparing the functional outcomes following ACLR using PL and HT graft demonstrated that the PL has comparable results with HT in terms of functional outcome and graft survivorship, and concluded the PL to be a suitable donor for ACLR outside of the knee, thus avoiding the complications following harvest from the knee.[17] The only concern following the PL harvest was a slight decrease in AOFAS score although it was statistically insignificant. Our study demonstrated an excellent AOFAS score at one-year follow-up of 98±0.8. This shows that PL has minimal donor site morbidity when compared to other grafts. A longer

follow-up and a larger study subjects may further improve our understanding in regards to graft selection when performing ACLR.

Conclusion

Our study concluded that Arthroscopically assisted ACL reconstruction with peroneus longus autograft using endobutton and bioabsorbable interference screw provides a stable graft and enables early rehabilitation. Graft fixation using endobutton and bioabsorbable screw provides good graft to bone healing. It allows the patient to return to pre-injury level of activity, allows the patient to sit cross legged, climb stairs, play sports and to perform the activities of daily living without any difficulty. The Harvest of the PL does not have any side-effects on the gait of the patient nor on the stability of the ankle joint. Thus, making it a suitable choice for ACLR.

Conflict of Interest: *None*

Funding Source: *None*

References

1. Gianotti SM, Marshall SW, Hume PA, Bunt L. Incidence of anterior cruciate ligament injury and other knee ligament injuries: A national population-based study. J Sci Med Sport 2009;12:622-627.
2. Guimarães MV, Junior LH, Terra DL. Reconstruction of the anterior cruciate ligament with the central third of the quadriceps muscle tendon: Analysis of 10-year results. Rev Bras Ortop 2015;44:306-312.
3. Diermeier T, Tisherman R, Hughes J, et al. Quadriceps tendon anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc 2020;28:2644-2656.
4. Pearsall AWIV, Hollis JM, Russell GV Jr, Scheer Z. A biomechanical comparison of three lower extremity tendons for ligamentous reconstruction about the knee. Arthroscopy 2003;19:1091-1096.
5. Shi FD, Hess DE, Zuo JZ, et al. Peroneus longus tendon autograft is a safe and effective alternative for anterior cruciate ligament reconstruction. J Knee Surg 2019;32: 804-811.
6. Coupens SD, Yates CK, Sheldon C, Ward C. Magnetic resonance imaging evaluation of the patellar tendon after use of its central one-third for anterior cruciate ligament reconstruction. Am J Sports Med. 1992 May; 20(3):332- 5
7. 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 Jul;31(4):521-9.
8. Nazem K, Barzegar M, Hosseini A, Karimi M. Can we use peroneus longus in addition to hamstring tendons for anterior cruciate ligament reconstruction?. Advan Biomed Res. 2014;3.
9. 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 Mar;40(3):662-7
10. Anterior Cruciate Ligament Reconstruction Using Bone-Patella Tendon-Bone Autograft With Press-Fit Femoral Fixation: The Original Chambat Technique. Arthroscopy Techniques Levy, Y., Gousopoulos, L., Hopper, G. P., Grob, C., Vieira, T. D., Fayard, J.-M., Thaunat, M., Chambat, P., and Sonnery-Cottet, B. (2022) Volume 11, Issue 11, E1889-E1895, November 01, 2022 DOI: https://doi.org/ 10. 1016/ j.eats.2022.07.001
11. Hertel, P., Behrend, H., Cierpinski, T. et al. ACL reconstruction using bone-patellar tendon-bone press-fit fixation: 10-year clinical results. Knee Surg Sports Traumatol Arthrosc 13, 248–255 (2005). https:// doi.org/10.1007/s00167-004-0606-5.
12. Müller B, Rupp S, Seil R, Kohn D (2000) Entnahmestellenmorbidität nach VKB-Ersatzplastik mit dem Ligamentum-patellae-Transplantat. Unfallchirurg 103: 662–667
13. Kartus J, Ejerhed L, Sernert N, Brandsson S, Karlsson J (2000) Comparison of traditional and subcuataneous patellar tendon harvest. A prospective study of donor site-related problems after anterior cruciate ligament reconstruction using different graft harvesting techniques. Am J Sports Med 28:328–335
14. Comparison of Peroneus Longus Tendon Graft versus BonePatellar Tendon-Bone Graft in Anterior Cruciate Ligament Reconstruction Farooq Azam Khan, Bilal Ahmad Abbas, Talha Qureshi, Abbas Bajwa. Journal of Sharif Medical and Dental College Lahore, Pakistan 2022; Vol 8(01):3-6 DOI: http://www.jsmdc.pk/wp-content/uploads/2022/11/Volume-8-Issue-01-Original-Article-01-3-6.pdf.
15. 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 Dec;29(12): 1948e1953

16. Widner M, Dunleavy M, Lynch S (2019) Outcomes following ACL reconstruction based on graft type: are all grafts equivalent? Curr Rev Musculoskelet Med 12: 460–465
17. Rudy ME, Phatama KY (2017) Tensile strength comparison between peroneus longus and hamstring tendons: a biomechanical study. Int J Surg Open 9:41–44.
18. He J, Tang Q, Ernst S, Linde MA, Smolinski P, Wu S, Fu F. Peroneus longus tendon autograft has functional outcomes comparable to hamstring tendon autograft for anterior cruciate ligament reconstruction: a systematic review and meta-analysis. Knee Surg Sports Traumatol Arthrosc. 2021 Sep;29(9):2869-2879. doi: 10.1007/s00167-020-06279-9. Epub 2020 Sep 27. PMID: 32984919.

Authors Contribution

ARH: Conceptualization of Project
SA, AH, AA, JAC: Data Collection
ARH: Literature Search
AS: Statistical Analysis
ARH: Drafting, Revision
MMBK: Writing of Manuscript