

## Original Research Article

# A study on peroneus longus autograft for anterior cruciate ligament reconstruction

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### ABSTRACT

**Background:** To compare the clinical outcome and donor site morbidity of ACL reconstruction with Peroneus longus tendon autografts in patients with isolated ACL injury.

**Methods:** This was a prospective study that included patients who underwent ACL reconstruction using Peroneus longus tendon autograft. Results were assessed via physical examination. Donor site morbidity of the foot and ankle after tendon harvesting was assessed using Medical Research Council (MRC) grading of ankle and foot movements. Post-operative knee function was evaluated by the International Knee Documentation Committee (IKDC) scoring.

**Results:** In this study sample of 25 patients, the ankle functions at the donor site are grossly preserved in almost all the patients, which was elucidated by grading the power of foot eversion. Post operatively knee function (IKDC scoring) were rated as normal in 92% (23 cases).

**Conclusions:** Peroneus longus is an appropriate autograft source for ACL reconstruction in view of ease of harvest, adequate size, cosmetically appealing, considering excellent post-operative knee scores. And removing the Peroneus longus tendon has no effect on gait parameters and does not lead to instability of the ankle. So, it can be used as an autogenous graft in orthopaedic surgeries.

**Keywords:** Anterior cruciate ligament, Arthroscopy, Peroneus longus, Reconstruction

### INTRODUCTION

Anterior Cruciate Ligament is the most commonly injured ligament in knee joint during sports activities and accidents. ACL stabilizes knee joint against translational and rotational forces. The incidence of ACL injury in general population is 1: 3000. If it is left untreated, can lead to knee instability, meniscal injuries and early osteoarthritic changes. Goal of anatomic reconstruction of ACL is to regenerate a stable knee that allow return to sports and daily activities. Ligament reconstructions of knee are common procedures used to restore knee stability and function. Anterior Cruciate Ligament (ACL) reconstruction is performed using different grafts.

Allografts, autografts and synthetic grafts have been used with variable success rates. The autografts have been time tested and consistently associated with good clinical results. The hamstring and the bone patella bone tendon grafts are the forerunners among the autografts with wide acceptability. The other autografts being quadriceps, patellar tendon, fascia lata etc. Although, these grafts are used commonly, disagreements regarding suitable graft choice still persist because of some disadvantages.<sup>1,2</sup>

Use of Peroneus longus tendon autograft is a recent development in the field of ACL reconstruction.<sup>3,4</sup> The advantages are its strength and mean thickness is nearly same as that of the native ACL and is very easy to

harvest. But there are very little studies regarding the donor site morbidity.<sup>5</sup> In this study, author evaluated the efficacy of Peroneus Longus tendon as a graft for primary ACL reconstruction and studied the possible effects of it on foot and ankle function.

## METHODS

This study was conducted in the department of Orthopedics, Sree Gokulam Medical College and Research Foundation, Venjaramoodu, Thiruvananthapuram between May 2018 to April 2019. Patients attending OPD and casualty are selected for the study. Thorough clinical examination was done (Lachman test, anterior drawer test and pivot shift test). Tests were also done to exclude tear of the Posterior Cruciate Ligament (PCL) and the Postero-Lateral Corner (PLC). Patients are evaluated with xrays of knee and confirmed by MR imaging.

### Inclusion criteria

- Patients with primary injuries of the ACL.

### Exclusion criteria

- Multi-ligamentous injury.
- Patients with pre-existing flat foot, ankle deformity, paralytic conditions, poliomyelitis or previous significant injuries to ankle.
- Age >60 years.
- Patients with overlying skin infections over the knee or the ankle.
- Patients with chronic systemic medical diseases.

A total of 25 patients are enrolled into the study, of which 19 are males and 6 females. On an acute ACL injury, prior to reconstruction surgery patient is treated with knee immobilizer, physiotherapy with goals of achieving near full range of motion, symmetric quadriceps strength and to decrease joint effusion. Once the inflammatory period is resolved patient is posted for surgery.

### Surgical technique

Surgery was performed in supine position under spinal anesthesia. Pneumatic tourniquet was used in all cases. The peroneus longus tendon was harvested through a 2 cm incision along the posterior border of the distal fibula, just above the superior peroneal retinaculum (Figure 1).

The peroneus longus tendon was exposed on its posterolateral surface through the incision after carefully incising the fascia (Figure 2). Distal cut end of Peroneus longus tendon sutured with intact peroneus brevis muscle to prevent retraction (Figure 3). The tendon was sutured with No. 2 of heavy non-absorbable suture and cut with a scalpel and harvested using a long tendon stripper (Figure 4).



Figure 1: 2 cm incision.



Figure 2: PL tendon identified.



Figure 3: Tenodesis of PL to PB.

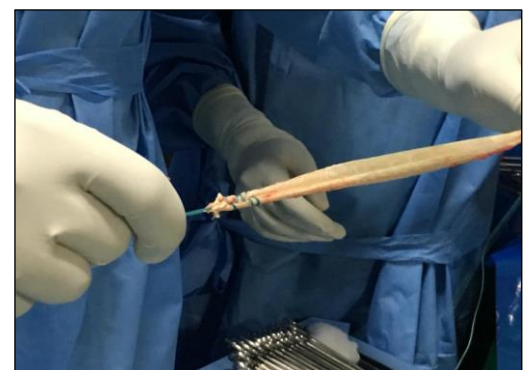
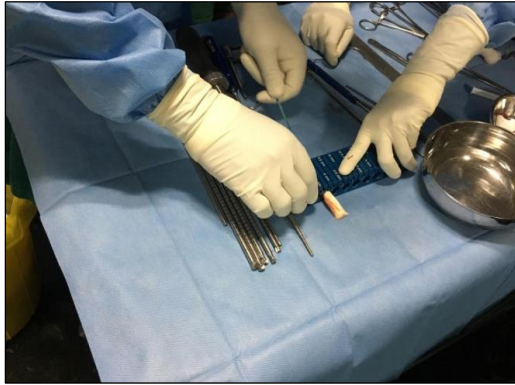


Figure 4: Harvested PL tendon.

Incision was closed using absorbable subcutaneous sutures and staples. Pre-tensioning of the harvested graft was done on a tendon board. The graft was then looped to constitute a triple graft. Femoral fixation device was attached to one end of the graft. Graft was passed through cylindrical sizers to determine the exact size of the triple graft to be matched with the needed femoral and tibial tunnel (Figure 5).



**Figure 5: Measuring PL tendon.**

Standard arthroscopic portals were established and through which arthroscopic survey was done. With the help of femoral offset aimer, a guide wire was placed into the posteromedial corner of the lateral femoral condyle. Using an appropriately sized reamer, femoral tunnel was made. The knee was flexed 70-90°, and then the tip of the tibial drill guide was placed into position through the anteromedial portal with the angle of drill guide set to 45 to 55°. The drill sleeve was placed against the medial tibial cortex, and a guide wire was drilled into place emerging at the tibial plateau. A cannulated tibial reamer of the size as determined by the thickness of the harvested graft was used to make the tibial tunnel. Appropriate markings were made on the graft and was rail-roaded into the femoral tunnel through the tibial tunnel under arthroscopic guidance. The knee joint was taken through the full range of flexion and extension (cycling of the knee joint up to 25 times) to remove any kinks in the graft. Maximal traction was applied on the graft and guide wire was passed into the tibial tunnel over which biodegradable screw was tightened until achieving satisfactory purchase. Patient was given antibiotics, analgesics and knee immobilizer. Post-operative x-ray was done to ensure proper placement of the tunnels and the position of the trans-fixation device

**Follow up and assessment**

On postoperative day 1, Continuous passive motion was initiated. Extension exercises (passive extensions, heel props, prone hangs and active assisted extension), flexion exercises (passive flexion and wall slides), quadriceps exercise (isometric contractions and straight leg raises), hamstrings exercise (curls), ankle exercises (dorsiflexion and plantar flexion, passive toe movements, inversion

and eversion movement), hip abduction, adduction and extension were also advised. Wound inspection was done on the fourth postoperative day and check the suture line, any swelling, effusion, skin condition and range of movement of knee and ankle. Patient was discharged with knee immobilizer, antibiotic, analgesics and advised to continue exercises at home. Patients were reviewed on day 13, wound inspected and all staples removed. The following parameters were looked for: Suture line, swelling or effusion if any, surrounding skin and range of movement of knee and ankle. Knee immobilizer was continued till one month post operatively. The following exercises were advised after 2 weeks: partial squats, toe raises, stationary bicycling, wall slides, hand assisted heel drags and inclined leg-press machine. In the period between 1<sup>st</sup> and 3<sup>rd</sup> post-operative month, knee immobilizer was discontinued. Tread mill was introduced (flat only). Leg curls, leg presses and outdoor bike riding on flat road was advised to the patient. After the third postoperative month, the following exercises were introduced: jogging, light running, leg raising with application of sandbags as counterweights, one and two leg jumping, swimming etc.

Post-operative knee function was evaluated by the International Knee Documentation Committee (IKDC) (Annexure 1) and assessment of MRC scoring (Table 1) for donor site ankle and foot done at 2 weeks, 1 month and 3-month follow-ups.

**Table 1: Medical Research Council (MRC) grading of muscle power.**

MRC grade	Muscle state
0	No contraction
1	Flicker or trace of contraction
2	Active movement with gravity eliminated
3	Active movement against gravity
4	Active movement against gravity and resistance
5	Normal power

**RESULTS**

Study sample of 25 patients consists of 19(76%) males and 6(24%) female. Road traffic accidents are the most common mode of injury in 76% (19 cases) followed by sport related injury in 16% (4 cases) and fall from height in 8% (2 cases). At presentation, knee effusion was present in 15 cases (60%)

Author have done arthroscopic ACL reconstruction on 15 right and 10 left knees. Intraoperatively, only 11 patients had partial tear of the medial menisci of whom only 6 patients required partial meniscectomy. Mid substance tear of ACL noted in 19 patients, 2 patients had ACL avulsion from tibial attachment and 3 patient had avulsion from the femoral attachment. The length of the

Peroneus longus graft harvested in the study ranged from 280-310 mm. The minimum length was 280 mm and maximum length was 310 mm. The mean length was 292.8 mm (Table 2).

**Table 2: Length of peroneus longus tendon graft.**

Length of graft (mm)	Number of patients	(%)
275-285	7	28
286-295	8	32
296-305	6	24
>305	4	16

The mean thickness of the Peroneus longus graft obtained in this study was 8.74 mm. The maximum thickness of the graft was 9.5 mm and minimum thickness was 7.5 mm. In 44% (11 cases) graft of 8 mm thickness was harvested (Table 3).

**Table 3: Thickness of peroneus longus tendon graft.**

Thickness of graft (mm)	Number of patients	(%)
7.5-8.0	8	32
8.1-8.5	3	12
8.6-9.0	8	32
>9	6	24

Post operatively, knee joint stability was assessed using Lachman test which showed normal finding in 22 cases (88%), while 3 patients (12%) had 1+ laxity (Table 4).

**Table 4: Lachman test preoperative vs postoperative.**

Lachman test grade	Preoperative	Postoperative
Negative	03	22
1+	10	03
2+	11	00
3+	01	00

Pivot shift test was reported negative in 24(96%) cases (Table 5).

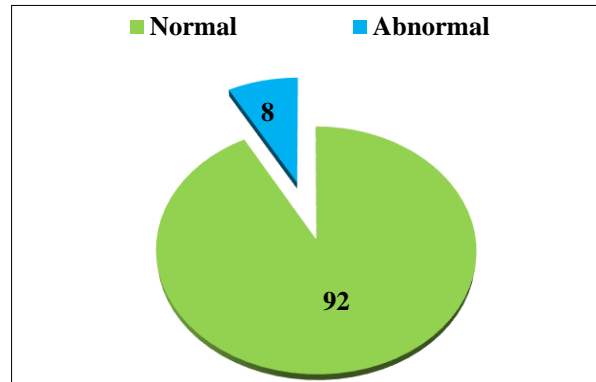
**Table 5: Pivot shift test preoperative vs postoperative.**

Pivot shift test	Preoperative	Postoperative
Negative	10	24
Positive	08	01
Gross	07	00

The results in this study was assessed by IKDC criteria at the end of 3 months. According to the IKDC, 23 cases were rated as normal or nearly normal (92%) and 2 cases (8%) cases were rated as abnormal (Figure 6). The mean IKDC score was 98.53. There was no flexion or extension loss at the end of 3months of follow up.

In the evaluation of ankle ROM, author assessed MRC grading of flexion/extension, inversion/eversion, and

rotation of ankle in the operated ankle and compared with opposite normal ankle.



**Figure 6: IKDC score.**

In the operated ankle, MRC grading of flexion /extension, inversion/ eversion, and rotation of ankle were grade 5. In this study author found that the ankle functions were grossly preserved in almost all the patients which was elucidated by grading the power of the muscles of the foot particularly the eversion movement on a scale of five and comparing it with the normal ankle.

**DISCUSSION**

Knee joint stability is mainly contributed by ligaments around it, most importantly cruciate ligaments (anterior and posterior cruciate). Anterior cruciate ligament is usually injured during road traffic accident and sports activities, in which forceful valgus and external rotation movement of knee is the most common mechanism. Injury to ACL is now reconstructed arthroscopically using autografts and allografts. There are multiple graft options available like, bone-patellar tendon-bone complex, hamstring tendon autograft, and allografts. But controversy exists about the most suitable graft for ACL reconstruction.<sup>6,7</sup>

The gold standard for ACL reconstruction is BPTB graft (Bone-patellar tendon-bone graft) because of its strength, consistency, size of the graft, ease of harvesting and most importantly because of bone to bone healing within the tibial and femoral tunnel.<sup>7,8</sup> Complications of bone patella tendon bone graft include patellar tendon rupture, patellar/tibial fracture, quadriceps weakness, loss of full extension, anterior knee pain, difficulty in kneeling and numbness due to injury to the infra-patellar branch of saphenous nerve. Hence it is to be avoided in patients whose occupation or lifestyle requires frequent kneeling.

The hamstring tendon grafts have greater mechanical strength than a bone-patellar tendon-bone graft. Patients treated with hamstring tendon grafts are less likely to suffer patella / femoral pain and extension loss. Using the hamstring tendon can cause a significant change in hamstring muscle strength. Hamstring function is very

important after ACL reconstruction in order to protect the reconstructed ACL from anterior drawer force, which is exerted by quadriceps contraction.<sup>9</sup>

The advantages of the allograft are shorter operation and anesthetic time and good cosmetic results, however high costs, less availability, disease transmission and immunological reaction have limited their use. The enthusiasm surrounding the introduction of synthetic graft materials stemmed from their lack of donor morbidity, their abundant supply and significant strength of these devices.<sup>10</sup> Several artificial biomaterials are available like Carbon, Dacron, polyester and polypropylene etc. Disadvantages are early breakage and tendency to elongate (wear and tear), deposition of carbon, inflammatory synovitis, cross-infections, immunological responses, tunnel osteolysis, femoral and tibial fractures, foreign-body synovitis and knee osteoarthritis.<sup>11</sup>

For these reasons author used the Peroneus Longus Tendon (PLT) in ACL reconstruction in patients. Peroneus longus is one of the main ankles evertors. So, one of the main concerns about Peroneus longus tendon is ankle instability.<sup>12</sup> The highlight of this study is the donor ankle morbidity in whom Peroneus longus tendon is used for ACL reconstruction. Primary action of Peroneus longus is to plantar flex the first ray of foot, while plantar flexion and eversion of foot at ankle are the other actions. The primary concern of a donor ankle is the deficit of first ray plantar flexion while the patient is in the stance phase of gait. The other concern is the ankle instability.<sup>13</sup>

In view of cosmetic concerns, the harvesting of a PLT graft conceals the tendon harvesting scar behind the lateral malleolus and also the scar around the tibial tunnel is significantly smaller. Hence it provides a cosmetic advantage to athletes who often need to have their legs exposed in their profession.

Biomechanically, Peroneus longus tendon is as strong as native ACL. The maximum tensile load of the native ACL is 1725N and the maximum tensile load of single strand Peroneus longus tendon in the study by Kerimoglu et al, was 1950N.<sup>14</sup> The mean thickness of the graft obtained in this study was 8.74 mm which was way far satisfactory than the thickness obtained in most of the hamstring grafts. There was no extension or flexion loss in this patient. Furthermore, no patella or femoral pain was reported by the patients. The results of this study were better than that done by Kerimoglu et al, and Anghong et al, with better IKDC score. There was no ankle dysfunction related to graft harvest, pressure pain could be elicited in only 2 patients. Cao also found the Peroneus longus a good substitute of anterior cruciate ligament reconstruction and its resection has no major influence for ankle joint.<sup>14</sup>

The limitation of this study was that the MRC grading of muscle power was used for assessment of the ankle

function. Newer devices such as arthrometers which measure ankle functions objectively were not used. The results are very encouraging, but long term follow up and large number of patients are needed further to conclude these results and observations.

## CONCLUSION

This study concluded that peroneus longus is an appropriate autograft source for ACL reconstruction in view of ease of harvest, adequate size, cosmetically appealing, considering excellent post-operative knee scores. And removing the Peroneus longus tendon has no effect on gait parameters and does not lead to instability of the ankle. So, it can be used as an autogenous graft in orthopedic surgeries.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**ANNEXURE 1**

**IKDC subjective knee evaluation form**

**2000 IKDC SUBJECTIVE KNEE EVALUATION FORM**

Name:   Date:   
First Last

Physician:  Date of Injury:

**SYMPTOMS\*:**  
 \*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain?  
 Very strenuous activities like jumping or pivoting as in basketball or soccer  
 Strenuous activities like heavy physical work, skiing or tennis  
 Moderate activities like moderate physical work, running or jogging  
 Light activities like walking, housework or yard work  
 Unable to perform any of the above activities due to knee pain
2. During the past 4 weeks, or since your injury, how often have you had pain?  

0	1	2	3	4	5	6	7	8	9	10
Never	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Constant
3. If you have pain, how severe is it?  

0	1	2	3	4	5	6	7	8	9	10
No pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Worst pain imaginable
4. During the past 4 weeks, or since your injury, how stiff or swollen was your knee?  
 Not at all  
 Mildly  
 Moderately  
 Very  
 Extremely
5. What is the highest level of activity you can perform without significant swelling in your knee?  
 Very strenuous activities like jumping or pivoting as in basketball or soccer  
 Strenuous activities like heavy physical work, skiing or tennis  
 Moderate activities like moderate physical work, running or jogging  
 Light activities like walking, housework or yard work  
 Unable to perform any of the above activities due to knee swelling
6. During the past 4 weeks, or since your injury, did your knee lock or catch?  
 Yes  No
7. What is the highest level of activity you can perform without significant giving way in your knee?  
 Very strenuous activities like jumping or pivoting as in basketball or soccer  
 Strenuous activities like heavy physical work, skiing or tennis  
 Moderate activities like moderate physical work, running or jogging  
 Light activities like walking, housework or yard work  
 Unable to perform any of the above activities due to giving way of the knee

Page 2 – 2000 IKDC SUBJECTIVE KNEE EVALUATION FORM

**SPORTS ACTIVITIES:**

8. What is the highest level of activity you can participate in on a regular basis?  
 Very strenuous activities like jumping or pivoting as in basketball or soccer  
 Strenuous activities like heavy physical work, skiing or tennis  
 Moderate activities like moderate physical work, running or jogging  
 Light activities like walking, housework or yard work  
 Unable to perform any of the above activities due to knee

9. How does your knee affect your ability to:

	Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
a. Go up stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Go down stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Kneel on the front of your knee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Squat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Sit with your knee bent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Rise from a chair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Run straight ahead	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Jump and land on your involved leg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Stop and start quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**FUNCTION:**

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

**FUNCTION PRIOR TO YOUR KNEE INJURY:**

0	1	2	3	4	5	6	7	8	9	10
Couldn't perform daily activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No limitation in daily activities

**CURRENT FUNCTION OF YOUR KNEE:**

0	1	2	3	4	5	6	7	8	9	10
Cannot perform daily activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No limitation in daily activities

IKDC Score