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Effect of Peroneus Longus Graft in Patient Undergoing Anterior Cruciate Reconstruction on Foot Dynamics

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Abstract: ***The anterior cruciate ligament (ACL) aids in stabilizing the knee joint. ACL is most commonly injured ligament, commonly among sport players. ACL reconstruction is one of the most common orthopaedic techniques performed worldwide. Peroneus longus tendon (PLT) is a promising graft in ACL reconstruction, apart from patellar tendon and the hamstring tendon. We aimed to evaluate the dynamics of foot in patients undergoing ACL reconstruction with PLT. Total 42 patients undergoing ACL reconstruction with PLT were included above the age of 18 years. Patient assessment was done based on Constant - American Ankle and Foot score preoperatively, at 3 months, 6 months and 1 year after surgery. The mean age of the patients was 32.24 ± 7.81 years. Majority of the patients (42.86%) belonged to the age group of 31 to 40 years, and there were 29 males and 13 females. The clinical foot and ankle score pre - operatively was 100 in all the patients, which was at 3 months declined to 90 among 30.95% and to 80 in 4.76% patients. At 6 months, 37 patients continued in the study with the score was 100 in 83.33% and 90 in 4.76% patients, while at 12 months 26 patients were continued for follow up, all had the score of 100. The pre - operative mean score was 100, while at 3 months it was 95.95 ± 5.80, at 6 months 99.46 ± 2.26 and at 1 year it was again 100. So, present study gave the satisfactory results with insignificant change in the clinical foot and ankle score till 1 year follow up. Therefore, we recommend the use of PLT for ACL reconstruction as it has least effect on the foot and ankle dynamics.***

Keywords: ACL reconstruction, Peroneus longus tendon, clinical foot and ankle score, foot dynamics

1. Introduction

Muscles and ligaments work together to stabilize the knee joint. The anterior cruciate ligament controls anterior tibial translation, axial rotation, and varus moment. [1, 2] The anterior cruciate ligament (ACL) tears frequently in young male athletes and accounts for the majority of knee ligament injuries. This ligament is a dynamic structure with two major bundles: antromedial and posterolateral. [3]

Extrinsic risk factors for ACL injury include uneven, wet, or muddy playing fields, higher levels of competition, more aggressive play styles, shoe - surface interaction, rain or extreme cold (potentially affecting playing fields), and genetic predisposition. Hormonal fluctuations reported to potentially contribute to increased ligament laxity at ovulatory and postovulatory phase. [4]

A musculoskeletal exam of lower extremities should be performed. ACL tears or other causes of pain should be investigated using imaging studies. MRI can be used to confirm ACL injury if reconstruction is planned. [5] Reconstruction of the ACL is indicated in patients with an ACL tear and a locked knee due to displaced meniscal tears. [6]

Despite the high prevalence and socioeconomic impact of this injury, orthopaedics still disagree on the best treatment strategy. Preventing recurrent instability, secondary meniscal tears, arthritis, and future total knee arthroplasty is the most common surgical option for young, active patients. The ideal graft source for ACL reconstruction is still debated in surgical management. The most common grafts are bone - patellar - tendon - bone (BPTB), hamstring - tendon - quadriceps (HTQT), Peroneus graft autografts, and allografts. The surgeon's preference, patient factors, and graft characteristics all influence graft selection. [7]

ACL grafts should closely mimic the anatomical and biomechanical properties of the original ligament, provide safe fixation, and promote rapid biological integration, reducing recovery time and donor site morbidity. Although autogenous, allogenic, and synthetic grafts have been proposed, none have met all of the criteria. ACL reconstruction grafts have been studied extensively recently, but there is no gold standard for selecting the best graft. [8] Strength and stiffness are important factors to consider when choosing a graft and repair procedure.

The peroneus longus tendon (PLT) is as strong as the ACL and may substitute for it. Also, regeneration potential in harvested tendon has been observed in several studies. [9] PLT autografts are commonly used in orthopaedic surgery (anterior half of the PLT). These two muscles work synergistically, making this possible. The peroneus brevis is a more efficient ankle evertor, supporting the PLT harvest.

Previously, the PLT was used as an autograft for ACL reconstruction, with good clinical outcomes and low donor site morbidity. [9 - 11] The ideal autograft donor should be strong, large enough, and easily and safely harvested. [11] This tendon's length and strength are reported to be adequate for ACL reconstruction, but there is no direct comparison to hamstring tendon's functional outcomes. [12] In biomechanical and kinematic studies, removing the entire PLT had no effect on gait or ankle stability. [13] Thus, we conducted this study to assess the foot dynamics in patients undergoing anterior cruciate reconstruction with peroneus longus graft, using the clinical Foot and Ankle score.

2. Material and Methods

The present study was observational hospital - based study was performed in Department of Orthopedics, Bharati Vidyapeeth (DTU) Medical college, Pune, which is a tertiary care teaching hospital. For this study 42 patients with ACL tear undergoing reconstruction with peroneus longus graft were selected between the period of 2 years from October 2019 to September 2021. Out of 42 patients the data for 27 (64.29%) was collected prospectively while for 15 (35.71%) patients the data was collected retrospectively. The patients above 18 years with near/total ACL tear operated as ACL Reconstruction/Augmentation were included after taking informed consent. Patients in whom other than peroneus longus graft was used, or managed conservatively were excluded from the study. The informed consent was taken from all the patients, after explanation of study details in written format. Ethical Committee approval was obtained before commencing the study.

3. Methodology

As per inclusion criteria the patients were recruited a detailed history of the patient with operated case of ACL was carried out and entered in a specially designed proforma, and assessment of each patient was done based on Constant - American Ankle and Foot score at preoperatively, 3 months and 6 months and 1 year after surgery. This scale has 9 sections including pain, function - activity limitations/support requirement, maximum walking distance (blocks), walking surfaces, gait abnormality, sagittal motion (flexion plus extension), hind foot motion (inversion plus eversion), alignment and nkle - hind foot stability (anteroposterior, varus - valgus). Collected data was coded and entered in Microsoft Excel sheet. Statistical analysis was carried out using software SPSS - statistical package for social sciences version 20. The qualitative variables were presented as frequencies and percentages. Pre operatively, 3 months, 6 months, 1 year.

4. Results

The present study was aimed at evaluation of the dynamics of foot in patient undergoing ACL reconstruction with peroneus longus graft. Total 42 patients of either gender undergoing ACL reconstruction were included. The mean age of the patients was 32.24 ± 7.81, There were 29 males and 13 females included in the study. Majority of the patients i. e., 18 (42.86%) belonged to the age group of 31 to 40 years followed by 17 (40.48%) in <30 years and 7 (16.67%) were between the age of 41 to 50 years. The distribution of patients as per the age groups is shown in table number 1.

Table 1: Distribution of patients undergoing ACL reconstruction according to age

	N	%
<30	17	40.48
31 - 40	18	42.86
41 - 50	7	16.67
Total	42	100.00

Out of total 42 patients 28 (66.67%) had ACL tear, followed by 7 (16.67%) had ACL with medial meniscus tear, 3 (7.14%) patients had ACL with lateral meniscus tear, and 1 patient each had ACL with medial collateral ligament tear, ACL with medial meniscus tear and lateral collateral ligament tear, ACL with posterior cruciate ligament tear, and only with posterior cruciate ligament tear. The distribution of patients according to site of ligament tear is depicted in table number 2.

Table 2: Distribution of patients as per site of ligament tear

Row Labels	N	%
ACL	28	66.67
ACL + LM	3	7.14
ACL + MCL	1	2.38
ACL + MM	7	16.67
ACL + MM + LCL	1	2.38
ACL + PCL	1	2.38
PCL	1	2.38
Grand Total	42	100.00

ACL - Anterior cruciate ligament; LM - lateral meniscus tear; MCL - Medial collateral ligament; MM - medial meniscus tear; LCL - lateral collateral ligament; PCL - posterior cruciate ligament.

The clinical foot and ankle score was evaluated among the patients underwent ACL reconstruction. The score was recorded pre - operatively and then at 3, 6 and 12 months follow up. The score pre - operatively was 100 in all the patients, which was at 3 months declined to 90 among 13 (3095%) and to 80 in 2 (4.76%) patients. At 6 months, 5 patients lost follow up, and in remaining 37, the score was 100 in 35 (83.33%) and 90 in 2 (4.76%) patients, while at 12 months 26 patients were continued for follow up, all had the score of 100.

The pre - operative mean score was 100 ± 0.00, while at 3 months it was 95.95 ± 5.80, at 6 months 99.46 ± 2.26 and at 1 year it was again 100 ± 0.00. The decline in score was reported at 3 months, which then again improved at 6 months and was to 100% at 1 year follow - up. The distribution of patients as per clinical foot and ankle score is at different timelines is depicted in table number 3.

Table 3: Distribution of patients according to pre - operative clinical foot and ankle score, and at follow up and 3 and 6 months

Clinical foot and ankle score	Pre operative		3 months		6 months		1 year	
	N	%	N	%	N	%	N	%
80	0	0	2	4.76	0	0	0	0
90	0	0	13	30.95	2	4.76	0	0
100	42	100	27	64.29	35	83.33	26	100

Total 8 patient's foot prints were taken to assess the arch of foot, out of 8 patient 1 patient had slight loss of arch of foot with no functional impairment was found. For rest patient there was no change in arch of foot. Representative of footprints of 3 patients are as below figures.

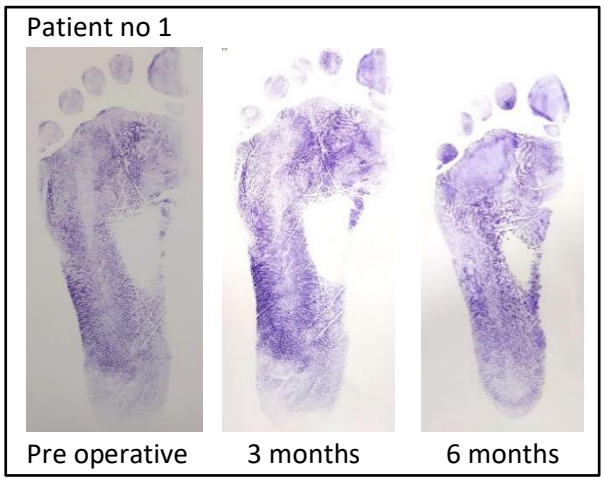

Figure 1: Representative of footprints of 3 patients

5. Discussion

The ACL is one of the most commonly damaged knee joint structures, with 1.5 percent to 1.7 percent primary ACL cases per year in the general population. Surgical reconstruction using a commonly derived graft from the patient's muscle (autograft) has become a standard treatment for preserving the knee's function and stability after an ACL injury. The most common surgery for restoring an injured ACL is ACL reconstruction, which involves the placement of graft material. [14] The goal of surgical reconstruction is to restore the mechanical properties of the knee so that the patient can resume an active lifestyle. [15]

For reconstruction of an ACL rupture, many graft options exist; the most commonly described and used techniques for index procedures are bone–patellar–bone autograft and quadrupled, or four - strand, hamstring autograft. However, despite having the longest history of use, bone–patellar–bone autograft can be complicated by anterior knee pain, particularly in patients who spend a lot of time on their knees due to their culture, job, or sport, and is less commonly associated with postoperative patella fracture, fat pad fibrosis, or patellar tendon contracture. [16] Alternative autografts for ACL reconstruction, such as the PLT, have been suggested in the literature. [9] Zhao JZ [12] et al discovered that the anterior half of PLT has sufficient length and strength to be used as an autograft in the reconstruction of the ACL. The removal of the entire PLT has no effect on gait or ankle stability, according to biomechanical and kinematic studies. [13]

In view of this the present study evaluated the dynamics of foot in patient undergoing ACL reconstruction with PLT. Total 42 patients of either gender undergoing ACL reconstruction using peroneus longus graft were included. The mean age of the patients was 32.24 ± 7.81. Majority of the patients i. e., 18 (42.86%) belonged to the age group of 31 to 40 years, with males to female ratio of 2.23: 1. Majority (66.67%) of patients only had ACL tear, followed by ACL tear with medial meniscus tear, ACL tear with lateral meniscus tear, and 1 patient each had ACL tear with medial collateral ligament tear, ACL tear with medial meniscus tear and lateral collateral ligament tear, ACL tear with posterior cruciate ligament tear, and 1 patient only with posterior cruciate ligament tear.

According to Kerimolu S [9], harvesting the PLT will have little to no effect on foot and ankle function. The IKDC scale classified 58.6 percent of those studied as normal or nearly normal, while 41.4 percent were classified as abnormal or severely abnormal. The average Lysholm score was 83.7 out of a possible 100, with 79.3 percent of cases scoring excellent or good. At the PLT donor site, 6.9 percent reported mild to moderate pressure pain, paresthesia, and dysesthesia. Similarly to the current study, no patient experienced ankle joint dysfunction or difficulty participating in athletic activities as a result of the PLT graft transfer.

Based on AOFAS and the Foot and Ankle Disability Index, the PLT graft was deemed superior because it provides a larger graft diameter, less thigh hypotrophy, and excellent ankle function (FADI). [14, 17] Rhatomy S [18] et al included fifty - two patients in their study, and the diameter of the PLT graft was significantly larger than the diameter of the hamstring. The mean for the AOFAS in the peroneus longus group was 97.3 ± 4.2 and for the FADI was 98 ± 3.4, with a significant decrease in thigh circumference in the hamstring group.

We in the present study evaluated the dynamics of the ankle and foot using clinical foot and ankle score and foot print among the patients underwent ACL reconstruction. The score pre - operatively was 100 in all the patients, which was at 3 months was consistent among 27 patients while declined to 90 among 13 (30.95%) and to 80 in 2 (4.76%)

patients. At 6 months, 5 patients lost follow up, and in remaining 37, the score was 100 in 35 (83.33%) and 90 in 2 (4.76%) patients, at 12 months among 26 (100%) followed up had score of 100. The pre - operative mean score was declined at 3 months, which then again improved at 6 months and was to 100% at 1 year follow - up.

Zhao JZ [12] et al reported the AOFAS score pre - and post - operation, which did not differ significantly from the current study findings of clinical foot and ankle score. Similarly to the current study, no evidence of peroneus nerve injury, peroneus longus tendon rupture, or tendinopathy was found. Angthong C [19] et al also demonstrated a greater drop in mean AOFAS scores from pre - operative to 6 months follow up, as the clinical foot and ankle score was reduced to 99.46 ± 2.26 in the current study. Peak torques of eversion and inversion on the harvested ankle were significantly lower than on the contralateral ankle at both velocities during a 7 - month follow - up by isokinetic testing.

Kumar R [20] et al measured and documented the diameter of the PLT graft intraoperatively in their study, and the mean diameter of the PLT graft was 8.55 0.73 mm. Thigh circumference was 44.77 ± 2.87 at the damage site and 45.95 ± 2.97 at the contralateral location at 10 cm from the top pole of the patella bone. Post - operative IKDC, modified Cincinnati, and Tegner - Lysholm scores improved significantly when compared to pre - operative scores. Cao HB et al [21] found significant differences in the Lysholm knee score and the KT - 3000 arthrometer evaluation, but not in the AOFAS score; their findings were similar to those of the current study.

Trung DT et al [22] studied patients with ACL and MCL injuries who underwent ACL reconstruction using the front half of a PLT autograft. According to their findings, the year average was 35.4 years, and the rate of ACL rupture associated with meniscus damage was 40%. Six months after surgery, Lysholm function scores increased from 59 to 94.27, but there was no difference between preoperative and postoperative AOFAS scores. As a result, the current study's findings were satisfactory, with no significant change in clinical foot and ankle scores before and after the procedure, as well as at the one - year follow - up. As a result, we recommend using a peroneus longus graft for ACL reconstruction because it has the least impact on foot and ankle dynamics.

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