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Comparative study of peroneus longus versus hamstring tendons autologus graft to assess the functional outcome of arthroscopic reconstruction of ACL

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Abstract

Introduction: Arthroscopic anterior cruciate ligament (ACL) reconstruction can be performed using autograft from various sources namely bone patellar tendon bone graft, hamstring graft, quadriceps tendon, or peroneus longus tendon. Purpose of this study was to compare the clinical outcome and donor site morbidity of ACL reconstruction with peroneus longus tendon versus hamstring tendon autograft in patients with ACL tear.

Methods: Patients with ACL tear were divided into Peroneus and Hamstring group by systematic random sampling.Functional score (IKDC score and AOFAS score) was taken at 6 months post-operatively. Graft diameter was measured intra-operatively. Donor site morbidity was assessed with AOFAS Score.

Results: 61 patients (30-Hamstring and 31-peroneus group) met the inclusion criteria. The mean Peroneus longus graft diameter (9.03mm) was significantly larger than the Hamstring graft diameter (8.43mm). In terms of 6 months postoperative outcomes statistically there is very little comparable difference between both these grafts when used for arthroscopic ACL reconstruction.

Conclusion: Our study we found peroneus longus graft was equivalent to hamstring tendons graft in terms of functional score (IKDC score). Peroneus longus graft had larger graft diameter, and excellent ankle function based on AOFAS score.

Abbreviations:

ACL- Anterior cruciate ligament

BPTB- Bone-patellar tendon-bone

IKDC -International knee documentation committee

AOFAS-American Orthopaedic Foot and Ankle Society score

Keywords: ACL reconstruction, acl graft comparison, peroneus longus graft, hamstring tendon graft

Introduction

Biomechanics is key to the function, stability and ageing process of joints. Knee is a complex joint and it's stability and motion are mainly controlled by ligaments such as the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL).

ACL provides stability against anterior tibial translation and internal rotation. Anterior cruciate ligament injuries are common in athletes .Approximately 70% of ACL injuries are caused by sports[1].It predispose towards meniscal and cartilage lesions and if left untreated may evolve to arthrosis.

A typical mechanism of injury is deceleration with twisting, pivoting, or a change of direction. Wilk et al. estimated that at least 60% of all ACL injuries sustained by athletes are due to a non-contact mechanism of injury[2].

The most common mechanism for an ACL injury is a valgus stress with tibial external rotation at the knee joint with the knee flexed [3].

Other common mechanism is a combination of internal rotation and varus strain with the knee flexed, typically occurring when the tibia is unable to move[3].

Arthroscopic ACL reconstruction using autograft is treatment of choice. There are mainly four types of grafts that can be used in ACL reconstruction which are BPBT graft , hamstring tendon graft (formed from the gracilis and semitendinosus tendons), quadriceps tendon graft, and peroneus longus tendon graft .

ACL reconstruction improves knee stability and function with many graft types, either autografts or allografts[(4,5)]. An ideal graft donor should have acceptable strength, and of adequate size, and can be easily and safely harvested.

Among these grafts, bone patellar tendon bone (BPTB) and four strand hamstring autografts are most common autografts used for ACL reconstruction and each has its advantages and disadvantages.

BPTB have a merit that bone to bone healing which permits the effective incorporation of tunnel and graft leading to a faster return to function and sports activity. Risk of patellar fracture, large incision, fixed length, and weaker than native ACL makes it less suitable for ACL reconstruction[(6,7,8)].

A hamstring autograft is easy to harvest with minimal donor site morbidity and strength that is comparable to native ACL. On the other hand, it has unpredictable graft size and potential decrease in hamstring power, which is crucial for some athlete who need dominant hamstring power[9].

Some orthopaedic surgeons are therefore attempting to use the peroneus longus tendon as a graft of choice.Due to non-involvement of knee joint peroneus longus tendon graft can be used for ACL reconstruction .Experts estimate that the peroneus longus tendon (PLT) has a muscle graft strength that is almost similar to the strength of the ACL so that it can be used for reconstruction[10]. Some previous case series reported using the peroneus longus tendon as the first choice for an autograft in ACL reconstruction, with good clinical outcome and minimal donor site morbidity[(11,12)].

Objectives

This study is to compare the functional outcome and donor site morbidities of ACL reconstruction using hamstring tendon autologous graft and peroneus longus tendon autologous graft.

IKDC score and AOFAS score is used in this study.

Method And Materials

This study is a prospective study of ACL reconstruction patients from December 2020 to December 2022 including a follow-up period of minimum six months. Once patient diagnosed with ACL tear and met inclusion

criteria given below was included in the study with their consent. A total of 61 patients underwent the ACL reconstruction during the given period.31 patients in peroneus group and 30 patients of hamstring group were randomly chosen according to systematic random sampling.

Inclusion Criteria

1. Complete ACL tear both acute and chronic with or without meniscal tear
2. Symptomatic instability of the knee joint
3. Age group 18 to 50 years both male and female

Exclusion Criteria

1. Bony avulsion of tibial spine with ACL attachment
2. ACL tear with posterior cruciate ligament(PCL) tear
3. ACL tear with collateral ligament tear
4. Neuromuscular disorder
5. Osteoarthritis of knee joint
6. Revision surgery
7. Deformed or stiff knee
8. Posterolateral Knee Instability (Dial Test Positive)
9. ACL tear with compound knee injury
10. Patient having any Ankle, foot and hip joint abnormality

A detailed clinical history of the patient about mode of injury, time of injury, presenting complaints, past history, surgical history and personal history was taken and documented. A complete general physical examination including gait analysis was done. Clinical evaluation of patients was done in an outpatient clinic first and reassessment was done under anaesthesia prior to surgery.

Normal extremity was examined first to gain the patient's confidence and to know patient's normal ligamentous tightness. Various clinical test eg. Lachman test, Anterior drawer, pivot shift, posterior drawer, dial test, Mcmurray tests were performed and noted.

MRI findings were analysed with clinical and diagnostic arthroscopy findings later during procedure.

Planning for Surgery

Once patient diagnosed with ACL tear by clinical and radiological findings, informed consent was taken yet to be part of study. Routine pre-operative blood investigations like hemogram, renal and liver function tests, serum electrolytes, random blood sugar, chest radiograph and an electrocardiograph were ordered and the patient reviewed with the anaesthetist along with reports for pre anaesthetic check-up.

The questionnaire for IKDC, and AOFAS score were initially handed over to the patient to fill up. On most occasions, patients were not able to understand English and the terms mentioned therein, so we helped them fill the form by translating it into Hindi or their regional language.

The postoperative evaluation was performed 6 months after the surgery.

Arthroscopic Technique

A single senior knee surgeon performed all the procedures. The patients lay in a supine position under regional anaesthesia and a tourniquet was applied to the thigh and inflated after elevation and exsanguination. Standard anterolateral and anteromedial portals were used. Diagnostic arthroscopy for ACL rupture was performed, followed by graft harvesting of either the ipsilateral peroneus longus or the hamstring tendon.

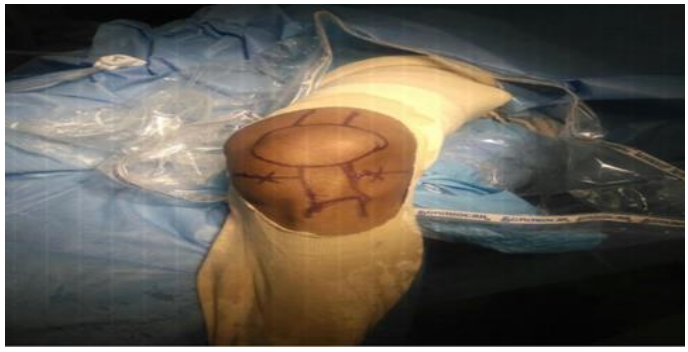

Figure 1: Skin Marking for Ports

Hamstring graft harvesting: An oblique incision is given tangential to Hamstring tendons, positioned proximal and medial to the insertion of the pes anserinus to avoid injury to infrapatellar branch of the saphenous nerve. After the tendons have been positively identified, tendon is released from its tibial insertion. Release the tendon proximally by controlled tension on the tendon, while advancing the stripper proximally, followed by graft preparation**.**

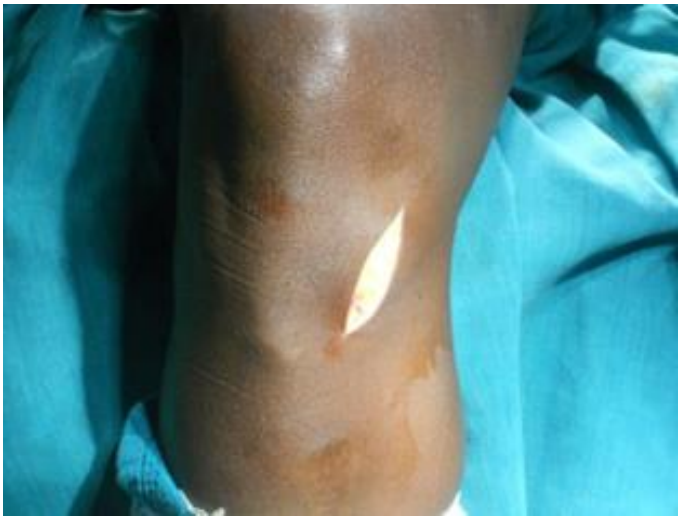

Figure 2: Skin incision for Hamstring Graft

Figure 3: Hamstring tendons identified

Peroneus graft harvesting; For the peroneus tendon, the location of the skin incision was marked, 2–3 cm above and 1 cm behind the lateral malleolus. The incision was made through the skin, subcutaneous tissue and superficial fascia. The peroneus longus and peroneus brevis tendons were identified. The location of the tendon division was marked, 2–3 cm above the level of the lateral malleolus. The distal part of the peroneus longus tendon to the peroneus brevis tendon was sutured with end-to-side sutures. The peroneus longus tendon was stripped proximally with a tendon stripper to about 4–5 cm from the fibular head to prevent peroneal nerve injury.

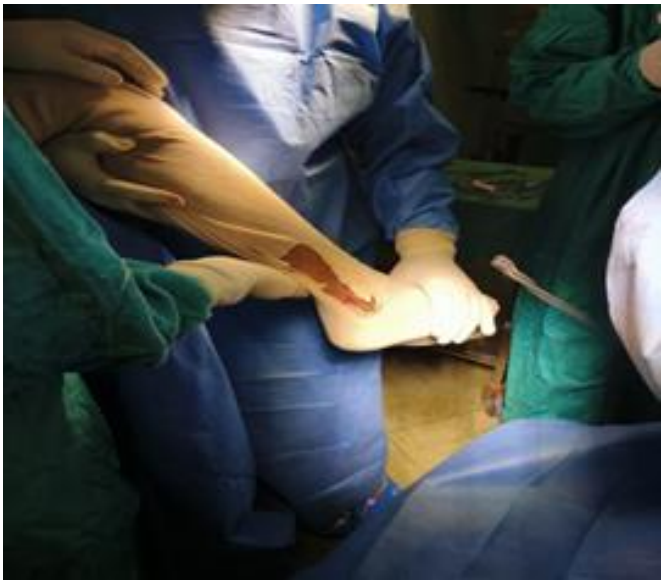

Figure 4: Incision for peroneus graft

Figure 5: Peroneus longus graft harvest

Tibial and femoral tunnel preparation; The intercondylar notch was then cleared of fibrous tissue to ease visualisation during preparation of the tunnels, but some remaining ACL fibres were preserved as a reference for tunnel placement. The femoral tunnel and the tibial tunnel were then prepared independently. After drilling the tunnels, we proceeded with the implantation of the tendon with graft fixation on the femoral side with a button and graft fixation on the tibial side with a bioabsorbable screw after appropriate tensioning by cycling manoeuvre**.**

Figure 6: Femoral tunnel preparation

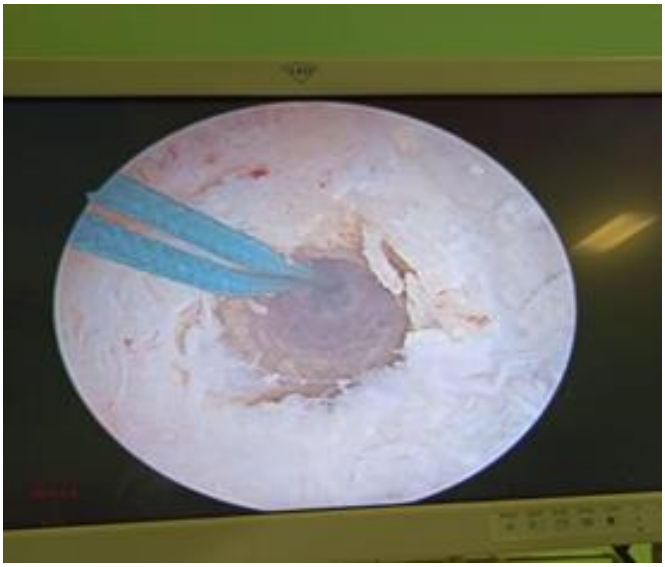

Figure 7: Femoral tunnel

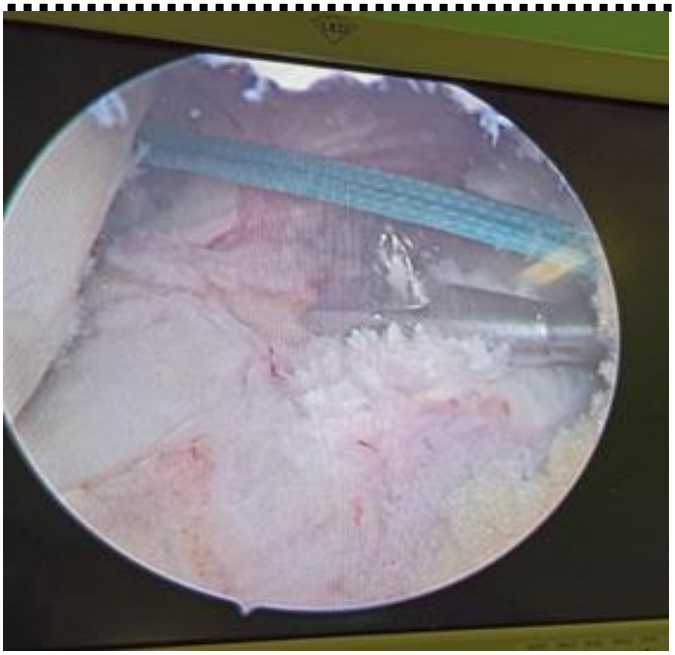

Figure 8: Tibial tunnel preparation

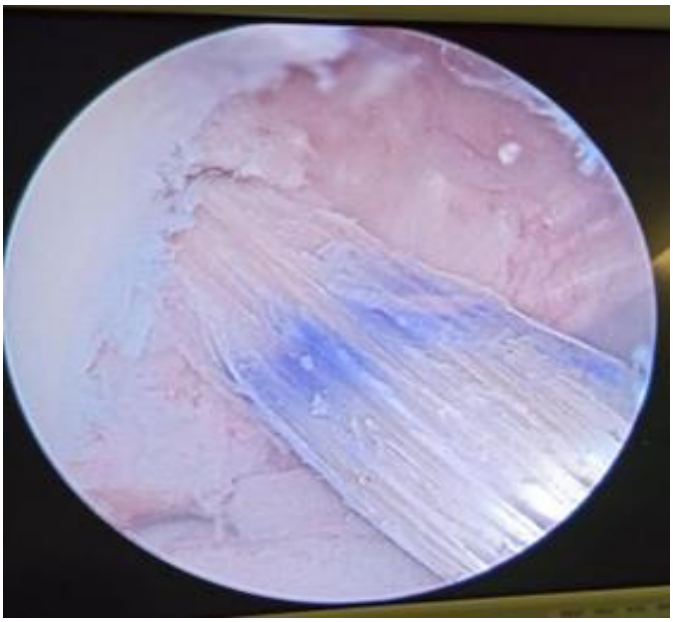

Figure 9: Fixation of graft

Statistical analysis

A sample size calculation was performed using the Lemeshow method, as shown below. $n = (z/\Delta)2\ \ p(1-p)$. The proportion of patients with an ACL rupture (p) was found to be around 8% in our study population. With 95% CI and a precision level of 10%, the calculation was $(1.96)2 \times 0.08 \times (0.92)/(0.1)2 = 28$. At least 28 patients were needed in each group to be included in this study.

The outcomes of continuous measurements (IKDC score and AOFAS score) were compared between the two groups using the Mann–Whitney U test. Statistical significance was accepted at $p < 0.05$.

Results

During the study period, 61 patients underwent single-bundle ACL reconstruction. Out of all patients, 30 patients in the hamstring group and 31 patients in the peroneus longus group. The mean age of all patients was 30.15 years. Majority were males 58, and 3 were females. There is a significant difference between duration of injury and procedure done. A duration of <3 months between injury and procedure done was found in 27 patients, while 34 patients were having a history of >3 months. Right side was affected in 46 patients and the left side was involved in 15 patients. There was wide variation in mechanism of injury causing ACL tear among patients, most common being Sports activity accounting for 26 cases, RTA 25 cases.

Table 1: Distribution of cases according to Age and Gender

Age Group	Sex				Total	
	Male		Female			
	No.	%	No.	%	No.	%
20–30	34	58.62	1	33.33	35	57.38
31–40	21	36.21	1	33.33	22	36.07
≥ 41	3	5.17	1	33.33	4	6.56
Total	58		3		61	
Mean	29.81		36.67		30.15	
SD	7.83		6.11		7.86	
Range	20-44		38-42		20-44	

In our study males were more vulnerable than females for ACL injury. There were 95.08% males and 4.92% females. Mean ± SD of males were 29.81±7.83 and females were 36.67±6.11.

Table 2: Distribution of cases according to occupation

Occupation	Peroneus longus		Hamstring		Total	
	No.	%	No.	%	No.	%
Student	12	38.71	14	46.67	26	42.62
Farmer	6	19.35	7	23.33	13	21.31
Housewife	2	6.45	0	0.00	2	3.28
Shopkeeper	1	3.23	3	10.00	4	6.56
BSF	2	6.45	1	3.33	3	4.92
Others	8	25.81	5	16.67	13	21.31
Total	31		30		61	

In our study, maximum patients were students 26(42.62%) followed by farmer 13(21.31%) and others.

Table 3: Mode of Injury

Mode of injury	Peroneus longus		Hamstrings tendons		Total	%
	No.	%	No.	%		
Fall from height	2	6.45	5	16.66	7	11.48
Fall from stairs	2	6.45	0	-	2	3.28
Field work	1	3.23	0	-	1	1.64
RTA	16	51.61	9	30.00	25	40.98
Sports	10	32.26	16	53.34	26	42.62
Total	31		30		61	

In our study most vulnerable mode of injury of the ACL was sports with 42.62% followed by RTA 40.98%. Both groups are comparable regarding mode of injury.

Table 4: Thickness of prepared Graft

Auto-graft Length (In mm)	No. of patients			
	Peroneus longus		Hamstrings tendons	
	No.	%	No.	%
7	0	–	3	10.00
7.5	0	–	3	10.00
8	3	9.68	8	26.66
8.5	6	19.5	2	6.66

9	10	32.26	10	33.33
9.5	10	32.26	3	10.00
10	2	6.45	1	3.33
Total	31		30	
Mean	9.03		8.43	
SD	0.54		0.81	
P value	0.02			

Minimum thickness of graft was 7mm in 3 patients of total study population. Maximum thickness of graft 10mm in 3 patients of total study population. The Mean ± SD of thickness of graft was 9.59±0.54 in peroneus group and 8.43±0.81 in hamstring group. P value was 0.02 statistically significant.

Table 5: Lachman Test (Post operative)

	No. of patients			
	Peroneus longus		Hamstrings tendons	
Grading	No.	%	No.	%
Absent / Negative	25	80.65	23	76.66
1+	6	19.35	7	23.34
2+	0	-	0	-
3+	0	-	0	-
Total	31		30	

In our study, after surgery 25 (80.65%) patients had negative Lachman test in Peroneus group and 6 (19.35%) cases had 1+ Lachman test. In Hamstring gorup 23 (76.66%) patients were having negative Lachman test while 7(23.44%) were having 1+ Lachman test. In both group no patients have found 2+ and 3+ Lachman test.

Table 6: Anterior Drawer test (Post operative)

	No. of patients			
	Peroneus longus		Hamstrings tendons	
Grading	No.	%	No.	%
Negative	28	90.32	28	93.33
1+	3	9.68	2	6.67
2+	0	-	0	-
3+	0	-	0	-
Total	31		30	

Anterior Drawer test (Post operative) amongst study population. After surgery 28 (90.32%) patients of peroneus group were having negative anterior drawer test while 3 (9.68%) patients were having 1+. In hamstring group 28 (93.33%) were having negative anterior drawer test followed by 2 (6.67%) patients of 1+ anterior drawer test.

Table 7: Pivot shift test (Post operative)

	No. of patients				p value
	Peroneus longus		Hamstrings tendons		
	No.	%	No.	%	
Negative	31	100	30	100	?
Positive	0	-	0	-	
Total	31		30		

In our study we found that 100% cases were negative for Pivot shift test in both groups.

Donor site morbidity of hamstring autografts

No patient was found with infection. At 6 months post-operatively knee effusion was complained by 4 cases which was resolved by rest and knee cap support in hamstring group. 3 case of numbness in leg was found probably due to infrapatellar branch of saphenous nerve injury managed with neurotropics.

Donor site morbidity of peroneus longus autografts

For the evaluation of donor site morbidity for peroneus longus tendon autografts, assessments of the functional score for the ankle using AOFAS scores was performed. Out of which 26 patients were excellent grading and 5 were good. No patient showed fair and poor grade.

Knee stiffness was noticed in 1 patient of hamstring group which was mobilised under general anaesthesia.

Table 8: IKDC score (Post–operative)

Post operative IKDC Scoring	Peroneus Longus		Hamstring		Total	
	No.	%	No.	%	No.	%
Normal (≥90)	18	58.06	9	30.00	27	44.26
Near normal (76–89)	13	41.94	21	70.00	34	55.74
Abnormal	0	-	0	-	0	-

(50–75)						
Severely abnormal (<50)	0	-	0	-	0	
Total	31		30		61	

	Peroneus Longus	Hamstring tendon	Total
IKDC subjective score	88.51±5.14	86.6±4.76	87.57±5.01

IKDC score was Normal (>90) in 18 cases, Near normal (76-89) in 13 cases of PL group. While 9 cases were Normal (>90) and 21 cases were Near normal (76-89) in Hamstring group.Zero case of Abnormal and severely abnormal reported in both groups.In our study, mean IKDC score in Peroneus longus was 88.51±5.14, in Hamstring tendons group was 86.6±4.76 and 87.57±5.01 in total study population.

Table 9: Post operative AOFAS score

Post operative AOFAS scoring	Peroneus Longus		Hamstring		Total	
	No.	%	No.	%	No.	%
Excellent (95–100)	26	83.87	24	80	50	81.97
Good (75–94)	5	16.13	6	20	11	18.03
Fair (51–74)	0	-	0	-	0	-
Poor (0–50)	0	-	0	-	0	-
Total	31		30		61	

In our study, 26 (83.87%) patients of peroneus group scored excellent while 5 (16.13%) patients scored good. In hamstring group 24 (80%) patients scored excellent while 6 (20%) patients scored good AOFAS score.

Figure 10: Postoperative X ray

Figure 11 : Clinical photo showing patient's ability to squat & full ROM at knee.

Discussion

Rupture of the ACL impairs the stability of the knee, resulting in difficulty with athletic performance, increases risk of subsequent meniscal injury, and increased risk of early degenerative joint disease. ACL rupture more commonly occurs during sports injuries, or during road traffic accidents. Forceful valgus-external Rotation is the most common mechanism of injury. ACL injury is more common in males and younger age Autograft choice is one of the most important considerations during ACL reconstruction surgery of the knee. Bone-patellar tendon bone complex, hamstring tendon autografts, and peroneus

longus autograft are commonly used as the graft sources. The BPTB graft is considered as a gold standard for ACL reconstruction because of its strength, consistency of the size of the graft, ease of harvesting and most importantly because of bone-to-bone healing within the tibial and femoral tunnel. 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. 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.

Peroneus longus can be used as an alternative to hamstring autograft as biomechanically PLT is strong as native ACL. It is easy to harvest as it is superficially located, the peroneus longus tendon can be exposed quickly as to the semitendinosus tendons. Also, there aren`t many

Complications related to the structures around the peroneus longus tendon as compared to the hamstring tendons which makes it easier for one to harvest the graft. There is no effect on ankle eversion power as peroneus brevis tendon is left in-situ which is strong evertor of ankle in comparison to peroneus longus. Furthermore we tenodessed peroneus longus stump with peroneus brevis tendon.

In the operated ankle, MRC grading of flexion/extension, inversion/ eversion, and rotation of ankle were grade 5. In this study we 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.

Difference in graft diameter between the hamstring and peroneus longus tendons was significant (p=0.02). Most of ACL injury were reported due to sports activity, road traffic accidents, knee twisting injury by slip and fall. Patients met with road traffic accidents had multiple associated injuries. Incidence trends in male and female patients may potentially reflect difference in sports participation and probability of more prevalence of road traffic accidents and outdoor activity among males. Patients who reported late showed higher incidence of cartilage erosion and meniscal tear. This indicate that a longer duration of torn ACL produces strain over other structures of knee causing meniscal tear, cartilage erosions and evolve to arthrosis.

Lachman test, Anterior drawer's tests and Pivot shift test were used for stability testings. All patients showed excellent knee stability intra-op, and 6 months postoperatively. On 6 months follow-up only 6 cases out of 31 cases of peroneus group reported grade 1+ translation on Lachman`s test while hamstring group showed 7 cases out of 30 cases. On 6 months postoperatively only 3 cases out of 31 cases of peroneus group reported grade 1+ translation on Anterior drawer test while hamstring group showed 2 cases out of 30 cases.

There was only a minor difference in the number and the distribution of grading of instability in both groups.

Hypoesthesia in infrapatellar area is a complication of knee arthroscopy which is caused by injury to infra patellar branch of saphenous nerve (IPBSN) during hamstring graft harvesting or tibial tunnel drilling. Donor site morbidity in 3 patient using hamstring grafts as hypoesthesia caused by injury to the infrapatellar branch

of the saphenous nerve was noted while in peroneus group it was 1 probably due to tibial tunnel drilling .

We used IKDC score for post-op subjective assessment of knee stability and functioning. Mean IKDC score in PL group was 88.51 and in hamstring group was 86.6 at 6 months post-operatively.

With the result of this study, the use of the peroneus longus as the graft of choice in single-bundle ACL reconstruction can be encouraged in clinical practice, because it shows comparable functional scores compared the peroneus graft.

Conclusion

In this Hospital based prospective comparative randomized interventional study for Single-bundle ACL reconstruction, Peroneus longus tendon autografts found equivalent to Hamstring autografts in term of excellent functional outcome (IKDC & AOFAS score), knee stability (Lachman & Anterior Drawer test) and showed good results to the four-strand hamstring tendon , with no donor site morbidity.

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