

## COMPARATIVE STUDY OF SINGLE BUNDLE ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION USING THE PERONEUS LONGUS TENDON AUTOGRAFT VERSUS HAMSTRING TENDON AUTOGRAFT

<sup>1</sup>Dr. Pankaj Jain<sup>1</sup>, Dr. Rajesh Kumar Kushwaha<sup>1</sup>, Dr. Ahteshyam Khan<sup>1</sup>, Dr. Prashant Modi<sup>1</sup>, Dr. Hari Saini<sup>1</sup>

<sup>1</sup>Department of Orthopaedics, SMS Medical college, Jaipur, Rajasthan, India

**Article Info:** Received 20 July 2021; Accepted 29 August 2021

**DOI:** <https://doi.org/10.32553/ijmbs.v5i9.2188>

**Corresponding author:** Dr. Rajesh Kumar Kushwaha

**Conflict of interest:** No conflict of interest.

### Abstract

**Introduction:** Arthroscopic anterior cruciate ligament (ACL) reconstruction can be performed using autograft from various sources namely bone patellar tendon bone graft, hamstring graft, 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 an isolated ACL injury.

**Methods:** Patients who underwent isolated single bundle ACL reconstruction were allocated in peroneus and hamstring groups and observed prospectively. Functional score (IKDC, & Modified Cincinnati score) was recorded preoperatively and 1 year post-operatively. Graft diameter was measured intra-operatively. Donor site morbidity were assessed with thigh circumference measurements and ankle scoring by MRC grading and FADI Score.

**Results:** 56 patients (28-Hamstring and 28-peroneus group) met the inclusion criteria. The average Peroneus longus graft diameter ( $8.8 \pm 0.8$ ) was significantly larger than the Hamstring graft diameter ( $8.1 \pm 0.9$ ). In terms of 1-year postoperative outcomes statistically there is very little comparable difference between both these grafts when used for arthroscopic ACL reconstruction.

**Conclusion:** Our study brings forth the superior efficacy and quality of double stranded peroneus longus tendon autograft in term of good functional score (IKDC, & Modified Cincinnati score), larger graft diameter, less thigh hypotrophy, and excellent ankle function based on FADI Score. Prospective cohort study, level II.

### Abbreviations:

ACL- Anterior cruciate ligament

BPTB- Bone-patellar tendon-bone

IKDC – International knee documentation committee

FADI- Foot and ankle disability index.

### Introduction

Biomechanics is one major key to the function, stability and aging process of joints. The knee is a major and complex joint. Its stability and motion are basically controlled by ligaments such as the anterior cruciate ligament (ACL). The main functional role of the ACL is to provide stability against anterior tibial translation and internal rotation. Anterior cruciate ligament (ACL) injuries are common in athletes, incapacitating for certain sports activities and predispose towards meniscal and cartilage lesions and if left untreated may evolve to arthrosis. The typical mechanism of injury is deceleration with twisting, pivoting, or a change of direction. It was estimated by Wilk *et al.* (1999) that at least 60% of all ACL

injuries sustained by athletes are due to a non-contact mechanism of injury. Perhaps the most common mechanism for sustaining an ACL injury is a valgus stress with tibial external rotation at the knee joint with the knee flexed (Ebstrup & Bojsen-Möller 2000, Natri 1996). This mechanism of ACL injury is especially common when the athlete lands from a jump (Wilk *et al.* 1999).

Another common mechanism is a combination of internal rotation and varus strain with the knee flexed, typically occurring when the tibia is unable to move, as in team handball players on high friction artificial turfs (Ebstrup & Bojsen-Möller 2000, Natri 1996). The incidence of ACL injury in general population is 1:3000. The knee is

essentially a hinged joint that is held together by the medial collateral, lateral collateral, anterior cruciate, and posterior cruciate ligaments. The ACL runs diagonally in the middle of the knee, preventing the tibia from sliding out in front of the femur, as well as rotational stability to the knee. ACL injury reconstruction has been done using silver wire, fascia lata, and Iliotibial band. Till present so many various techniques have been described for anterior cruciate ligament reconstruction from open procedure to arthroscopic procedure. In 1954, the development of successful arthroscope has led to new possibilities to the field of knee surgery. Since 1982, the Anterior Cruciate ligament reconstruction is performed arthroscopically often. Arthroscopic reconstruction of ACL has several advantages such as it is minimally invasive, it has higher accuracy of placement of the graft, less disturbance of normal surrounding tissue leading to faster recovery and rehabilitation, less stay in the hospital and minimum infections in the post-operative phase.

ACL reconstruction improves knee stability and function with many graft types, either autografts or allografts<sup>(1,2)</sup>. 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<sup>(3,4,5)</sup>.

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<sup>(6)</sup>. Some orthopaedic surgeons are therefore attempting to use the peroneus longus tendon as a graft of choice.

Peroneus longus tendon autografts are commonly used in some orthopaedic procedures, including, Deltoid ligament Reconstruction<sup>(7)</sup>, spring ligament Reconstruction<sup>(8)</sup>, and medial patellofemoral ligament reconstruction<sup>(9)</sup>. There is synergistic action of peroneus longus and peroneus brevis for everting the ankle. Some studies have even found that the peroneus brevis is a more effective evertor of the ankle, justifying the harvest of Peroneus longus tendon<sup>(10)</sup>.

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<sup>(11,12)</sup>, while other studies did not agree, due to donor site morbidity<sup>(13)</sup>.

There is high risk of graft failure and revision surgery if we use a less graft diameter. Decreased hamstring autograft size and decreased patient age are predictors of early graft revision. Use of hamstring autografts 8 mm in diameter or less in patients aged under 20 years is associated with higher revision rates<sup>(14,15,16)</sup>.

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<sup>(11,12)</sup>, while other studies did not agree, due to donor site morbidity<sup>(13)</sup>.

There is high risk of graft failure and revision surgery if we use a less graft diameter. Decreased hamstring autograft size and decreased patient age are predictors of early graft revision. Use of hamstring autografts 8 mm in diameter or less in patients aged under 20 years is associated with higher revision rates<sup>(14,15,16)</sup>.

Autograft shows moderate superiority compared with allograft, Allograft shows higher failure rate and higher risk of infection.<sup>(17)</sup> With the same cross-sectional surface area, there is no significant difference in tensile strength between the peroneus longus (446.1 ± 233.2) and a four-strand hamstring (405.8 ± 202.9). Other biomechanical studies reported that the ultimate tensile strength of the peroneus longus tendon was 2500 N, while the ultimate tensile strength of the native ACL was 1725 N<sup>(18)</sup>.

The amount of initial ligament damage is a statistically significant predictive factor of evolution into a complete tear. In a study by Bak *et al.*,<sup>(19)</sup> only 30% of patients with partial ACL tears were able to return to the pre-injury level of sporting activity at 5 years follow-up, whereas Buckley *et al.*<sup>(20)</sup> in their study have reported 44% return to pre-injury level of sports in 18 months.

Use of peroneus longus tendon autograft is a recent development in the field of ACL reconstruction. The advantages are its strength and mean thickness is nearly same as that of native ACL and is very easy to harvest. Removing of PLT has no effect on stability of ankle. Zhao and Huangfu found that the anterior half of peroneus longus tendon has appropriate length and appropriate strength to be of use in reconstruction of ACL. Results after two years of followup when using the anterior half of the peroneus longus tendon have been found satisfactory, however there doesn't seem to be any direct comparison of the functional outcomes between anterior half of the peroneus longus tendon and hamstring tendon. Studying the biomechanical and kinematic aspects of removing the entire peroneus longus tendon has revealed no effect on gait or stability of the ankle.

#### **OBJECTIVE**

The purpose of this study is to compare the functional outcome between the peroneus longus and hamstring tendon autograft in ACL reconstruction. If a peroneus longus autograft does in fact show a comparable functional outcome with less donor site morbidity

compared with hamstring tendon, its use as the graft of choice in single bundle ACL reconstruction can be encouraged in clinical practice, especially in the group of patients in whom dominant hamstring power is needed or the group of patients who frequently kneel as part of their daily religious activity, where any anterior kneeling pain could not be tolerated.

#### **MATERIAL AND METHODS**

This study is a prospective observational study of a consecutive study series of ACL reconstruction patients. The diagnosis of ACL rupture was established and the patients gave their informed consent to be included in this study. Sample size was calculated 28 cases in each of two group at  $\alpha$  error 0.05 and power 80%. Expecting minimum difference of mean to be detected in graft diameter after peroneus longus autograft and hamstring autograft 0.6 mm with SD 0.8. Total fifty-six patients underwent single-bundle ACL reconstruction from November 2018 to October 2020. Patients who attend Department of Orthopaedics in SMS Hospital, Jaipur and attached hospitals with ACL tear were allocated in hamstring and peroneus group randomly according to simple chit box method.

#### **INCLUSION CRITERIA**

Patients between age group of 18 to 45 years presenting with complaint of knee joint pain, swelling, and joint instability having previous history of knee joint trauma during walking or other sport activity.

1. Willingness to participate in an investigational technique and follow-up with written consent.
2. Willingness to forgo any other concomitant conservative treatment modality; NSAIDs and orthotic devices during the study period.

#### **EXCLUSION CRITERIA**

1. Previous surgery for knee joint or around knee joint fracture/pathology.
2. Patients having any peripheral vascular disease of lower limb.
3. ACL tear associated with other knee joint ligament, menisci or tendon injury.
4. Any knee joint anatomical or pathological abnormality other than ACL tear.
5. Patient having ankle joint, foot or hip joint abnormality.

A detailed clinical history of the patient regarding mode of injury, time of injury, presenting complaints, past medical and surgical history and personal history was taken and documented. A knee effusion usually develops over the next 24 hours.

A complete general physical examination including gait analysis was done. Clinical evaluation of patients was done on an outpatient clinic first and reassessment was done under anaesthesia prior to surgery.

#### **Local examination**

The opposite, normal extremity was examined initially to gain the patient's confidence and to establish a baseline of

the patient's normal ligamentous tightness. The results of Lachman, anterior drawer and pivot shift tests were noted by surgeons independently. The patients with equivocal findings clinically at the outpatient clinic.

#### **Imaging**

Subsequently patients were subjected to MRI examination. A group of radiologists, who were unaware of clinical details, analyzed the status of ACL on MRI and reached a report in consensus.

#### **Preparation for Surgery**

Once the diagnosis of ACL tear was suspected by clinical and radiological findings, informed consent was taken to be a part of study and patient was counseled and advised to undergo surgery for ACL reconstruction. 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 anesthetic check up.

Pre-operative Modified Cincinnati score and IKDC Score

The patient was given the schedule of our study and an informed consent was taken for their willingness to participate in our study and agreement to come for follow up. The questionnaire for IKDC, and Modified Cincinnati scoring 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 patient was planned for surgery.

The postoperative evaluation was performed 1 year after the surgery to give the patient enough time to complete the rehabilitation protocol and return to sports activity, as well as being likely to obtain peak function after an ACL injury.

#### **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.

Hamstring graft harvesting;

After the tendons have been positively identified, semitendinosus 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.

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.

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 maneuver.

#### 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, modified Cincinnati and Lysholm scores) 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 an isolated single-bundle ACL reconstruction. Five patients were excluded because of the presence of a concomitant injury to the meniscus/cartilage or refusal to participate in this study. 56 patients met the inclusion criteria, 28 patients in the hamstring group and 28 patients in the peroneus longus group. The demographic data of the study population are shown in Table 1&2.

The mean age in PL graft people is 28.86 years and in STG graft is 26.6 years. Majority were males 51, and 5 were females.

There is significant difference between duration of injury and procedure done. A duration of <3 month between injury and procedure done was found in 40 patients, while 16 out of 56 patients were having a history of >3 months. Right side was affected in 33 patients and left side was involved in 23 patients.

There was wide variation in mechanism of injury causing ACL tear among patients, most common being Activity of daily living accounting for 29 cases, sports 21 cases and Road traffic accident 6 cases.

**Table 1: Demographic data of study population**

Variable	PL Grafts	STG Grafts	P-value
Age	28.86±7.39 years	26.60±8.34 years	0.027
Gender	Male: 25, Female : 3	Male: 26, Female : 2	n.s
Mechanism of injury	ADL: 14, RTA: 4, SPORTS:10	ADL: 15, RTA: 2, SPORTS:11	0.06
Duration between injury and procedure	<3 months: 22, ≥3 months: 6	<3 months: 18, ≥3 months: 10	0.029
Side affected	Left: 15, Right: 13	Left: 8, Right: 20	n.s

#### Graft diameter

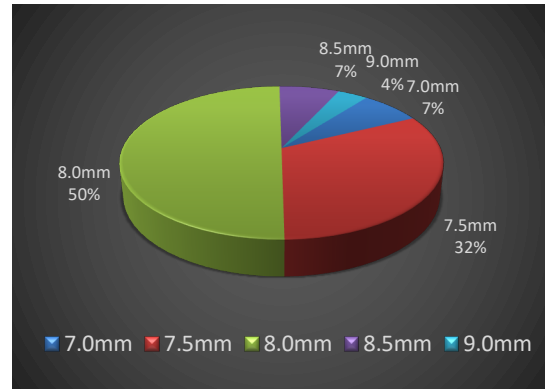
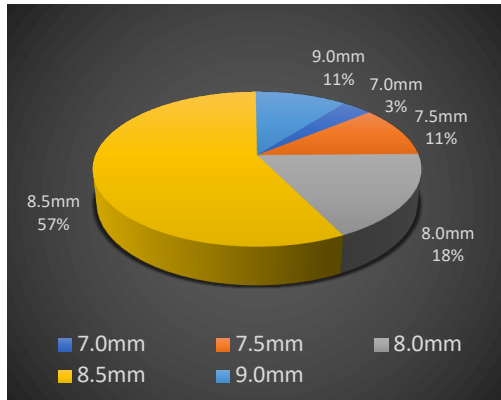
Intraoperatively, the diameter of the graft was measured and recorded and the result shows that the mean diameter of the peroneus longus graft ( $8.8 \pm 0.8$  mm, range 8–10 mm) was significantly larger than that of the hamstring tendon ( $8.1 \pm 0.9$  mm, range 7–9 mm) ( $p = 0.011$ ), with a mean difference of 0.7 mm, as shown in Table 3.

**Table 2: Diameter of graft**

Thickness of graft(mm)	Peroneus group		Hamstring group	
	Number of patients	Percentage (%)	Number of patients	Percentage (%)
7.0	1	3.5	2	7.2
7.5	3	10.7	9	32.1
8.0	5	17.9	14	50.0
8.5	16	57.2	2	7.2
9.0	3	10.7	1	3.5

**Table 3: Comparison of graft diameter**

Graft	mean (mm)	Mean difference (mm)	95% CI	p value
Hamstring	8.1±0.9	0.7	(-0.8)-(-0.1)	0.011
Peroneus	8.8±0.8			



**Table 4: Functional outcome of the Peroneus longus group**

		Mean	Mean difference	95%CI	p value
IKDC	Preoperative	58.4±4.84	33.9±23.9	(-39.5)-(-27.8)	0.0016
	1year post op	92.3±2.68			
Modified cincinnati	Preoperative	66.9±4.16	25.9±18.3	(-32.9)-(-19.7)	0.018
	1year post op	92.8±1.24			

**Table 5: Functional outcome of the Hamstring group**

		Mean	Mean difference	95%CI	p value
IKDC	Preoperative	56.5±5.88	33.6±23.8	(-37.5)-(-24)	0.041
	1year post op	90.1±4.21			
Modified cincinnati	Preoperative	66.1±4.56	21.4±15.1	(-26.9)-(-14.9)	0.009
	1year post op	87.5±2.38			

**Table 6: Comparison of Functional outcome of the Peroneus and Hamstring**

Preoperative score			Preoperative versus Post-operative score		
Score	Graft	Mean	P value	Mean difference	P value
IKDC	Hamstring	56.5±5.88	n.s	33.6±23.8	n.s
	Peroneus longus	58.4±4.84	n.s	33.9±23.9	n.s
Modified cincinnati	Hamstring	66.1±4.56	n.s	21.4±15.1	n.s
	Peroneus longus	66.9±4.16	n.s	25.9±18.3	n.s

Manual Lachman and anterior drawer's tests were used for stability testings. On Lachmann's translation majority of patients were showing good knee stability and autograft strength in term of displacement 0-2 mm in 26 cases of PL group and 25 cases of STG group, while 3-5 mm translation was noted in 2 cases of PL group and 3 cases of STG group.

**Table 7: Lachman's translation test preop v/s post op**

Lachmans translation		PL group		STG group	
		Pre-op	Post-op	Pre-op	Post-op
A	<b>0-2mm</b>	7	26	9	25
B	<b>3-5mm</b>	15	2	12	3
C	<b>6-8mm</b>	4	0	6	0
D	<b>9-10mm</b>	2	0	1	0

At one year post-operatively knee effusion was complained by 1 case from both groups after a long time walking or sport activity which was resolved by rest and knee cap support.

**Table 8: Post-operative knee effusion after 1 year**

Effusion 1 yr	PL Grafts		STG Grafts	
	N	%	N	%
(A) None	27	96.4%	27	96.4%
(B) Mild	1	3.6%	1	3.6%

#### Donor site morbidity of hamstring autografts

In the peroneus longus tendon group, no patients had thigh hypotrophy of more than 20 mm, only one patient had thigh hypotrophy of 20 mm and four patients had thigh hypotrophy of 10 mm. Thigh hypotrophy was significantly greater in the hamstring tendon group 1 year after the surgery ( $p = 0.002$ ). The hamstring group showed a mean decrease in donor thigh circumference of  $11.4 \pm 3.6$  mm, compared with the peroneus longus group, with a mean thigh circumference difference of  $2.5 \pm 0.5$  mm.

Apart from the thigh circumference, an evaluation of the other potential donor site morbidities was also performed and it found that six patients (21.4%) complained of anterior kneeling pain.

#### 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 FADI scores was performed and the mean FADI score was  $98 \pm 3.4$  (85.6–100).

**Table 9: Thigh circumference**

Thigh hypotrophy	PL Grafts		STG Grafts	
	N	%	N	%
<10 mm	19	68%	12	42%
10-20 mm	9	32%	8	29%
>20 mm	-	0%	8	29%

Knee stiffness assessed by lack of extension and lack of flexion were also comparable in both groups. An extension loss of 3-5 degree or more was seen only in 1 case of PL and 2 cases of STG group. Flexion loss of 6-15 deg or more was seen only in 1 case of PL group and 2 case of STG group.

On performing Single leg Functional Hop test 23 cases out of 28 of PL group, and 21 cases out of 28 of STG group were able to perform >90% of functional hop test with accuracy.

**Table 10: Single leg functional hop test after 1 years**

Functional Hop Test- 1 Yr	Method			
	PL Grafts		STG Grafts	
	N	%	N	%
> 90%	23	82.1%	21	75.0%
76-89%	5	17.9%	7	25.0%

IKDC score was good (85-94) in majority of cases; 26 cases of PL group and 24 cases of STG group, while only 2 cases of PL group and 4 cases of STG reported a IKDC score 65-84 range category. Mean IKDC score was  $92.3 \pm 6.2$  in PL group and  $90.1 \pm 9.2$  in STG group.

**Table 11: IKDC subjective assessment**

I.K.D.C. Subjective Assessment -1 yr	Method		Total
	PL Grafts	STG Grafts	
(B) SCORE 85-94	26	24	50
	92.8%	85.7%	89.3%
(C) SCORE 65-84	2	4	6
	7.2%	14.3%	10.7%

## 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. Cases of Hamstring group also

had a thigh muscle hypotrophy of 10 mm or more while it was not found in peroneus group.

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 evtor of ankle in comparison to peroneus longus (21). Furthermore we tenodesed 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.

We found 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 group (25-35 year). Most of ACL injury were reported due to activity of daily living, knee twisting injury by slip and fall, jogging, running, sports activity and road traffic accidents. Patients met with road traffic accidents had multiple associated injuries. Difference in age specific

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 Irrespective of mode of trauma most of patients reported and operated within 3 months of injury. On 1 year follow up we found that these patients were having less complain and good knee functions as compare to patients who delayed surgery for more than 3 months. MRI study of the knee joint of 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.

Manual Lachman and anterior drawer's tests were used for stability testings. Patients operated with peroneus graft showed excellent knee stability intra-op, and 6 months postoperatively. On 6 months follow-up only 2 cases out of 28 cases of peroneus group reported 3-5 mm translation on Lachman's test. There was only a minor difference in the number and the distribution of grading of instability in both groups.

Knee stiffness in term of lack of extension and lack of flexion were also comparable in both groups. An extension loss of 3-5 degree or more was seen only in 1 case of PL and 2 cases of STG group. Flexion loss of 6-15 deg or more was seen only in 1 case of PL group and 2 case of STG group.

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. The infrapatellar branch of saphenous nerve emerged as fibers of the womb of the sartorius muscle, than it divide in one superior and one inferior branch, which present great variability in their path. Donor site morbidity in one patient using hamstring grafts as hypoesthesia caused by injury to the infrapatellar branch of the saphenous nerve was noted. The superior IBSN is at risk for iatrogenic injury with an accessory medial portal placed at 60° of knee flexion. Iatrogenic injury to this nerve can be avoided by doing arthrotomy for accessory medial portal placement at 110° knee flexion.<sup>(22)</sup>

We used IKDC score for post-op subjective assessment of knee stability and functioning. An IKDC score 86-95 is considered as excellent outcome. Mean IKDC score was 92.3±6.2 in PL group and 90.1±9.2 in STG group 1 year 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. Previous studies have concluded that a graft diameter of 8.5 mm had a 1.7% revision rate. Furthermore, the risk of a patient needing a revision ACL reconstruction was 0.82 times lower with every 0.5 mm increase in graft diameter between graft thicknesses of 7 mm and 9 mm<sup>(16)</sup>. Study found a significant positive correlation between a 1 mm increase in graft diameter, with a higher KOOS score and IKDC score, and a higher revision rate with graft sizes of less than 8 mm<sup>(12,14)</sup>. Rudy ME, Phatama KY (2017) reported that the ultimate tensile strength of the peroneus longus tendon was 2500 N, while the ultimate tensile strength of the native ACL was 1725 N<sup>(18)</sup>.

with the hamstring tendon with less donor site morbidity, especially in groups of patients who frequently kneel in their daily activities, as they do in our country. Results of our study clearly showed that both Peroneus longus and hamstring tendon grafts could effectively improve knee stability and functions after anterior cruciate ligament reconstruction. The peroneus longus autograft showed a better functional score at the 1-year follow up compared with the hamstring autograft.

## CONCLUSION

In this Hospital based prospective comparative randomized interventional study for Single-bundle ACL reconstruction, Peroneus longus tendon autografts found superior to Hamstring autografts in term of excellent functional outcome (IKDC & Modified Cincinnati Scores, Single leg functional Hop test ), more strong and thicker graft, knee stability (Lachmann's & Anterior Drawer test ) and showed good results to the four-strand hamstring tendon , with no donor site morbidity.

## Acknowledgements

My deepest gratitude to Dr.MC bansal, Dr. RL dayma, Dr. HL dhawan, Dr. Rakesh silayach, Dr. Varun chandoliya, Dr. ratan suthar, Dr. Ravindra saini. They were there at every step to guide and support me thanks for always being approachable.

**Ethical approval:** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the institutional ethics committee of SMS Medical college and attached hospitals under heading : 761/MC/EC/2020 Dated 15/10/2020.

## REFERENCES

1. Frank CB, Jackson DW (1997) The science of

- reconstruction of the anterior cruciate ligament. *J Bone Joint Surg Am* 79:1556–1576
2. Mohtadi NG, Chan DS, Dainty KN, Whelan DB (2011) Patellar tendon versus hamstring tendon autograft for anterior cruciate ligament rupture in adults. *Cochrane Database Syst Rev* 7(9):CD005960
  3. Adam F, Pape D, Schiel K, Steimer O, Kohn D, Rupp S (2004) Biomechanical properties of patellar and hamstring graft tibial fixation techniques in anterior cruciate ligament reconstruction. *Am J Sports Med* 32:71–78
  4. Beynon BD, Johnson RJ, Fleming BC, Kannus P, Kaplan M, Samani J, Renström P (2002) Anterior cruciate ligament replacement: comparison of bone-patellar tendon-bone grafts with twostrand hamstring grafts. A prospective, randomized study. *J Bone Joint Surg Am* 84-A:1503–1513
  5. Steiner ME, Hecker AT, Brown CH, Hayes WC (1994) Anterior cruciate ligament graft fixation. *Am J Sports Med* 22:240–247
  6. Murawski CD, van Eck CF, Irrgang JJ, Tashman S, Fu FH (2014) Operative treatment of primary anterior cruciate ligament rupture in adults. *J Bone Joint Surg Am* 96:685–694
  7. Ellis SJ, Williams BR, Wagshul AD, Pavlov H, Deland JT (2010) Deltoid ligament reconstruction with peroneus longus autograft in flatfoot deformity. *Foot Ankle Int* 31:781–789
  8. Williams BR, Ellis SJ, Deyer TW, Pavlov H, Deland JT (2010) Reconstruction of the spring ligament using a peroneus longus autograft tendon transfer. *Foot Ankle Int* 31:567–577
  9. Xu C, Zhao J, Xie G (2016) 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* 4:21–26
  10. Otis JC, Deland JT, Lee S, Gordon J (2004) Peroneus brevis is a more effective evertor than peroneus longus. *Foot Ankle Int* 25:242–246
  11. Kerimoğlu S, Aynaci O, Saraçoğlu M, Aydin H, Turhan AU (2008) Anterior cruciate ligament reconstruction with the peroneus longus tendon. *Acta Orthop Traumatol Turc* 42:38–43
  12. Sasetyo DR, Rhatomy S, Pontoh LA (2017) Peroneus longus tendon: the promising graft for anterior cruciate ligament reconstruction surgery. *Asia Pac J Sport Med Arthrosc Rehabil Technol* 9:25
  13. Anghong C, Chernchujit B, Apivatgaroon A, Chaijenkit K, Nualon P, Suchao-in K (2015) The anterior cruciate ligament reconstruction with the peroneus longus tendon: a biomechanical and clinical evaluation of the donor ankle morbidity. *J Med Assoc Thai* 98:555–560
  14. Magnussen RA, Lawrence JTR, West RL, Toth AP, Taylor DC, Garrett WE (2012) Graft size and patient age are predictors of Knee Surgery, Sports Traumatology, Arthroscopy 1 3 early revision after anterior cruciate ligament reconstruction with hamstring autograft. *Arthroscopy* 28:526–531
  15. Mariscalco MW, Flanigan DC, Mitchell J, Pedroza AD, Jones MH, Andrish JT, Parker RD, Kaeding CC, Magnussen RA (2013) 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. *Arthroscopy* 29:1948–1953
  16. Spragg L, Chen J, Mirzayan R, Love R, Maletis G (2016) The effect of autologous hamstring graft diameter on the likelihood for revision of anterior cruciate ligament reconstruction. *Am J Sports Med* 44:1475–1481
  17. Romanini E, D'Angelo F, De Masi S, Adriani E, Magaletti M, Lacorte E, Laricchiuta P, Saggiocca L, Morciano C, Mele A (2010) Graft selection in arthroscopic anterior cruciate ligament reconstruction. *J Orthop Traumatol* 11:211–219
  18. Rudy ME, Phatama KY (2017) Tensile strength comparison between peroneus longus and hamstring tendons: a biomechanical study. *Int J Surg Open* 9:41–44
  19. Noyes FR, Bassett RW, Grood ES, Butler DL. *Arthroscopy in acute traumatic hemarthrosis of the knee. Incidence of anterior cruciate tears and other injuries. J Bone Joint Surg Am.* 1980;62:687–95. 757
  20. Schlumberger M, Schuster P, Schulz M, Immendörfer M, Mayer P, Bartholomä J, Richter J (2017) Traumatic graft rupture after primary and revision anterior cruciate ligament reconstruction: retrospective analysis of incidence and risk factors in 2915 cases. *Knee Surg Sports Traumatol Arthrosc* 25(5):1535–1541
  21. Otis JC, Deland JT, Lee S, Gordon J (2004) Peroneus brevis is a more effective evertor than peroneus longus. *Foot Ankle Int* 25:242–246
  22. Tifford CD, Spero L, Luke T, Plancher KD. The relationship of the infrapatellar branches of the saphenous nerve to arthroscopy portals and incisions for anterior cruciate ligament surgery. An anatomic study. *Am J Sports Med.* 2000;28(4):562–7