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Is Peroneus Longus A Better Graft Replacement for Hamstring tendon in ACL Reconstruction? – A Comparative Study On Functional outcome and Donor Site Morbidity

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Abstract

Background: The ACL reconstruction aims to restore knee stability, allow the patient to return to regular activities, including sports, and delay the onset of osteoarthritis. The choice of graft plays a vital role and the most popular autograft for reconstruction is the hamstring tendon graft. Many orthopaedic surgeries use peroneus longus tendon autograft, and it is biomechanically comparable to a hamstring tendon autograft. The aim of this study is to assess the functional outcome and donor site morbidity and analyse complications.

Methods: A total of 120 patients who fulfilled the criteria were included and were allotted to two groups and observed prospectively for a period of 1 year. Functional scores were recorded preoperatively and 1 year after surgery. Donor site morbidities were assessed with MRC grading for hamstring- flexion at knee and extension at hip and for peroneus longus - plantarflexion at ankle and eversion at subtalar joint.

Results: There were no significant Differences between the pre- and 1-year postoperative score between the hamstring and peroneus longus groups in the IKDC and Lysholm scores. Donor site morbidity was found to be higher in peroneus longus but when compared with hamstring tendon donor morbidity was not statistically significant.

Conclusion: The functional outcome of the peroneus longus and hamstring are found to be similar. But with the increased rate of donor site morbidity in peroneus longus, So Peroneus longus can be used as an alternative choice of graft in cases involving multiple instability and in cases of revision ACL reconstruction

Keywords: Arthroscopy, Anterior Cruciate ligament, Hamstring tendon autograft, Peroneus longus tendon autograft, donor site morbidity

Introduction

The Anterior Cruciate Ligament (ACL) is the principal stabiliser against anterior translation of the tibia on the femur, as well as rotation and valgus stress. Anterior Cruciate Ligament Rupture is a common knee injury that results in a decreased quality of life. Recurrent episodes of instability and a higher risk of intraarticular injury, including meniscal and cartilage tears, result from an anterior cruciate ligament deficiency in the knee [1].

There have been rapid developments in ligament reconstruction and rehabilitation method in recent years, and various approaches for anterior cruciate ligament reconstruction have been described [1].

Autograft and allograft are two graft choices for ACL restoration. The hamstring autograft is one of the most common. The use of hamstrings in ACL reconstruction is still a point of debate among experts. The peroneus longus tendon is an autograft that can be used as a new option. There are currently just a few biomechanical studies on the strength of the peroneus longus as an alternative autograft in ACL reconstruction [2].

The peroneus longus tendon has been used as a graft in orthopaedic reconstructive surgeries because of its comparable biomechanical strength with the native anterior cruciate ligament (ACL) and hamstring tendon. However, one of the considerations in choosing an autograft is donor site morbidity [3].

Methods

Participant Demographics

This was a Prospective, comparative study. Patients who were admitted to our hospital due to ACL tear from October 2022 to March 2024 were selected.

Inclusion Criteria:

1. Age between 18-60 years.
2. Symptomatic anterior cruciate ligament insufficiency associated with or without meniscal or chondral injury.
3. MRI evidence of anterior cruciate ligament tear.
4. Examination under anaesthesia showing evidence of anterior cruciate ligament insufficiency like Lachman test and pivot shift test positive.

Exclusion Criteria:

1. Dislocated knee joint.
2. Grade 3 collateral ligament insufficiency.
3. Multi ligamentous injury.
4. Neurovascular insufficiency of affected limb.

A total of 120 patients met the inclusion criteria, with 60 patients in the first group and 60 patients in the second group (Group 1: Hamstring tendon was used as a graft, Group 2: Peroneus longus tendon was used as a graft) based on simple randomization. The two groups of patients were categorized in terms of age, sex, side, mode of injury, Symptoms & injury to surgery interval **[Table 1 to Table 4].**

Surgical Technique

All of the patients in our study were operated under spinal anaesthesia in supine position. In all cases, a prophylactic antibiotic, usually 1g ceftriaxone, is given before the tourniquet is inflated. A diagnostic arthroscopy was performed prior to the graft harvesting.

Hamstring Graft Harvest

With the ipsilateral knee flexed to 90 degrees. 5 cm below the joint line, an oblique 3-cm skin incision is made over the proximal edge of the pes anserine. Using this incision, harvest the graft and drill the tibial tunnel. The sartorius fascia is divided along the course of the tendons (Gracilis and semitendinosus) after the hamstring tendons have been identified. The scissors are used to release the tendon's distal end. Then, in line with the tendon, a tendon stripper is advanced over it to harvest the tendon. The gracilis appears to be more muscular than the semitendinosus [4]. **[Figure 1]**

Peroneus Longus Graft Harvest

The ipsilateral leg's peroneus longus tendon was harvested. The incision was made through the skin, subcutaneous tissue, and superficial fascia, and was marked 2 to 3 cm above and 1 cm behind the lateral malleolus. At 2 to 3 cm above the level of the lateral malleolus, the tendon division was marked. After tenodesis between the peroneus longus and peroneus brevis tendons, the distal part of the peroneus longus tendon was sutured with end-to-side suture [3]. **[Figure 2]**

Graft Preparation

Graft master board is then used to place the harvested graft. With the blunt end of the blade, any remaining muscle fibres are removed from the tendons. At both ends of the tendons, a whipstitch was placed. Both ends of the tendon were stitched together for around 3-4 cm. The umbilical tape is looped around the two tendons. The graft sizer is then used to size the composite graft. The length of the graft to be placed inside the femoral tunnel is marked to ensure the correct graft placement while being viewed arthroscopically. The graft's strands are connected to the graft master board's posts, and pretensioning is

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done by applying pressure for around fifteen minutes [5].

Notch, Femoral and Tibial Tunnel Preparation & Graft Fixation

Intercondylar notch visualised, except remnants of Femoral (Landmark) & tibial (Proprioceptive) attachments sites, the remaining of ACL debrided [6]. Femoral tunnel for the right knee, the guiding pin is positioned at 10 o'clock to 11 o'clock, and for the left knee, it is positioned at 1 o'clock to 2 o'clock. The femoral tunnel was then reamed with a reamer that corresponded to the graft's diameter. Depending on the length of the graft, the reaming was stopped 15–20 mm from the lateral cortex. For the tibial tunnel tip of the tibial guide is placed 2–3mm anterior to the posterior margin of anterior horn of the lateral meniscus with the knee in 70– 90 degrees of flexion. The tibial tunnel is then created by reaming over the guide pin with a cannulated drill bit that has the same diameter as the graft [7]. The hamstring graft is quadrupled or the peroneus longus is doubled, and the loop section of the graft is attached to the endobutton. The graft is pulled through the tibial tunnel into the joint and then into the femoral tunnel. The endobutton is flipped once the estimated length of the graft is within the tunnel. An interference screw (bioscrew) of adequate length is used to secure the graft on the tibial side [8]. The graft is next arthroscopically visualised to check for evidence of graft impingement, alignment, and other issues. Incision closed in layers. Wound dressing done and long knee brace applied.

Post-Operative Management:

Immobilization with a long knee brace and limb elevation were done immediately after surgery. Antibiotics were given intravenously for three days after surgery. On the 2nd and 7th post-operative days, the wound was examined. On the 15th post-operative day, the sutures were removed. From post op day one, standard ACL rehabilitation protocol was followed [1].

Evaluation

Anteroposterior and lateral radiographs were taken on all patients after surgery to determine the tunnel placement and position of the endobutton and interference screw. **[Figure 3]**

Patients were evaluated at two weeks, four weeks, six weeks, three months, six months, nine months, and one year and functional outcomes were assessed. Patients were assessed using the International Knee Documentation 2000 score (IKDC) and the Lysholm Knee Scoring Scale.

Results

During our present study a total of 164 patients with anterior cruciate Ligament tear were reviewed in OPD, among which 120 (60.97%) patients were enrolled into the study according to our study inclusion criteria and 44 (39.02%) patients were excluded according to exclusion criteria and 120 patients divided into two group based on the use of graft for anterior cruciate ligament reconstruction.

In our study group-1 that is hamstring tendon group the preoperative mean standard deviation of Lysholm knee score is found to be 67.32 ±11.67 and IKDC knee score is found to be 57.23±7.07. The mean standard deviation of postoperative at 1 year follow up of Lysholm knee score is found to be 94.4±7.13 and IKDC knee score is found to be 90.2 ±4.23. **[Figure 4; Table 5]**

In our study group-2 that is peroneus longus tendon group the preoperative mean standard deviation of Lysholm knee score is found to be 69.41 ±10.51 and IKDC knee score is found to be 58.17 ±6.42. The mean standard deviation of postoperative at 1 year follow up of Lysholm knee score is found to be 92.75 ±5.23 and IKDC knee score is found to be 91.07 ±3.91. **[Figure 4; Table 5]**

To assess the donor site morbidity of hamstring group - extension at hip and flexion at knee and peroneus longus group - plantar flexion at ankle and eversion at subtalar were assessed after surgery at 1 year follow by using the MRC grading and comparing with the contralateral side. However, P- Value is not significant in both the groups. **[Table 6 and 7]**

The complication after surgery at 1 year follow up noticed in group-1 patients, numbness at graft harvested site with 13.33% of patients followed by 10% patients with laxity and anterior kneeling pain in 3.33% patients. In group-2 23.33% patients suffer from numbness at graft harvested site followed by 16.67% patients with laxity and 10% patients with anterior kneeling pain. 3.33% of the patients presented with infection. **[Table 8]**

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Discussion

The observations and results of present study were compared with the available previous similar studies. A total of 120 patients is taken into study who met the inclusion and exclusion criteria. Among which 60 patients were grouped under hamstring autograft and 60 patients were grouped under Peroneus longus tendon autograft (PLT).

In a study by Sholahuddin Rhatomy, et.al [9] a similar observation is found among 52 patients, with 28 patients in hamstring tendon group and 24 patients in peroneus longus tendon group PLT.

In the current study patients of both the groups are divided as per their age into 4 categories with ages varying between 21-60 years, with majority of patients falling under age group of 21-30 years of age. This grouping of patients based on their age is similar to a study conducted by Dung Tran Trung, et.al [10] in which patients were grouped on the basis of the age with the youngest being 19-year-old and oldest is of 51-year-old.

In a study by Wendy J. Hurd, et.al [11] similar figures were observed with a mean age group of patients between 35-44 years of age. In another long-term study of Jamie E Collins, et.al [12] between age groups of 18-60 years of age, with majority of them falling between 31-50 years and an average being 47 years of age. This is because of more sports and rigorous activity in these age groups the ACL is at the high risk of injury.

In the current study the patients were divided based on the sex in each group with majority of them being male that is 80-83% of the patients or subjects included in the study were males. The percentage proportion of male to female being 4:1 in group-1 and 4.9:1 in group-2 respectively. In a study by Nathan Schilaty, et.al [13] the incidence 98 of ACL reconstruction is more in male population that is 3:1 between 25-40 years similar to the current study whereas the prevalence is more among females below 25 years of age when compared to male of same age group. In a study by Robert A. M, et.al [14] the proportion of male to female in all age groups is 4.3:1. The huge difference in ACL tear may be subjected to physical activity and the occupations of males.

In our study based on the injured side of involvement, the patients are again grouped with majority of them in group-1 and group-2 being injured on the right side with percentages being 56.67% and 60% respectively. These findings are similar to that of a study performed by Niharika Kochhal, et.al [15] 59% of patients are affected with right sided injury while 40% of them are with left sided injuries and 1% are injured on both sides. This is mainly because of the right-side dominant more in the Asian countries.

In our study based on the mode of injury majority of them in both the groups suffered from road traffic accidents with percentages varying between 60-70%, followed by equal proportion of sports activities. In study by Niharika Kochhal, et.al [15] patients suffering from road traffic accidents have highest rate of development of ACL injuries with percentage varying between 70-80%.

In our study patients were distributed based on the surgical time interval post injury in both the groups majority of the patients had surgery after 4-6 months. In a study by Robert A. Magnussen, et.al [14] out of 338 patients 120 patients had surgery after 6-7 months of injury. This because of the fact that negligence of the injury and following 99 which these patients are at higher risk of meniscal injury and present when the symptoms like pain starts after the meniscal injury.

In our study patients were divided based on symptoms at presentation. 40% patients in group-1 and 36.67% of patients in group-2 presented with knee pain and instability. This is followed by 26.67% patients with only knee instability and 20% patients had only knee pain in group-1. In group-2, 23.33% of patients had only knee pain and 20% of patients had only instability. A very low percentage of patients that is approximately 13.33% from group-1 and 20% from group-2 presented with locking of knees. In a study by Jennifer Evans, et.al [16] around 70% of patients complained of knee instability. In a study by A. M. Kiapour, et.al [17] 40% of patients suffered from pain in knees while 70% of them presented with knee instability and locking. In a study by Constance R. Chu, et.al [18] observed that approximately 50% of patients post injury suffered from acute pain in knee and proposed that this may be due to altered mechanical loading and accelerated degeneration of previously healthy joints.

In a by study Norimasa Nakamura, et.al [19], concluded that at 90 degrees of knee flexion, patients with hamstring autograft ACL reconstructed knees

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reported lower knee flexion torque. Although no research has shown the significance of knee flexion weakness at 90 degrees.

However, the above studies suggest that there may be weakness of knee flexion after hamstring graft harvest but in our study did not show any weakness of knee flexion and we conclude that this weakness can be prevented if proper pre and postoperative rehabilitation protocol is followed.

In a study by Sholahuddin Rhatomy, Fidelis H. Wicaksono, et.al [3], concluded that during eversion and first ray plantarflexion of the ankle joint, no muscular strength decrease was observed after ACL restoration with a peroneus longus tendon autograft and the donor site had outstanding FADI and AOFAS scores.

In a study by Fu dong shi, et.al [20], concluded that the PLT has any influence on maintaining the arch of the foot, it is a minor and redundant.

In our current study numbness at the peroneus longus graft harvested site was seen in 23.3% of the patients which was slightly higher when compared with the hamstring which was 13.33% but it was statistical not significant.

Conclusion

The functional outcome of the peroneus longus and hamstring are found to be similar. But with the increased rate of donor site morbidity in peroneus longus than the hamstring, So Peroneus longus can be used as an alternative choice of graft in cases involving multiple instability and in cases of revision ACL reconstruction.

Declarations

Ethical approval: taken

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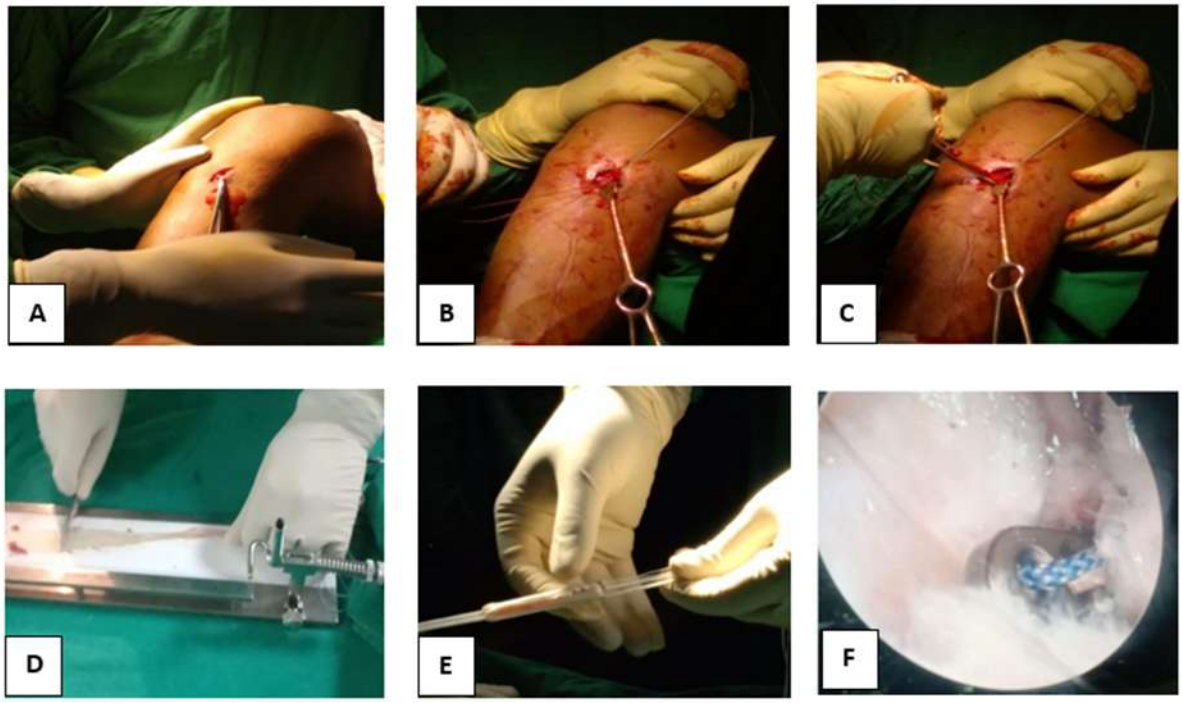
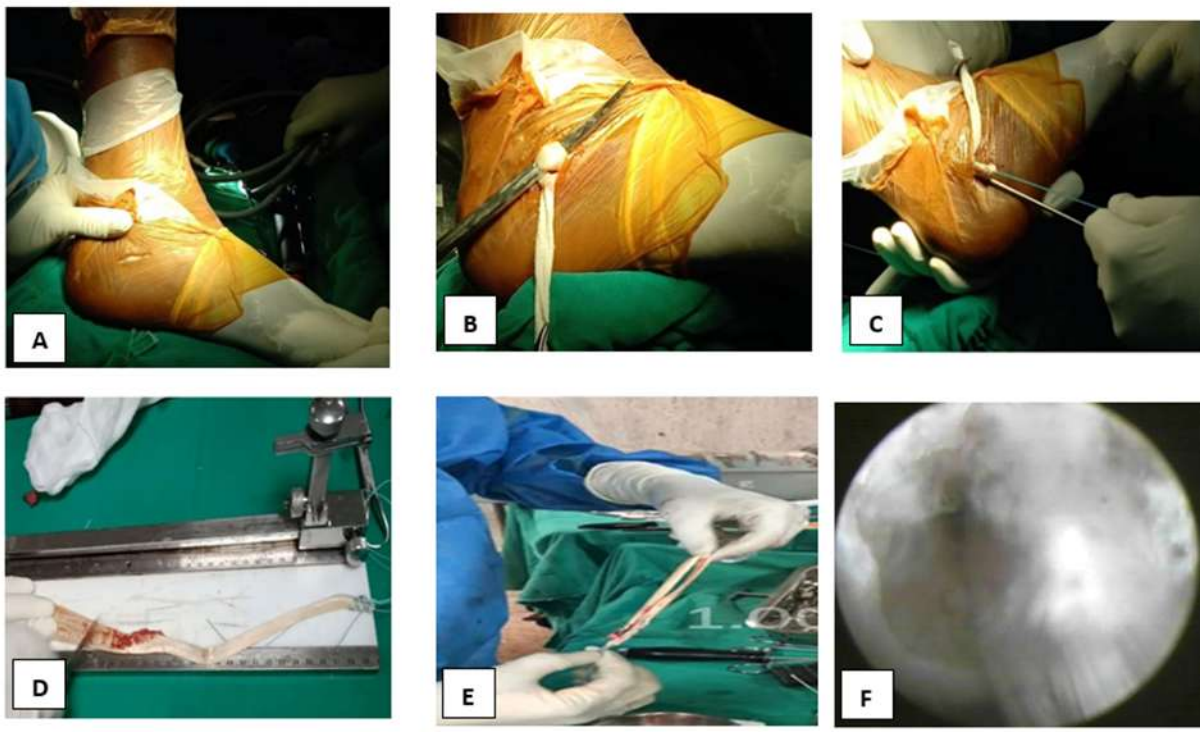
Figure Legends

[Figure 1: Intra-operative images of Hamstring harvest, A- Skin incision, B- Identification of semitendinosus and gracilis tendon, C- Stripping of tendon, D- Preparation of graft, E- Four strand HT graft, F- Arthroscopic view of graft passage.]



[Figure 2: Intra-operative images of Peroneus longus harvest, A- Skin incision, B- Identification of PL tendon, C- Stripping of tendon, D- Preparation of graft, E- Double strand PLT graft, F- Arthroscopic view of graft passage.]



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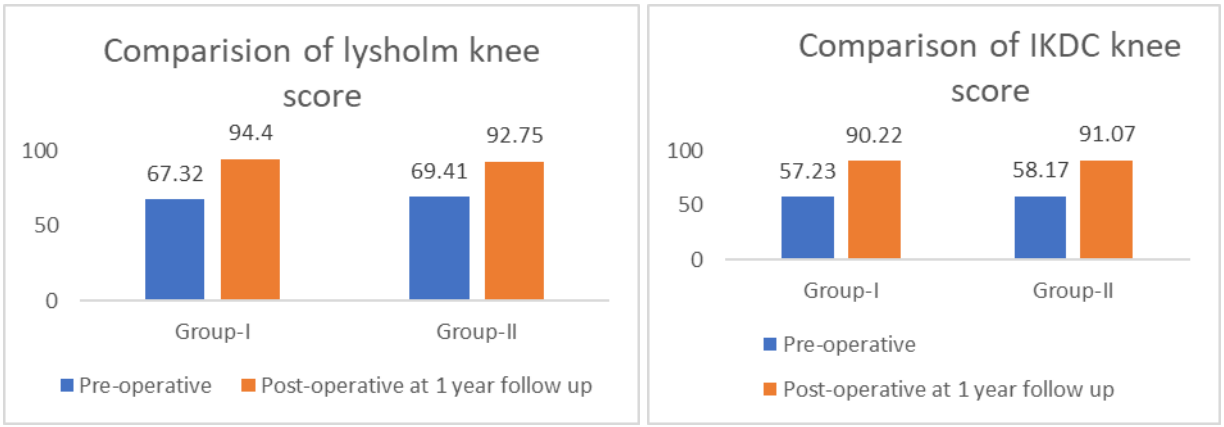
[Figure 3: Showing Post-operative ACL reconstruction Plain radiograph]

[Figure 4: Bar chart showing comparison of Lysholm knee score and IKDC knee score of both the groups.]



[Table 1: Patients are distributed according to age distribution]

Age Group	Group -I	Group-II	*P*-Value
21-30	24 (40%)	28 (46.67%)	0.13
31-40	16 (26.67%)	14 (23.33%)	
41-50	12 (20%)	10 (16.67%)	
51-60	8 (13.33%)	8 (13.33%)	
Total	60	60	

[Table 2: patients are distributed according to Sex distribution]

Sex	Group -I	Group-II	*P*-Value
Male	48 (80%)	50 (83.33%)	< 0.05
Female	12 (20%)	10 (16.67%)	
Total	60	60	

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[Table 3: Patients are distributed according to Side involvement]

Side involvement	Group -I	Group-II	*P*-Value
Right	34 (56.67%)	36 (60%)	0.42
Left	26 (43.33%)	24 (40%)	
Total	60	60	

[Table 4: Patients are distributed according to mode of injury]

Mode of injury	Group -I	Group-II	*P*-Value
RTA	36 (60%)	40 (66.67%)	0.32
Sports	12 (20%)	12 (20%)	
Others	12 (20%)	8 (13.33%)	
Total	60	60	

[Table 5: Functional outcome of hamstring and Peroneus longus group]

	Score	Pre-operative	Post-operative	*P*-Value
Group 1	**Lysholm Knee Score**	67.32 ± 11.67	94.4 ± 7.13	< **0.001**
	IKDC Knee Score	57.23 ± 7.07	90.22 ± 4.23	< **0.001**
Group 2	**Lysholm Knee Score**	69.41 ±10.51	92.75 ±5.23	< **0.001**
	IKDC Knee Score	58.17 ±6.42	91.07 ±3.91	< **0.001**

[Table 6: Donor site morbidity of hamstring group by MRC grading.]

MRC grading	Extension at hip after surgery at 1 year follow up		Flexion at knee after surgery at 1 year follow up		*P*-Value
	Donor site	Contralateral Site	Donor site	Contralateral Site	
Grade-5	58 (96.67%)	60 (100%)	56 (93.33%)	60 (100%)	0.11
Grade-4	2 (3.33%)	0	4 (6.67)	0	

[Table 7: Donor site morbidity of peroneus longus group by MRC grading.]

	Plantar flexion at ankle after surgery at 1 year follow up	Eversion at subtalar after surgery at 1 year follow up	

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MRC Grading	Donor site	Contralateral Site	Donor site	Contralateral Site	*P*-Value
Grade-5	48 (80%)	60 (100%)	50 (83.33%)	60 (100%)	**0.10**
Grade-4	12 (20%)	0	10 (16.67%)	0	

[Table 8: Comparison of complications in both groups post operatively at 1 year]

Complication after surgery at 1 year	Group-I	Group-II	*P*-Value
Anterior kneeling pain	2 (3.33%)	6 (10%)	0.33
Infection	0	2 (3.33%)	0.32
Numbness at graft harvested site	8 (13.33%)	14 (23.33%)	0.1
Laxity	6(10%)	10 (16.67%)	0.2

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