

## Original Research Article

# Hamstring versus peroneus longus autograft for arthroscopic anterior cruciate ligament reconstruction – which is better for Indian population?

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## ABSTRACT

**Background:** Hamstring autograft has been a popular option for anterior cruciate ligament (ACL) reconstruction. Of late, the use of peroneus longus tendon has shown promising results. Indian population is predominantly kneeling population where squatting and sitting crossed are associated with daily living activities. This study involves the comparative analysis of the morbidities associated with both the grafts and the choice of autograft based on the Indian population needs.

**Methods:** A comparative cohort study was conducted on 60 patients who underwent ACL reconstruction during 2022-2023. The patients were randomly assigned for either peroneus longus or hamstring autograft. After a follow-up of one year, the donor site morbidities were assessed using Lysholm score for knee and foot and ankle disability index (FADI) for ankle joint.

**Results:** A significant statistical difference ( $p$  value  $\leq 0.001$ ) was seen in the mean time required to harvest hamstring and peroneal grafts. Although the Lysholm scores were statistically insignificant ( $p=0.03$ ) in both the groups, 20% of patients with hamstring graft, recorded VAS pain score  $>7/10$  while deep squatting and loading heavy weights. FADI scores of the donor side and contralateral side in patients with peroneal graft showed statistically insignificant results ( $p$  value  $=0.06$ ).

**Conclusions:** Owing to the graft diameter, robust quality, tensile strength and lesser knee joint morbidity, peroneus longus can be considered as a better alternative autograft to the Indian population. However, in athletes, a careful decision should be made as further long-term studies are required to assess the ankle joint morbidity due to this autograft.

**Keywords:** ACL reconstruction, Hamstring autograft, Peroneus longus autograft, Indian population

## INTRODUCTION

Hamstring graft involving quadruple semi tendinosis and gracilis tendon has been a popular option for graft harvesting in anterior cruciate ligament (ACL) reconstruction surgeries. These medial hamstrings, play a pivotal role in providing the translational, rotational and valgus/varus stability of the knee joint. Their removal would therefore, lead to impairment of knee kinematics and stability.<sup>1</sup>

The usage of peroneus longus graft has not been very common until the recent years.<sup>2-4</sup> However, proper literature is still deficit to elicit this graft as a better option over the hamstrings. But few studies suggested clinical outcomes with peroneus longus is better than hamstring in ACLR.<sup>5-8</sup> Peroneus longus has a primary function of plantar flexion and eversion of foot. It also contributes to the stabilization of the ankle joint and the first ray of foot.<sup>9</sup> Removal of peroneus graft could therefore, lead to the ankle instability and impact gait cycle.<sup>10</sup> However, the peroneus brevis muscle which is still intact, being a

powerful evertor of the foot has the potential to restore the donor ankle function post operatively.<sup>11,12</sup>

Although both the tendons have strong biomechanical properties, a study found that the tensile strength of peroneus graft has slightly higher tensile strength than the patellar and the hamstring graft.<sup>13</sup> A minimal diameter of 8 mm with tensile strength greater than the native would be an ideal graft to replace ACL and to reduce the chances for revision ACLR.<sup>14,15</sup> Indian kneeling population predominantly use the hamstring, quadriceps, calf muscles for their daily activities. Usage of the hamstring autograft for ACLR can lead to thigh hypotrophy and weakness of the extension of knee joint.

Therefore, peroneus longus would be a promising graft in the non-athletes and kneeling population. But in athletic population and high physical demand individuals, careful assessment of their roles is required which would help surgeon to decide the choice of graft.

## METHODS

This was a comparative cohort study. A total of 60 patients who underwent ACL reconstruction between 2022- 2023 at Government Medical College and Hospital, Srikakulam were taken as sample. The Ethical Committee's approval from our institution (approval no. – IEC30/GMC&GGH/SKLM/211224/17) and informed consent were obtained for this study. The patients were assigned into 2 groups randomly. First group had 30 patients in whom the quadrupled hamstring autograft was used and the second group consisted of 30 patients in whom the doubled/tripled peroneus longus autograft was harvested for reconstruction. Clinical tests and magnetic resonance imaging were used to diagnose the ACL rupture cases.

All the surgeries were performed using similar technique, same instruments and patients had similar treatment and rehabilitation protocol. Preoperatively, the patients' anthropometric data was taken. Intraoperatively, the graft diameters were measured. Post operatively, after at least a follow up of one year (13–20 months) knee ROM was assessed and Lysholm scoring was used to determine the functional outcome of the knee.

For patients where peroneus longus autograft was harvested, ankle ROM and FADI were assessed.

### Inclusion criteria

Patient aged 18-50 years, ACL rupture, and with normal ankle joint were included.

### Exclusion criteria

Patients with multiple knee ligaments injury, revision cases, and previous surgeries to knee and ankle joints were excluded.

## Surgical technique

The surgeries were performed with patient in supine position and under spinal anesthesia. Standard knee portals were used. The Hamstring graft was harvested after an oblique incision was taken over anteromedial aspect of the knee. The harvested hamstring graft was measured and quadrupled using Ethibond sutures. Similarly, in the other group an inch incision was taken over the posterior aspect of the lateral malleolus in the ipsilateral leg (Figure 1). The harvested graft is measured and doubled/tripled using Ethibond sutures. The diameter and length of the harvested graft were noted (Figure 2). After harvesting autograft, it was passed through femoral and tibial tunnels drilled in anatomical position. The graft was fixed at the femoral side using endo button and tibial side using an interference screw.



**Figure 1: Peroneus longus graft harvesting technique.**



**Figure 2: ACL autograft preparation method.**

## Rehabilitation protocol

The patients were discharged 2 days after surgery with functional knee brace on the operated limb. Ankle pumps, quadriceps and hamstring static exercises were advised immediately, post-surgery. Partial weight bearing with a walker was encouraged in the first week. Subsequently, knee flexion was advised until 90 degrees in the next two weeks. Full weight bearing was permitted a month after surgery. Partial squatting was encouraged at 4 months. Patients were allowed for sports and other strenuous activities 8-9 months later. The functional outcomes of

both the knee and ankle joint were measured one year at the follow up.

### Statistical analysis

The data collected was entered in Microsoft excel sheet and statistical analysis was done using statistical package for the social sciences (SPSS) statistics software version 13. The descriptive data (range, mean and standard deviation) were utilised in this study. An independent t-test was used to compare quantitative variables in the two groups. A p value less than 0.05 was considered statistically significant.

## RESULTS

Out of 60 patients taken for study, 45 were males and 15 were females. The patients were randomized to the hamstring and peroneus group of 30 patients each and were followed up for a period of one year. The mean age of both the groups together was 29 years with a range of 19 – 48 years.

In the hamstring group males were 24 with a mean height of  $167.4 \pm 5.5$  cm and BMI  $24.1 \pm 3.1$  kg/m<sup>2</sup> whereas females were 6 with a mean height of  $153.2 \pm 3.3$  cm and BMI  $20.7 \pm 2.6$  kg/m<sup>2</sup>. The hamstring autograft harvested after quadrupled was having a mean diameter of  $7.5 \pm 0.5$  mm in males where as in females mean diameter of  $6.8 \pm 0.3$  mm (Figure 3). 2 patients were athletes out of 30 patients in the hamstring graft group. 5 patients had height <155 cm and BMI <20 kg/m<sup>2</sup>, all being females had a mean diameter of 6.8 cm as quadrupled hamstring harvested graft.

In the peroneus longus group, males were 21 with a mean height of  $168.9 \pm 5.3$  cm, BMI  $23.6 \pm 2.8$  kg/m<sup>2</sup> whereas females were 7 with a mean height of  $156 \pm 4$  cm and BMI  $24.7 \pm 3.6$  kg/m<sup>2</sup>. The peroneus autograft harvested after doubled/ tripled was having a mean diameter of  $8.5 \pm 0.5$  mm in males where as in females mean diameter of  $7.5 \pm 0.5$  mm (Figure 4). All the patients harvested with peroneus longus autograft were non athletes.

The mean diameter of both the grafts [hamstring ( $7.4 \pm 0.5$  mm), peroneus ( $8.4 \pm 0.5$  mm)] showed variation which is significant (p value  $\leq 0.0001$ ). Also, harvesting the

hamstring graft had taken significantly longer time ( $10.2 \pm 1.9$  min) compared to the time taken ( $5.96 \pm 1.1$  min) to harvest peroneal graft (p value  $\leq 0.0001$ ) (Table 1).

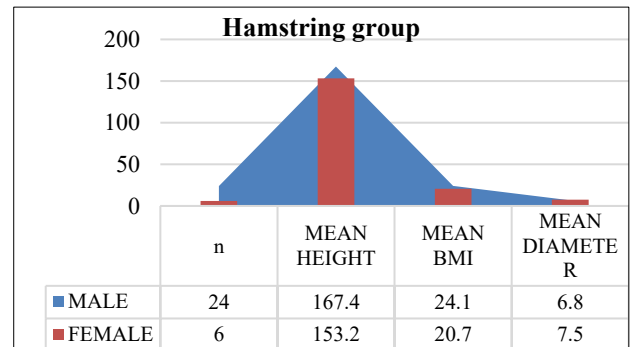


Figure 3: Demonstrating distribution of both the genders in the Hamstring group.

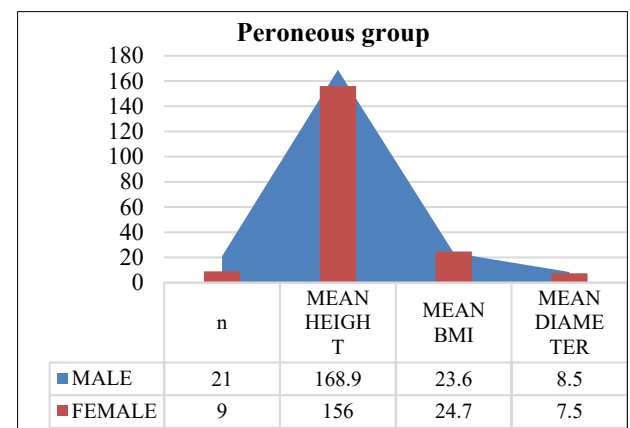


Figure 4: Demonstrating distribution of both the genders in the peroneus group.

Knee laxity was assessed by Lachman test. In hamstring group 2 patients out of 30 had mild laxity at the endpoint where as in the peroneus longus group 1 patient showed mild laxity. The Lysholm scores (range 0-100) of both the hamstring ( $89.6 \pm 4.37$ ) and peroneus group ( $90.7 \pm 3.9$ ) showed insignificant differences (p value=0.3). However, 20% in the hamstring patients complained of anteromedial knee joint pain on deep squatting and loading heavy weights while such complaints were registered in 6.7% patients in the peroneus group.

Table 1: Mean height, mean BMI, mean diameter, mean time taken to harvest the autograft in both the groups.

Variables	Mean height (cm)	Mean BMI (kg/m <sup>2</sup> )	Mean diameter (cm)	Mean time taken to harvest (min)
Hamstring	164.5±7.7	23.4±3.3	7.4±0.5	10.2±1.9
Peroneus	165±7.7	23.9±3	8.4±0.5	5.96±1.1
P value	p=0.8 (n.s.) t=0.2515	p=0.5 (n.s.) t=0.6141	p<0.0001 t=7.7460	p=0.0001 t=10.5780

Ankle ROM and FADI scores (range 0-104) are used to assess the donor site morbidity in the peroneus longus group. The ROM of the ankle joint showed any variation

compared to the opposite limb in all the planes. The mean FADI score for the donor side is  $97.9 \pm 2.32$  whereas the normal (contralateral) side showed  $99 \pm 2.32$ . Therefore,

indicating that the FADI score showed functionally insignificant results compared to the normal side ankle after the follow up ( $p$  value=0.06). 2 out of 30 patients complained of mild pressure pain at the surgical site incision at the graft harvest site of the peroneus longus group. None of the patients had neurovascular deficits.

**Table 2: Clinical outcomes of knee joint by Lysholm score.**

Variables	Pre-operative	Post-operative	P value
<b>Hamstring (n=30)</b>	55.5±5.64	89.6±4.37	$p \leq 0.0001$ $t=26.1775$
<b>Peroneus (n=30)</b>	54±2.8	90.7±3.9	$p \leq 0.0001$ $t=41.8689$
<b>P value</b>	$p=0.2$ (ns) $t=1.3048$	$p=0.3$ (ns) $t=1.0286$	

**Table 3: FADI scores of donor side and contralateral side in the peroneus group.**

Variables	Donor side	Contralateral side	P value
<b>Peroneus (n=30)</b>	97.9±2.32	99±2.32	$p=0.07$ (ns) $t=1.8363$

## DISCUSSION

Careful preoperative evaluation is essential to decide the choice of graft for the ACL reconstruction. Eventually, it is the surgeon's preference to choose the graft after considering various factors. The determinants to be considered can be broadly classified into patient factors; and surgeon factors.

Patient determinants include: demographic data, patient occupation and activity level, lifestyle and cultural aspects, previous surgeries and graft availability, incorporation to host bone and graft tension.

Surgeon determinants include: surgeon's expertise, preoperative planning for the graft choice that effects the surgical timing and need for reconstruction of other ligaments.

Patients whose height is less than 150 cm and BMI <18 kg/m<sup>2</sup> have more risk of having a diameter of <7 cm in the quadrupled hamstring graft.<sup>16-19</sup> Our study showed that 5 patients out of 30 in hamstring group had height <155 cm and BMI <20 kg/m<sup>2</sup> and average diameter of the hamstring graft harvested was 6.8 cm. However, no rupture was reported in these patients. A study by Mishra et al suggested to consider patient's height for preoperative prediction of tendon length and thickness and stated that a taller patient had a longer and thicker graft.<sup>15</sup> Ates et al in one of their studies determined that the need for revision surgery increased 5.5 times when graft diameter was  $\leq 7$  mm in ACLR.<sup>20</sup> Jagadeesh et al in their retrospective study

of 144 patients concluded that the number of revisions among those with a Hamstring graft diameter of  $\leq 7$  mm was high and such smaller graft leads to poorer functional outcomes of the patient's ACL reconstruction.<sup>21</sup> So, consideration of hamstring graft as an option should be revoked especially in the female population with height less than 150 cm and BMI <18 and thigh circumference less than 35 cm and other robust graft options like peroneus longus can be considered as an alternative in ACLR.

Anghong et al stated that there were some possible donor site morbidities with peroneus longus tendon harvesting. The potential donor site morbidity including ankle function deterioration and concern of ankle instability.<sup>22</sup> Zhao et al in their study proposed that postoperative gait changes post peroneus longus graft harvest may be more pronounced during prolonged walks or certain sports, such as soccer and basketball.<sup>9</sup> Therefore, peroneus longus tendon should be used with caution for athletes with high athletic demands. Furthermore, the use of hamstring graft can be considered in individuals with athletic activity as enough long-term studies over the peroneus longus graft as an option for high energy athletes are not documented.

Indian population especially the ones presenting at the public/Government hospitals are involved in traditional practices like squatting, crouching, sitting cross legged and majority involved in daily wage labor that involves heavy manual and physical work. Our study had 87% of patients as daily wage laborers, masons and other occupations involved in standing for long hours. Peroneus longus tendon might be considered in such patients as hamstring muscles play an important role in stabilizing pelvis and knee joint during locomotion and carrying heavy weights. Toor et al., quoted that the medial hamstrings are involved in rotational, translational, and varus/valgus control of the knee and harvesting the Gracilis and semitendinosus tendons alters native knee kinematics and stability.<sup>1</sup>

Keays et al found muscle strength deficit in only 10% after follow up of 6 months post ACL reconstruction using semitendinosus tendon grafts.<sup>23</sup> Ardern et al found about 27% isokinetic muscle strength deficit in the operated limb compared with the non-operated in 50 patients with high sports activity after a mean follow up >2 years post ACL reconstruction.<sup>24</sup> Although our study shows statistically insignificant Lysholm knee scoring on comparison of both the groups, the long-term follow-up of the hamstring muscle regeneration and the regaining of the muscle strength is beyond the scope of this study.

Thus, attributing to the above-mentioned studies and our study, peroneus longus can be considered as a good alternative for the kneeling populations and heavy work load involving laborers. It can also be utilized as an alternative donor in cases involving multiple instability that require more tendon donors in the reconstruction of knee joint ligaments.

The limitations of this study include the small study population, shorter follow up period. Hence, further studies involving a larger study population and a long-term follow-up should be conducted to substantiate the above findings.

## CONCLUSION

Owing to the graft diameter, robust quality, tensile strength and lesser knee joint morbidity, peroneus longus can be considered as a better alternative autograft to the Indian population undergoing ACL reconstruction. However, in athletes, a careful decision should be made for graft choice as further long-term studies are required to assess the ankle joint morbidity due to peroneus longus autograft.

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