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Comparative Study Between Functional Outcome of Knee with ACL Recontruction Using Hamstring Graft vs Peroneus longus Graft

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ABSTRACT
Anterior cruciate ligament (ACL) reconstruction is a crucial procedure for managing ACL deficiency, with various autograft options available. Recent interest has focused on the peroneus longus tendon (PLT) as a potential alternative to hamstring tendons (HT) due to its biomechanical properties and potential advantages. However, comparative studies assessing functional outcomes between PLT and HT in ACLR are lacking. We conducted a cross-sectional study involving 60 ACL injury cases treated with ACL reconstruction using either hamstring or peroneus longus tendon grafts. Patient selection was randomized, and assessments included preoperative planning, surgery under spinal or combined spinal-epidural anesthesia, and postoperative rehabilitation protocols. Functional scores were assessed using the Lysholm Knee Score and IKDC Score at various follow-up intervals. Both groups showed favorable outcomes in terms of knee stability and functional scores. There were no statistically significant differences in Lysholm and IKDC scores between the two groups at any time point during the follow-up period. Additionally, postoperative complications did not significantly differ between the groups. The study findings suggest that ACL reconstruction using peroneus longus tendon autografts yields comparable outcomes to hamstring tendon autografts in terms of knee stability and functional scores. The use of peroneus longus tendon grafts may offer advantages such as larger size, satisfactory ankle function preservation and avoidance of potential complications associated with hamstring graft harvesting. Thus, peroneus longus tendon autografts could be considered a safe and viable option for ACL reconstruction, particularly in specific patient populations showing a preference for this approach.

INTRODUCTION

The anterior cruciate ligament (ACL) is the knee join ligament that is most commonly injured [1,2], making its successful reconstruction a matter of great significance. Anterior cruciate ligament reconstruction (ACLR) is a commonly performed procedure for managing ACL deficiency, in which the patient's own tendon (autograft) is used[2]. The hamstring tendons (semitendinosus and gracilis), the bone-patellar tendon-bone (BPTB) and the quadriceps tendon are the most frequently used autografts[3,4,5]. Recent studies have shown that BPTB is the preferred graft due to its ability to facilitate bone to bone healing. This allows for successful fusion of the grafts within the tunnels, enabling a prompt return to the patient's professional activities. This distinguishing characteristic holds significant importance, particularly among professional athletes who have suffered ACL injuries. Nevertheless, there are potential complications associated with this procedure, including patellar fracture (particularly in the Asian population)[6], fat pad fibrosis[7] and patellar tendon contracture[8]. These risks arise from the invasive nature of the approach, which involves a longer incision, a fixed-length graft and a weaker tensile strength compared to the native ACL. Consequently, this method is not ideal for typical reconstruction cases where pain-free kneeling is essential, particularly during certain religious practices. Consequently, hamstring tendons are now the favoured choice for grafts due to their relatively simple harvesting process, low risk of complications at the donor site and a tensile strength similar to that of the original ACL. However, the drawbacks of unpredictable graft size (resulting in a surgeon's dilemma of using plastic fibre tape augmentation), the risk of saphenous nerve paresthesia and the potential reduction in hamstring muscle strength[9], which is vital for athletes relying on dominant hamstring power, contribute to its disadvantages. Having optimal hamstring strength is essential for patients who have recently undergone ACL reconstruction surgery, as it helps to counteract the forward movement of the shin bone caused by the contraction of the quadriceps muscles. Additionally, it helps to prevent any imbalance between the quadriceps and hamstring muscles.

Surgeons are continuously seeking an optimal autograft that can be easily obtained with minimal harm to the donor site and can be used in patients of all ethnicities without affecting their daily activities, due to the functional restrictions of current autografts. Currently, there is ongoing research on the peroneus longus tendon (PLT) as a potential preferred graft for regular ACLR. Furthermore, there is no possibility of experiencing post-operative hamstring muscle weakness or sustaining injury to the saphenous nerve while retrieving the graft. Due to its favourable biomechanical properties and high load-to-failure strength[11], the use of PLT as a graft for ACLR is widely preferred by orthopaedic surgeons[12]. Research has indicated that the peroneus brevis tendon (PBT) is more effective at turning the ankle outward[13], which supports the idea of using the PLT for ankle eversion purposes. Furthermore, PL has previously been employed for ligament reconstructions and specifically for cruciate ligament reconstructions in cases of multiligamentous injuries. As far as we know, there is no existing comparative study that examines the use of peroneus longus tendon (PLT) and hamstring tendon (HT) in primary anterior cruciate ligament reconstruction (ACLR). Hence, the objective of this study is to compare the functional outcome of arthroscopic anterior cruciate ligament reconstruction using hamstring tendon versus peroneus longus tendon. Additionally, it aims to assess knee stability, donor site morbidity and improvement in thigh wasting in patients with an ACL injury.

MATERIAL AND METHODS

This was a Cross-sectional study and 60 cases of ACL injuries were included which were operated by anterior cruciate ligament reconstruction using hamstring or peroneus longus graft at our institute with 30 patients in each group. Patient selection was randomized and odd-even rule was followed to assign which graft would be taken. The study was undertaken after obtaining the institute's ethical committee approval. The cases were selected based on the following inclusion and exclusion criteria. The criteria for inclusion were symptomatic individuals with anterior cruciate ligament insufficiency, aged between 18 and 60 years, without a history of previous knee surgery and with a normal contra lateral knee. The exclusion criteria included asymptomatic individuals, patients with systemic diseases affecting their pre-anesthetic condition, those with PCL tear or Grade III MCL and LCL injuries, patients with osteoarthritis knee or cartilage injury, individuals with tibial plateau fractures, those with local skin infections and patients who refused to give consent.

Following admission, an OT profile was sent and the pre-anesthesia check fitness was obtained for all patients. Preoperative planning involved obtaining plain radiographs of the knee from the front and side, an MRI scan and selecting the appropriate implant. All patients underwent surgery under spinal or combined spinal-epidural anaesthesia with a tourniquet used in every case. IV antibiotics were administered one hour before surgery and continued until the second day

after surgery. Oral antibiotics were then continued until suture removal on the 13th day after surgery. All patients underwent surgery using conventional arthroscopy methods. Hamstring graft was taken from approximately 3 cm incision located 3 cm distal to the joint line and 2 finger breaths medial to tibial tubercle followed by dissection of subcutaneous tissue and harvesting of semitendinosis graft. The peroneus tendon was taken from the same side leg. The incision was located 2-3 cm above and 1 cm behind the lateral malleolus. Following dissection, the Peroneus longus and Peroneus brevis tendons were located, with the longus tendon being isolated and harvested.

After surgery, patients were encouraged to engage in active assisted knee range of motion exercises starting on the first day post-operation. They were provided with a long knee brace and were allowed to bear full weight while wearing the brace the day after surgery. All patients received instruction on static and dynamic quadriceps strengthening exercises. Postoperative dressing was performed on the second and fifth days after the operation, and sutures were removed on the thirteenth postoperative day. The knee brace was worn for walking up to 3 weeks after the operation. The initial patient follow-up occurred two weeks after the operation, during which sutures were extracted and the range of motion of the knee was assessed. Follow-up assessments were conducted at 6 weeks, 3 months and 6 months. Functional scores were obtained using the Lysholm Knee Score and IKDC Score, in addition to AP and lateral plain X-rays of the affected knee at each follow-up.

RESULTS AND DISCUSSIONS

The summary of patient data reveals that there were 30 patients in each group, with Group-H comprising hamstring tendon patients and Group-P involving patients with the Peroneus Longus tendon. In terms of sex distribution, Group-H had 22 males and 5 females, while Group-P had 25 males and 5 females. The side involved in the injury varied, with Group-H showing 60.0% involvement on the left side and 40.0% on the right, while Group-P had the opposite distribution. The mean age for Group-H was 33.10 years with a standard deviation of 9.17, while Group-P had a slightly lower mean age of 30.90 years with a standard deviation of 6.98. Both groups had similar mean heights and weights, with slight variations in graft diameter.

(Table 2) presents the comparison of mean Lysholm Score between Group-H (hamstring tendon) and Group-P (P. Longus tendon) at different time periods. The mean scores and standard deviations are listed for each group at each time point. The 't' value, degrees of freedom (df) and the corresponding p-values are provided to assess the statistical significance of the differences. However, none of the comparisons show statistically significant differences

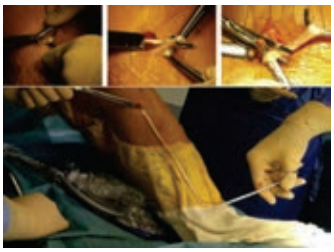

Fig. 1: Hamstring graft harvesting

Fig. 2: Hamstring graft preparation

Fig. 3: Peroneus tendon graft markings and Peroneus tendon graft harvesting

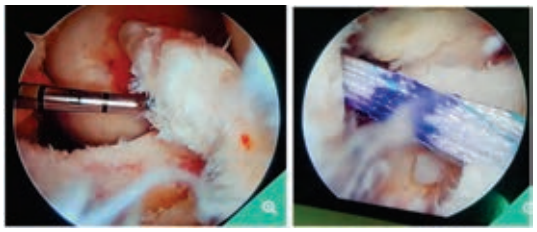

Fig. 4: Intra operative Image and Intra operative Image

Fig. 5: Clinical outcomes at final follow up in peroneus tendon group

Table 1: Summary of Patient Data.

	Group-H (Hamstring tendon)	Group-P (P. Longus tendon)
Total Patients	30	30
Sex		
Male	22	25
Female	5	5
Side Involved		
Left side	1860.0%	1240.0%
Right side	1240.0%	1860.0%
Mean Age	33.10±9.17years (range 20-54 years)	30.90±6.98 years (range 19-42 years)
Mean Height	167.00±7.05 cm	166.95±5.53 cm
Mean Weight	63.40±6.56 kg	65.25±6.34 kg
Average Graft Diameter	8.3±0.47 mm	8.4 ±0.35 mm

Table 2: Comparison of mean Lysholm Score between the two groups.

Time Period	Group-H (mean±SD)	Group-P(mean±SD)	't' value, df	p-value
Preoperative	25.50±4.35	26.00±2.05	-0.465, df = 38	0.644, NS
At 6 weeks	44.15±3.88	44.80±3.09	-0.586, df = 38	0.561, NS
At 3 Months	69.70±4.71	70.65±3.62	-0.715, df = 38	0.479, NS
At 6 Months	80.80±2.91	81.20±2.35	-0.478, df = 38	0.636, NS

Table 3: Comparison of mean IKDC Score between the two groups.

Time Period	Group-H (mean±SD)	Group-P (mean±SD)	't' value, df	p-value
Preoperative	32.27±2.31	32.77±1.84	-0.759, df = 38	0.452, NS
At 6 weeks	47.13±2.46	47.81±2.14	-0.926, df = 38	0.360, NS
At 3 Months	60.69±1.44	61.12±1.54	-0.926, df = 38	0.360, NS
At 6 Months	68.43±1.59	68.84±1.44	-0.847, df = 38	0.402, NS

Unpaired 't' test applied. P value <0.05 was taken as statistically significant

Table 4: Comparison of postoperative complications between the two groups.

Postoperative Complications	Group-H	Group-P	Fisher's Exact Test p-value
No Complications	22	26	
Knee stiffness	6 (20.0%)	2 (5.0%)	0.342, NS
Infection requiring Arthroscopic debridement	2 (5.0%)	2 (5.0%)	1.000, NS

Fisher's Exact test applied. A p<0.05 was taken as statistically significant

between the two groups, as indicated by the p-values being greater than the threshold for significance (0.05), denoted as "NS" for "not significant".

(Table 3) compares the mean International Knee Documentation Committee (IKDC) scores between Group-H (hamstring tendon) and Group-P (P. Longus tendon) at various time intervals. The table provides the mean scores and standard deviations for each group at each time point, along with the calculated 't' values, degrees of freedom (df), and corresponding p-values. Similar to (Table 2), none of the comparisons show statistically significant differences between the two groups, as indicated by the p-values being greater than the threshold for significance (0.05), denoted as "NS" for "not significant". Additionally, it's mentioned that an unpaired 't' test was applied and a p<0.05 was considered statistically significant.

(Table 4) presents a comparison of postoperative complications between Group-H (hamstring tendon) and Group-P (P. Longus tendon). The table lists various complications, including knee stiffness and infection requiring arthroscopic debridement, along with the number and percentage of occurrences in each group. Fisher's exact test was applied to assess the significance of the differences, with a p-value less than 0.05 considered statistically significant. However, none of the complications showed a statistically significant difference between the two groups, as indicated by the p>0.05, denoted as "NS" for "not significant". Our study focused solely on assessing the functional outcome of 60 patients with ACL injuries who underwent ACL reconstruction. The results of our study indicated that both the peroneus longus and hamstring tendon groups achieved favourable to outstanding outcomes. The selection of graft is the paramount consideration in the operative plan. An appropriate graft is essential for preventing further injury or rupture and ensuring optimal stability of the knee. Rousseau *et al*[14]. found that the use of hamstring tendon graft and bone patella tendon bone (BPTB) is associated with postoperative complications, such as anterior knee pain and stiffness. Our study involved utilising a peroneus longus tendon graft as a substitute for the damaged ACL, with the aim of assessing its viability as an alternative to hamstring autograft. We conducted a comparative analysis of these two graft options, focusing on their functional outcomes. Remarkably, the mean diameter of the peroneus longus tendon graft was 8.4 ± 0.35mm, exceeding the optimal diameter required for swift reconstruction. According to Magnussen *et al*[15], it is recommended to use a graft diameter of at least 8 mm to minimise the need for additional surgery. Group H consisted of 30 patients who underwent a hamstring tendon graft, while Group P included 30 patients who received a peroneus longus tendon graft. Both groups exhibited similar characteristics in terms of age, sex, height, weight and the side affected. Both groups demonstrated a positive change in the average

Lysholm score from before the operation to 6 months later. However, the statistical analysis revealed that the differences in Lysholm scores between the two groups at each follow-up were not significant. Both groups exhibited a positive change in the average IKDC score from before the operation to 6 months later. However, the statistical analysis revealed that the differences in IKDC scores between the two groups at each follow-up were not significant. A comparative analysis of functional outcomes using hamstring tendon and peroneus longus tendon grafts revealed no statistically significant differences between the pre-surgery and 6-month post-surgery periods, as assessed by the IKDC and Lysholm Knee Scoring Scale. Several studies have documented favourable outcomes following ACL reconstruction using the peroneus longus tendon, with regards to both functional outcome and knee stability. In their study, Keyhani *et al*[16]. examined 130 patients and compared the functional outcome of using the peroneus longus graft versus the hamstring graft in anterior cruciate ligament reconstruction (ACLR). They concluded that there was no significant difference in clinical outcome and knee stability between the two grafts. Several studies have indicated that the peroneus longus tendon graft is superior due to its larger graft diameter and reduced thigh hypotrophy, while still maintaining excellent ankle function[17,18]. Bi *et al*[19] conducted a comparison between the utilisation of a single-bundle anterior half of the patellar ligament (PLT) and the semitendinosus tendon. Upon the 2-year evaluation, the study observed no disparities between the two groups in terms of the VAS scale, IKDC score, pivot shift test and KT-1000. In addition, the AOFAS score was significantly higher in the PLT group compared to the semitendinosus tendon group. This study determined that the use of PLT grafts results in superior strength and is relatively safe for reconstruction purposes. In their study, Trung *et al*[20]. found that anterior half peroneus longus tendon grafts used in ACLR resulted in no complications in the ankle and foot after surgery. A separate study demonstrated improvement in knee functionality as measured by the Lysholm scale, with no observed differences in ankle functionality[21].The user's text is enclosed in tags. At 6 months after surgery, a comparative analysis of the strength of ankle eversion and first ray plantar flexion showed no notable disparities between the donor site and the contralateral site[22]. In addition, the donor site was excellent. Our patient, following reconstruction, exhibited the ability to perform tiptoe walking without any restrictions on ankle and foot function, which aligns with these findings. In their study, He *et al*[23] determined that the peroneus longus tendon graft is a viable autograft option when harvested from outside the knee. This approach helps prevent the potential complication of quadriceps-hamstring imbalance that can arise from harvesting the graft within the knee. The choice of graft preference in ACL reconstruction was determined using a randomised odd-even method to eliminate any bias, despite the numerous benefits associated with peroneus longus tendon grafts. When aiming for a favourable outcome, the selection of the suitable graft relies on various factors such as the presence of meniscal and ligament injuries, the level of physical activity of the patient, their medical condition and any other existing health issues, their condition before the surgery, the patient's preference, and the rehabilitation plan after the operation[24].

CONCLUSION

The clinical and stability outcomes of anterior cruciate ligament (ACL) reconstruction using different techniques to prepare the peroneus longus tendon autograft are similar to those of hamstring autografts in the short-term. However, there is enough evidence to justify the use of peroneus longus tendon autografts in specific populations that have shown a strong motivation for this approach. Therefore, the use of the peroneus longus tendon autograft could be regarded as a secure and convenient source for arthroscopic anterior cruciate ligament reconstruction. This is due to its robustness, larger size, ability to maintain satisfactory ankle function and avoidance of potential complications associated with obtaining a hamstring autograft from the knee area.

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