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Outcome and donor site morbidity in trans-portal single bundle ACL reconstruction using peroneus longus tendon graft

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Abstract
Background: Hamstring and peroneus longus tendon auto graft has similar biomechanical strength. Peroneus longus is a potential graft in reconstructive orthopaedic procedures. There was few study in evaluation of peroneus longus usage in ACL reconstruction. We aimed to quantify the outcome and donor site morbidity in ACL reconstruction using peroneus longus tendon auto graft.
Methods: Patients who suffered isolated ACL injury were enrolled in the study and underwent trans-portal single bundle ACL reconstruction using peroneus longus auto graft. Functional score (IKDC, Modified Cincinnati, and Tegner-Lysholm score) were assessed at pre-operative and 2-years after surgery. Graft diameter was measured at the time of graft harvest. Thigh circumference, ankle score (AOFAS and FADI) and serial hop test were assessed to evaluate donor site morbidities.
Results: Sixty-eight patients fulfilled inclusion criteria. Peroneus longus graft diameter was 8.16±0.65 mm. There was significant difference between pre and 2-years post-operative functional score in IKDC, Modified Cincinnati and Tegner-Lysholm score. Mean of AOFAS was 93.98±2.95 and FADI was 94.80±0.56 with no significant decrease of thigh circumference, and good serial hop test result.
Conclusion: ACL reconstruction with peroneus longus auto graft has excellent functional score in IKDC, Modified Cincinnati, Tegner-Lysholm score at 2-years follow up with the advantages of larger graft diameter, less thigh hypotrophy, good serial hop test result, and excellent ankle function based on AOFAS and FADI score.

Keywords: ACL reconstruction, peroneus longus auto graft

Introduction
Arthroscopic anterior cruciate ligament (ACL) reconstruction is a common ligament reconstruction surgery with the aim of restoring functional knee stability. Various auto grafts like hamstring tendon, bone patellar tendon bone (BPTB), quadriceps tendon are used to reconstruct ACL. However, the site of graft harvesting is vulnerable to have donor site complications. The BPTB graft is still considered to be the gold standard graft in reconstruction [1]. Biomechanical strength of BPTB graft and native ACL is similar. BPTB graft allows early-active-safe-rehabilitation without an increased risk of graft failure and has good long-term result [1]. However, BPTB has potential morbidity to the site of graft harvesting include patellofemoral pain, loss of motion, and patellar fracture [2]. Thus, peroneus longus tendon has been used as a graft by some orthopaedic surgeons. Peroneus longus tendon auto graft is nowadays used in some orthopaedic procedures including deltoid ligament reconstruction [3] and Medial Patellofemoral Ligament (MPFL) reconstruction [4]. Peroneus longus and brevis has synergistic function [5]. Some previous studies have reported the usage of peroneus longus tendon as an auto graft in ACL reconstruction with good clinical outcome and minimal donor site morbidity [6]. Phatama *et al*., in 2017 reported there is no difference between peroneus longus and hamstring tendon tensile strength [7]. The purpose of this study is to evaluate the functional outcome and donor site morbidity of trans portal single bundle ACL reconstruction using peroneus longus tendon graft. This study considers the usage of peroneus longus tendon auto graft as a graft of choice in ACL reconstruction.

Materials and methods

This study is retrospective with consecutive sampling of ACL reconstruction patients operated in January 2018 until December 2019. The tear of ACL was diagnosed on the basis of history, physical examination and Magnetic Resonance Imaging of the injured knee. Isolated ACL tear patient at age between 18 and 45 years old and who had undergone trans-portal single bundle ACL reconstruction using peroneous longus tendon graft in the study period were included in the study. Exclusion criteria's were associated other ligament injury, meniscal tear, chondral damage, fracture around the knee, and presence of pathologic condition in the lower extremity or an abnormal contralateral knee joint. All the cases meeting inclusion criteria operated in study period from January 2018 to December 2019 and giving consent to take part in study were included in the study. A total of 68 patients met criteria to be enrolled in this study. The functional scores (International Knee Documentation Committee (IKDC), Modified Cincinnati, Tegner-Lysholm score) were recorded before the surgery. The final post-operative evaluation was performed at two years after the surgery to finish the rehabilitation protocol and obtain the peak function after ACL injury. Functional scores (IKDC, Modified Cincinnati, Tegner-Lysholm score), ankle functionial score (The American Orthopaedic Foot & Ankle Society (AOFAS) score and Foot and Ankle Disability Index (FADI) score), serial hop tests (single hop test, triple hop test, cross over hop test, time hop test), thigh circumference difference of bilateral femoral region at 10 cm and 20 cm form upper pole of the patella were recorded. All patients were operated by a single experienced knee surgeon. Patients positioned supine under spinal anesthesia. Tourniquet was used. Standard anterolateral and anteromedial portal were made. ACL tear was confirmed by diagnostic arthroscopy and followed by peroneus longus tendon harvesting. Peroneus longus tendon was harvested from ipsilateral leg. The incision site was marked at about 1 inch above and 1/2 inch behind the lateral malleolus. Skin, subcutaneous tissue, and superficial fascia were incised in line. Peroneus longus and peroneus brevis tendon were identified. The Peroneus longus tendon was divided at about 1 inch above the level of lateral malleolus. Distal part of the peroneus longus tendon was sutured with end-to-side suture. Peroneus longus tendon was stripped proximally using tendon stripper until about 2 inches below the fibular head to avoid common peroneal nerve injury. Fibrous tissue was cleared from the intercondylar notch to facilitate good visualization during preparation of the tunnels. Remnant ACL fibers were preserved as a reference for graft insertion. The femoral tunnel and the tibial tunnel were drilled independently. Graft tendon was implanted and tensioned to prevent graft loosening in the future. Graft tendon was fixed with suspensory fixation (Endobutton®, Smith & Nephew) on femoral side and bio absorbable aperture fixation (Bio RCI®, Smith & Nephew) on tibial side. Patients were treated with the standard ACL rehabilitation program. Patients were trained to exercise the injury site leg using partial weight bearing for 6-weeks post-operative period then after full weight bearing was allowed. Knee extension was begun immediate after surgery. Knee flexion was increased gradually from 0 to 90 degree until 3 weeks post-surgery with subsequent full flexion. Long Knee Brace was applied rest of the time. The patient was allowed to jog after 3 months. Patients allowed to return for sport activity after passing functional outcome test and serial hop test at 9 months. The knee stability was tested by anterior drawer test, Lachmann test. Final functional outcome and donor site morbidity were recorded two year after surgery. IKDC, Modified Cincinnati, Tegner-Lysholm score, AOFAS score, and FADI score were recorded. Thigh circumference of donor site was compared to the contralateral healthy side. Serial hop test was also recorded.

Results

During the study period, 76 patients underwent the isolated transportal single bundle ACL reconstruction using peroneus longus autograft. Eight patients were excluded because of concomitant injury to the meniscus/cartilage or refusing to give consent to participate in this study. Sixty-eight patients fulfilled inclusion criteria. Fifty-three patients were male and 15 patients were female. Mean age of the patients was 24.03±7.71 with range from 19 until 45 years old. Mechanism of injury was sport injury in 47 patients, motorcycle accident in 6 patients and others injury in 15 patients. Diameter of the peroneus longus autograft was measured and recorded in patient case record file at the time of surgery. The mean diameter of peroneus longus autograft was 8.16±0.65 mm. See Table 1.

Table 1: The mean diameter of peroneus longus autograft was 8.16±0.65 mm

Variables	Mean	SD	Minimum	Maximum	N (Total 68)
Age	24.03	7.71	19	45	
Sex					
Male					53 (77.9%)
Female					15 (22.1%)
Injury Mechanism					
Sports					47 (69.1%)
Motorcycle					6 (8.8%)
Others					15 (22.1%)
Graft Diameter	8.16 mm	0.65	6.5 mm	10 mm	

There was thigh hypotrophy of less than 2 cm. The mean thigh circumference at 10 cm from upper pole of patella was 40.79±2.39 cm at injury side and 41.49±2.52 cm at contralateral side. The mean of thigh circumference at 20 cm from upper pole of patella bone was 48.07±3.11 cm at injury side and 48.99±3.02 cm at contralateral side. There was no difference both at 10 cm and 20 cm of thigh circumference between injury side and contralateral side ($p>0.05$). See Table 2.

Table 2: Thigh Circumference

	Injury Side				Contralateral Side				p-value
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	
10cm above patella	40.79	2.39	37	48	41.49	2.52	37	49	>0.05
20cm above patella	48.07	3.11	42	56	48.99	3.02	43	57	>0.05

Result of mean IKDC score pre-operative was 51.93±13.32 and post-operative was 90.91±3.18. Mean Modified Cincinnati score pre-operative was 62.18±15.43 and post-operative was 88.63±6.69. Mean Tegner-Lysholm score pre-operative was 64.41±14.53 and post-operative was 85.21±7.92. There were significant differences between preoperative and 2-year postoperative score in IKDC, Modified Cincinnati, and Tegner-Lysholm score ($p<0.05$). See Table 3.

Table 3: Functional Outcome

	Pre-operative		Post-operative		p-value
	Mean	SD	Mean	SD	
IKDC	51.93	13.32	90.91	3.18	<0.05
Modified Cincinnati Score	62.18	15.43	88.63	6.69	<0.05
Tegner-Lysholm Score	64.41	14.53	85.21	7.92	<0.05

Evaluation of donor site morbidity of peroneus longus tendon autograft was done using AOFAS and FADI score. The mean of AOFAS score of donor ankle was 93.98±2.95 and FADI score was 94.80±0.56. See Table 4.

Table 4: Donor Site morbidity

	Mean	SD	Minimum	Maximum
AOFAS	93.98	2.95	86	95
FADI	94.80	0.56	93	95

The mean score of single hop test was 86.84±2.33. The mean score of triple hop test was 89.45±2.22. The mean score of cross over hop test was 89.04±2.19. The mean score of timed hop test was 89.09±3.89. See Table 5.

Table 5: Serial hop test

	Mean	SD	Minimum	Maximum
Single Hop test	86.84	2.33	84	91
Triple Hop test	89.45	2.22	86	93
Cross over hop test	89.04	2.19	86	93
Timed hop test	89.09	3.89	84	93

Discussion

Biomechanical study has shown no significant difference of tensile strength between the peroneus longus tendon and four strand hamstrings tendons [7]. ACL reconstruction with peroneus longus tendon has shown good result in functional outcome of the knee [6]. Diameter of auto graft is one of the most important considerations during arthroscopic ACL reconstruction surgery of the knee. ACL reconstruction using quadrupled-strand hamstring auto graft with a diameter equal to or larger than 8mm decreases failure rates [8]. The effect of the auto graft diameter to rupture and revision rate of the reconstructed ACL of the knee has been studied. Graft failure rate is higher in younger patients [9]. Patient with height less than 149 cm has potential hamstring graft size less than 7mm and needs to augmentation of the graft. Study have also found significant positive correlation between 1mm increase in graft diameter, with higher KOOS score and IKDC score. It has also been found that there was higher revision rate with autograft size less than 8 mm [10] in this study, we had found that mean of peroneus longus tendon autograft diameter was more than 8 mm. This result indicates that peroneus longus autograft is potential choice for ACL reconstruction minimizing risks of post-operative rupture incidence. There are some donor site morbidities using hamstring autograft namely thigh hypotrophy and hypoesthesia or anesthesia subjective feeling caused by injury of infrapatellar branch of saphenous nerve. Thigh hypotrophy due to hamstring (semitendinosus and gracilis) tendon harvesting results in decreased hamstring strength, particularly in deep flexion angles. The hypotrophy of the hamstring also results in quadriceps and hamstring imbalance resulting in imbalance of knee dynamic stability [11]. Injured leg is usually hypotrophied in hamstring tendon usage as ACL reconstruction auto graft [12]. our study has no similar thigh hypotrophy in injured side because of the use of peroneus longus as an autograft for ACL reconstruction. Our study showed excellent result in IKDC score, Modified Cincinnati, and Tegner-Lysholm score. In a study by Khajotia *et al*., improvement in IKDC score was noted in 6 months post ACL reconstruction using peroneus longus tendon with mean score 83.53 [13]. Similarly, Kerimoglu *et al*. showed good result in mean Lysholm score 83.7 in ACL reconstruction with usage of peroneus longus tendon as a graft [6]. Peroneus longus tendon is preferred as autograft because of no loss in knee extension or flexion and absence of patellofemoral pain [6]. A study by Angthong *et al*. mentioned possible donor site morbidity using peroneus longus tendon as autograft, including decreased peak torque eversion and inversion, decreased ankle function and stability [14]. However, we found contradicting result in this study. We found that the function of donor ankle was excellent even after harvesting peroneus longus tendon according to ankle functional test based on AOFAS and FADI score. This may be probably because of intact peroneous brevis. Previous studies had shown that peroneus brevis is a more effective evertor of the ankle, which will maintain ankle eversion function after harvesting of peroneus longus tendon [5] further study could be directed in measurement of ankle stability and power, and correlate it with functional score after harvesting of peroneus longus tendon. Our study had shown excellent score in single hop test, triple hop test, and cross over hop test, and timed hop test. Serial hop test is a predictive test to consider the ACL reconstructed patients when they can return to sport [15] our study has some limitations. The sample size is small. There is no objective evaluation for stability and range of motion of ankle. However, the bias was minimized with using a single surgeon, same rehabilitation protocol and operative technique. Objective measurement of ankle evictor strength also could be used to evaluate donor site morbidity of peroneus longus harvesting, and its relationship with ankle functional score can be evaluated.

Conclusion

Tran's portal single bundle ACL reconstruction with peroneus longus tendon auto graft had excellent functional outcome, minimal donor site morbidity, excellent serial hop test, and no thigh wasting. Peroneus longus can be considered as potential graft of choice in ACL reconstruction.

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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Conflict of Interest

Not available

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Not available

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