

Original research article

Single bundle ACL Reconstruction with Peroneus Longus Tendon Autograft: A short-term study

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Abstract

Background: A peroneus longus tendon autograft is used in many orthopaedic procedures and it is biomechanically comparable to a hamstring tendon autograft. Despite its potential, there are few studies that have evaluated the use of the peroneus longus tendon in ACL reconstruction. The purpose of this study is to evaluate the functional outcome and donor site morbidity of single bundle ACL reconstruction using peroneus tendon graft. This study considers the usage of peroneus longus tendon autograft as a graft of choice in ACL reconstruction.

Material and methods: This prospective study was done across two different tertiary hospitals from April 2017 to June 2020. A total of 100 patients gave informed consent to be included in this study and underwent single bundle ACL reconstruction using peroneous tendon graft. The functional scores (International Knee Documentation Committee (IKDC), Modified Cincinnati, Tegner-Lysholm score) were recorded before the surgery and after the surgery.

Results: Out of 100, 80 patients were male and 20 patients were female. Mean age of the patients was 27.25 ± 9.11 with range from 19 to 46 years old. Injury mechanism of the patients was motorcycle accident 7 patients, sport injury 75 patients, and others injury 18 patients. Diameter of the peroneus longus graft was measured and recorded intraoperative, and the result peroneus longus graft mean diameter was 8.55 ± 0.73 mm. The mean of thigh circumference at 10 cm from upper pole of patella bone was 44.77 ± 2.87 at injury site and 45.95 ± 2.97 at contralateral site. The mean of thigh circumference at 20 cm from upper pole of patella bone was 52.77 ± 3.73 at injury site and 53.83 ± 3.55 at contralateral site. Result of mean IKDC score pre-operative was 55.77 ± 15.11 and post-operative was 96.12 ± 3.52 . Mean Modified Cincinnati score pre-operative was 66.12 ± 17.32 and post-operative was 94.36 ± 7.21 . Mean Tegner-Lysholm score pre-operative was 68.45 ± 15.65 and post-operative was 90.44 ± 8.56 .

Conclusion: ACL reconstruction with peroneus longus autograft has excellent functional score in IKDC, Modified Cincinnati, Tegner-Lysholm score at 1-years follow up with the advantages of greater graft diameter, less thigh hypotrophy, good serial hop test result, and excellent ankle function based on AOFAS and FADI score.

Introduction

Anterior cruciate ligament (ACL) reconstruction is performed using different grafts. Allografts, autografts and synthetic grafts have been used with variable success rates.¹ Among these grafts, bone-patellar tendon-bone (BPTB) and four-strand hamstring autografts are the two most common autografts used for ACL reconstruction and each has its own advantages and

disadvantages. According to the latest studies, BPTB is the best graft choice because it has bone-to-bone healing which permits the effective incorporation of tunnel and graft, leading to a faster return to function and sports activity. This characteristic is important in professional athletes with ACL injuries. However, it carries the risk of patellar fracture, with an invasive approach and a large incision, fixed length and a weaker than native ACL, making it unsuitable for double-bundle reconstruction and anterior kneeling pain.^{2,3,4} Pain free kneeling is considered very important in the Asian population, especially in Indonesians, who kneel rigorously when praying. For these reasons, hamstring autografts are becoming popular in the Asian population.^{5,6} A hamstring autograft is easy to harvest with minimal donor site morbidity and strength that is comparable to that of the native ACL. On the other hand, it has unpredictable graft size and a potential decrease in hamstring power, which is crucial for some athletes who need dominant hamstring power.⁷ Some orthopaedic surgeons are therefore attempting to use the peroneus longus tendon as a graft. Peroneus longus tendon autografts are commonly used in some orthopaedic procedures, including spring ligament reconstruction⁸, deltoid ligament reconstruction and medial patellofemoral ligament (MPFL) reconstruction⁹ (anterior half of the peroneus longus tendon). This is possible, due to the synergistic function of the peroneus longus and peroneus brevis. Some studies have even found that the peroneus brevis is a more effective evertor of the ankle, justifying the harvest of the peroneus longus tendon.¹⁰ The purpose of this study is to evaluate the functional outcome and donor site morbidity of single bundle ACL reconstruction using peroneus tendon graft. This study considers the usage of peroneus longus tendon autograft as a graft of choice in ACL reconstruction.

Material and methods

This prospective study was done across two different tertiary hospitals from April 2017 to June 2020, after taking the approval of the protocol review committee and institutional ethics committee.

Inclusion criteria

ACL tear in patients aged between 18-45 years

Exclusion criteria

Associated ligament injury

Chondral damage

Meniscal injury

Fracture around the knee

Presence of pathologic condition in the lower extremity

Methodology:

A total of 100 patients gave informed consent to be included in this study and underwent single bundle ACL reconstruction using peroneus tendon graft. The functional scores (International Knee Documentation Committee (IKDC), Modified Cincinnati, Tegner-Lysholm score) were recorded before the surgery. The post operative evaluation was performed at two years after the surgery to finish the rehabilitation protocol and obtain the peak function after ACL injury. We recorded functional scores (IKDC, Modified Cincinnati, Tegner-Lysholm score), ankle functional 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 from upper pole of the patella. A single experienced knee surgeon operated all patients. Patients placed in supine position under regional anesthesia. Tourniquet was applied

in the thigh and inflated without elevation and exsanguination. Standard anterolateral and anteromedial portal were made. Diagnostic arthroscopy for ACL rupture was performed and followed by peroneus longus tendon harvesting. Peroneus tendon harvesting was done in ipsilateral leg. The incision location was marked at 2-3 cm above and 1 cm behind the lateral malleolus. The incision was made through the skin, subcutaneous tissue, and superficial fascia. Peroneus longus and peroneus brevis tendon were identified.

Patients were managed with the similar hospital based ACL rehabilitation program. Patients were trained to exercise the injury site leg using partial weight bearing until 3-weeks post-surgical procedure. Patients were allowed to full weight bearing. Active knee flexion started from 0 to 90 (increased gradually) until 3 weeks post-surgery with subsequent full flexion. The patient was allowed to jog after 2 months. Patients allowed to return for sport activity after passing functional outcome test and serial hop test at 6 months. The test consists of evaluation of knee stability based on anterior drawer test, lachmann test, and serial hop test. Post-operative functional outcome and donor site morbidity were recorded two year after surgery. A single orthopaedic surgeon, outside from surgical team, examined and interviewed all the patients. We recorded IKDC, Modified Cincinnati, Tegner-Lysholm score, AOFAS score, FADI score, measured thigh circumference of donor site, and compared to the contralateral healthy side, and also recorded serial hop test.

Results

During the period of study, 100 patients underwent the isolated single bundle ACL reconstruction. Out of 100, male was 80 patients and female was 20 patients. Mean age of the patients was 27.25 ± 9.11 with range from 19 to 46 years old. Injury mechanism of the patients was motorcycle accident 7 patients, sport injury 75 patients, and others injury 18 patients. See Table 1.

Diameter of the peroneus longus graft was measured and recorded intraoperative, and the result peroneus longus graft mean diameter was 8.55 ± 0.73 mm. See Table 1. No patients had thigh hypotrophy of more than 20 mm. The mean of thigh circumference at 10 cm from upper pole of patella bone was 44.77 ± 2.87 at injury site and 45.95 ± 2.97 at contralateral site. The mean of thigh circumference at 20 cm from upper pole of patella bone was 52.77 ± 3.73 at injury site and 53.83 ± 3.55 at contralateral site. There was no difference both at 10 cm and 20 cm of thigh circumference between injury site and contralateral site ($p > 0.05$). See Table 2.

Result of mean IKDC score pre-operative was 55.77 ± 15.11 and post-operative was 96.12 ± 3.52 . Mean Modified Cincinnati score pre-operative was 66.12 ± 17.32 and post-operative was 94.36 ± 7.21 . Mean Tegner-Lysholm score pre-operative was 68.45 ± 15.65 and post-operative was 90.44 ± 8.56 . 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.

Evaluation of donor site morbidity of peroneus longus tendon autograft using AOFAS and FADI score. The mean of AOFAS score of donor ankle was 97.87 ± 3.21 and FADI score was 98.98 ± 0.61 . See Table 4.

The mean score of single hop test was 92.42 ± 2.52 . The mean score of triple hop test was 94.16 ± 2.37 . The mean score of cross over hop test was 94.44 ± 2.39 . The mean score of timed hop test was 94.25 ± 4.18 . See Table 4.

Table 1: Demographic profile of the patients

Characteristics	Mean
Age (Mean±SD)	27.25±SD
Sex	

Male	80(80)
Female	20 (20)
Injury mechanism	
Motorcycle accident	7 (7)
Sport	75(75)
Others	18 (18)
Graft diameter	8.55±0.73

Table 2: Thigh circumference

Thigh circumference	Injury site		Contralateral site		p-value
	Mean	SD	Mean	SD	
10 cm thigh diameter	44.77	2.87	45.95	2.97	0.086
20 cm thigh diameter	52.77	3.73	53.83	3.55	0.666

Table 3: Functional outcome

Outcome	Pre-operative		Post-operative		p-value
	Mean	SD	Mean	SD	
IKDC	55.77	15.11	96.12	3.52	0.000
Modified cincinnati	66.12	17.32	94.36	7.21	0.000
Tegner-Lysholm	68.45	15.65	90.44	8.56	0.000

Table 4: Donor site morbidity and serial hop test

	Mean	SD
FADI	98.98	0.61
AOFAS	97.87	3.21
Single hop	92.42	2.52
Triple hop	94.16	2.37
Cross over hop	94.44	2.39
Timed hop	94.25	4.18

Discussion

A previous biomechanical study showed no significant difference of tensile strength between the peroneus longus and four strand hamstring.¹¹ ACL reconstruction with peroneus longus tendon showed good result in functional outcome.¹² Diameter of the graft is one of the most important considerations during ACL reconstruction surgery of the knee. ACL reconstruction using quadrupled-strand hamstring autograft with a diameter equal to or larger than 8 mm decreases failure rates.¹³ Grafts larger than 8 mm were found to provide a protective effect in patients aged younger than 20 year.¹³ The effect of the autograft diameter to rerupture and revision rate of the reconstructed ACL of the knee has been studied intensively. Graft failure rate is higher in younger patients.¹⁴ Patient with height less than 149 cm has potential graft size less than 7 mm and needs to augment of the graft. Another study found significant positive correlation between 1 mm increase in graft diameter, with higher KOOS score and IKDC score, and also higher revision rate with graft size of less than 8 mm.¹⁵ In this study, we found that mean of peroneus longus tendon graft diameter was 8.55 ± 0.73 mm. This result indicates that peroneus longus autograft is potential choice for ACL reconstruction and minimizing risks of rerupture incidence in the future. There is some donor site morbidity using hamstring graft, including 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,

especially in deep flexion angles. The hypotrophy of the hamstring also results in quadriceps and hamstring imbalance which results in imbalance of knee dynamic stability.¹⁶ Injured leg is usually smaller than uninjured leg in hamstring tendon usage as ACL reconstruction graft.¹⁷ The suggested reason why our study has similar thigh circumference between injured site and uninjured site is because of the peroneus longus as a graft for ACL reconstruction. According to the research result, peroneus longus graft does not interfere the thigh diameter in injured leg. Our study showed excellent result in IKDC score pre-operative was 55.77 ± 15.11 and post-operative was 96.12 ± 3.52 . Mean Modified Cincinnati score pre-operative was 66.12 ± 17.32 and post-operative was 94.36 ± 7.21 . Mean Tegner-Lysholm score pre-operative was 68.45 ± 15.65 and post-operative was 90.44 ± 8.56 . There were significant differences between preoperative and 2-year postoperative score in IKDC, Modified Cincinnati, and Tegner-Lysholm score ($p < 0.05$). Khajotia et al. stated improvement in IKDC score in 6 months post ACL reconstruction using peroneus longus tendon with mean score 83.53.¹⁸ Kerimoglu et al. showed good result in mean Lysholm score 83.¹² in ACL reconstruction with usage of peroneus longus tendon as a graft.¹² Peroneus longus tendon is preferred because of there is no extension or flexion loss and no patellofemoral pain in patients.¹² A previous study by Anghong et al. mentioned possible donor site morbidity using peroneus longus tendon, including decreased peak torque eversion and inversion, decreased ankle function, and concern of ankle stability.¹⁹ However, this study found the contradicting result with the previous study. We found that the function of donor ankle was excellent after harvesting peroneus longus tendon according to ankle functional test based on FADI and AOFAS score. This probably because donor ankle has intact peroneus brevis. Previous studies mentioned that peroneus brevis is a more effective evertor of the ankle, which will maintain ankle eversion function after harvesting of peroneus longus tendon.²⁰ 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 reported excellent score in single hop test, triple hop test, cross over hop test, and timed hop test. The mean score of single hop test was 92.42 ± 2.52 . The mean score of triple hop test was 94.16 ± 2.37 . The mean score of cross over hop test was 94.44 ± 2.39 . The mean score of timed hop test was 94.25 ± 4.18 . Serial hop test is a predictive test to consider the ACL injury patients when they can return to sport.²¹ This study has some limitations like the cohort is too small with no comparison, short follow up and no evaluation for stability and range of motion. However, the bias was minimized with using a single surgeon, the same rehabilitation protocol and operative technique. Objective measurement of ankle evertor or 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

ACL reconstruction with peroneus longus autograft has excellent functional score in IKDC, Modified Cincinnati, Tegner-Lysholm score at 1-years follow up with the advantages of greater graft diameter, less thigh hypotrophy, good serial hop test result, and excellent ankle function based on AOFAS and FADI score.

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Received: 12-08-2020 || Revised: 23-08-2020 || Accepted: 28-09-2020