

A comparison of functional knee outcomes post-arthroscopic anterior cruciate ligament (ACL) reconstruction using hamstring and *peroneus longus* (PL) autograft

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ABSTRACT

Background: Hamstring autograft (HA) is the most common graft used in ACL reconstruction procedures. However, harvesting HA could weaken the secondary stabilizer of the knee joint. *Peroneus longus* grafts (PL) is a novel option secondary to hamstring graft with less morbidity at the knee joint. We intended to determine whether *peroneus longus* autograft (PL) is a comparable alternative to hamstring autograft for ACL Reconstruction.

Methods: 84 patients were grouped into "hamstring" (n = 51) and "*peroneus longus*" (n = 33) groups, with a mean age of 26.2 ± 5.9 in the Hamstring group and a mean age of 26.4 ± 6.6 in *peroneus* group. We obtain secondary data from the medical records of several hospitals in Makassar.

Results: There was a significant difference in Lysholm score (p<0.05) in the hamstring group with *peroneus* at 6 months and 12 months postoperatively for IKDC score, anterior translation, Power Grading Flexi-Extension, ROM on flexion, and extension. In addition, in muscle atrophy, the Hamstring group compared to the *peroneus* group also showed a significant difference (p=0.001).

Conclusion: The study's results did not show significant differences between the hamstring and *peroneus* groups other than atrophy of thigh muscles in the hamstring group. Based on the results of this study, we conclude *peroneus longus* graft is one of the graft options in ACL reconstruction surgery.

Keywords: ACL reconstruction, clinical function, hamstring, *peroneus*.

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INTRODUCTION

The anterior cruciate ligament (ACL) is an intra-articular structure important for the knee joint's normal movement. The incidence of ACL injuries reaches up to 200,000 cases every year and is even predicted to continue to grow. Approximately 70% of ACL injuries are caused by sports.¹

In general, there are four types of grafts that can be used in ACL reconstruction which is the patellar tendon (PT), the 4-strand hamstring (HS, formed from the gracilis and semitendinosus tendons), the quadriceps tendon, and the *peroneus longus* tendon (PL).²

Due to the many knee joint complications involving patellar

and hamstring tendon grafts in ACL reconstruction, the proposed new solution is the use of the surgical technique by performing anterior cruciate ligament reconstruction using the *peroneus longus* tendon.³

Experts estimate that the *peroneus longus* tendon (PLT) has a muscle graft strength that is almost similar to the strength of the ACL so that it can be used for reconstruction.^{3,4}

The hamstring tendon has recently been known as a secondary stabilizer for the knee and hip joints, so when the hamstring muscles are weaker than the quadriceps muscles, there will be an imbalance in the movement of the flexor and extensor muscles which results in increased stress on the anterior cruciate

ligament.^{1,3}

The purpose of this study is to evaluate and research made to strengthen previous studies that *peroneus longus* tendon graft is a good alternative choice to hamstring graft. Orthopedic surgeons can use the *peroneus longus* tendon as an alternative to graft in performing ACL reconstruction surgery.

METHODS

This study is an observational cross-sectional analytic study on a series of patients who have undergone ACL reconstruction surgery with either hamstring or *peroneus longus* graft. The diagnosis of ACL rupture is confirmed by an MRI study, and all patients give their

consent to be included in this study.

The samples studied were 97 patients diagnosed with ACL rupture who received ACL reconstruction treatment using hamstring tendon autograft and 44 *peroneus longus* tendon autograft obtained from secondary data at several hospitals, including Wahidin Sudirohusodo Hospital Makassar and Hasanuddin University Education Hospital Makassar in the period January 2019 - June 2020. Data were collected at the 6th and 12th months postoperatively. Statistical analysis was carried out with a comparative study to determine the comparison of functional outcomes in this sample group.

Inclusion criteria were patients undergoing ACL reconstruction at 6 months and 12 months with hamstring and *peroneus longus* autograft from January 2019 – June 2020. Patients who agreed to participate in this study with aged around 18 – 45 years old. The patient completed the post-operative physiotherapy program as scheduled. In comparison, the exclusion of this study was lost to follow-up patients, patients with other injuries around the knee and leg (including meniscal/other ligament injuries), and patients with a post-surgery infection.

RESULT

Arthroscopic Technique

The operation was done by either of our two senior knee consultants. All patient was positioned in a supine position with regional anesthesia and assisted with a tourniquet. The standard incision was done on the anteromedial and anterolateral sides to establish a route for the portals. The diagnosis of ACL tear was ensured with diagnostic arthroscopy.

We perform the graft harvesting of either hamstring or *peroneus longus* graft with a tendon stripper and clear the graft from any excess soft tissue before we prepare the graft for fixation. The graft preparation is made in a sterile graft preparation table, and we tailor the graft to adequate length and diameter. We sought to have a graft diameter above 8.5 mm to reduce the complication of graft failure, as Brett et al. have demonstrated.⁵

We prepare the tibial and femoral tunnel for a single bundle graft with the

the axis aligned with the joint, the distal portion of the device is translated with the distal segment of the body. The device assesses the linear translation and displays it in a light emitting diode (LED) display in millimeters, and we perform the test with criteria of laxity; more than 3 mm is termed unstable.⁷

Thigh Diameter

The wasting (thinning) or loss of muscle tissue, measurement of thigh circumference is usually performed 15 cm proximal to the superior pole of the patella. This level is the most relevant level to detect muscle atrophy due to knee problems.⁸ The thigh circumference is measured in cm with a measurement tape.



Figure 1. Diagnostic arthroscopy performed via the classic anteromedial and anterolateral portal.

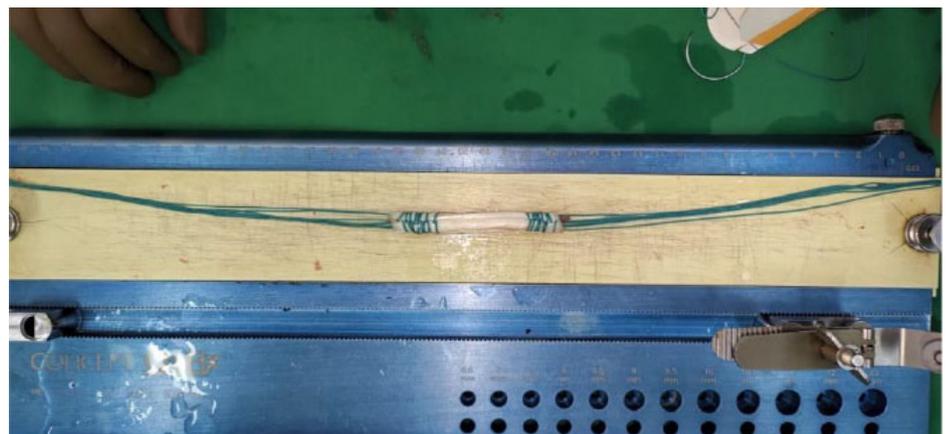


Figure 2. Graft preparation.

SECTION 1 - LIMP

- I have no limp when I walk. (5)
- I have a slight or periodical limp when I walk. (3)
- I have a severe and constant limp when I walk. (0)

SECTION 2 - Using cane or crutches

- I do not use a cane or crutches. (5)
- I use a cane or crutches with some weight-bearing. (2)
- Putting weight on my hurt leg is impossible. (0)

SECTION 3 - Locking sensation in the knee

- I have no locking and no catching sensation in my knee. (15)
- I have catching sensation but no locking sensation in my knee. (10)
- My knee locks occasionally. (6)
- My knee locks frequently. (2)
- My knee feels locked at this moment.. (0)

SECTION 4 - Giving way sensation from the knee

- My knee gives way. (25)
- My knee rarely gives way, only during athletics or vigorous activity. (20)
- My knee frequently gives way during athletics or other vigorous activities. In turn I am unable to participate in these activities. (15)
- My knee frequently gives way during daily activities. (10)
- My knee often gives way during daily activities. (5)
- My knee gives way every step I take. (0)

SECTION 5 - PAIN

- I have no pain in my knee. (25)
- I have intermittent or slight pain in my knee during vigorous activities. (20)
- I have marked pain in my knee during vigorous activities. (15)
- I have marked pain in my knee during or after walking more than 1 mile. (10)
- I have marked pain in my knee during or after walking less than 1 mile. (5)
- I have constant pain in my knee. (0)

SECTION 6 - SWELLING

- I have swelling in my knee. (10)
- I have swelling in my knee only after vigorous activities. (6)
- I have swelling in my knee after ordinary activities. (2)
- I have swelling constantly in my knee. (0)

SECTION 7 - CLIMBING STAIRS

- I have no problems climbing stairs. (10)
- I have slight problems climbing stairs. (6)
- I can climb stairs only one at a time. (2)
- Climbing stairs is impossible for me. (0)

SECTION 8 - SQUATTING

- I have no problems squatting. (5)
- I have slight problems squatting. (4)
- I cannot squat beyond a 90deg. Bend in my knee. (1)
- Squatting is impossible because of my knee. (0)

Figure 3. Lysholm Knee Score.

former prepared first. We perform the tunnel drilling with the remaining ACL remnant as our guide for correct tunnel placement. The graft was fixed in place after tensioning with EndoButton on the femoral side and an interference screw on the tibial side.

Post-Operative Rehabilitation

The rehabilitation protocol is done according to the Clinical Orthopaedic Rehabilitation Manual by Brotzman, which is divided into 5 phases, and all rehabilitation protocol is performed under the supervision of our Physical Medicine and Rehabilitation Consultant.⁶

Lysholm Knee Score

A questionnaire to assess functional disability in patients with knee disorders

after the ACL reconstruction. The score ranges from 0-100. Categorized as 95-100 excellent, 84-94 good, 65-83 fair, and less than 64 is bad.

IKDC Scoring

A subjective measurement tool to detect improvement or deterioration in symptoms, function, and sports activities due to knee impairment. Scores range from 0 points (lowest level of function or highest level of symptoms) to 100 points (highest level of function and the lowest level of symptoms).

Mobile Aider

It is a device used to objectively calculate the anterior translation of the tibia relative to the femur. When the device is stabilized against the proximal joint surface with

Power Grading

Assessed by gauging the examiner's ability to overcome the patient's full voluntary muscle resistance, determine with complete paralysis (0), a flicker of contraction possible (1), movement is possible when gravity is excluded (2), movement is possible against gravity (3), movement is possible against gravity and some mild to moderate resistance (4), and movement is possible against maximal resistance (5).⁹

Range of Motion

Measured with A completely straight knee joint will measure 0°, and a fully bent knee will have flexion of at 135° degrees. Some would have an inter-individual variation that would range with a mean of 143.7° of flexion and -1.6° for extension.¹⁰

DISCUSSION

In the range of January 2019 – June 2020, 97 patients underwent ACL reconstructive surgery using the Hamstring tendon. A total of 7 patients could not be contacted, 25 patients with other injuries around the knee and leg other than ACL rupture and 14 patients outside the age of 18 to 45 years, so the total sample processed was 51 patients. In the range of January 2019-June 2020, 44 patients underwent ACL reconstructive surgery using the *peroneus longus* tendon. A total of 2 patients could not be contacted, and 9 patients had other injuries around the knee, so the total sample processed was 33 patients.

In Lysholm Knee Score, there were no significant differences between the two groups both at 6 months and 12 months follow-up, with a score of 0.922 and 0.796. The IKDC score shows that there were no significant differences between the two groups at both 6 and 12-month follow-ups, with a score of 0.975 and 1.000. Mobile aider comparison also showed there were no significant differences on both 6 and 12 months follow up with a score of 0.909 and 0.954. Flexion power grading shows there are no significant differences between groups. Extension power grading also shows the same result. In the range of motion for both extension and flexion, there are also no significant differences to be found. In the muscle atrophy group, we found there were significant differences at

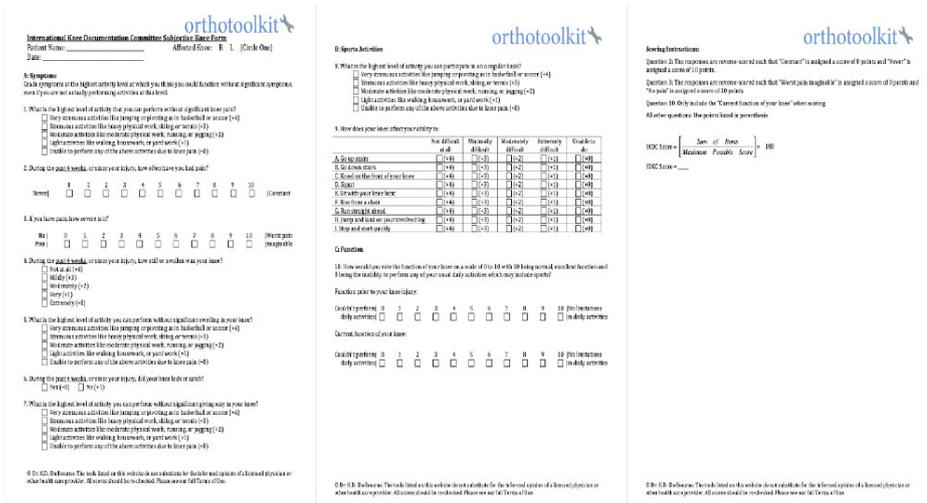


Figure 4. IKDC Scoring.



Figure 5. Measurement using mobile aider. Defined as a more than 3 mm increase in AP translation (Lachman test).

6 months and 12 months follow-up with a score of 0.001 for both follow-ups, with the hamstring group having significant muscle atrophy compared to the *peroneus longus* tendon group.

Previous studies have shown good results after ACL reconstruction using *peroneus longus* autograft in terms of functional outcome and knee stability. Rhatomy et al. compared the hamstring with PLT autograft and found no significant difference between the functional outcomes of the two at 1 year postoperatively.¹¹ In our study, we



Figure 6. Measure muscle to detect muscle atrophy due to knee problem.

evaluated the functional outcome and stability of the knee joint after *peroneus longus* and hamstring autograft repair of the ACL, which have shown comparable results to Kerimoglu et al.¹²

In knee joint instability, there were no significant differences in the examination of anterior translation using a mobile aider, for this study is also in line with the research of Fu Dong Shi et al.¹³

In the strength of the knee flexor and extensor muscles, there was no significant difference in this study between the comparison of ACL reconstruction using hamstring tendon and *peroneus longus* tendon, where this study was not in line with the study of Sofia Sergia et al. because this study was assessed at 6 months and 12 months postoperatively while previous studies were carried out at 4 to 6 months, where the recovery of the muscle has not returned, causing weakness of the flexor and extensor muscles of the knee.¹⁴

In this study, there is a significant difference when the muscle bulk was compared between the hamstring and *peroneus longus* tendon, with the former having a more significant muscle bulk reduction than the latter. This study is in line with previous research conducted by Rhatomy et al.¹¹

Another meta-analysis also supports the use of the *peroneus longus* tendon graft as the graft of choice outside the knee, with the resultant survival rate of the *peroneus longus* tendon graft having no significant difference from the hamstring graft. Using the *peroneus longus* tendon

graft would avoid the complication of quadriceps-hamstring imbalance, which can occur when harvesting autografts from the knee, but with the risk of lower AOFAS (American Orthopaedic Foot and Ankle Society) score due to donor site complication.¹⁵ However, there were several limitations to this study. We did not have an objective machine to determine the power. We only used a clinical assessment to determine the power grading of flexion and extension of the knee and did not separate between athlete and non-athlete groups in this study. Further study with a bigger sample size and prospective approach is required to clarify the recent findings.

CONCLUSION

There was no significant difference in clinical or functional outcomes based on Lysholm Knee Score, International Knee Documented Chart (IKDC), Mobile aider, Power Grading flexion-extension, and range of knee motion in patients undergoing ACL reconstruction using hamstring tendon or *peroneus* tendon. The hamstring group has more incidence of muscle atrophy rather than the *peroneus* group despite similar rehabilitation protocol. *Peroneus longus* tendon graft could be another choice in a surgeon's armamentarium to perform anterior cruciate ligament reconstruction with a result comparable to the classic hamstring graft.

CONFLICT OF INTEREST

The author reports no conflicts of interest in this work.

ETHICS CONSIDERATION

Ethics approval has been obtained from the Ethics Committee of Universitas Hasanuddin, Makassar, Indonesia, prior to the study being conducted.

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AUTHOR CONTRIBUTIONS

All authors equally contribute to the study from the conceptual framework,

Table 1. Assessed examiner's ability to overcome the patient's full voluntary muscle resistance.

Grade	Ability move
5	The muscle can move the joint it crosses through a full range of motion, against gravity, and against full resistance applied by the examiner.
4	The muscle can move the joint it crosses through a full range of motion against moderate resistance.
3	The muscle can move the joint it crosses through a full range of motion against gravity but without any resistance.
2	The muscle can move the joint it crosses through a full range of motion only if the part is properly positioned so that the force of gravity is eliminated.
1	Muscle contraction is seen or identified with palpation, but it is insufficient to produce joint motion even with elimination of gravity.
0	No muscle contraction is seen or identified with palpation; paralysis.

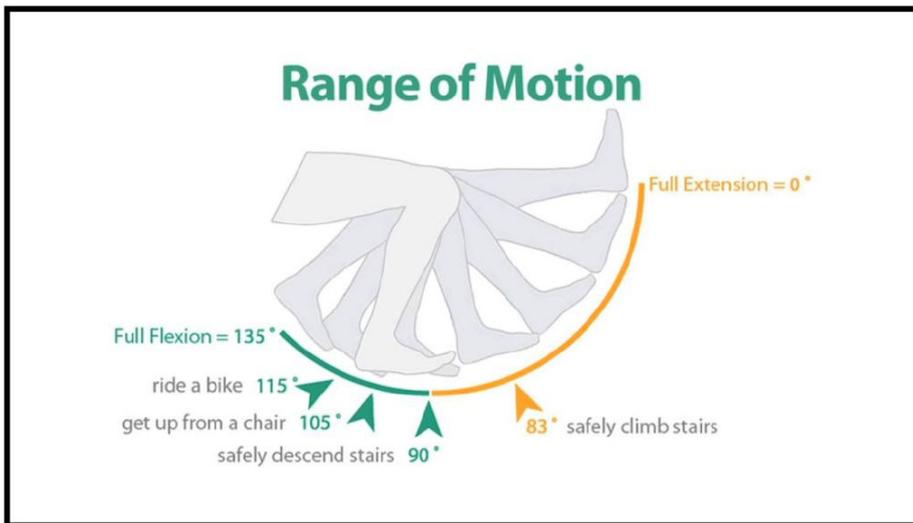


Figure 7. Range of Motion of knee.

data acquisition, and data analysis until reporting the results of the study through publication.

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