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*Review Article*

# Comparison of Peroneus Longus Tendon Autograft and Hamstring Tendon Autograft for Anterior Cruciate Ligament Reconstruction: A Systematic Review

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## Abstract

**Purpose:** The aim of this study is to compare the outcomes between peroneus longus tendon autograft versus hamstring tendon autograft for anterior cruciate ligament reconstruction such as International Knee Documentation Committee (IKDC), Lysholm score, Modified cincinnati score, Tegner activity scale, and donor site morbidity.

**Methods:** This systematic review uses Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Multiple databases were searched for studies that compared functional outcomes of ACL reconstruction with peroneus longus tendon autograft versus hamstring tendon autografts with a minimum 1 year follow-up.

**Result:** We analyzed 5 studies that included direct comparison of the peroneus longus tendon (106 patients) versus the hamstring tendon (137 patients). There was no significant difference comparison of the outcome such as Modified Cincinnati, Tegner scale activity, and Lysholm score. On IKDC score, 1 study reported there was a significant difference between peroneus longus tendon autograft 87.4 (67.8-100) versus hamstring tendon autograft 78.2 (35.6-95.6) with p=0. Two studies reported donor site morbidity mostly occurred in hamstring tendon autograft (11.4 ± 3.6) were higher than peroneus longus tendon (2.5 ± 0.5) (P=0.002). The knee flexion of donor site morbidity in the peroneus longus tendon group (41.97 ± 1.98) is higher than the hamstring tendon group (40.65 ± 1.74) (P=0.02).

**Conclusion:** This study concluded there was no significant difference of comparison between the peroneus longus group and the hamstring group after ACL reconstruction but the IKDC score after a reconstruction could be affected by gender and graft size. Donor site morbidity most occurred in hamstring group than peroneus longus group after ACL reconstruction

## Introduction

The anterior cruciate ligament (ACL) is a ligament that functions to stabilize the knee joint. The anterior cruciate ligament consists of two bundles, the posterolateral and the anteromedial bundle.[1,2,3,4] Anterior cruciate ligament tears are the most common ligament injuries.[1,5,6] In the United States the incidence of anterior cruciate ligament tears is around 100,000-200,000 per year and about 53% occur in athletes, especially football players.[7]

Anterior cruciate ligament tears consist of partial and complete tears (appley, netter). Partial tears usually cause symptoms of unlimited joint movement but are painful, while complete tears complain of limited joint movement without pain. Apart from that, other symptoms that can arise from an ACL tear are hemarthrosis, a sound popping as a tissue is snapped,

and swelling around the joint is heard. The typical physical examination of an ACL tear is positive on the Lachman test and anterior drawer test.[3,5,8]

One of the surgical procedures that can be performed on an ACL tear is anterior cruciate ligament reconstruction (ACLR). The hamstring tendon or patella tendon is the most frequently used graft method for ACLR because the hamstring tendon is easy to harvest with minimal donor site morbidity.[9,10] Several recent cases reported that the peroneus longus tendon is used as the main choice of autograft in ACL reconstruction and is often used in several orthopedic procedures because it has good outcome results with minimal donor site morbidity.[11,12]

The purpose of this study was to compare the outcomes between the peroneus longus tendon and hamstring tendon as autografts in ACL reconstruction by looking at several indicators such as the International Knee Documentation Committee (IKDC), Modified Cincinnati, Lysholm score, Tegner activity scale, and donor site morbidity.

## Methods

### Search Strategy

This study was designed with a systematic review. We evaluated and interpreted the qualified studies using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). A literature search was performed comprehensively to gather a full-length, peer-reviewed paper in English on the evaluation of Peroneus Longus Tendon vs Hamstring Tendon on ACL reconstruction. The literature was searched through PubMed, Google Scholar, Science Direct, and Cochrane Library using Boolean operators with the following keywords:

- "Anterior Cruciate Ligament Reconstruction" or "ACL Reconstruction"
- "PLT" or "Autograft" or "Peroneus Longus Tendon" or "HT" or "Hamstring Tendon" or "Groups" and
- "Randomized Controlled Trial" or "Prospective Cohort" or "Retrospective Cohort"

We screened the literature to report relevant results based on inclusion and exclusion criteria which were downloaded full articles that met the criteria to be evaluated for quality assessment and underwent data extraction. A total of 1074 studies were obtained upon executing the search strategy, 910 were excluded based on duplication and 746 were excluded based on title screening. Further 145 articles were excluded after reading the abstract. The full text of the remaining 19 articles was reviewed. Out of these, 14 articles were excluded upon full-text review. The final number of included studies in this systematic review was 5 studies (Figure 1).

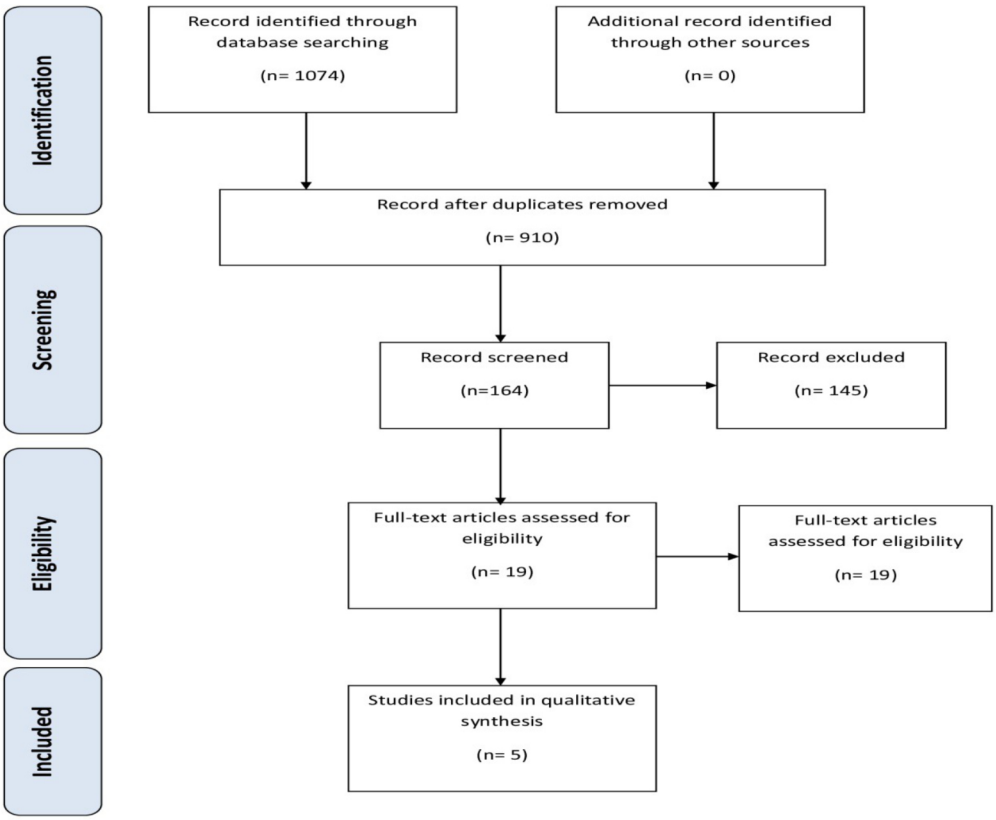


**Figure 1.** The diagram flow of PRISMA

**Inclusion Criteria**

The author uses a logic grid method with the PICO approach to search for suitable keywords. Any studies that evaluated peroneus longus tendon vs hamstring tendon in ACL reconstruction published in English were included in this review. The clinical outcomes were assessed by the subjective International Knee Documentation Committee (IKDC) score, Modified Cincinnati score, Lysholm score, Tegner, and donor site morbidity. Due to a limited number of research comparing both procedures, there was no limitation in patient demographics. Any study that was not in English was excluded.

**Quality Evaluation**

The class of evidence in each study was categorized into class I, II, III, and IV, each for good quality RCT, moderate to poor quality RCT and cohort study, moderate to poor quality cohorts and case-control studies and case series, respectively. Risk of bias assessed using the Cochrane Risk of Bias Tool: i) random sequencing, ii) allocation concealment, iii) blinding of participants and personnel, iv) blinding of outcome assessment, v) incomplete outcome data, vi) selective reporting, and vii) other biases (Figure 2). Then, from these components, we label them into three groups: low-risk, moderate, and high-risk bias. A total of 5 studies have the low-quality risk of bias.

## Result

Key characteristics of the included studies and their level of evidence are depicted in Tables 1 and 2. Among these five studies, one is retrospective cohort study, two are prospective cohort studies and two are randomized control trials. A total of 243 patients from five studies were included, with 106 patients undergoing peroneus longus tendon autograft and the rest 137 patients having hamstring tendon autograft, as shown in Table 2. The summary of outcomes assessed and the outcomes in each study are presented in Table 3 and 4, respectively. The outcome was assessed by IKDC, Modified Cincinnati score, Lysholm score, Tegner activity scale, and donor site morbidity.

## Discussion

The ACL is one of the most common injuries to the knee. The hamstring tendon has recently been known as a frequently used graft method for ACLR. Several studies have confirmed that the peroneus longus tendon graft can be used as an alternative graft in ACL reconstruction.

IKDC scores were obtained in 4 studies conducted by Rhatomy S., et al, Gunadham U., et al, Seed U., et al and Shi F et al. There was no significant results were obtained in 3 studies and significant results were obtained in 1 study. Results that were not significant on the IKDC score were obtained in the study of Rhatomy S., et al on the peroneus longus group and hamstring group with mean 92.5±6.2 and 88.8 ± 9.7 (P>0.05). Nonsignificant results were also found in a study conducted by Saeed., et al with a result of 91.4 ± 1 in the peroneus longus group and 92.7±3 in the hamstring group (P>0.05). In a study conducted by Shi., et al, the results were not significant in IKDC after 24 months with a mean of 90.13 ± 3.01 in the peroneus longus group and 89.22 ± 3.83 for the hamstring group (P=0.4298). Meanwhile, a study conducted by

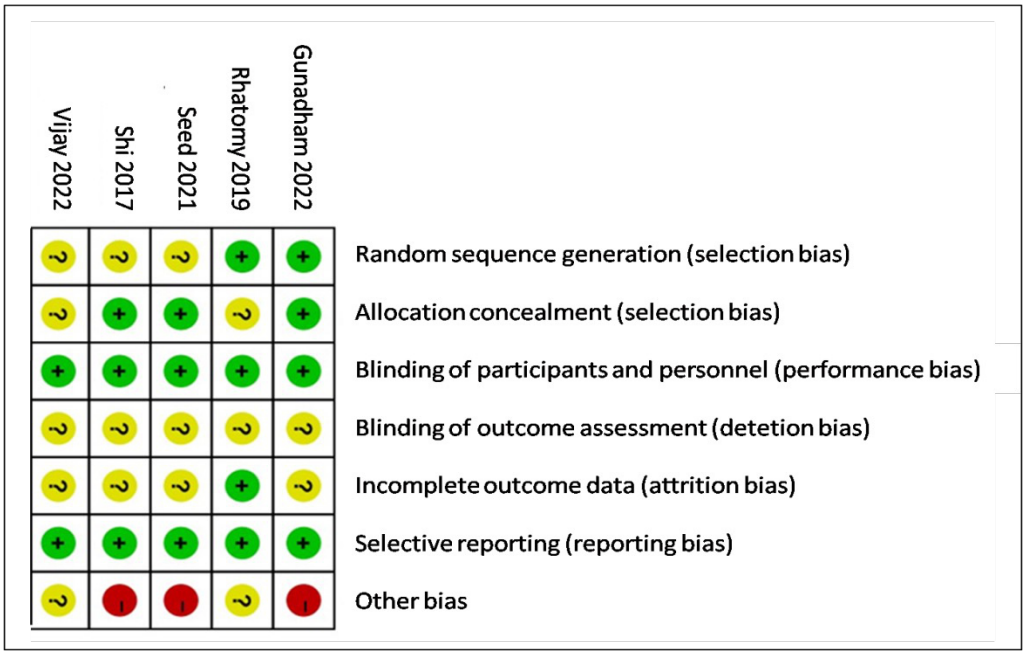


**Figure 2.** Risk of Bias Assessment using Cochrane Risk of BIAS tools

| No. | Reference | Year | Country | Journal | Study design | Level of evidence |
|---|---|---|---|---|---|---|
| 1. | Rhatomy S., et al | 2019 | Indonesia | Knee surgery, Sports Traumatology, Arthroscopy | Prospective Cohort | II |
| 2. | Gunadham U., et al | 2022 | Thailand | Journal of Orthopaedics, Trauma, and Rehabilitation | Retrospective Cohort | II |
| 3. | Vijay C., et al | 2022 | India | Journal of Orthopaedics, Trauma, and Rehabilitation | Prospective cohort | II |
| 4. | Seed U., et al | 2021 | Pakistan | Journal of Pakistan Orthopedic Association | RCT | I |
| 5. | Shi F., et al | 2017 | China | The Journal of Knee Surgery | RCT | I |

**Table 1.** List of included studies

| No | Reference | Total Sample | Mean age (Age range in a year) | Male | Female |
|---|---|---|---|---|---|
| 1. | Rhatomy S., et al, 2019 | 52<br>PL: 24<br>HT: 28 | PL: 23.4±8.1<br>HT: 26.4 ± 8.6 | 44 | 8 |
| 2. | Gunadham U., et al, 2022 | 52<br>PL: 13<br>HT: 39 | PL: 27.6 ± 9.4<br>HT: 31.1 ± 10.7 | 48 | 4 |
| 3. | Vijay C., et al, 2022 | 45<br>PL: 23<br>HT: 22 | PL: 33.57 ± 9.54<br>HT: 31.82 ± 9.62 | 35 | 10 |
| 4. | Seed U., et al, 2021 | 56<br>PL: 28<br>HT: 28 | PL: 39.4±6<br>HT: 39.6±2 | 53 | 3 |
| 5. | Shi F., et al, 2017 | 38<br>PL: 18<br>HT: 20 | PL: 42 (19-58)<br>HT: 40 (19-58) | N/A | N/A |

**Table 2.** Characteristic Patient of included studies

| No | Reference | Study Comparison | Follow-up duration (Year) | Outcome |
|---|---|---|---|---|
| 1. | Rhatomy S., et al, 2019 | Peroneus Longus Tendon versus Hamsting Tendon | 1 year | IKDC, Modified Cincinnati, Donor site morbidity, Lysholm score |
| 2. | Gunadham U., et al, 2022 | Anterior Half Peroneus Longus Tendon versus Hamstring Tendon | 3 year | IKDC, Tegner activity scale |
| 3. | Vijay C., et al, 2022 | Peroneus Longus Tendon versus Hamsting Tendon | 1 Year | Modified Cincinnati, Lysholm score, Donor site morbidity (knee flexion and knee extension) |
| 4. | Saeed U., et al, 2021 | Peroneus Longus Tendon versus Hamsting Tendon | 1 year | IKDC, Lysholm score |
| 5. | Shi F., et al, 2017 | Peroneus Longus Tendon versus Hamsting Tendon | 2 year | Tegner activity scale, IKDC, Lysholm score |

**Table 3.** Summary of outcome

| No. | Reference | Outcome Measure | | | |
|---|---|---|---|---|---|
| | | IKDC | Modified Cincinnati | Donor site morbidity | Lysholm score |
| 1. | Rhatomy S., et al, 2019 | PL: 92.5 ± 6.2<br>HT: 88.8 ± 9.7 | PL: 92.7 ± 5.9<br>HT: 88.1 ± 8.5 | PL: 2.5 ± 0.5<br>HT: 11.4 ± 3.6 | PL: 94.9 ± 5.6<br>HT: 93.1 ± 7.3 |
| | P Value | P>0.05 | P>0.05 | P=0.02 | P>0.05 |
| No. | Reference | Outcome Measure | | | |
| | | IKDC | | Tegner activity scale | |
| 2. | Gunadham U., et al, 2022 | PL: 78.2 (35.6-96.6)<br>HT: 87.4 (67.8-100) | | PL: 92.7 ± 5.9<br>HT: 88.1 ± 8.5 | |
| | P Value | P=0.015 | | P=0.157 | |
| No. | Reference | Outcome Measure | | | |
| | | Modified Cincinnati | Lysholm score | Donor site morbidity | |
| 3 | Vijay C., et al, 2022 | PL: 89.83 ± 3.47<br>HT: 86.45 ±3.31 | PL: 88.39 ± 4.60<br>HT: 86.55 ± 2.74 | Knee flexion<br>PL: 41.97 ± 1.98<br>HT: 40.65 ± 1.74 | Knee extension<br>PL: 51.37 ±3.41<br>HT: 51.92 ±2.47 |
| | P Value | P=0.002 | P=0.1 | P: 0.02 | P: 0.5 |
| No. | Reference | Outcome Measure | | | |
| | | Tegner-Lysholm | | IKDC | |
| 4. | Saeed U., et al | PL: 92.2 + 2.5<br>HT: 91.4 +1.7 | | PL: 91.4 ± 1<br>HT: 92.7 ± 3 | |
| | P Value | P>0.05 | | P>0.05 | |
| No. | Reference | Outcome Measure | | | |
| | | Tegner | IKDC | Lysholm | |
| 5. | Shi F., et al, 2017 | PL: 5 ± 0.89<br>HT: 6 ± 0.12 | PL: 90.13 ± 3.01<br>HT: 89.22 ± 3.83 | PL: 94 ± 6.81<br>HT: 93 ± 5.22 | |
| | P Value | P=0.41 | P=0.429 | P=0.427 | |

**Table 4.** Characteristics of Outcome Studies

Gunadham showed significant results in which hamstring group higher than the peroneus longus group with mean 87.4 and 78.2 ($p<0.05$) but there was significant factors that affected postoperative IKDC scores such as graft type and gender because smaller graft size which less than 8 mm associated with re-rupture after ACL reconstruction that was reported femoral graft size 8.1±0.6 mm in hamstring group larger than peroneus longus group is 7.6±0.6 mm (P=0.023) and tibial graft size in hamstring tendon group is 8.1±0.6 mm larger than 7.8±0.8 mm in peroneus longus tendon group (P=0.0006). Females were shorter and had a smaller graft size than males with p-value is 0.009.[9,11,13,14]

The modified Cincinnati score was only done by Rhatomy, et al. The modified Cincinnati score was not significant with a mean of 92.7 ± 5.9 for the peroneus longus tendon and 88.1 ± 8.5 for the hamstring tendon (P>0.05).[7]

The Lysholm score that compared the peroneus longus tendon and hamstring tendon after ACL reconstruction was obtained in four studies conducted by Rhatomy., et al, Vijay C., et al, Saeed U., et al, and Shi F., et al had a non significant result with P>0.05.[11,13,14,15]

The donor site morbidity score was obtained in 2 studies conducted by Rhatomy., et al and Vijay C., et al. Rhatomy., et al explained that thigh hypotrophy, hypoesthesia, or anaesthesia most occurs in the hamstring tendon group and there was a significant result of donor site morbidity when used hamstring tendon with a mean was 11.4 ± 3.6 were higher than peroneus longus tendon was 2.5 ± 0.5 (P=0.002). That

study also reported an excellent result after harvesting peroneus longus tendon namely AOFAS was 97.3 ± 4.2 (range 88–100) and FADI score was 98 ± 3.4 (85.6–100) because the peroneus brevis is still intact in the donor's ankle for maintain eversion function of the ankle. The study conducted by Vijay C., et al explained the strength of knee flexion after 1 year of follow up was reduced in the hamstring tendon group than normal contralateral knee because the hamstring tendon had to contribute as component for normal knee flexion. Meanwhile, there was normal strength of knee flexion in the peroneus longus tendon group but instead improved after one year follow up which donor site morbidity of knee flexion with a mean 41.97 ± 1.98 in the peroneus longus tendon group higher than hamstring tendon group with mean 40.65 ± 1.74 (P=0.02). There was no difference in the strength of plantar flexion and eversion at the donor side ankle compared with normal contralateral ankle after 1 year follow-up. That study also reported 27% of patients had knee pain in the hamstring group but there was no patients who had ankle pain, numbness and limitation of movement at the ankle joint in the peroneus longus group with AOFAS had an excellent improvement after 1 year with mean 96.43 ±3.13.[13,15]

The Tegner activity scale showed non-significant results which compared the peroneus longus tendon and hamstring tendon after ACL reconstruction conducted by Gundham U., et al and Shi F., et al with 0.157 and 0.41 respectively with P>0.05.[9,11]

## Conclusion

ACL tears are one of the most common ligament injuries in orthopedics. The autograft method for ACL reconstruction can be used such as hamstring tendon autograft or peroneus longus tendon autograft. In this systematic review, we reviewed several studies that used the two autograft methods and focused on functional outcomes. We concluded that the IKDC score after ACL reconstruction with hamstring tendon and peroneus longus tendon had an equally excellent result but some factors affected post operative IKDC score such as graft size and gender. Meanwhile, peroneus longus tendon autograft showed better donor site morbidity than hamstring tendon for ACL reconstruction.

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