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Original Research Article

Comparison of Functional Outcomes After Using Hamstring Graft Versus Peroneus Longus Graft Reconstruction in Patients Having Anterior Cruciate Ligament Injury

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Abstract: *Anterior cruciate ligament (ACL) reconstruction is a commonly performed orthopedic procedure, with autologous grafts, such as hamstring and peroneus longus tendons, widely used. Emerging evidence suggests that the peroneus longus tendon may offer comparable or superior functional outcomes with minimal donor-site morbidity, yet limited comparative data are available in the Pakistani population.* ***Objective:*** *To compare the functional outcomes of ACL reconstruction using hamstring tendon grafts versus peroneus longus tendon grafts, assessed by the International Knee Documentation Committee (IKDC) score at three months postoperatively.* ***Methods:*** *A randomized controlled trial was conducted in the Department of Orthopaedic Surgery at Nishtar Hospital, Multan, from 15 February to 15 May 2025, enrolling 78 patients aged 20–50 years with isolated ACL injuries. Participants were randomized into two equal groups: Group A underwent ACL reconstruction using a hamstring tendon autograft, while Group B received an autograft from the peroneus longus tendon. Standardized postoperative rehabilitation was followed. Functional outcomes were assessed using the IKDC score at three months. Data were analyzed using SPSS version 22, with independent t-tests and stratified analyses to control for effect modifiers. A p-value < 0.05 was considered statistically significant.* ***Results:*** *The mean IKDC score was significantly higher in the peroneus longus group (83.1 ± 5.8) compared with the hamstring group (78.6 ± 6.9) (p < 0.01). Stratified analyses demonstrated consistently higher IKDC scores across age groups, gender, residence, and socioeconomic strata, with no subgroup favoring the hamstring graft. Baseline demographic and clinical characteristics were comparable between the groups.* ***Conclusion:*** *Peroneus longus autograft demonstrated superior early postoperative functional outcomes compared with the hamstring autograft. These findings support the use of the peroneus longus tendon as a reliable and effective alternative for ACL reconstruction in the Pakistani population.*

Keywords: Anterior cruciate ligament, ACL reconstruction, hamstring graft, peroneus longus tendon, IKDC score, orthopaedic surgery, randomized controlled trial

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Introduction

Anterior cruciate ligament (ACL) injuries are common in orthopedics and often necessitate surgical reconstruction to restore knee stability and function. Among surgical options, autologous grafts have gained popularity for their potential to achieve satisfactory functional outcomes and minimal risk of rejection. Two viable graft sources typically considered are the hamstring tendons and the peroneus longus tendon. Recent studies have suggested that both graft types yield favorable post-operative results, thus prompting comparisons to evaluate their effectiveness in clinical practice.

The hamstring graft, particularly the semitendinosus and gracilis tendons, has been widely employed due to its adequate biomechanical properties and lower donor-site morbidity compared with patellar tendon grafts (1). However, harvesting from the hamstrings may diminish muscle strength and contribute to knee instability, especially in individuals involved in high-demand sports (2). Conversely, the peroneus longus tendon has emerged as a viable alternative, offering anatomical and biomechanical advantages while minimizing donor-site complications (3). A systematic review highlighted that grafts derived from the peroneus longus exhibit mechanical properties comparable to those harvested from hamstring tendons, thereby suggesting similar functional outcomes following ACL reconstruction (3).

Several studies have demonstrated the efficacy of peroneus longus tendon autografts in ACL reconstruction. For example, research conducted by Butt et al. reported significant improvements in functional outcomes, as measured by the International Knee Documentation Committee (IKDC) scores, in patients undergoing peroneus longus tendon grafting compared with traditional hamstring grafts (4). Moreover, a randomized controlled trial by Vijay et al. indicated that patients receiving peroneus longus grafts reported similar or superior postoperative outcomes compared with those receiving hamstring grafts, as evidenced by higher return-to-sport rates (5). In their analysis, the IKDC score post-surgery showed a mean improvement of more than 80, underscoring the clinical relevance of these findings in contemporary surgical practice (6).

Despite the growing body of evidence supporting the use of peroneus longus grafts, there are limited comparative studies that explicitly compare the two graft types in the Pakistani population, where factors such as anthropometric differences may influence graft selection and outcomes. Given that ACL injuries have a high prevalence in active individuals in Pakistan, understanding the efficacy and functional consequences of different graft sources is crucial. This study aims to fill this gap by comparing functional outcomes between patients undergoing ACL reconstruction with peroneus longus grafts versus hamstring grafts, thereby providing targeted insights to enhance clinical decision-making in the Pakistani demographic.

In Pakistan, the prevalence of sports injuries, particularly ACL injuries, is considerable due to the increasing interest in recreational and professional sports. Selecting appropriate graft types tailored to the unique characteristics and needs of the Pakistani population is vital, as inadequate

graft selection may affect recovery timelines and long-term knee function. Moreover, previous studies have indicated that the dimensions of the harvested graft can be significantly affected by anthropometric variations, such as height and body mass index, across different populations (7, 8). This underscores the importance of a comparative study of hamstring and peroneus longus tendon grafts that accounts for these demographic factors, thereby contributing to optimized surgical outcomes and enhanced quality of life for patients post-reconstruction.

Methodology

This randomized controlled trial was conducted in the Department of Orthopaedic Surgery at Nishtar Hospital, Multan, over a period of three months, from 15 February to 15 May 2025, following approval of the synopsis and institutional ethics committee clearance. Patients aged 20 to 50 years who presented with an anterior cruciate ligament (ACL) injury, confirmed by history, physical examination, and KT-1000–assisted laxity assessment, and with a duration of injury exceeding 4 weeks, were screened for eligibility. ACL injury was operationally defined through the presence of knee pain, abnormal forward tibial translation on the Lachman test, and a positive anterior drawer test indicating increased anterior displacement compared with the contralateral knee. Only patients with isolated ACL injuries were included. Individuals with knee joint stiffness characterized by flexion less than 30°, those with multiple ligamentous injuries assessed on examination, and patients with fractures around the knee on radiographs were excluded to avoid confounding by additional structural pathology.

Eligible patients who provided written informed consent were consecutively enrolled using a non-probability consecutive sampling technique. A sample size of 78 participants, with 39 patients allocated to each arm, was calculated using the WHO sample size calculator based on a power of 80 percent, a two-sided significance level of 5 percent, and previously published mean IKDC scores of 79.73 ± 6.83 for the hamstring tendon graft group and 83.28 ± 3.71 for the peroneus longus graft group. Randomization into two equal groups was performed using the lottery method to ensure unbiased allocation. Group A underwent ACL reconstruction using a hamstring tendon autograft, while Group B underwent reconstruction using a peroneus longus tendon autograft. Qualified consultants performed all surgeries following standardized arthroscopic techniques. Immediate postoperative rehabilitation allowed full knee extension, with progressive flexion restricted to 0–90 degrees during the first three weeks, followed by gradual advancement to full flexion thereafter. Partial weight bearing was initiated at three weeks postoperatively and subsequently progressed to full weight bearing as tolerated.

Comprehensive demographic and clinical information—including age, gender, mode of injury, duration of injury, residence, profession, educational level, and socioeconomic class according to World Bank income brackets adjusted for Pakistan—was documented using a structured proforma. Postoperative functional outcomes were evaluated using the International Knee Documentation Committee (IKDC) scoring system at the three-month follow-up visit. The IKDC score, a validated patient-reported outcome measure assessing symptoms, daily activities, and sports function, was recorded by an experienced consultant orthopedic surgeon with more than 5 years of post-fellowship clinical experience, who was not involved in the patient's initial surgery to minimize measurement bias.

All data were entered and analyzed using SPSS version 22. Quantitative variables such as age, injury duration, and IKDC scores were assessed for normality using the Shapiro–Wilk test. Mean and standard deviation were computed for normally distributed variables, while median and interquartile ranges were calculated in cases of non-normality. The independent samples t-test was used to compare postoperative IKDC scores between the two groups, with a p-value <0.05 considered statistically significant. Categorical variables, including gender, residence, mode of injury, educational status, and socioeconomic class, were summarized using frequencies and percentages. Potential effect modifiers—age, gender, duration of injury, residence, education, and socioeconomic status—were controlled through stratification followed by post-stratification independent t-tests to determine whether observed differences in IKDC scores persisted within subgroups. All analyses adhered to the CONSORT-based methodological rigor to ensure the reliability and validity of findings.

Results

The mean age of all participants was 31.4 ± 6.7 years, ranging from 20 to 50 years. The mean age was 30.9 ± 6.3 years in Group A and 31.8 ± 7.1 years in Group B. Males predominated, with 56 (71.8%) males and 22 (28.2%) females. Gender distribution was comparable between the two groups. Most injuries resulted from road-traffic accidents (44.9%), followed by sports injuries (34.6%) and falls (20.5%). The majority of patients resided in an urban area (67.9%), had secondary or matric-level education, and fell into the middle socioeconomic class according to the World Bank income brackets adapted for Pakistan. The mean duration of injury was 7.5 ± 2.0 weeks, with no significant difference between the groups ($p > 0.05$). No patient had multiple ligament injuries, stiffness, or fractures per exclusion criteria. (Table 1) Table 2 compares the clinical characteristics of 39 patients with hamstring injuries to those of 39 with peroneus longus injuries. The mean duration of injury was 7.4 weeks for the hamstring group and 7.7 weeks for the peroneus longus group, with a p-value of 0.47 showing no significant difference. Both groups had similar modes of injury (road traffic accidents, sports, and falls) and residence distribution, with a p-value of 0.79. The socioeconomic class data is incomplete. Overall, the findings indicate that the two groups have comparable characteristics. (Table 2) The primary outcome of the study was the IKDC score measured at three months postoperatively. The results indicated that the Peroneus Longus group had a significantly higher mean IKDC score than the Hamstring group. Specifically, Group A (Hamstring) reported a mean score of 78.6 with a standard deviation of 6.9, while Group B (Peroneus Longus) achieved a mean score of 83.1 with a standard deviation of 5.8. The observed mean difference between the two groups was 4.5 points, with a p-value <0.01. These findings suggest that patients in the Peroneus Longus group had a better early functional recovery following the procedure. (Table 3) In our analysis, we performed stratified comparisons to evaluate effect modifiers. We found significant differences in IKDC scores across age, gender, residence, education, and socioeconomic status, all with p-values under 0.05. However, no subgroup demonstrated any advantage of the hamstring graft over alternative options. (Table 4)

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Table 1. Demographic Characteristics of the Study Population (N = 78)

Variables	Hamstring Graft (n = 39)	Peroneus Longus Graft (n = 39)	Total (N = 78)
Age (years), mean ± SD	30.9 ± 6.3	31.8 ± 7.1	31.4 ± 6.7
Gender			
Male	27 (69.2%)	29 (74.3%)	56 (71.8%)
Female	12 (30.8%)	10 (25.7%)	22 (28.2%)
Residence			

Urban	26 (66.7%)	27 (69.2%)	53 (67.9%)
Rural	13 (33.3%)	12 (30.8%)	25 (32.1%)
Mode of Injury			
Road Traffic Accident	18 (46.2%)	17 (43.6%)	35 (44.9%)
Sports Injury	13 (33.3%)	14 (35.9%)	27 (34.6%)
Fall from Height	8 (20.5%)	8 (20.5%)	16 (20.5%)
Duration of Injury (weeks), mean ± SD	7.4 ± 1.9	7.7 ± 2.1	7.5 ± 2.0
Education Level			
Illiterate	6 (15.4%)	5 (12.8%)	11 (14.1%)
Primary	7 (17.9%)	6 (15.4%)	13 (16.7%)
Secondary	13 (33.3%)	14 (35.9%)	27 (34.6%)
Matric and Above	13 (33.3%)	14 (35.9%)	27 (34.6%)
Socioeconomic Status			
Low	10 (25.6%)	9 (23.1%)	19 (24.4%)
Middle	20 (51.3%)	21 (53.8%)	41 (52.6%)
High	9 (23.1%)	9 (23.1%)	18 (23.1%)

Table 2. Clinical Characteristics of Patients (N = 78)

Variable	Hamstring (n = 39)	Peroneus Longus (n = 39)	p-value
Duration of injury (weeks), mean ± SD	7.4 ± 1.9	7.7 ± 2.1	0.47
Mode of Injury (RTA / Sports / Fall)	18/13/8	17/14/8	0.96
Residence (Urban / Rural)	26/13	27/12	0.79
Socioeconomic Class (Low/Mid/High)	10/20/9	9/21/9	0.97

Table 3. Comparison of Postoperative IKDC Score Between Groups

Outcome	Hamstring Graft (n = 39)	Peroneus Longus Graft (n = 39)	p-value
IKDC Score (Mean ± SD)	78.6 ± 6.9	83.1 ± 5.8	**0.003**

Table 4. Stratified IKDC Score Comparison Across Subgroups

Stratum	Hamstring Mean ± SD	Peroneus Longus Mean ± SD	p-value
Age < 30 yrs	79.4 ± 6.3	84.1 ± 5.4	0.01
Age ≥ 30 yrs	77.9 ± 7.2	82.7 ± 6.1	0.03
Male	79.0 ± 6.7	83.5 ± 5.6	0.01
Female	77.5 ± 7.4	82.0 ± 6.0	0.04
Urban	79.1 ± 6.8	83.6 ± 5.7	0.01
Rural	77.8 ± 7.2	82.2 ± 6.3	0.04
Middle Class	79.0 ± 6.9	83.3 ± 5.7	0.01

Discussion

The results of our study demonstrated a significant difference in functional outcomes between the two ACL reconstruction graft options, with the peroneus longus graft achieving superior results compared to the hamstring graft. Specifically, patients in the peroneus longus group achieved a mean IKDC score of 83.1 ± 5.8, contrasted with the hamstring group's score of 78.6 ± 6.9 ($p < 0.01$). This finding corroborates existing literature suggesting that peroneus longus tendon autografts provide comparable or even superior clinical outcomes to traditional hamstring tendon grafts following ACL reconstruction.

In a systematic review conducted by He et al. (3), the authors reported that peroneus longus tendon autografts yield functional outcomes similar to those of hamstring tendon autografts. This aligns closely with our findings and reinforces the hypothesis that the peroneus longus is an efficacious graft choice for ACL reconstruction. Likewise, a study by Agrawal et al. (2) highlighted the benefits of using peroneus longus grafts, demonstrating satisfactory functional outcomes and low donor-site morbidity, further supporting the clinical relevance of our results.

Moreover, stratified comparisons across demographic subgroups in our study revealed consistent trends favoring the peroneus longus graft. Younger patients and individuals residing in urban areas showed marked improvement in IKDC scores when reconstructed with the peroneus longus tendon, paralleling observations reported by Ueda et al. (9), who emphasized that demographic differences may influence postoperative functional recovery. The comparable baseline characteristics between our two study groups allowed for an unbiased assessment, thereby strengthening the external validity of the findings.

Despite strong evidence supporting the use of the peroneus longus graft, some studies yield mixed conclusions. Patomy et al. (10) described clinical situations in which hamstring grafts produced favorable outcomes, attributing these findings to factors such as graft thickness and inherent biomechanical strength. Similarly, Kumar et al. (11) found that hamstring autografts generally yield acceptable results and emphasized the critical role of graft diameter in determining postoperative performance. These contrasting perspectives highlight the need for future long-term, multicenter studies to understand better the variables influencing graft success.

Although our study contributes valuable insights, certain limitations must be acknowledged. While the sample size ensured adequate statistical power, larger studies with extended follow-up durations are needed to evaluate graft durability and long-term functional stability. Additionally, incorporating long-term assessments such as return-to-sport rates, graft re-rupture rates, and patient-reported quality-of-life outcomes would further strengthen the evidence base.

Overall, our study adds to the growing body of literature supporting the peroneus longus tendon as a favorable graft option for ACL reconstruction. The significant postoperative improvements observed, combined with minimal donor-site morbidity, underscore its role as a strong alternative to the conventional hamstring graft. Future research should focus on broader demographic cohorts and long-term comparative analyses to refine graft selection strategies in diverse clinical settings.

This study has a few limitations. The three-month follow-up period reflects only early postoperative recovery and does not capture long-term graft performance. The single-center design and relatively small sample size may also limit generalizability. Additionally, factors such as physiotherapy adherence and activity level were not controlled, which could influence functional outcomes. Larger multicenter studies with longer follow-up are recommended.

Conclusion

The study found that ACL reconstruction using the peroneus longus tendon yields significantly better early functional outcomes than the hamstring tendon graft. With higher IKDC scores and consistent superiority across demographic subgroups, the peroneus longus tendon emerges as a strong and effective alternative for ACL reconstruction, particularly within the Pakistani clinical setting. Larger multicenter studies with more extended follow-up periods are recommended to confirm long-term graft durability and functional success.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-NMUM-080-24)

Consent for publication
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

SH (PGR)
Conception of study; study design; development of research methodology; data collection; data analysis; manuscript drafting.
HMKS *(Professor)*
validation of methodology; critical review of manuscript; expert input in interpretation of findings.
AF (PhD scholar)
Literature review; data entry; statistical assistance; drafting and refinement of the manuscript.
SS (Principal Research Officer)
Data management; technical support in analysis; manuscript proofreading and critical revisions.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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