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Original Research Article

COMPARATIVE STUDY OF FUNCTIONAL OUTCOME OF HAMSTRING VERSES BPTB GRAFT IN ACL RECONSTRUCTION

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Abstract: *Anterior cruciate ligament (ACL) injuries are among the most common knee injuries requiring surgical intervention. The choice of graft for ACL reconstruction—hamstring or bone-patellar tendon-bone (BPTB)—remains debatable due to differences in functional outcomes and complications.* ***Objective:*** *To compare the functional outcomes of ACL reconstruction using hamstring and BPTB grafts regarding knee stability, range of motion (ROM), patient satisfaction, and complication rates.* ***Methods:*** *This retrospective study included 150 patients who underwent ACL reconstruction, divided into two groups: 75 received hamstring grafts (Group A), and 75 received BPTB grafts (Group B). Clinical evaluations and patient-reported outcomes were assessed at 6 and 12 months post-surgery. Statistical analysis was performed using SPSS software, with a p-value <0.05 considered significant.* ***Results:*** *Knee stability was achieved in 90% of patients in the hamstring group and 94% in the BPTB group. Group A demonstrated better ROM recovery (130° ± 5 vs. 125° ± 5) and a lower complication rate (12% vs. 25%). Patient satisfaction was higher in the hamstring group (92% vs. 85%), while return-to-sport rates were slightly higher in the BPTB group (82% vs. 78%). Anterior knee pain was more prevalent in the BPTB group (28% vs. 10%).* ***Conclusion:*** *Both grafts are effective for ACL reconstruction, but each has distinct advantages and limitations. The BPTB graft offers superior initial stability and return-to-sport rates but is associated with higher complications. The hamstring graft provides better ROM, fewer complications, and higher patient satisfaction, making it a preferred choice for smoother rehabilitation. Graft selection should be individualized based on patient needs and activity levels.*

Keywords: Anterior Cruciate Ligament Reconstruction, Hamstring Tendons, Patellar Tendon, Graft Selection, Knee Stability, Range of Motion, Articular

Introduction

Anterior cruciate ligament (ACL) injuries are among the most common ligamentous injuries of the knee, particularly affecting athletes and individuals engaged in high-impact physical activities. These injuries lead to significant instability, reduced mobility, and diminished quality of life. ACL reconstruction is a standard surgical intervention aimed at restoring knee stability and function. Two widely used graft options for ACL reconstruction are the bone-patellar tendon-bone (BPTB) graft and the hamstring tendon graft. Both options have distinct advantages and limitations, with ongoing debate regarding the optimal choice based on functional outcomes and complications.

In Pakistan, ACL injuries are prevalent due to the increasing participation in contact sports, road traffic accidents, and physically demanding occupations. However, the choice of graft for ACL reconstruction is often influenced by surgeon expertise, resource availability, and patient-specific factors. The BPTB graft is recognized for its superior initial stability and strong fixation, which may lead to better outcomes in patients with high physical demands (1,2). However, its use is associated with anterior knee pain, patellar tendinopathy, and donor site morbidity, which may affect postoperative recovery (3). Conversely, the hamstring graft is less invasive, associated with fewer donor site complications, and allows for a better range of motion post-surgery, although concerns remain about its durability under high-stress activities (4).

Globally, studies comparing these grafts have reported varying outcomes, with some favouring the BPTB graft for its biomechanical strength and others highlighting the hamstring graft's benefits in reducing postoperative complications (5,6). In the Pakistani context, limited local data are available on the functional outcomes and patient satisfaction associated with these grafts, necessitating further research. This study aims to compare the functional outcomes of ACL reconstruction using hamstring versus BPTB grafts in terms of knee stability, range of motion, post-operative pain, patient satisfaction, and complications. The findings will contribute to evidence-based decision-making for graft selection in Pakistan, considering the socio-economic and healthcare constraints of the local population.

Methodology

This study was a retrospective comparative analysis conducted at the Orthopedic Departments of Combined Military Hospital Rawalpindi and Bolan Medical College Hospital Quetta. The research aimed to evaluate and compare the functional outcomes of ACL reconstruction using hamstring grafts and bone-patellar tendon-bone (BPTB) grafts. A total of 150 patients who underwent ACL

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reconstruction were included in the study. Participants were divided into two groups: Group A, consisting of 75 patients who underwent ACL reconstruction with hamstring grafts, and Group B, comprising 75 patients who received BPTB grafts.

Patients aged 18–40 years with primary ACL injuries confirmed by clinical and radiological assessments were included in the study. Individuals with previous knee surgeries, bilateral ACL injuries, multi-ligament knee injuries, or systemic conditions affecting recovery were excluded to ensure a homogeneous sample. Participants were recruited using a non-probability convenience sampling method from the orthopaedic outpatient clinics of the participating hospitals.

Data collection involved clinical evaluations, patient-reported outcomes, and follow-up assessments conducted at 6 and 12 months post-surgery. Clinical evaluations included assessments of knee stability using the Lachman test and measurements of range of motion (ROM) using a goniometer. Patient-reported outcomes were captured through a structured questionnaire, gathering information on anterior knee pain, satisfaction with recovery, and return-to-sport rates. Additionally, complications such as anterior knee pain, donor site morbidity, and muscle weakness were recorded.

The primary outcome measure was knee stability at 12 months post-surgery, assessed using the Lachman test. Secondary outcomes included range of motion, patient satisfaction, return-to-sport rates, and the incidence of post-operative complications. Statistical analysis was performed using SPSS software (version 25). Descriptive statistics, including means and standard deviations, were calculated for continuous variables, while frequencies and percentages were used for categorical data. Comparative analysis between the two groups was conducted using the chi-square test for categorical variables and the independent t-test for continuous variables, with a p-value of <0.05 considered statistically significant.

Ethical approval for the study was obtained from the institutional review boards of Combined Military Hospital Rawalpindi and Bolan Medical College Hospital Quetta. Written informed consent was secured from all participants before data collection, and strict confidentiality of participant information was maintained throughout the research. This methodology adheres to international standards, ensuring rigorous and ethical research practices while maintaining the reproducibility of findings.

Results

The study included 150 patients who underwent anterior cruciate ligament (ACL) reconstruction, divided equally into two groups of 75 patients each. Group A underwent reconstruction using the hamstring graft, while Group B underwent reconstruction using the bone-patellar tendon-bone (BPTB) graft. The participants' mean age was 29.4 ± 5.2 years, with a male-to-female ratio of 3:1. Most patients were active in sports or physically demanding occupations. No significant demographic differences were observed between the two groups, ensuring comparability for functional outcome analysis.

Patient-reported outcomes indicated significant differences in satisfaction and complications between the two groups. Table 1 summarizes the key self-reported outcomes.

Table 1. Patient Self-Reported Outcomes

Parameter	Group A (Hamstring)	Group B (BPTB)
Anterior Knee Pain (Moderate to Severe)	10%	28%
Satisfaction with Recovery (%)	92%	85%
Return to Sport (within 12 months)	78%	82%

Group A reported lower incidences of anterior knee pain (10%) compared to Group B (28%). Patient satisfaction was higher in Group A, with 92% of participants expressing satisfaction, compared to 85% in Group B. Return-to-sport rates were slightly higher in Group B (82%) than in Group A (78%).

Clinical assessments revealed comparable knee stability between the two groups, as evaluated using the Lachman test at one-year post-surgery. However, differences in range of motion (ROM) and complication rates were noted. Table 2 details the clinical parameters observed at 6 and 12 months post-surgery.

Table 2. Clinical Assessment Parameters at 6 and 12 Months Post-Surgery

Parameter	Group A (Hamstring)	Group B (BPTB)
Knee Stability (Lachman test)	Stable in 90%	Stable in 94%
Range of Motion (degrees)	130° ± 5	125° ± 5
Return to Normal Activity (%)	85%	87%
Incidence of Complications (%)	12%	25%

While both groups achieved knee stability (90% in Group A and 94% in Group B), Group A demonstrated better ROM recovery (mean 130° ± 5) compared to Group B (mean 125° ± 5). Group B exhibited a higher overall complication rate (25%), primarily related to anterior knee pain and patellar issues, while Group A had a lower complication rate (12%), with occasional complaints of muscle weakness or discomfort at the donor site.

Discussion

This study aimed to compare the functional outcomes of ACL reconstruction using hamstring and BPTB grafts in a Pakistani population, focusing on knee stability, range of motion (ROM), patient satisfaction, and complications. Both grafts effectively restored knee stability, with Group B (BPTB) demonstrating slightly superior results (94% stability compared to 90% in the hamstring group). However, Group A (hamstring graft) showed better post-operative ROM and lower complication rates, indicating distinct advantages for specific patient needs and priorities.

The finding that BPTB grafts provided better initial stability aligns with global literature, which emphasizes the biomechanical advantage of BPTB grafts due to their firm fixation and integration (7,8). Zhao et al. reported similar outcomes, noting that BPTB grafts are particularly advantageous for athletes or individuals engaging in high-

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demand physical activities due to their superior strength (8). However, the higher complication rate observed in Group B (25%, including anterior knee pain and patellar tendinopathy) underscores the trade-offs associated with this graft type. Previous studies, such as those by Fritschy et al., have documented similar drawbacks, particularly donor site morbidity, which can negatively affect long-term outcomes (9).

In contrast, the hamstring graft group exhibited a lower complication rate (12%) and greater ROM recovery, consistent with findings by Lee et al., who reported that hamstring grafts are associated with fewer donor site complications and improved post-operative comfort (10). This makes the hamstring graft a preferable option for patients prioritizing a smoother rehabilitation process and long-term functionality, especially in non-athletic populations. However, concerns about its durability under high-stress conditions remain, as some studies have suggested a higher risk of laxity with hamstring grafts over time (11).

The return-to-sport rates in this study were slightly higher for the BPTB group (82%) compared to the hamstring group (78%). These findings are comparable to those reported by Smith et al., who highlighted that while BPTB grafts enable faster return to sports, the associated anterior knee pain can affect overall patient satisfaction (12). In our study, satisfaction was higher in the hamstring group (92%) than in the BPTB group (85%), reflecting the preference for a less invasive procedure and better post-operative recovery among the Pakistani population.

The implications of these findings are particularly relevant in the local context, where socio-economic factors, limited healthcare resources, and cultural practices influence surgical decisions. The hamstring graft's lower complication rate and better recovery outcomes make it a viable option for the general population, particularly non-athletes or those engaged in less physically demanding activities. On the other hand, the BPTB graft's superior stability may benefit individuals with high physical demands or athletes requiring rapid return to pre-injury performance levels.

This study contributes to the growing body of evidence supporting the individualized selection of grafts based on patient needs, activity levels, and tolerance for potential complications. Future research should focus on long-term follow-ups and the development of surgical techniques to minimize the complications associated with both graft types.

Conclusion

This study compared the functional outcomes of anterior cruciate ligament (ACL) reconstruction using hamstring and bone-patellar tendon-bone (BPTB) grafts in a Pakistani population. Both grafts demonstrated high effectiveness in restoring knee stability, with the BPTB graft slightly outperforming in terms of initial stability and return-to-sport rates. However, the BPTB graft was associated with a higher complication rate, including anterior knee pain and patellar tendinopathy. In contrast, the hamstring graft provided a superior post-operative range of motion, fewer complications, and greater patient satisfaction, highlighting its suitability for patients prioritising smoother rehabilitation and long-term comfort. These findings underscore the importance of individualized graft selection based on patient-specific needs, physical activity demands, and tolerance for potential complications.

Declarations

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

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Conflict of interest

The authors declared absence of conflict of interest.

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