

A Retrospective Analysis of Outcomes in Patients Undergoing ACL Reconstruction: Graft Choice, Fixation Methods, and Return to Sports

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Abstract

Background: Anterior Cruciate ligament (ACL) injuries are a major cause of knee instability, especially in young and physically active people. ACL reconstruction is extensively used to restore knee performance and enable athletes to resume sport, but the results can be different due to the type of grafts and fixation techniques.

Methods: It was a retrospective observational study that was carried out in Patna Medical College and Hospital (PMCH), Bihar, between March 2025-December 2025. A total of 100 patients aged 18–45 years who underwent primary ACL reconstruction were included. Medical records, operative reports, and follow-ups were used to collect data. Such variables as graft type (hamstring tendon vs bone) and fixation (interference screws vs endobuttons) and functional outcomes as Lysholm and IKDC scores, complications and return-to-sport rates were analyzed. The SPSS was used to perform the statistical analysis, and the $p < 0.05$ was regarded as significant.

Result: 64% of the patients received hamstring grafts, with 36% receiving BPTB grafts. Mean Lysholm and IKDC scores were a slightly higher in the bone–patellar tendon–bone (BPTB) group than those of hamstring group but the difference was not significant ($p > 0.05$). The most common fixation method was the interference screws (58%). In total, 72% of patients were back to sports in a mean of 7.8 months. There were low complication rates and no significant difference in complication rates were noted between graft or fixation groups.

Conclusion: ACL reconstruction has shown good functional results and return-to-sport rates regardless of graft type or fixation technique. The use of BPTB grafts might only have some marginal benefits, yet personalized treatment planning is critical to the optimal outcomes.

Keywords: ACL Reconstruction, Graft Choice, Fixation, Functional Outcome, Return To Sports.

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Introduction

One of the most frequent ligament ruptures of the knee joint is the anterior cruciate ligament (ACL), and it occurs especially in young, active people and in athletes who play pivoting sports (football, basketball, and cricket) [1]. The number of ACL tears has also been on the rise because of increased engagement in high-intensity body movements and increased diagnostic ability [2]. The consequences of these injuries usually include knee instability, reduced functional performance and a heightened risk of long-term complications including meniscal injury and early onset osteoarthritis without treatment [3].

The ACL reconstruction has become the gold standard of restoring knee stability and allowing

the patients to resume their activity levels before the injury [4]. The process consists of substituting the torn ligament with an appropriate graft, and the graft selection is an important factor influencing the results of the postoperative period [5]. The hamstring tendon graft and the BPTB graft is some of the grafts commonly used [6]. Hamstring grafts are highly desirable because of their less donor-site morbidity and less anterior knee pain, but BPTB grafts are commonly considered because of their high initial fixation strength and bone-to-bone healing properties [7].

Another aspect of graft selection that is critical is the fixation technique to be employed during surgery [8,9]. The most commonly used fixation

devices are interference screws and endobuttons. Interference screws give direct compression to the graft in the bone tunnel which enhances stability whereas endobuttons give cortical fixation and are especially applicable to soft tissue grafts [10,11]. Although surgical procedures have improved, there are various issues that remain several challenges persist in achieving optimal post-surgical outcomes, especially with regard to functional recovery and prompt sports resumption. Graft type, fixation method, rehabilitation protocols, and patient compliance are some of the factors that can greatly affect the recovery journeys [12].

Though many studies have been conducted to determine the results of ACL reconstruction globally, there remains a paucity of region-specific retrospective studies, especially in the tertiary care facilities in India like in PMCH, Bihar. Knowledge of the local patient demographics, surgical practices, and outcomes are vital in enhancing patient care and clinical decision-making.

Objective

- To evaluate and compare the clinical outcomes of anterior cruciate ligament (ACL) reconstruction based on graft choice (hamstring tendon vs bone-patellar tendon-bone) and fixation methods (interference screws vs endobuttons) in patients treated at a tertiary care hospital.
- To assess functional recovery and return-to-sport rates following ACL reconstruction and identify factors influencing postoperative outcomes in the study population.

Materials and Methods

Study Design: This is a retrospective observational study to assess the clinical outcome among patients undergoing ACL reconstruction. The retrospective type of design also allowed evaluating existing clinical information to determine trends connected to graft selection, fixation methods, and post-surgery recovery, especially to sports.

Study Setting: This research was undertaken in PMCH, Bihar which is a tertiary care hospital serving a large and diverse patient population.

The institution offers quality orthopedics surgery, such as arthroscopic ACL reconstruction.

Study Duration: The participants of the study were patients who have received treatment during ten months, between March 2025 and December 2025. This period was long enough to include an adequate number of cases and had a follow-up data to evaluate the outcomes.

Sample Size: 100 patients who had undergone ACL reconstruction were included in the study. The sample was selected on the basis of the

accessibility of complete medical history and follow-up data.

Inclusion Criteria

- Adults (between 18 and 45 years old).
- Patients who had primary ACL reconstruction.
- Patients who have followed up a minimum of 6 months.

Exclusion Criteria

- Patients who have ACL revision surgery.
- Patients who have multi-ligament knee injuries.
- Severe comorbid patients with mobility or recovery problems.

Data Collection: Medical records, operative note, and follow up registers were used to collect data in hospitals. Data on patient demographics, surgical and postoperative outcomes were systematically retrieved and documented. Clinical measures and patient-reported outcomes reported at normal postoperative visits were used as follow-up data.

Variables Studied: In the study, various variables were assessed, which included demographic factors like age and gender, clinical and surgical factors. These were the kind of graft applied (hamstring or bone patellar tendon bone), fixation technique (interference screws or endobuttons) and postoperative complications. The standardized scoring systems (Lysholm Knee Score and International Knee Documentation Committee (IKDC) score) were used to measure functional outcomes. Also, the analysis was made on return to sports with respect to the occurrence of patients returning to sports and the duration it took them to attain this milestone.

Statistical Analysis: The statistical software SPSS and Microsoft Excel were used to analyze the data. The data were summarized using descriptive statistics with mean, standard deviation, and percentages. The Chi-square test was used to compare the categorical variables and t-test or ANOVA to compare continuous variables. A p-value below 0.05 was considered statistically significant and the study showed that the variables have significant relationships.

Ethical Considerations: This research was carried out in accordance with ethical guidelines on medical research using human subjects. The Institutional Ethics Committee of PMCH gave their consent before data collection. Since it was a retrospective study, informed consent was not obtained; patient confidentiality and data privacy were ensured during the study. All the records of patients were anonymized, and no personal data were disclosed. The research followed the guidelines of the Declaration of Helsinki. The use of data was only academic and research-based, with

full protection of patient rights, safety, and dignity, at any phase.

Results

Demographic Profile: A total of 100 patients who underwent ACL reconstruction were included in the study. Most of the patients were young, which corresponded to the increased rates of ACL injuries in physically active people. The majority of

patients were in the 21-30 year's age, then followed by the 31-40 age group. The age of the study population was 28.6 ± 6.4 years. It was distinctly male dominant, with male population making 78% of the cases and female population 22% representing greater exposure to sports and physical activities among male individuals in this cohort.

Table 1: Demographic Characteristics of Patients

Variable	Category	Number (n)	Percentage (%)
Age Group (years)	18-20	12	12%
	21-30	46	46%
	31-40	30	30%
	41-45	12	12%
Gender	Male	78	78%
	Female	22	22%

Graft Choice Distribution: Hamstring tendon grafts were the most frequently used grafts amongst the 100 patients with 64% of the patients having hamstring tendon grafts and 36% patients having

BPTB grafts. The popularity of hamstring grafts could be explained by the decreased morbidity of the donor-site and improved postoperative comfort.

Table 2: Distribution of Graft Types

Graft Type	Number (n)	Percentage (%)
Hamstring Tendon	64	64%
Bone-Patellar Tendon-Bone	36	36%

Fixation Methods Used: In terms of the fixation, 58% of patients were fixed with interference screws and 42% with endobutton fixation. The type of fixation was dependent on the graft type and the preference of the surgeon.

Table 3: Fixation Methods

Fixation Method	Number (n)	Percentage (%)
Interference Screws	58	58%
Endobutton	42	42%

Functional Outcomes: Lysholm and IKDC scores were used to measure functional outcomes at follow-up. The average Lysholm score was 89.2/6.8 and the average IKDC score was 86.5/7.2 which shows that good to excellent results were

obtained in most patients. In the comparison of the types of graft, BPTB graft patients showed marginally higher mean scores (Lysholm: 91.1; IKDC: 88.3) than hamstring graft (Lysholm: 88.1; IKDC: 85.4) but not significantly ($p > 0.05$).

Table 4: Functional Outcome Scores by Graft Type

Graft Type	Mean Lysholm Score	Mean IKDC Score
Hamstring	88.1 ± 6.9	85.4 ± 7.5
BPTB	91.1 ± 6.2	88.3 ± 6.7

Return to Sports: Among 100 patients, 72% of patients were able to return to sports activities during the follow-up. The mean duration of recovery to sports was 7.8 months $\pm$ 1.9 months. The return rate was a slightly higher in patients

with BPTB grafts (75% versus hamstring grafts 70%). The patients who had the interference screw fixation showed slightly earlier return than the endobutton fixation but this difference was not found to be significant.

Table 5: Return to Sports Analysis

Parameter	Value
Patients returned to sports	72 (72%)
Average time (months)	7.8 ± 1.9
Hamstring graft return rate	70%
BPTB graft return rate	75%

Complications: Minority of the patients had postoperative complications. There were 4% cases of superficial infections, which were treated conservatively. Graft failure has been observed in 3% of patients, and 6% of patients reported knee stiffness, necessitating physiotherapy. In general, the level of complication was low and did not differ between groups with grafts or fixation significantly.

Table 6: Postoperative Complications

Complication	Number (n)	Percentage (%)
Infection	4	4%
Graft Failure	3	3%
Knee Stiffness	6	6%

Overall, the findings suggest positive clinical outcomes after ACL reconstruction, high levels of functional scores, satisfactory rates of return-to-sport, and low rates of complications in regard to the various graft and fixation techniques.

Discussion

The current retrospective study compared the clinical outcomes of ACL reconstruction in terms of graft choice, fixation techniques, and the return-to-sport rate among a group of 100 patients. The results showed relatively positive results with high functional scores, satisfactory rates of return-to-sport and low occurrence of complications. These findings support the efficacy of ACL reconstruction as a dependable surgery to restore knee stability and functionality in active people. Regarding the graft choice, the hamstring tendon grafts were the more frequently used grafts in this study; patients who had grafts in the form of BPTB grafts had better functional results and higher rates of returning to sport. Though this was not statistically significant, this tendency is similar with a [13] that indicate that BPTB grafts could provide higher fixation strength and quicker biological integration because of bone-to-bone healing. Hamstring grafts have been linked to lower donor-site morbidity and less anterior knee pain and are a choice in most clinical environments [14,15]. Hence, the selection of graft must be personalized according to the patient characteristics, activity, and skills of the surgeons.

In the area of fixation techniques, both endobuttons and interference screws showed similar results in regard to functional recovery and complication rates. While the interference screws provide direct compression with rigid fixation, endobuttons also allows for stable cortical suspension, which is most important in soft tissue grafts. The current study shows no significant difference between methods, meaning they can both work well when used appropriately. This correlates with the prevailing literature that fixation method alone may be less of a driving force to long-term outcomes given optimized surgical technique and rehabilitation regimens. Return to sports is another important outcome measure of ACL reconstruction, particularly in young and active patients. In this study, 72% of patients were able to return to sports within an average of 7.8 months. The factors that

affect the return to sports are probably the type of graft, stability of fixation, compliance with rehabilitation, psychological readiness, and the lack of complications. Return was earlier with patients having BPTB grafts and interference screw fixation but not significant. These results highlight not only the multifactoriality of recovery, but also the importance of postoperative rehabilitation as a whole.

The clinical implications from the results presented in this study are that BPTB grafts may be better suited for more active patients or for athletes needing to return to high demand activity sooner. However, hamstring autografts may be preferable in patients who are more focused on postoperative pain and donor-site morbidity. When choosing grafts, fixation techniques, surgeons ought to use a patient-centered approach.

The advantages of this research are the application of real clinical data of a tertiary care hospital, which increases the practical nature of the results. Nevertheless, there are a number of drawbacks that have to be considered. The retrospective design restricts causation establishment, and the sample size used is relatively small, which can minimize the results generalizability.

Also, the follow-up period was short and this might not adequately measure long term results like graft-life and late complications. These results warrant further investigation in prospective studies with larger sample size and longer follow up.

Conclusion

The present study shows that ACL reconstruction is typically associated with an excellent clinical outcome, even higher for BPTB grafts and comparable regardless of fixation type. The majority of patients went on to successfully return to sports in a reasonable timeframe. Graft selection must be tailored to the individual patient needs and activity levels. More large-scale prospective studies with longer follow-up are needed to define concrete clinical guidelines and optimize surgical outcomes.

Recommendations

This study suggests that ACL reconstruction graft selection should be tailored to the patient based on activity level, occupational requirements of patients as well as surgeon based proficiency. BPTB grafts

may be best for most active individuals because they have slightly higher functional outcomes, and hamstring grafts can still be a good choice with less donor-site morbidity. Return-to-sport outcomes may be improved through greater use of standardized rehabilitation protocols.

These findings should be confirmed in larger multicenter prospective studies with extended follow-up. Further, the use of patient-reported outcome measures and assessing psychological readiness can also improve postoperative recovery and overall satisfaction.

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