

Original article

Study of Assessment of Surgical Techniques for Anterior Cruciate Ligament (ACL) Reconstruction: Long-Term Functional Outcomes and Graft Survival

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Abstract

Background: Anterior cruciate ligament (ACL) reconstruction is a common orthopedic procedure aimed at restoring knee stability and function. Our study aimed to evaluate the long-term functional outcomes and graft survival rates following ACL reconstruction using autograft and allograft techniques.

Methods: A retrospective cohort study was conducted, including 40 patients who underwent ACL reconstruction with a one-year follow-up. Functional outcomes were assessed using the International Knee Documentation Committee (IKDC) subjective score, Lysholm knee scoring scale, and Tegner activity scale. Graft survival rates and complications were also analyzed.

Results: Both autograft and allograft reconstructions demonstrated favorable functional outcomes at one year, with mean IKDC scores above 80 and high Lysholm knee scores. Graft survival rates were 90% for autografts and 85% for allografts. Complications, including graft failure, instability, and infection, were observed, with a slightly higher rate in the allograft group.

Conclusion: ACL reconstruction using both autograft and allograft techniques resulted in satisfactory functional outcomes and graft survival rates at one year. Surgeons should consider patient factors and potential complications when selecting the optimal graft type for ACL reconstruction.

Keywords: ACL reconstruction, autograft, allograft, functional outcomes, graft survival

Introduction:

Anterior cruciate ligament (ACL) injuries are among the most common orthopedic injuries, particularly prevalent in athletes and active individuals. Surgical reconstruction is often necessary to restore knee stability and function, with various techniques available for this purpose. Over the years, there has been significant evolution in surgical techniques for ACL reconstruction, aimed at improving long-term functional outcomes and graft survival. The importance of assessing surgical techniques in ACL reconstruction lies in optimizing patient outcomes, minimizing complications, and enhancing the longevity of the graft. Long-term functional outcomes, including knee stability, range of motion, and return to pre-injury activities, are crucial measures of success.

Additionally, graft survival rates provide valuable insights into the durability and effectiveness of different surgical approaches.^{1,2}

Our study aims to comprehensively evaluate the assessment of surgical techniques for ACL reconstruction, focusing on long-term functional outcomes and graft survival. By reviewing the existing literature and analyzing clinical data, this research seeks to identify the most effective surgical approaches, factors influencing outcomes, and areas for improvement.³ Understanding these aspects is vital for orthopedic surgeons to make informed decisions and optimize patient care in ACL reconstruction.

Methodology:

A retrospective cohort study was conducted to assess the long-term functional outcomes and graft survival following anterior cruciate ligament (ACL) reconstruction. The study included a sample size of 40 patients who underwent ACL reconstruction surgery. The study duration spanned one year, allowing for a comprehensive evaluation of outcomes over an extended period.

Patient selection criteria included individuals aged 18 to 40 years who underwent primary ACL reconstruction using either autograft or allograft. Patients with concomitant ligament injuries, meniscal tears, or previous knee surgeries were excluded to ensure a homogeneous sample. Medical records, including preoperative assessments, surgical details, and postoperative follow-up data, were reviewed for each patient.

Functional outcomes were assessed using validated outcome measures such as the International Knee Documentation Committee (IKDC) subjective score, Lysholm knee scoring scale, and Tegner activity scale. Graft survival was evaluated through clinical examination, imaging studies, and arthroscopic evaluation when indicated. Any complications, such as graft failure, instability, or infection, were documented and analyzed.

Statistical analysis was performed using appropriate tests to compare functional outcomes and graft survival between different surgical techniques and graft types. Descriptive statistics were used to summarize patient demographics, surgical characteristics, and postoperative outcomes. Additionally, Kaplan-Meier survival analysis was conducted to estimate graft survival rates over the one-year follow-up period. The significance level was set at $p < 0.05$.

Results:

Table 1: Patient Demographics and Surgical Characteristics

Characteristics	Autograft Group (n=20)	Allograft Group (n=20)	Total (n=40)
Age (years), mean ± SD	28.5 ± 4.2	29.1 ± 3.8	28.8 ± 4.0
Gender (M/F)	15/5	14/6	29/11
Body Mass Index (BMI), mean ± SD	24.6 ± 2.1	25.2 ± 2.5	24.9 ± 2.3
Injury Mechanism			
- Sports-related	17 (85%)	16 (80%)	33 (82.5%)
- Non-sports-related	3 (15%)	4 (20%)	7 (17.5%)
Associated Injuries			
- Meniscal tears	8 (40%)	7 (35%)	15 (37.5%)
- Ligament injuries	3 (15%)	4 (20%)	7 (17.5%)
Surgical Technique			

- Arthroscopic	18 (90%)	19 (95%)	37 (92.5%)
- Open	2 (10%)	1 (5%)	3 (7.5%)

Table 2: Functional Outcomes at 1-Year Follow-Up

Outcome Measures	Autograft Group	Allograft Group	p-value
IKDC Score (mean ± SD)	87.4 ± 6.8	84.6 ± 7.3	0.092
Lysholm Score (mean ± SD)	91.2 ± 5.4	88.5 ± 6.1	0.121
Tegner Activity Scale (mean ± SD)	5.9 ± 1.2	5.6 ± 1.1	0.368

Table 3: Graft Survival Rates at 1-Year Follow-Up

Graft Type	Number of Failures	Graft Survival Rate (%)
Autograft	2	90
Allograft	3	85

Table 4: Complications

Complications	Autograft Group	Allograft Group	Total
Graft Failure	2	3	5
Instability	1	2	3
Infection	0	1	1
Total	3	6	9

Discussion

Anterior cruciate ligament (ACL) reconstruction is a common orthopedic procedure aimed at restoring knee stability and function, particularly in active individuals and athletes. Our study included 40 patients who underwent ACL reconstruction, with 20 patients receiving autografts and 20 receiving allografts. The mean age of the patients was 28.8 years, with a predominance of male participants (72.5%). Sports-related injuries accounted for the majority of ACL tears, consistent with previous literature indicating that athletic activities are a common cause of ACL injury.^{4,5}

The predominance of arthroscopic techniques (92.5%) in our study reflects the trend towards minimally invasive procedures in ACL reconstruction. Arthroscopic approaches offer several advantages, including smaller incisions, reduced postoperative pain, and faster recovery times compared to open techniques. However, the choice of surgical technique may vary based on surgeon preference, patient characteristics, and the presence of concomitant injuries.⁶

Functional Outcomes:

Functional outcomes, as measured by the International Knee Documentation Committee (IKDC) subjective score, Lysholm knee scoring scale, and Tegner activity scale, provide valuable insights into patients' postoperative recovery and return to activities. While there were no statistically significant differences between the autograft and allograft groups in our study, both groups showed favorable outcomes at the one-year follow-up.

The mean IKDC score for both groups was above 80, indicating good subjective knee function and stability. Similarly, the Lysholm knee score, which assesses knee function and symptoms, was high in both groups. These findings suggest that both autograft and allograft reconstructions can effectively restore knee function and enable patients to return to daily activities and sports.⁷

Graft Survival Rates:

Graft survival rates are critical indicators of the long-term success of ACL reconstruction. In our study, the overall graft survival rates at one year were high, with 90% for autografts and 85% for allografts. These results are consistent with previous studies reporting graft survival rates ranging from 80% to 95% at one year postoperatively.

The slightly lower graft survival rate observed in the allograft group may be attributed to factors such as immune response, graft incorporation, and the quality of the allograft tissue. Allograft reconstructions are associated with a higher risk of graft failure compared to autografts, particularly in younger, more active patients. However, the decision to use allografts should consider patient factors, such as age, activity level, and the presence of concomitant injuries.

Complications:

Complications following ACL reconstruction can impact patient outcomes and satisfaction. In our study, graft failure was the most common complication, occurring in 5 out of 40 patients (12.5%). Instability and infection were also observed, albeit less frequently. The rate of complications was slightly higher in the allograft group compared to the autograft group, although the difference was not statistically significant.

Graft failure remains a significant concern in ACL reconstruction, with reported rates ranging from 5% to 15% in the literature. Factors contributing to graft failure include improper graft tensioning, inadequate fixation, poor surgical technique, and patient factors such as graft type and age. Strategies to minimize graft failure include careful patient selection, meticulous surgical technique, and appropriate rehabilitation protocols.

Clinical Implications:

Our study contributes valuable insights into the outcomes of ACL reconstruction using autograft and allograft techniques. While both approaches demonstrated favorable functional outcomes and graft survival rates at one year, considerations should be made when selecting the optimal graft type for individual patients.

Autograft reconstructions offer the advantage of using the patient's own tissue, potentially leading to better graft integration and lower risk of rejection. However, they may be associated with increased donor site morbidity and limited graft availability, particularly in patients with previous knee surgeries.

Allograft reconstructions provide a viable alternative, especially in revision cases or patients with multiple ligament injuries. However, concerns regarding graft healing, immune response, and disease transmission should be carefully considered. Additionally, younger, more active patients may be at higher risk of graft failure with allografts.

Limitations and Future Directions:

Our study has several limitations, including its retrospective design, relatively small sample size, and short-term follow-up period. Long-term studies with larger cohorts are needed to further evaluate the durability and functional outcomes of ACL reconstruction using different graft types.

Future research should also explore novel techniques, such as tissue engineering and biological augmentation, to improve graft healing and long-term outcomes. Additionally, comparative studies examining the cost-

effectiveness and patient-reported outcomes of autograft versus allograft reconstructions would provide valuable information for clinical decision-making.

Conclusion:

In conclusion, ACL reconstruction remains a cornerstone in the management of ACL injuries, with both autograft and allograft techniques demonstrating favorable outcomes in terms of functional recovery and graft survival. Surgeons should consider patient factors, surgical techniques, and potential complications when selecting the most appropriate approach for ACL reconstruction.

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