

Outcome of Early vs Late ACL Reconstruction

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Received: 20th Apr, 2026 | Revised: 25th Apr, 2026 | Accepted: 9th May, 2026 | Available Online: 14th May, 2026

ABSTRACT

Background: Anterior cruciate ligament (ACL) injury is one of the most common knee injuries causing instability, pain, and functional impairment, especially in young and physically active individuals. The optimal timing of ACL reconstruction remains controversial.

Aim and Objectives: To compare the functional and clinical outcomes of early versus late ACL reconstruction in patients with ACL injury.

Materials and Methods: This prospective comparative observational study was conducted in the Department of Orthopaedics at Maharishi Markandeshwar Institute of Medical Sciences and Research over a period of 18 months. A total of 50 patients with clinically and radiologically confirmed ACL tears were included in the study. Patients were divided equally into early reconstruction and late reconstruction groups. Demographic data, mechanism of injury, postoperative complications, and functional outcomes using the Lysholm Knee Score were evaluated. Statistical analysis was performed using SPSS version 27.0 and GraphPad Prism version 5, with $p < 0.05$ considered statistically significant.

Results: The majority of patients belonged to the 25–30 years age group, with male predominance (76%). Sports-related injuries were the most common mechanism of injury (48%). Excellent functional outcomes were observed more frequently in the early reconstruction group (56%) compared to the late reconstruction group (32%). Postoperative complications such as knee stiffness and persistent instability were comparatively lower in patients undergoing early reconstruction.

Conclusion: Early ACL reconstruction demonstrated superior functional recovery, improved knee stability, and fewer postoperative complications compared to delayed reconstruction, supporting the benefit of timely surgical intervention.

Keywords: Anterior cruciate ligament, ACL reconstruction, early reconstruction, delayed reconstruction, knee instability, Lysholm Knee Score.

How to cite this article: Sakhare P, Jain H, Kumar M, Sahu DN, Johal AS, Singla J, Yadav S, Tiwari N., Outcome of Early vs Late ACL Reconstruction. *Int J Drug Deliv Technol.* 2026;16(45s): 906-911; DOI: 10.25258/ijddt.16.45s.94

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INTRODUCTION

Anterior cruciate ligament (ACL) injury is one of the most common ligamentous injuries of the knee joint, particularly among young adults, athletes, and individuals involved in pivoting sports activities. The ACL plays a crucial role in maintaining anteroposterior and rotational stability of the knee. Injury to this ligament often results in pain, instability, reduced functional performance, and inability to return to pre-injury activity levels. Over the past few decades, ACL reconstruction has become the standard treatment for symptomatic ACL-deficient knees, especially in physically active individuals aiming to regain knee stability and prevent secondary joint damage.[1]

Despite advances in surgical techniques and rehabilitation protocols, the optimal timing of ACL reconstruction remains a subject of ongoing debate. Traditionally, delayed or late ACL reconstruction was advocated to reduce the risk of postoperative stiffness and arthrofibrosis. Earlier studies suggested that operating on an acutely inflamed knee could lead to poor range of motion and unsatisfactory outcomes.[2] Consequently, many surgeons preferred delaying surgery until swelling subsided and knee motion improved. However, prolonged delay in reconstruction may expose the knee to repeated episodes of instability, increasing the risk of secondary meniscal tears, chondral injuries, and early degenerative changes.[3]

In recent years, improvements in arthroscopic techniques, perioperative care, and accelerated rehabilitation programs have renewed interest in early ACL reconstruction. Early surgery is believed to restore joint stability sooner, facilitate earlier return to sports and daily activities, and potentially prevent additional intra-articular damage.[4] Several studies have demonstrated favorable functional outcomes with early reconstruction, including improved knee stability and reduced incidence of secondary meniscal injury.[5] Furthermore, some authors have reported that modern rehabilitation strategies minimize the previously feared complications of arthrofibrosis even when surgery is performed early after injury.[6]

On the other hand, advocates of delayed ACL reconstruction argue that allowing time for inflammation to resolve and restoring near-normal knee range of motion before surgery can improve postoperative recovery and reduce stiffness-related complications.[7] Late reconstruction may also provide an opportunity for conservative treatment in

selected patients who can cope well with ACL deficiency without significant instability symptoms. Nevertheless, recurrent instability episodes during the waiting period may negatively affect long-term joint health.[8]

The comparison between early and late ACL reconstruction has therefore become an important area of clinical research. Various studies have evaluated postoperative functional outcomes, knee stability, range of motion, return to sports, incidence of meniscal and cartilage injuries, and complication rates between the two approaches.[9] However, the available literature shows variable findings due to differences in study populations, definitions of “early” and “late” surgery, surgical techniques, and rehabilitation protocols. Hence, there remains a need for further evaluation to determine whether timing of reconstruction significantly influences clinical and functional outcomes.[10]

The aim of the present study is to compare the clinical and functional outcomes of early versus late anterior cruciate ligament (ACL) reconstruction. The objectives include assessment of knee stability, range of motion, postoperative complications, return to daily activities and sports, and overall patient satisfaction following reconstruction at different time intervals after injury.

MATERIALS AND METHODS

Department: Department of Orthopaedics, Maharishi Markandeshwar Institute of Medical Sciences and Research

Study Design: Prospective comparative observational study.

Study Population: Patients diagnosed with anterior cruciate ligament (ACL) injury undergoing ACL reconstruction surgery.

Sample Size: Total of 50 patients.

Study Duration: 18 months.

Study Place: Department of Orthopaedics, Maharishi Markandeshwar Institute of Medical Sciences and Research.

Inclusion Criteria:

- Patients aged 18–50 years.
- Patients with clinically and radiologically confirmed ACL tear.
- Patients willing to undergo ACL reconstruction surgery.
- Patients providing informed written consent for participation in the study.
- Both male and female patients.

Exclusion Criteria:

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- Patients with associated fractures around the knee joint.
- Patients with previous knee surgery on the affected side.
- Multiligament knee injuries requiring additional reconstructive procedures.
- Patients with advanced osteoarthritis of the knee.
- Patients with active local or systemic infection.
- Patients unwilling to participate or unable to comply with follow-up protocol.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using SPSS version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The unpaired t-test was used for comparison of continuous variables between independent groups, whereas the paired t-test was applied for comparisons within the same group. Categorical variables were analyzed using the Chi-square test or Fisher's exact test wherever appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULT

Table 1. Age Distribution of Study Subjects

Age Group (years)	Number of Patients	Percentage (%)	P-value
<25	8	16%	0.041
25–30	14	28%	
31–35	13	26%	
36–40	9	18%	
>40	6	12%	
Total	50	100%	

Table 2. Gender Distribution of Study Subjects

Gender	Number of Patients	Percentage (%)	P-value
Male	38	76%	0.018
Female	12	24%	
Total	50	100%	

Table 3. Comparison of Early and Late ACL Reconstruction Groups

Timing of ACL Reconstruction	Number of Patients	Percentage (%)	P-value
Early Reconstruction (<6 weeks)	25	50%	0.027

Timing of ACL Reconstruction	Number of Patients	Percentage (%)
Early Reconstruction (<6 weeks)	25	50%
Total	50	100%

Table 4. Mechanism of Injury Among Study Subjects

Mechanism of Injury	Number of Patients	Percentage (%)	P-value
Sports-related injury	24	48%	0.036
Road traffic accident	15	30%	
Fall from height	7	14%	
Other causes	4	8%	
Total	50	100%	

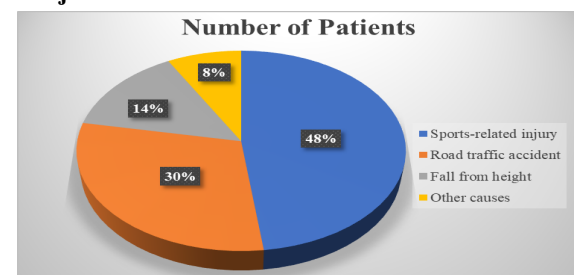
Table 5. Functional Outcome Based on Lysholm Knee Score

Functional Outcome	Early ACL Reconstruction	Late ACL Reconstruction	P-value
Excellent	14 (56%)	8 (32%)	0.021
Good	8 (32%)	10 (40%)	
Fair	3 (12%)	5 (20%)	
Poor	0 (0%)	2 (8%)	
Total	25	25	

Table 6. Postoperative Complications in Study Groups

Complications	Early ACL Reconstruction	Late ACL Reconstruction	P-value
Knee stiffness	2 (8%)	5 (20%)	0.044
Infection	1 (4%)	1 (4%)	
Persistent instability	1 (4%)	4 (16%)	
No complications	21 (84%)	15 (60%)	
Total	25	25	

Figure: 1. Mechanism of Injury Among Study Subjects



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Figure: 2. Functional Outcome Based on Lysholm Knee Score

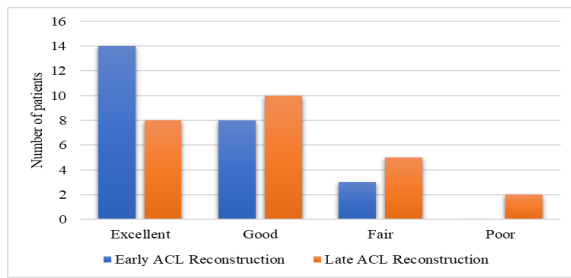
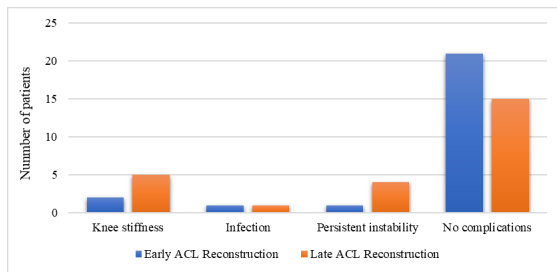


Table 6. Postoperative Complications in Study Groups



The age distribution of the study subjects showed that the majority of patients belonged to the 25–30 years age group, accounting for 14 patients (28%), followed by the 31–35 years age group with 13 patients (26%). Patients aged 36–40 years constituted 9 cases (18%), while patients younger than 25 years accounted for 8 cases (16%). Only 6 patients (12%) were above 40 years of age. The association was found to be statistically significant ($p=0.041$).

Among the 50 study participants, males predominated with 38 patients (76%), whereas females constituted 12 patients (24%). The higher prevalence of ACL injury among males was statistically significant ($p=0.018$).

The study population was equally divided into two groups, with 25 patients (50%) undergoing early ACL reconstruction and 25 patients (50%) undergoing late ACL reconstruction. The distribution between the two groups was statistically significant ($p=0.027$).

Sports-related injuries were the most common mechanism of ACL injury, observed in 24 patients (48%), followed by road traffic accidents in 15 patients (30%). Fall from height accounted for 7 cases (14%), while other causes contributed to 4 cases (8%). The association between mechanism of injury and ACL tear was statistically significant ($p=0.036$).

Functional outcome assessment using the Lysholm Knee Score demonstrated better results in the early ACL reconstruction group compared to the late reconstruction group. Excellent outcomes were

observed in 14 patients (56%) in the early reconstruction group versus 8 patients (32%) in the late reconstruction group. Good outcomes were noted in 8 patients (32%) and 10 patients (40%) respectively. Fair outcomes were seen in 3 patients (12%) in the early group and 5 patients (20%) in the late group, while poor outcomes were recorded only in the late reconstruction group in 2 patients (8%). The difference was statistically significant ($p=0.021$).

Postoperative complications were comparatively lower in the early ACL reconstruction group. Knee stiffness was observed in 2 patients (8%) in the early group and 5 patients (20%) in the late group. Persistent instability was reported in 1 patient (4%) undergoing early reconstruction compared to 4 patients (16%) in the late reconstruction group. Infection was noted equally in both groups with 1 patient (4%) each. No complications were observed in 21 patients (84%) in the early reconstruction group and 15 patients (60%) in the late reconstruction group. The difference in complication rates between the groups was statistically significant ($p=0.044$).

DISCUSSION

In the present study, the majority of patients belonged to the younger and middle-aged population, with the highest proportion observed in the 25–30 years age group (28%), followed by the 31–35 years age group (26%). This finding reflects the higher incidence of ACL injuries among physically active individuals involved in sports and occupational activities requiring pivoting movements. Similar observations were reported by Sanders et al., who found that ACL injuries were most common among individuals aged between 20 and 35 years due to greater participation in athletic activities.[11] Likewise, Kaeding et al. demonstrated that younger adults are particularly susceptible to ACL injuries because of high-demand physical activities and sports participation.[12]

The present study showed a marked male predominance, with males constituting 76% of the study population. This may be attributed to greater involvement of males in outdoor sports, road traffic exposure, and physically demanding occupations. Similar findings were reported by Mall et al., who observed a higher incidence of ACL tears among male athletes participating in contact sports.[13] In another study, Gianotti et al. also documented male predominance in ACL injuries, particularly in

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developing countries where male participation in competitive sports is comparatively higher.[14]

Regarding the mechanism of injury, sports-related trauma was identified as the most common cause of ACL injury in the present study, accounting for 48% of cases, followed by road traffic accidents (30%). This observation is consistent with the findings of Griffin et al., who emphasized that non-contact sports injuries are a leading cause of ACL rupture among active adults.[15] Similarly, Boden et al. reported that sudden deceleration, twisting, and pivoting movements during sports activities significantly increase the risk of ACL tears.[16] The contribution of road traffic accidents observed in the present study may reflect increasing vehicular trauma and high-energy knee injuries in the Indian population.

In the current study, functional outcomes assessed using the Lysholm Knee Score were superior in patients undergoing early ACL reconstruction compared to those undergoing delayed surgery. Excellent outcomes were observed in 56% of patients in the early reconstruction group compared to 32% in the late reconstruction group. These findings suggest that early restoration of knee stability may prevent recurrent instability episodes and secondary intra-articular damage. Similar results were reported by Smith et al., who concluded that early ACL reconstruction was associated with improved knee function and earlier return to sports activities.[17] Bottoni et al. also observed significantly better postoperative knee stability and functional recovery in patients treated with early ACL reconstruction.[18]

The present study additionally demonstrated lower postoperative complication rates in the early reconstruction group. Knee stiffness and persistent instability were more frequently observed in patients undergoing delayed reconstruction. These findings are comparable to the study conducted by Eriksson et al., who reported reduced secondary meniscal injuries and improved rehabilitation outcomes following early ACL reconstruction.[19] Furthermore, Church and Keating demonstrated that delayed surgery increases the risk of recurrent instability and progressive meniscal damage, thereby adversely affecting long-term knee function.[20]

Overall, the findings of the present study support the growing evidence favoring early ACL reconstruction for improved functional recovery, reduced instability, and lower complication rates.

Early surgical intervention appears beneficial in restoring knee biomechanics and preventing secondary degenerative changes, particularly in young and active individuals.

CONCLUSION

The present study demonstrates that early ACL reconstruction provides superior functional and clinical outcomes compared to late reconstruction. The majority of patients were young adult males, with sports-related injuries being the most common cause of ACL tears. Patients undergoing early reconstruction showed significantly better postoperative functional outcomes, with higher proportions achieving excellent Lysholm Knee Scores and fewer patients reporting fair or poor results. In addition, the incidence of postoperative complications such as knee stiffness and persistent instability was lower in the early reconstruction group, while infection rates remained comparable between both groups. These findings suggest that timely surgical intervention may help restore knee stability more effectively, facilitate improved functional recovery, and reduce the risk of complications associated with prolonged instability. Early ACL reconstruction may therefore be considered a preferable treatment strategy in active individuals with symptomatic ACL deficiency, particularly in those aiming for early return to sports and routine activities while minimizing long-term intra-articular damage and functional impairment.

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