

Management and Outcomes of Anterior Cruciate Ligament Failure: An Observational Study

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Abstract:

Background: Anterior cruciate ligament (ACL) injuries are prevalent among young, physically active individuals and can significantly impair knee function. The management of ACL failures, whether through surgical or non-surgical means, presents various challenges and outcomes.

Objective: This study aimed to evaluate the causes, management strategies, and outcomes of ACL failures in patients treated at a tertiary care hospital in Maharashtra, India.

Methods: A retrospective observational study was conducted involving 29 patients diagnosed with ACL failure. Participants were divided into surgical (n=18) and non-surgical (n=11) management groups. Data were collected on demographic characteristics, injury mechanisms, treatment details, functional outcomes, and complications. Functional outcomes were assessed using the Lysholm Knee Score and the International Knee Documentation Committee (IKDC) subjective knee evaluation. Statistical analyses were performed to compare outcomes between the two groups.

Results: The mean age of participants was 30.5 years, with a higher prevalence among males (65.5%). Sports-related injuries accounted for 58.6% of cases. The surgical group showed superior functional outcomes with a mean Lysholm Knee Score of 88.2 compared to 80.4 in the non-surgical group. Similarly, the IKDC scores were higher in the surgical group (85.3 vs. 78.6). Return to pre-injury activity levels was achieved by 72.2% of surgically treated patients and 63.6% of those managed non-surgically. Complications included graft failure (11.1%) and postoperative infection (5.6%) in the surgical group. Osteoarthritis development was noted in 22.2% of the surgical group and 27.3% of the non-surgical group.

Conclusion: Surgical management of ACL failures tends to result in better functional outcomes and a higher rate of return to pre-injury activity levels. However, it is associated with specific complications such as graft failure and infection. Non-surgical management, while avoiding these surgical risks, still presents significant long-term complications like osteoarthritis. These findings underscore the need for personalized treatment plans to optimize patient outcomes and manage complications effectively.

Keywords: Anterior cruciate ligament, ACL failure, surgical management, non-surgical management, functional outcomes, complications, osteoarthritis.

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Introduction

The anterior cruciate ligament (ACL) is a crucial component of the knee joint, providing stability and allowing for a wide range of motion. It is particularly vital for activities that involve sudden stops, jumps, or changes in direction, making it susceptible to injury, especially among athletes. ACL injuries are among the most common and

severe injuries in sports medicine, often leading to significant functional impairment and a prolonged recovery period. The incidence of ACL injuries is estimated to be around 68.6 per 100,000 person-years in the general population, with higher rates observed among individuals engaged in high-risk sports such as soccer, basketball, and skiing.[1,2]

Despite advances in surgical techniques and rehabilitation protocols, managing ACL injuries remains a significant challenge. Successful treatment not only requires restoring knee stability but also addressing the risk of recurrent injuries and the development of long-term complications such as osteoarthritis.[3]

The decision between non-surgical and surgical management of ACL injuries depends on various factors, including the patient's age, activity level, and injury severity. While surgical reconstruction is often recommended for young, active individuals, non-surgical management may be appropriate for older or less active patients. However, there is ongoing debate regarding the optimal approach, and clinical outcomes can vary widely based on the chosen treatment strategy and the quality of postoperative rehabilitation.[4,5]

Given the substantial impact of ACL injuries on individuals' quality of life and the high costs associated with their management, there is a need for comprehensive studies that evaluate the real-world effectiveness of different treatment modalities. This observational study aims to investigate the causes, management strategies, and outcomes of ACL injuries in a diverse patient population. By examining the factors associated with successful and unsuccessful treatment outcomes, this study seeks to provide valuable insights that can guide clinical practice and improve patient care.

Methodology

This observational study evaluated the causes, management strategies, and outcomes of anterior cruciate ligament (ACL) failure in patients at a tertiary care hospital. The study was carried out over a period of one year, from January to December 2023, at the Department of Orthopedics.

A total of 29 patients diagnosed with ACL failure were included in this study. Participants were selected based on the following inclusion criteria: individuals aged 18-60 years, presenting with symptomatic ACL injury confirmed by clinical examination and magnetic resonance imaging (MRI), and those who had undergone initial management (either surgical or non-surgical) for ACL injury. Exclusion criteria included patients with multi-ligament knee injuries, those with previous knee surgeries other than for ACL reconstruction, and individuals with incomplete

medical records. Data were collected retrospectively from the patients' medical records. Demographic information such as age, gender, occupation, and activity level was recorded. Clinical data included the mechanism of injury, duration since injury, type of initial management (surgical or non-surgical), and any associated injuries. The primary outcomes assessed were the success of the management strategies and the incidence of complications.

Patients who underwent surgical management had their procedure details documented, including the type of graft used, surgical technique, and intraoperative findings. For non-surgically managed patients, details of the conservative treatment protocols, including physical therapy regimens and bracing, were noted.

The primary outcome measure was the functional outcome of ACL management, assessed using the Lysholm Knee Scoring Scale and the International Knee Documentation Committee (IKDC) subjective knee evaluation form at the final follow-up. Secondary outcomes included the rate of return to pre-injury activity levels, the incidence of complications such as graft failure or infection, and the development of osteoarthritis as assessed by follow-up radiographs.

Data were analyzed using descriptive statistics to summarize the baseline characteristics and outcomes of the study population. Continuous variables were presented as means and standard deviations, while categorical variables were expressed as frequencies and percentages. Comparative analyses were conducted to evaluate the differences in outcomes between surgically and non-surgically managed patients using the Chi-square test for categorical variables and the t-test for continuous variables.

A p-value of less than 0.05 was considered statistically significant. The study was approved by the Institutional Ethics Committee of [Name of the Hospital], and all procedures were conducted in accordance with the ethical standards of the Declaration of Helsinki. Informed consent was obtained from all participants included in the study, ensuring confidentiality and the right to withdraw from the study at any time without any consequences on their treatment.

Results

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	N (%)
Total Participants	29
Age (Mean ± SD)	30.5 ± 10.2 years
Gender	
- Male	19 (65.5)
- Female	10 (34.5)

Mechanism of Injury	
- Sports-related	17 (58.6)
- Accidents/Falls	12 (41.4)
Duration Since Injury	
- ≤ 6 months	16 (55.2)
- > 6 months	13 (44.8)
Type of Initial Management	
- Surgical	18 (62.1)
- Non-surgical	11 (37.9)

This observational study included a total of 29 participants diagnosed with anterior cruciate ligament (ACL) failure. The mean age of the participants was 30.5 years, with a standard deviation of 10.2 years, indicating a relatively young cohort.

The gender distribution showed a higher prevalence of ACL injuries among males, with 19 males (65.5%) compared to 10 females (34.5%). Regarding the mechanism of injury, a significant majority of the injuries were sports-related, accounting for 17 cases (58.6%). The remaining 12 cases (41.4%) were due to accidents or falls, highlighting the high risk of ACL injuries associated with athletic activi-

ties. The duration since injury was also documented, with 16 participants (55.2%) having sustained their injury within the past six months, and 13 participants (44.8%) were having experienced their injury more than six months prior to the study.

In terms of initial management, 18 participants (62.1%) underwent surgical treatment, while 11 participants (37.9%) received non-surgical, conservative management. This distribution reflects the diverse approaches to ACL injury treatment and provides a basis for comparing the outcomes of different management strategies within this patient population.

Table 2: Surgical Management Details

Surgical Variable	N (%)
Type of Graft Used	
- Autograft	18 (100)
Surgical Technique	
- Arthroscopic Reconstruction	18 (100)
Intraoperative Findings	
- Isolated ACL Tear	10 (55.6)
- ACL + Meniscus Tear	8 (44.4)
Complications	
- Graft Failure	2 (11.1)
- Post-operative Infection	1 (5.6)

In this study, 18 participants underwent surgical management for anterior cruciate ligament (ACL) failure. Among these patients, the type of graft used for the reconstruction was predominantly autograft, utilized in 18 cases (100%). The surgical technique employed was arthroscopic reconstruction, performed in 18 patients (100%), reflecting the preference for minimally invasive procedures. In contrast, open reconstruction was carried out in 3 patients (16.7%). Intraoperative findings revealed that 10 patients (55.6%) had isolated ACL tears, whereas 8 patients (44.4%) presented with

combined ACL and meniscus tears, indicating the complexity of some injuries and the necessity for comprehensive surgical intervention. Complications observed in the postoperative period included graft failure in 2 patients (11.1%) and post-operative infection in 1 patient (5.6%). These complications underscore the potential risks associated with surgical management of ACL injuries and the importance of monitoring and addressing these issues to improve patient outcomes.

Table 3: Non-Surgical Management Details

Conservative Treatment Variable	N (%)
Physical Therapy Regimen	
- Standard Protocol	9 (81.8)
- Modified Protocol	2 (18.2)
Bracing	

- Yes	7 (63.6)
- No	4 (36.4)
Duration of Non-Surgical Treatment (Months)	Mean \pm SD
-	6.5 \pm 2.3

In this study, 11 participants received non-surgical, conservative management for anterior cruciate ligament (ACL) failure.

The majority of these patients, 9 out of 11 (81.8%), followed a standard physical therapy regimen, which typically includes exercises aimed at strengthening the muscles around the knee, improving flexibility, and restoring function. The remaining 2 patients (18.2%) underwent a modified physical therapy protocol, tailored to their specific needs and circumstances. Bracing was another common component of conservative treatment,

with 7 patients (63.6%) utilizing knee braces to provide additional support and stability during the rehabilitation process.

In contrast, 4 patients (36.4%) did not use bracing as part of their treatment plan. The duration of non-surgical treatment varied among participants, with an average duration of 6.5 months, and a standard deviation of 2.3 months. This indicates a relatively long period of conservative management, reflecting the time required for significant improvement and stabilization of knee function without surgical intervention.

Table 4: Functional Outcomes

Outcome Measure	Surgical (N=18)	Non-Surgical (N=11)
Lysholm Knee Score (Mean \pm SD)	88.2 \pm 6.5	80.4 \pm 8.7
IKDC Subjective Knee Evaluation (Mean \pm SD)	85.3 \pm 7.1	78.6 \pm 9.4
Return to Pre-Injury Activity Level		
- Yes	13 (72.2)	7 (63.6)
- No	5 (27.8)	4 (36.4)

The functional outcomes of the study participants assessed using both the Lysholm Knee Score and the International Knee Documentation Committee (IKDC) subjective knee evaluation, demonstrated notable differences between the surgical and non-surgical management groups. For the 18 patients who underwent surgical treatment, the mean Lysholm Knee Score was 88.2 with a standard deviation of 6.5. This score reflects a relatively high level of knee function and stability post-surgery. In contrast, the 11 patients who received non-surgical management had a mean Lysholm Knee Score of 80.4 with a standard deviation of 8.7, indicating somewhat lower knee function compared to the surgical group. Similarly, the IKDC subjective knee evaluation scores were higher in the surgical group, with a mean score of

85.3 \pm 7.1, compared to the non-surgical group, which had a mean score of 78.6 \pm 9.4. These results suggest better subjective knee function and patient satisfaction following surgical intervention. Regarding the return to pre-injury activity levels, 13 out of 18 patients (72.2%) in the surgical group were able to resume their previous activity levels, while 5 patients (27.8%) did not achieve this outcome. In the non-surgical group, 7 out of 11 patients (63.6%) returned to their pre-injury activity levels, whereas 4 patients (36.4%) were unable to do so. These findings indicate that while both management strategies can be effective, surgical treatment may offer a higher likelihood of returning to pre-injury activity levels for some patients.

Table 5: Complications and Long-Term Outcomes

Complication/Outcome	Surgical (N=18)	Non-Surgical (N=11)
Total Complications	3 (16.7)	2 (18.2)
- Graft Failure	2 (11.1)	N/A
- Post-operative Infection	1 (5.6)	N/A
Development of Osteoarthritis (Radiographic Evidence)	4 (22.2)	3 (27.3)
Secondary Surgical Interventions	2 (11.1)	N/A

The study assessed the complications and long-term outcomes of anterior cruciate ligament (ACL) failure management in both surgical and non-surgical groups. Among the 18 patients who underwent surgical treatment, a total of 3 complications (16.7%) were recorded. These included 2 cases of graft failure (11.1%) and 1 case

of post-operative infection (5.6%). The need for secondary surgical interventions was also noted in 2 patients (11.1%), highlighting the potential for additional procedures following initial surgery. In the non-surgical group of 11 patients, 2 complications (18.2%) were reported. Although no graft failures or post-operative infections were

relevant to this group, the comparable rate of complications underscores the challenges in managing ACL injuries conservatively. Radiographic evidence of osteoarthritis development was observed in both groups. In the surgical group, 4 patients (22.2%) showed signs of osteoarthritis on follow-up radiographs. Similarly, 3 patients (27.3%) in the non-surgical group developed osteoarthritis, indicating a significant long-term risk associated with ACL injuries regardless of the management approach.

Discussion

The findings from this observational study provide valuable insights into the management and outcomes of anterior cruciate ligament (ACL) failure in a tertiary care setting in Maharashtra, India. The study highlights the demographic distribution, clinical characteristics, treatment modalities, functional outcomes, and complications associated with ACL injuries.

The study population predominantly consisted of young adults, with a mean age of 30.5 years. This is consistent with global trends indicating that ACL injuries are most common in younger, physically active individuals (Herzog et al., 2018).[6] The higher prevalence of injuries among males (65.5%) also aligns with existing literature, which suggests that males are at greater risk due to higher participation rates in high-risk sports (Gianotti et al., 2009).[7] The majority of ACL injuries in this study were sports-related (58.6%), reinforcing the well-documented association between athletic activities and ACL tears (Lohmander et al., 2007).[3] The study also identified a substantial number of injuries resulting from accidents and falls, emphasizing the need for preventive strategies beyond the athletic population.

Patients who underwent surgical management demonstrated better functional outcomes compared to those who received non-surgical treatment. The mean Lysholm Knee Score for the surgical group was 88.2, significantly higher than the non-surgical group's mean score of 80.4. Similarly, the IKDC subjective knee evaluation scores were higher in the surgical group (85.3 vs. 78.6). These findings are supported by Frobell et al. (2013),[8] who found that surgical intervention can lead to improved knee function and patient satisfaction. Additionally, the return to pre-injury activity levels was higher in the surgical group (72.2%) compared to the non-surgical group (63.6%), indicating that surgical management may better restore the knee's functional capacity. Complications were observed in both treatment groups, with a total complication rate of 16.7% in the surgical group and 18.2% in the non-surgical group. Surgical complications included graft failure (11.1%) and post-operative infection (5.6%). These results are consistent with

the findings of Meuffels et al. (2012)[9], who reported similar complication rates following ACL reconstruction surgeries. Notably, both groups showed a significant incidence of osteoarthritis development, with 22.2% in the surgical group and 27.3% in the non-surgical group. This underscores the long-term risks associated with ACL injuries, irrespective of the treatment approach (Lohmander et al., 2007).[3]

Limitations

The study's relatively small sample size and its single-center design may limit the generalizability of the findings. Additionally, the retrospective nature of the data collection could introduce bias related to the accuracy and completeness of medical records. Future research should consider larger, multi-center studies with prospective data collection to validate these results.

Conclusion

This study highlights the complexities and challenges in managing ACL failures. While surgical management tends to offer better functional outcomes and a higher likelihood of returning to pre-injury activity levels, it also carries risks of complications such as graft failure and infection.

Non-surgical management, while avoiding surgical risks, still presents a significant incidence of complications and long-term osteoarthritis development. These findings emphasize the need for individualized treatment plans, considering patient-specific factors to optimize outcomes.

Ongoing research and advancements in both surgical techniques and rehabilitation protocols are essential to improve the long-term prognosis for patients with ACL injuries.

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