



Assessment of functional recovery in patients with ACL injuries managed conservatively versus surgically: A comparative observational study.

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Abstract

Background: Anterior cruciate ligament injury is a leading cause of knee instability that compromises physical activity and quality of life. Although surgical reconstruction remains the gold standard for restoring knee stability in young and active individuals, conservative treatment continues to be employed in patients with lower activity levels or surgical contraindications. This study evaluated functional outcomes, return to activity, instability, and complications among ACL-injured patients managed conservatively or surgically.

Methods: A comparative observational study was conducted on 100 patients with ACL injuries, divided equally into conservative (n = 50) and surgical (n = 50) groups. Baseline demographics, injury characteristics, and management details were recorded. Functional outcomes were assessed using the International Knee Documentation Committee (IKDC) and Lysholm scores at baseline, six months, and 11 months. Return to pre-injury activity, instability episodes, and complications were analyzed. Statistical tests included Student's *t*-test and Chi-square, with $p < 0.05$ considered significant.

Results: Baseline characteristics, including mean age (27.6 ± 5.4 vs. 26.9 ± 6.1 years) and gender distribution, were comparable between groups ($p > 0.05$). At 11 months, surgically managed patients demonstrated significantly higher IKDC (85.1 ± 7.6 vs. 70.4 ± 8.2) and Lysholm scores (88.6 ± 6.9 vs. 74.3 ± 8.4) ($p < 0.001$ for both). Return to pre-injury sports was achieved in 62% of surgical versus 34% of conservative cases ($p = 0.01$). Instability episodes were more frequent with conservative care (28% vs. 10%, $p = 0.02$). Minor complications included donor-site pain (10%) and superficial infection (4%) in the surgical group.

Conclusion: Surgical reconstruction of ACL injuries yielded superior functional outcomes, greater return-to-sport rates, and fewer instability episodes compared with conservative management. Conservative treatment remains reasonable for patients with limited functional demands.

Recommendations: Multicentric studies with larger cohorts and extended follow-up are warranted to strengthen evidence and refine individualized treatment strategies.

Keywords: Anterior cruciate ligament, functional outcome, conservative management, surgical reconstruction, International Knee Documentation Committee Lysholm score.

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Introduction

Anterior cruciate ligament (ACL) injury is one of the most frequent ligamentous injuries of the knee, particularly in young and physically active populations. It commonly results from sports-related trauma or high-energy accidents and is a major cause of knee instability, impaired mobility, and early-onset osteoarthritis when inadequately treated [1,2]. The functional limitations caused by ACL insufficiency significantly affect an individual's ability to resume pre-injury levels of activity, especially in athletes and those engaged in high-demand physical activities [1]. Management of ACL injuries continues to be debated. Surgical reconstruction is widely regarded as the preferred option for restoring knee stability and facilitating early return to sports, particularly in younger and more active patients [3,4]. Advances in arthroscopic techniques and graft options have further enhanced surgical outcomes [3]. Nevertheless, conservative treatment—including physiotherapy, muscle strengthening, and activity modification—remains relevant, particularly for patients with lower activity demands, advanced age, or contraindications to surgery [5].

Although both approaches have demonstrated favorable outcomes in selected patients, evidence remains inconsistent regarding long-term functional recovery, return to pre-injury activity levels, and risks of recurrent instability. While surgery generally provides superior stability and higher patient satisfaction, it carries potential risks such as donor site morbidity and surgical complications. Conversely, conservative management avoids surgical risks but may predispose patients to persistent instability and reduced athletic performance.

Given these contrasting outcomes, there is a need for well-structured comparative evaluations to guide individualized treatment strategies. This study was undertaken to assess functional recovery, return to activity, instability rates, and complications in patients with ACL injuries managed conservatively versus surgically, using validated outcome measures including the International Knee Documentation Committee (IKDC) and Lysholm scores.

Methodology

Study Design and Setting

This was a prospective comparative observational cohort study involving two parallel groups of patients with anterior cruciate ligament (ACL) injuries managed either conservatively or surgically. The study was conducted in the Department of Orthopaedics, Jawaharlal Nehru Medical College (JNMC), Sawangi (Meghe), Wardha, Maharashtra,

India, between 1 August 2024 and 30 June 2025. JNMC is a tertiary care teaching and referral institution affiliated with the Datta Meghe Institute of Higher Education and Research. It serves a mixed urban–rural population and houses advanced trauma, arthroscopy, and rehabilitation facilities, ensuring comprehensive patient evaluation and standardized follow-up.

Study Population

Participants and Selection

All adults aged 18–50 years presenting with **clinically and radiologically confirmed ACL injury** were screened consecutively during the study period. Eligible patients were enrolled after obtaining informed written consent and were allocated to either the conservative or surgical group based on clinical assessment, patient preference, and the surgeon's discretion. This approach reflected real-world decision-making and avoided artificial selection. Exclusion criteria included multi-ligamentous injuries, peri-articular fractures, revision ACL cases, systemic disorders interfering with rehabilitation, and inability to complete follow-up.

Bias Control

Potential biases were minimized through multiple measures. **Selection bias** was reduced by consecutive enrolment and predefined eligibility criteria.

Measurement bias was minimized by using validated outcome tools (International Knee Documentation Committee and Lysholm scores) administered by trained personnel at fixed intervals (baseline, six months, and 11 months).

Performance bias was addressed by providing standardized physiotherapy protocols and uniform follow-up schedules across both groups.

Attrition bias was minimized through reminder calls and scheduled reviews to ensure complete data collection. Baseline comparability between groups was statistically verified to confirm the absence of major confounders.

Sample Size Justification

The required sample size was calculated using the formula for comparing two independent means:

$$n = 2(Z_{1-\alpha/2} + Z_{1-\beta})^2 \sigma^2 / \Delta^2$$

Assuming a two-tailed $\alpha = 0.05$ ($Z = 1.96$), power = 80% ($Z = 0.84$), a clinically significant difference (Δ) of 8 points in IKDC score, and standard deviation (σ) of 14 based on prior studies, the computed minimum sample size was 48 per group. To compensate for potential 5–10% attrition, the final



target was 50 participants in each group (total = 100), which was successfully achieved.

Inclusion Criteria

Patients aged between 18 and 50 years.

Clinically and radiologically confirmed ACL injury.

Patients are willing to participate and provide informed consent.

Both conservative and surgical management groups.

Exclusion Criteria

Patients with multi-ligamentous knee injuries.

Associated fractures around the knee joint.

Revision ACL reconstruction cases.

Patients with systemic disorders interfere with rehabilitation.

Patients are unwilling or unable to complete follow-up.

Data Collection and Assessment Tools

Detailed demographic information, injury history, and clinical findings were systematically documented for all participants. Functional outcomes were evaluated using the International Knee Documentation Committee (IKDC) subjective knee evaluation form and the Lysholm Knee Scoring Scale at baseline, at 6 months, and at the final follow-up (up to 11 months). Return to pre-injury activity levels and episodes of knee instability were assessed through patient interviews and clinical examination. Treatment-related complications, including persistent pain, stiffness, infections, and donor site morbidity, were recorded during scheduled follow-up visits.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of Jawaharlal Nehru Medical College, Sawangi, Meghe, Wardha, Maharashtra, India. Written informed consent was obtained from all participants before enrolment.

Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD) and compared between groups using the Student's *t*-test. Categorical variables were expressed as frequencies and percentages, and analyzed using the Chi-square test or Fisher's exact test as appropriate. A *p*-value < 0.05 was considered statistically significant.

Results

Participant Flow

During the study period, 128 patients with anterior cruciate ligament (ACL) injury were screened for eligibility. 18 patients were excluded: 6 had multi-ligamentous knee injuries, 4 had peri-articular fractures, 3 were revision ACL cases, and 5 declined consent. The remaining 110 patients were enrolled and examined; 10 were lost before baseline evaluation due to relocation or withdrawal. Thus, 100 patients were finally included and analyzed—50 managed conservatively and 50 surgically reconstructed. During follow-up, four participants (two per group) missed their six-month assessment but completed the 11-month evaluation, ensuring complete endpoint data. No participants were excluded from the final analysis.

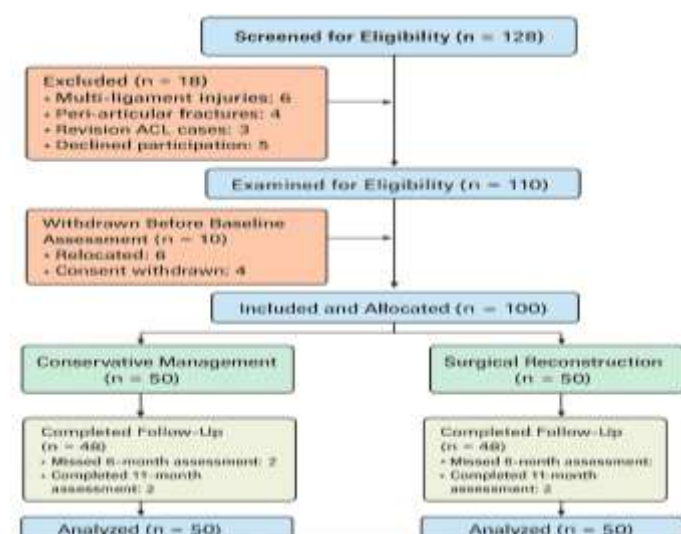


Figure 1. Participant Flow Diagram

A total of 100 patients with ACL injuries were included, comprising 50 patients managed conservatively and 50 treated surgically.

Baseline Characteristics

The two groups were comparable at baseline in terms of demographic and injury-related variables. The mean age was 27.6 ± 5.4 years in the conservative group and 26.9 ± 6.1 years in the surgical group. The male predominance was similar in both groups (72% vs. 68%). Duration of injury before treatment and the side involved also showed no statistically significant differences ($p > 0.05$) (Table 1).

Table 1. Baseline Characteristics of Study Participants (n = 100)

Parameter	Conservative (n = 50)	Surgical (n = 50)	p-value
Mean Age (years)	27.6 ± 5.4	26.9 ± 6.1	0.62
Male (%)	36 (72%)	34 (68%)	0.68
Duration of Injury (weeks)	5.1 ± 2.3	5.3 ± 2.6	0.74
Side Involved (Right)	28 (56%)	27 (54%)	0.84

Functional Outcomes

At baseline, mean IKDC and Lysholm scores were comparable between the two groups. By six months, functional improvement was evident in both groups, but patients who underwent surgical management showed

significantly higher scores. At 11 months, the mean IKDC score reached 85.1 ± 7.6 in the surgical group compared to 70.4 ± 8.2 in the conservative group ($p < 0.001$). Similarly, the mean Lysholm score was significantly higher in the surgical group (88.6 ± 6.9) than in the conservative group (74.3 ± 8.4) ($p < 0.001$) (Table 2).



Table 2. Functional Outcomes (IKDC and Lysholm Scores)

Outcome Measure	Baseline (Mean $\pm$ SD)	6 months (Mean $\pm$ SD)	11 months (Mean $\pm$ SD)	p-value (11 months)
IKDC – Conservative	45.2 $\pm$ 7.3	61.8 $\pm$ 9.5	70.4 $\pm$ 8.2	<0.001
IKDC – Surgical	44.8 $\pm$ 6.9	72.6 $\pm$ 8.7	85.1 $\pm$ 7.6	
Lysholm – Conservative	49.5 $\pm$ 8.1	68.2 $\pm$ 9.7	74.3 $\pm$ 8.4	<0.001
Lysholm – Surgical	50.1 $\pm$ 7.6	77.4 $\pm$ 9.2	88.6 $\pm$ 6.9	

Return to Activity and Instability

Return to pre-injury level of sports activity at eleven months was achieved by 62% of patients in the surgical group compared to 34% in the conservative group, a statistically significant difference ($p = 0.01$). Instability episodes were

reported more frequently in the conservative group (28%) compared with the surgical group (10%) ($p = 0.02$). Re-injury requiring further intervention was observed in 8% of conservatively treated patients and 2% of surgically treated patients, though the difference was not statistically significant ($p = 0.16$) (Table 3).

Table 3. Return to Activity and Instability Episodes

Outcome	Conservative (n = 50)	Surgical (n = 50)	p-value
Returned to Pre-injury Sports	17 (34%)	31 (62%)	0.01
Reported Knee Instability	14 (28%)	5 (10%)	0.02
Re-injury Requiring Treatment	4 (8%)	1 (2%)	0.16

Complications

Overall complication rates were low in both groups. Persistent pain was reported in 12% of conservatively treated patients and 10% of surgical patients. Knee stiffness

occurred equally in both groups (6%). Superficial infection (4%) and donor site pain (10%) were reported only in the surgical group. No major complications were observed in either group (Table 4).

Table 4. Complications Observed

Complication	Conservative (n = 50)	Surgical (n = 50)
Persistent Pain	6 (12%)	5 (10%)
Knee Stiffness	3 (6%)	3 (6%)
Superficial Infection	0 (0%)	2 (4%)
Donor Site Pain	–	5 (10%)
Major Complications	0 (0%)	0 (0%)

Discussion

This comparative observational study evaluated functional recovery, return to activity, instability, and complications among patients with anterior cruciate ligament (ACL) injuries managed conservatively or surgically. The findings demonstrated that surgical reconstruction produced significantly superior outcomes at 11 months, with higher functional scores, better return-to-sport rates, and fewer instability episodes compared with conservative management.

Interpretation of Key Findings

The progressive improvement observed in both groups indicates that structured rehabilitation contributes substantially to knee function recovery, irrespective of management type. However, the surgical group achieved markedly higher IKDC (85.1) and Lysholm (88.6) scores compared with the conservative group (70.4 and 74.3, respectively). This improvement can be attributed to anatomical restoration of ligament continuity and enhanced joint stability following reconstruction, which facilitates more efficient neuromuscular coordination and confidence during physical activity.



Previous comparative data support this interpretation, showing that reconstruction leads to better mechanical stability, improved proprioception, and long-term functional endurance [6,7,8]. The similarity of these results to contemporary studies reinforces the reliability of surgical reconstruction as the preferred strategy for active individuals seeking return to sport.

The significantly greater **return-to-activity rate (62% vs 34%)** in the surgical group highlights the functional advantage conferred by restored stability. Persistent laxity in the conservatively managed knees likely explains the lower return rate and higher proportion of instability episodes (28% vs 10%). Comparable outcomes have been reported in meta-analyses that identified recurrent instability and secondary meniscal damage as major drawbacks of non-operative treatment [9–11]. Thus, surgical reconstruction appears to provide biomechanical and psychological benefits that enhance postoperative rehabilitation and athletic reintegration.

Complications and Safety Profile

Minor complications observed after surgery, including donor-site discomfort (10%) and superficial infection (4%), were within the expected range and did not impact overall recovery. Conservative management, although free from operative risk, was associated with persistent pain and higher re-injury frequency, reflecting the limitation of non-restorative therapy. These findings align with prior evidence showing that the absence of ligament continuity predisposes to recurrent micro-trauma and degenerative joint changes [6,10].

Clinical and Practical Implications

The collective evidence from this study supports surgical reconstruction as the more reliable approach for achieving durable functional recovery and knee stability, particularly among young or physically active patients. Conservative therapy remains a reasonable alternative for those with lower activity demands, comorbidities, or surgical contraindications. This individualized treatment framework is consistent with recent consensus recommendations advocating patient-specific decision-making based on functional requirements and expectations [12].

Generalizability

The results of this study are generalizable to tertiary-care and athletic populations with isolated ACL injuries, as inclusion criteria, rehabilitation protocols, and assessment tools (IKDC and Lysholm) reflect widely adopted clinical

standards. However, caution should be exercised in extrapolating these outcomes to populations with multi-ligament injuries, advanced degenerative changes, or limited access to structured physiotherapy. The study's single-center design and one-year follow-up may constrain applicability to broader or long-term contexts, but the demographic representativeness and complete follow-up enhance its external validity within similar clinical settings.

Conclusion

This comparative observational study demonstrated that surgical reconstruction of anterior cruciate ligament (ACL) injuries provides superior functional recovery, higher return-to-sport rates, and fewer instability episodes compared with conservative management. Although both treatment strategies resulted in functional improvement over time, patients undergoing surgery achieved significantly better IKDC and Lysholm scores at eleven months. Conservative management remains a reasonable option in older or low-demand individuals and those unfit for surgery, but carries a higher risk of persistent instability and lower athletic performance. Overall, ACL reconstruction should be the preferred approach in active patients, while individualized treatment selection remains essential for optimal outcomes.

Strengths and Limitations

The strengths of this study include its prospective design, use of validated outcome measures (IKDC and Lysholm scores), and one-year follow-up. However, the study is limited by its single-center design, relatively small sample size, and absence of long-term follow-up beyond 11 months. Additionally, allocation to treatment groups was not randomized, which introduces selection bias.

Recommendations

Based on the findings of this study, surgical reconstruction should be considered the preferred treatment for anterior cruciate ligament (ACL) injuries in young and physically active individuals, as it ensures better knee stability, superior functional recovery, and higher return-to-sport rates. Conservative management may be reserved for patients with low functional demands, advanced age, or contraindications to surgery. Preoperative counseling should emphasize realistic expectations regarding outcomes and possible complications for both approaches. Future multicentric studies with larger cohorts and longer follow-up are recommended to strengthen evidence, guide clinical



decision-making, and develop standardized management protocols tailored to the Indian population.

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Abbreviations

ACL – Anterior Cruciate Ligament

IKDC – International Knee Documentation Committee

BMI – Body Mass Index

SD – Standard Deviation

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The study had no funding.

Conflicts of interest

The Author declares no conflict of interest.

Author's contribution

VK-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **RA**-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. **SK**-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation. **GSB**-preparing first draft of manuscript. Statistical analysis and interpretation

Data Availability

Data available on request

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