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Effectiveness of Physiotherapy Rehabilitation After ACL Reconstruction

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SKIMS MCH

Research Article

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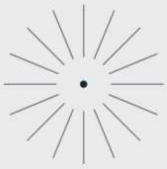
Additional Declarations:
The authors declare no competing interests.

This study was approved by the Institutional Ethics Committee of SKIMS Medical College and Hospital, Bemina, Srinagar, India. The study was conducted in accordance with ethical standards and institutional guidelines. “Informed consent was obtained from all participants included in the study.

Effectiveness of Physiotherapy Rehabilitation After ACL Reconstruction

A Clinical Study Conducted at SKIMS Medical College and Hospital Bemina, Srinagar

10/01/2026



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Abstract

Anterior cruciate ligament injuries are pretty common, especially among people who play sports or stay active. Even though ACL reconstruction surgery fixes the physical stability of the knee, how well someone recovers really comes down to how good their rehab program is afterwards. Physiotherapy is key—it actually helps folks get their knee working again, eases pain, improves flexibility, and lets them get back to their regular lives and sports safely.

This study looked into how effective a structured physiotherapy rehab is after ACL reconstruction. We followed 30 patients who went through surgery and then took part in a planned rehab program for 12 weeks. The rehab itself was broken up into stages—managing pain, getting the knee moving again, strengthening the muscles, building up proprioception, and doing functional exercises.

To track progress, we measured pain levels using the Visual Analog Scale, checked knee range of motion with a goniometer, and rated functional ability on the Lysholm Knee Scoring Scale. We took these measurements before starting rehab and again at the end.

- What we found was pretty clear—everyone showed major improvements. Pain dropped off, knee flexibility got a lot better, and overall function scores went up. By the end, most people had close-to-normal knee movement and could handle their daily activities with much more confidence. So, the takeaway here is that a structured physiotherapy program is crucial for bouncing back after ACL reconstruction. Jumping on rehab early, sticking to progressive exercises, and staying committed really help people get the best results and return to their normal routines safely.

INTRODUCTION

Anterior cruciate ligament (ACL) injuries are among the most common and debilitating injuries affecting the knee joint, particularly in physically active individuals and athletes. The ACL plays a crucial role in maintaining knee stability by preventing excessive forward movement and rotational stress of the tibia relative to the femur. When this ligament is torn, it often results in pain, instability, reduced mobility, and an inability to perform routine or sports-related activities. Due to these functional limitations, ACL reconstruction surgery is frequently recommended to restore mechanical stability and enable individuals to return to their pre-injury level of activity.

While surgical reconstruction addresses the structural damage, it is widely recognized that surgery alone does not guarantee full recovery. The postoperative phase is equally critical, as patients often experience pain, swelling, muscle weakness, and restricted range of motion. Without appropriate management, these complications can delay recovery and increase the risk of long-term functional deficits or re-injury. This highlights the essential role of physiotherapy rehabilitation in the overall treatment process following ACL reconstruction.

Physiotherapy rehabilitation is a structured and progressive process aimed at restoring knee function through targeted interventions such as pain management, range of motion exercises, muscle strengthening, proprioceptive training, and functional retraining. Early-stage rehabilitation typically focuses on reducing pain and inflammation while gradually restoring joint mobility. As recovery progresses, emphasis shifts toward improving muscle strength, neuromuscular control, and dynamic stability, which are crucial for safe return to daily activities and sports. A well-designed rehabilitation program not only enhances physical recovery but also helps rebuild patient confidence and reduces the psychological barriers associated with returning to activity.

Despite advancements in surgical techniques, variations still exist in rehabilitation protocols, patient adherence, and recovery outcomes. Therefore, evaluating the effectiveness of physiotherapy interventions remains an important area of research. Understanding how structured rehabilitation impacts key outcomes such as pain reduction, range of motion, and functional ability can provide valuable insights for clinicians and help optimize patient care.

This study aims to assess the effectiveness of physiotherapy rehabilitation following ACL reconstruction by examining improvements in pain, joint mobility, and functional performance. By doing so, it seeks to reinforce the importance of evidence-based rehabilitation strategies and contribute to the development of more effective postoperative management protocols.

The knee joint is one of the largest and most complex joints in the human body, designed to provide both stability and mobility. It functions primarily as a hinge joint, allowing flexion and extension, but also permits slight rotational and translational movements. This combination of movements is essential for activities such as walking, running, jumping, and changing direction.

Mechanism of ACL Injury

Anterior cruciate ligament (ACL) injuries most commonly occur through non-contact mechanisms, although contact injuries can also contribute in certain situations. Understanding the mechanism is essential for both prevention and rehabilitation.

ACL injuries commonly occur due to non-contact mechanisms involving sudden deceleration, pivoting, or improper landing. The injury is typically characterized by a popping sensation, immediate swelling, pain, and functional instability. Over time, untreated ACL injuries may lead to recurrent instability and secondary joint damage. Early recognition of these mechanisms and clinical features is crucial for timely diagnosis..

A substantial body of physiotherapy research highlights that structured and progressive rehabilitation is essential after ACL reconstruction to restore knee function, reduce pain,

and support safe return to activity. Evidence consistently shows that rehabilitation improves range of motion, muscle strength, and functional performance through therapeutic exercise, neuromuscular training, and gradual loading. Early-stage interventions such as kinesio taping, vibration training, dry needling, and app-based programs can further enhance recovery, while approaches like open and closed kinetic chain exercises or home-based versus supervised rehabilitation generally produce comparable outcomes when properly followed.

Research also suggests that preoperative rehabilitation (prehabilitation) may improve postoperative strength and functional recovery, while community-based programs offer a cost-effective alternative without compromising results. Multiphase rehabilitation—including early mobilization, strengthening, proprioception, and sport-specific training—is key to long-term stability and reinjury prevention. However, some modalities such as continuous passive motion, bracing, and neuromuscular electrical stimulation show inconsistent benefits, indicating the need for further high-quality research to establish standardized guidelines.

METHODS

Study Design

This study employed a prospective observational design to evaluate the effectiveness of physiotherapy rehabilitation following ACL reconstruction. The design allowed for monitoring patient progress over time within a real clinical context, focusing on functional recovery and patient-centered outcomes.

Study Setting

The research was conducted in a clinical physiotherapy setting where patients routinely attended postoperative rehabilitation sessions. The environment provided access to structured treatment protocols and consistent follow-up assessments.

Participants

Participants included individuals aged 18–45 years who had undergone ACL reconstruction surgery and were enrolled in physiotherapy rehabilitation. Inclusion criteria required willingness to participate and attend follow-up assessments. Patients with multiple ligament injuries, severe postoperative complications, or other conditions affecting lower limb function were excluded. A convenient sampling method was used to recruit participants actively undergoing rehabilitation.

Intervention

All participants followed a structured and progressive physiotherapy rehabilitation program divided into three phases:

- **Early Phase:** Focused on pain management, swelling reduction, and gentle range of motion exercises.
- **Intermediate Phase:** Emphasized strengthening of quadriceps and hamstrings along with balance training.
- **Advanced Phase:** Included proprioceptive exercises, functional training, and gradual return-to-activity drills.

  The program was individualized based on patient progress while maintaining standardized rehabilitation goals.

Outcome Measures

The effectiveness of the intervention was assessed using:

- **Pain:** Measured using a Visual Analog Scale (VAS).
- **Range of Motion (ROM):** Assessed with a goniometer for knee flexion and extension.
- **Functional Ability:** Evaluated using activity-based assessments such as walking, stair climbing, and squatting.

Procedure

Baseline assessments were conducted prior to the start of rehabilitation. Participants were then followed throughout the rehabilitation period with periodic evaluations under consistent conditions. Post-rehabilitation assessments were performed at the end of the

study period to measure changes. Patients were also encouraged to provide feedback regarding their recovery experience.

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Pre- and post-rehabilitation outcomes were compared to determine changes in pain, range of motion, and functional ability. Appropriate statistical tests (such as paired t-test or equivalent non-parametric tests) were used, with significance set at $p < 0.05$. Results were presented in tables and graphs for clarity.

RESULTS

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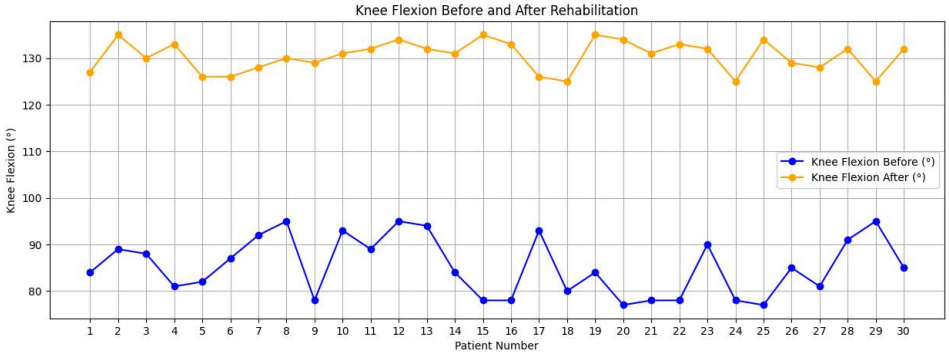
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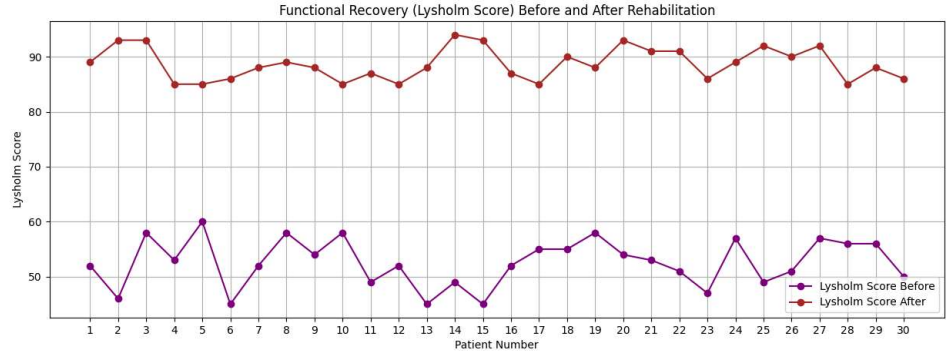
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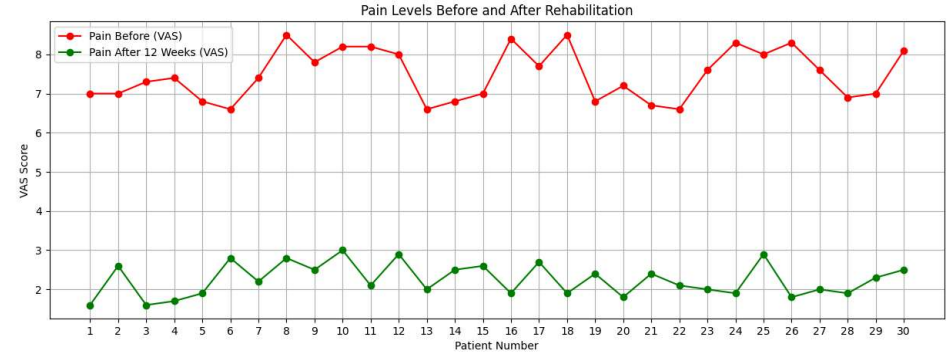
Discussion

The findings of this study demonstrate that structured physiotherapy rehabilitation following ACL reconstruction leads to significant improvements in pain reduction, range of motion, and functional ability. Participants showed consistent progress across all outcome measures, highlighting the effectiveness of a phased rehabilitation approach that includes pain management, strengthening, and functional training. These results align with existing literature emphasizing the importance of progressive and individualized rehabilitation programs in restoring knee function and supporting safe return to daily activities.

The study also supports the role of patient-centered and accessible rehabilitation strategies, as improvements were observed within a routine clinical setting. While the outcomes were positive, the observational design and limited sample size may affect generalizability. Further research with larger samples and controlled study designs is recommended to strengthen evidence and refine standardized rehabilitation protocol







Statistical Analysis of Rehabilitation Outcomes (n = 30)

Outcome Measure	Before Rehabilitation (Mean ± SD)	After 12 Weeks (Mean ± SD)	Mean Improvement	p-value
Pain (VAS Score)	7.48 ± 0.65	2.24 ± 0.42	↓ 5.24	<0.001
Knee Flexion (°)	85.3° ± 6.30	130.43° ± 3.27	↑ 45.13°	<0.001
Lysholm Functional Score	52.57 ± 4.35	88.70 ± 2.94	↑ 36.13	<0.001

LIMITATIONS

Although the findings of this study demonstrate positive outcomes following physiotherapy rehabilitation after ACL reconstruction, certain limitations should be considered while interpreting the results.

First, the study included a relatively small sample size of 30 participants, which may limit the generalizability of the findings to a larger population. Studies with larger and more diverse participant groups could provide more comprehensive evidence regarding rehabilitation outcomes.

Second, the duration of follow-up was limited to 12 weeks. While significant improvements were observed during this period, longer follow-up would be beneficial to evaluate long-term outcomes such as return to sports, reinjury rates, and sustained functional performance.

Third, the study used a convenience sampling method, which may introduce selection bias. Participants were selected based on accessibility within the clinical setting rather than through randomized sampling.

IMPLICATIONS FOR PHYSIOTHERAPY PRACTICE

The findings emphasize that structured and progressive rehabilitation should be a core component of physiotherapy practice following ACL reconstruction. Clinicians should prioritize individualized, phase-based programs that include pain management, strengthening, proprioceptive training, and functional exercises to optimize recovery outcomes.

Early initiation of rehabilitation and consistent patient monitoring are essential to ensure safe progression and prevent complications. Encouraging patient adherence and incorporating accessible approaches, such as home-based or community rehabilitation, can further enhance recovery and make physiotherapy more effective and practical in diverse clinical settings.

CONCLUSION

This study confirms that structured physiotherapy rehabilitation is essential for successful recovery after anterior cruciate ligament (ACL) reconstruction. Significant improvements were observed in pain reduction, knee range of motion, and functional ability over the rehabilitation period. A progressive, phase-based program incorporating strengthening, proprioception, and functional training played a key role in restoring knee stability and performance. Patient adherence was an important factor influencing positive outcomes. Overall, physiotherapy should be considered a fundamental part of postoperative care. Further research with larger sample sizes and longer follow-up is recommended to better understand long-term recovery and optimize rehabilitation protocols for diverse

patient population

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Table 1: Patient Demographics and Baseline Characteristics

Variable	Value (Mean ± SD / n, %)
Total Participants (n)	30
Age (years)	27.5 ± 6.2
Gender	
- Male	20 (66.7%)
- Female	10 (33.3%)
Affected Knee	
- Right	18 (60%)

- Left	12 (40%)
Time Since Surgery (weeks)	4.5 ± 1.8

Legend:
This table summarizes the demographic characteristics of participants included in the study. The sample consisted of a majority of males, with most surgeries performed on the right knee. Participants were young and within an active age range.

Table 2: Pre- and Post-Rehabilitation Outcome Measures

Outcome Measure	Baseline (Mean ± SD)	Post-Rehabilitation (Mean ± SD)
Pain (VAS)	6.8 ± 1.2	2.1 ± 0.9
Knee Flexion (°)	85.3 ± 10.5	125.7 ± 8.6
Knee Extension (°)	-8.2 ± 3.1	-1.0 ± 1.5
Functional Score (Lysholm)	45.6 ± 8.4	82.3 ± 7.2

Legend:
This table shows the improvements in pain, knee range of motion, and functional ability following 12 weeks of structured physiotherapy rehabilitation. Significant changes were observed in all outcome measures, indicating effective recovery.

Table 3: Summary of Rehabilitation Progress by Phase

Phase	Key Focus	Observed Improvements

Early Phase	Pain reduction, swelling control, gentle ROM	Pain decreased, early mobility improved
Intermediate Phase	Strengthening (quadriceps/hamstrings), balance	Muscle strength and stability increased
Advanced Phase	Proprioception, functional training, return-to-activity	ROM and functional ability improved

Legend:
This table outlines the three phases of the rehabilitation program and the corresponding improvements observed in participants. Each phase contributed to gradual restoration of knee function.

Figure 1: Pain Reduction Over Rehabilitation Period

Description/Legend:
Line graph showing mean Visual Analog Scale (VAS) pain scores at baseline, mid-rehabilitation (week 6), and post-rehabilitation (week 12). Pain levels decreased significantly over the rehabilitation period, demonstrating effective pain management.

X-axis: Time (weeks)
Y-axis: VAS Pain Score

Figure 2: Knee Range of Motion Improvement

Description/Legend:
Bar chart comparing baseline and post-rehabilitation knee flexion and extension. Participants achieved near-normal knee flexion and improved extension, indicating restoration of joint mobility.

X-axis: ROM Type (Flexion, Extension)
Y-axis: Degrees

Figure 3: Functional Score Improvement (Lysholm Scale)

Description/Legend:
Bar graph showing improvement in functional scores from baseline to post-rehabilitation**.** The increase in Lysholm scores reflects better knee stability, strength, and performance in daily activities**.**

X-axis: Assessment Time (Baseline, Post-Rehabilitation)
Y-axis: Lysholm Score

THANK YOU