

# Impact of Prehabilitation Training on Recovery, Functional Performance, and Return to Sport After Anterior Cruciate Ligament Reconstruction in athletes.

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## Abstract

Anterior cruciate ligament (ACL) injuries are among the most common and debilitating injuries in athletes, often resulting in impaired knee stability, reduced functional performance, and delayed return to sport. While ACL reconstruction followed by postoperative rehabilitation is the standard approach to restore knee function, variability in recovery outcomes has led to increased interest in prehabilitation strategies. Prehabilitation involves structured exercise interventions implemented prior to surgery with the aim of enhancing muscle strength, neuromuscular control, joint mobility, and overall functional capacity. The present study aims to investigate the effect of prehabilitation exercises on post-operative recovery and return to sport in athletes undergoing ACL reconstruction. A sample of athletes scheduled for ACL reconstruction will be recruited and divided into groups receiving prehabilitation in addition to standard care and those receiving conventional care alone. Outcome measures will include quadriceps strength, functional performance, knee-specific outcome scores, and psychological readiness for return to sport, assessed at baseline and at specified postoperative intervals. It is hypothesized that athletes who undergo prehabilitation will demonstrate significantly better postoperative recovery, improved functional outcomes, and earlier return to sport compared to those who do not receive prehabilitation. The findings of this study are expected to provide evidence for the incorporation of prehabilitation protocols in clinical practice, thereby improving rehabilitation outcomes and optimizing return-to-sport timelines in athletes following ACL reconstruction.

**Keywords:** Anterior Cruciate Ligament (ACL), ACL Reconstruction, Prehabilitation, Postoperative Recovery, Return to Sport, Athletes, Quadriceps Strength, Neuromuscular Training, Knee Function, Rehabilitation Outcomes

## Introduction

Anterior cruciate ligament (ACL) injury is one of the most common and debilitating injuries among athletes, particularly those participating in pivoting and high-intensity sports such as football, basketball, and badminton. ACL rupture not only results in mechanical instability of the knee joint but also leads to deficits in strength, proprioception, and neuromuscular control, significantly affecting athletic performance and long-term joint health (Griffin et al., 2006). Surgical reconstruction of the ACL is widely accepted as the standard treatment for restoring knee stability and enabling athletes to return to sport. However, despite advances in surgical techniques, many athletes fail to regain pre-injury levels of performance, highlighting the importance of effective rehabilitation strategies (Arden et al., 2014).

Traditionally, rehabilitation has focused primarily on the postoperative phase. However, emerging evidence suggests that the preoperative period represents a critical window of opportunity to optimize physical and

psychological readiness before surgery. Prehabilitation, defined as structured exercise and conditioning performed prior to surgical intervention, aims to enhance muscle strength, joint stability, range of motion, and neuromuscular control (Topp et al., 2002). By improving baseline functional status, prehabilitation may facilitate faster and more effective postoperative recovery.

One of the most significant impairments following ACL injury is quadriceps muscle weakness, which persists even after reconstruction and is associated with poor functional outcomes and increased risk of reinjury (Palmieri-Smith et al., 2008). Prehabilitation programs that emphasize strengthening of the quadriceps and hamstring muscles can help mitigate these deficits and improve postoperative recovery trajectories. In addition, neuromuscular and proprioceptive training incorporated in prehabilitation has been shown to enhance dynamic stability and movement coordination, which are essential for safe return to sport (Hewett et al., 2005).

Functional performance measures such as the International Knee Documentation Committee (IKDC) score, Lysholm score, and hop tests are widely used to assess recovery after ACL reconstruction. These measures reflect not only physical recovery but also the athlete's ability to perform sport-specific activities. Studies have shown that athletes who achieve better preoperative functional status tend to report superior postoperative outcomes (Logerstedt et al., 2012). Furthermore, dynamic balance, commonly assessed using tools such as the Y-Balance Test, is a key indicator of neuromuscular control and has been linked to injury risk and functional performance (Plisky et al., 2006).

Return to sport (RTS) is considered a primary goal for athletes undergoing ACL reconstruction; however, successful RTS is influenced by multiple factors, including physical recovery, psychological readiness, and fear of reinjury. It has been reported that only a proportion of athletes return to their pre-injury level of sport, emphasizing the need for comprehensive rehabilitation approaches (Arden et al., 2014). Prehabilitation may play an important role in addressing both physical and psychological aspects of recovery by improving confidence and reducing kinesiophobia prior to surgery.

Despite growing interest in prehabilitation, there remains variability in the literature regarding its effectiveness, particularly in terms of functional outcomes and return-to-sport rates. Differences in program design, duration, intensity, and patient characteristics contribute to inconsistent findings. Therefore, there is a need for further research to establish the role of structured prehabilitation programs in enhancing postoperative recovery.

In this context, the present study aims to evaluate the **impact of prehabilitation training on recovery, functional performance, and return to sport in athletes undergoing ACL reconstruction**. By comparing outcomes between athletes who underwent prehabilitation and those who did not, the study seeks to provide evidence on the effectiveness of integrating prehabilitation into standard ACL rehabilitation protocols.

## RESEARCH METHODOLOGY

### Study Design

The present study is a prospective randomized controlled experimental study designed to evaluate the effect of prehabilitation exercises prior to anterior cruciate ligament reconstruction on postoperative recovery and return-to-sport outcomes in athletes.

### Study Setting

The study was conducted at the Private Physiotherapy centres at Ambala where athletes undergoing ACL reconstruction surgery are treated and rehabilitated.

## Study Duration

The total duration of the study was approx 11-12 months, which included:

- **3 months** – Participant recruitment and baseline assessment
- **4–6 weeks** – Prehabilitation intervention
- **6 months** – Postoperative rehabilitation and follow-up assessment

**Study Population** The study population consisted of male and female athletes diagnosed with complete ACL rupture and scheduled for ACL reconstruction surgery.

**Sample Size** A total of 50 athletes were recruited for the study.

Participants were randomly divided into two groups:

Group	Description	Sample
Group A	Prehabilitation + Postoperative rehabilitation	25
Group B	Conventional postoperative rehabilitation only	25

**Sampling Technique** Participants were selected using purposive sampling from athletes referred for ACL reconstruction surgery. Randomization was performed using the lottery method or computer-generated randomization.

## Inclusion Criteria

Participants who meet the following criteria were included:

1. Athletes aged 18–35 years
2. Diagnosed with unilateral ACL rupture confirmed by MRI
3. Scheduled for arthroscopic ACL reconstruction
4. Engaged in competitive or recreational sports
5. Willing to participate and provide written informed consent

## Exclusion Criteria

Participants with the following conditions were excluded:

1. Associated grade III ligament injuries (PCL, MCL, LCL)
2. Previous knee surgery
3. Meniscal repair requiring restricted rehabilitation
4. Fractures around the knee joint
5. Neurological disorders affecting balance or movement.
6. Systemic musculoskeletal disorders

## Ethical Considerations

- All participants gave verbal consent before participation.
- Participants had the right to withdraw from the study at any time.
- Confidentiality of participant information was maintained.

## Outcome Measures

Outcome measures are standardized instruments or evaluation methods used to determine the effectiveness of a treatment or intervention in both research and clinical settings. In the present study, these measures play a crucial role in assessing changes in muscle strength, functional performance, knee stability, and psychological readiness for return to sport. The following validated outcome measures were used:

Outcome Variable	Assessment Tool
Knee function	International Knee Documentation Committee (IKDC) Score
Functional disability	Lysholm Knee Scoring Scale
Dynamic balance	Y-Balance Test
Quadriceps strength	Hand-held dynamometer / Isokinetic dynamometer
Return to sport readiness	ACL-Return to Sport after Injury Scale (ACL-RSI)
Functional performance	Single Leg Hop Test

Three questionnaires together were used in ACL rehabilitation research:

1. IKDC – Subjective knee evaluation
2. Lysholm Score – Knee function
3. ACL-RSI – Psychological readiness for return to sport

❖ **Quadriceps Strength Test** To assess the strength of the quadriceps muscle, which is essential for knee stability, functional movement, and return to sports following ACL reconstruction.

❖ **The ACL–Return to Sport after Injury Scale (ACL-RSI)** It is a patient-reported questionnaire developed to assess the psychological readiness of athletes to return to sport after anterior cruciate ligament (ACL) injury or reconstruction. It evaluates important psychological factors such as confidence in knee performance, fear of re-injury, and emotional response to returning to sport. The ACL-RSI scale is useful because psychological factors play a significant role in determining whether an athlete can safely and successfully return to sports activities after ACL reconstruction. The scale helps clinicians and researchers measure mental readiness, confidence levels, and potential psychological barriers, thereby supporting better rehabilitation planning and return-to-sport decision making.

❖ **Single leg hop test**

### 3.11 Assessment Timeline

Time Point	Assessment
Baseline (Before Prehabilitation)	Strength, balance, IKDC, Lysholm
Pre-surgery (After Prehabilitation)	Repeat all baseline measures
3 months post-surgery	Functional assessment
6 months post-surgery	Return-to-sport assessment

### 3.12 Prehabilitation Protocol (Group A)

Supervised prehabilitation refers to a structured exercise program performed before surgery under the guidance of a physiotherapist. The main aim of prehabilitation is to improve muscle strength, joint mobility, neuromuscular control, and overall physical condition before the surgical procedure. In the case of ACL injuries, prehabilitation helps in strengthening the quadriceps and hamstring muscles, improving knee stability, and reducing postoperative complications.

Participants in Group A performed 4 weeks of supervised prehabilitation before surgery.

Frequency: 3 sessions per week

#### Exercise Program

Exercise	Sets	Repetitions
Quadriceps isometric contractions	3	10
Straight leg raises	3	10
Hamstring curls	3	10
Hip abduction strengthening	3	12
Mini squats	3	10
Step-ups	3	10
Balance training (single-leg stance)	3	30 sec
Core stabilization exercises	3	10

Progression was based on pain tolerance and functional ability.

#### Postoperative Rehabilitation Protocol (Both Groups)

Postoperative rehabilitation protocol is defined as a structured and progressive exercise regimen implemented after surgery to restore the normal function of the affected joint. In the context of ACL reconstruction, postoperative rehabilitation primarily aims to reduce pain and swelling, regain range of motion, strengthen muscles, and improve knee stability. Following surgery, participants in both groups adhered to a standardized rehabilitation protocol.

#### Phase 1 (0–2 weeks)

Goals:

- Reduce pain and swelling
- Restore knee extension
- Initiate quadriceps activation

Exercises:

- Ankle pumps
- Quadriceps sets
- Heel slides
- Straight leg raises

## **Phase 2 (3–6 weeks)**

Goals:

- Improve knee ROM
- Begin weight-bearing strengthening

Exercises:

- Closed chain exercises
- Mini squats
- Stationary cycling
- Step-ups

## **Phase 3 (7–12 weeks)**

Goals:

- Improve strength and neuromuscular control

Exercises:

- Lunges
- Resistance training
- Balance board exercises
- Proprioception training

## **Phase 4 (3–6 months)**

Goals:

- Prepare for return to sport

Exercises:

- Plyometric drills
- Agility drills
- Sport-specific training
- Running progression

## Criteria for Return to Sport

Athletes were cleared for return to sport when they meet the following criteria:

1.  $\geq 90\%$  quadriceps strength symmetry
2.  $\geq 90\%$  performance on hop tests
3. No pain or swelling
4. Full knee range of motion
5. Acceptable ACL-RSI score

## Data Collection Procedure

1. Eligible athletes were selected according to the inclusion criteria.
2. Participants gave written informed consent.
3. Baseline assessments were performed.
4. Participants were randomly assigned to Group A or Group B.
5. Group A were given prehabilitation training before surgery.
6. Both groups received standard postoperative rehabilitation.
7. Follow-up assessments were conducted at 3 months and 6 months post-surgery.

## Statistical Analysis

Data was analysed using Statistical Package for Social Sciences (SPSS).

The following statistical tests were used:

Analysis	Test
Comparison between groups	Independent t-test
Pre and post comparison within group	Paired t-test
Association between variables	Chi-square test
Significance level	$p < 0.05$

Results were presented as mean  $\pm$  standard deviation.

## RESULTS

The present study was conducted to assess the impact of prehabilitation exercises on postoperative recovery and return to sport in athletes undergoing ACL reconstruction. A total of 50 athletes with ACL injury participated in the study.

Participants were randomly divided into two groups:

- Group A: Prehabilitation + Postoperative Rehabilitation (n = 25)
- Group B: Conventional Postoperative Rehabilitation only (n = 25)

Statistical analysis was performed using SPSS software, and the level of significance was set at  $p < 0.05$ .

## Socio-Demographic Characteristics of Participants

In the present study, the socio-demographic profile of 50 athletes undergoing ACL reconstruction was analyzed to describe the distribution of participants according to selected variables. The details have been discussed below

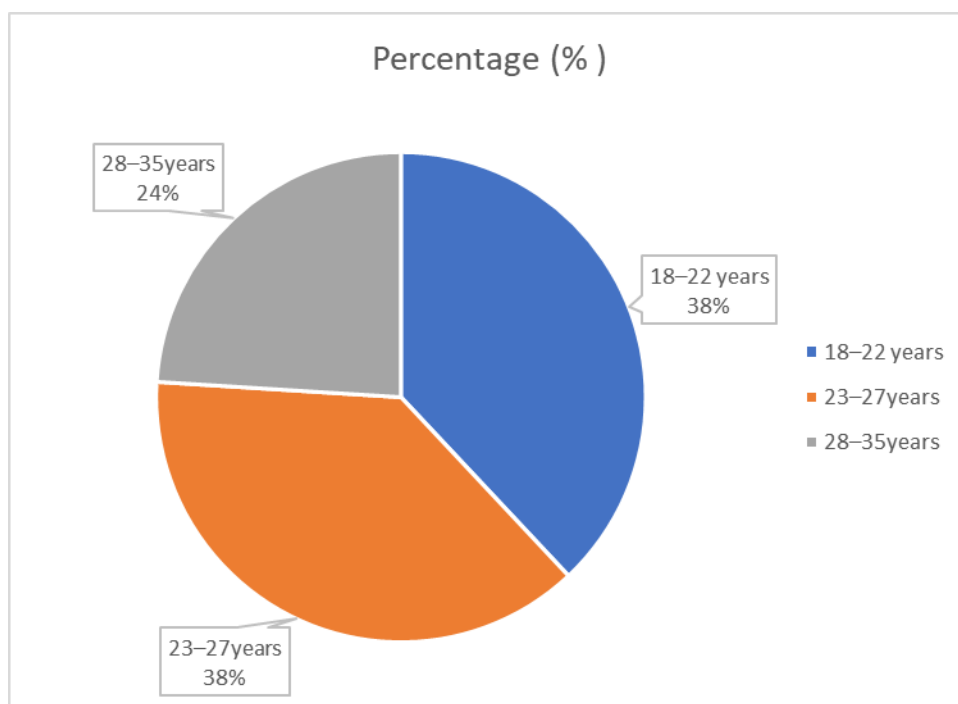
### 1. Age:

**Table 1 Distribution of Participants According to Age**

Age Group (Years)	Frequency (n)	Percentage (%)
18–22	19	38.0
23–27	19	38.0
28–35	12	24.0
<b>Total</b>	<b>50</b>	<b>100.0</b>

The table above shows that in the present study, majority of the participants (38 percent) belonged to the age group of 18–22 years and 23–27 years, while 24 percent were in the 28–35 years age group. This indicates that ACL injuries are more common among young athletes engaged in competitive sports activities.

**Figure 1 Distribution of Participants According to Age**



### 2. Gender

**Table 2 Distribution of Participants According to Gender**

Gender	Frequency (n)	Percentage (%)
Male	37	74.0
Female	13	26.0
<b>Total</b>	<b>50</b>	<b>100.0</b>

The findings reveal that majority of the participants were male athletes (74percent ), whereas 26percent were female athletes. This reflects the higher participation of males in high-intensity sports and a higher incidence of ACL injuries among them.

### 3. Type of Sport

**Table 3 Distribution of Participants According to Type of Sport**

Type of Sport	Frequency (n)	Percentage (%)
Football	18	36.0
Kabaddi	12	24.0
Basketball	8	16.0
Volleyball	7	14.0
Others	5	10.0
<b>Total</b>	<b>50</b>	<b>100.0</b>

The findings in the table reveal that most ACL injuries occurred in football players (36 percent ), followed by kabaddi players (24 percent ), indicating that sports involving pivoting, cutting, and sudden directional changes carry a higher risk of ACL injury

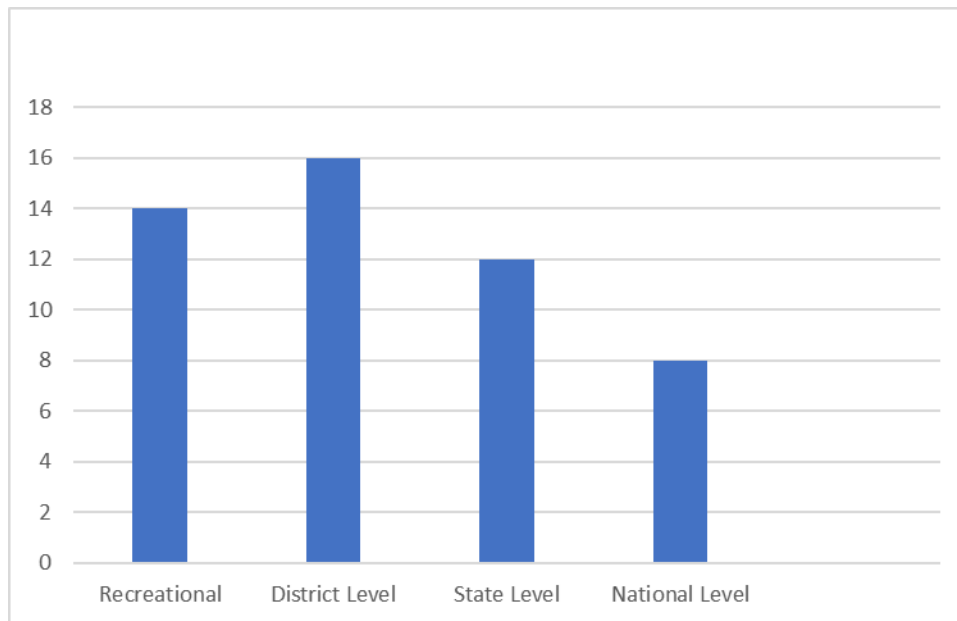
### 4. Level of Sports Participation

The level of participation (recreational, district, state, or national) indicates the intensity of sports participation and helps to determine how athletic performance demands may influence injury risk and return-to-sport outcomes.

**Table 4 Distribution According to Level of Sports Participation**

Level of Participation	Frequency (n)	Percentage (%)
Recreational	14	28.0
District Level	16	32.0
State Level	12	24.0
National Level	8	16.0
<b>Total</b>	<b>50</b>	<b>100.0</b>

The table shows that majority of the players were district-level players (32percent ), followed by recreational athletes (28percent ), indicating that ACL injuries occur across different levels of sports participation.

**Figure 2 Distribution According to Level of Sports Participation**


### 6. Injured Limb

**Table 5 Distribution According to Injured Limb**

Injured Limb	Frequency (n)	Percentage (%)
Right Knee	29	58.0
Left Knee	21	42.0
<b>Total</b>	<b>50</b>	<b>100.0</b>

The findings in the table reveal that right knee (58percent ) was more commonly injured compared to the left knee (42percent ), which may be related to dominant limb usage during sports activities.

### 6. Duration of Injury Before Surgery

**Table 6 Distribution According to Duration of Injury Before Surgery**

Duration of Injury	Frequency (n)	Percentage (%)
< 3 months	16	32.0
3–6 months	21	42.0
> 6 months	13	26.0
<b>Total</b>	<b>50</b>	<b>100.0</b>

The table above shows the duration of injury before surgery. Most athletes (42percent ) underwent surgery within 3–6 months after injury, while 32percent had surgery within 3 months.

Statistical analysis was performed using mean, standard deviation, independent t-test, paired t-test and Chi-square test with  $p < 0.05$  considered significant.

## 7 Baseline Characteristics of Participants

**Table 7 Comparison of Age Between Groups**

Group	N	Mean Age (years)	SD	t-value	p-value
Group A	25	24.6	4.2		
Group B	25	25.1	4.5	0.41	0.68

The findings reveal that there was no significant difference in age between the groups ( $p > 0.05$ ) indicating that both groups were comparable at baseline.

## 8. Baseline Quadriceps Strength

**Quadriceps Strength Test** The aim of this test is to assess the strength of the quadriceps muscle, which is essential for knee stability, functional movement, and return to sports following ACL reconstruction.

**Table 8. Comparison of Preoperative Quadriceps Strength**

Group	N	Mean (kg)	SD	t-value	p-value
Group A	25	29.1	4.7		
Group B	25	28.7	4.4	0.31	0.75

The findings of the table reveal when Comparison of Preoperative Quadriceps Strength was done it was found that there is no statistically significant difference in baseline quadriceps strength between groups.

## 9.Pre- and Post-Quadriceps Strength (Group A)

**Table 9. Paired t-Test for Quadriceps Strength in Group A**

Measurement	Mean (kg)	SD	t-value	p-value	Measurement
Preoperative	29.1	4.7			Preoperative
6 Months Postoperative	42.8	5.6	9.82	<0.001	6Months Postoperative

The table above reveals that on using Paired t-Test for Quadriceps Strength in Group A a highly significant improvement in quadriceps strength was observed in Group A after rehabilitation. may be attributed to the combined effects of targeted strengthening exercises, neuromuscular re-education, progressive overload, and reduction in pain and inhibition during the rehabilitation program.

## 10. Pre- and Post-Quadriceps Strength (Group B)

In group B ,Pre- and Post-Quadriceps Strength was analyzed using paired t-test. The findings are shown below.

**Table 10. Paired t-Test for Quadriceps Strength in Group B**

Measurement	Mean (kg)	SD	t-value	p-value
Preoperative	28.7	4.4		
6Months Postoperative	36.9	5.2	7.14	<0.001

When paired t-test for testing quadriceps strength was applied on group B, it was observed that Group B also showed significant improvement; however, the improvement was less compared to Group A. The significant improvement in quadriceps strength in Group B may be attributed to the effect of the rehabilitation exercises which enhanced muscle activation and strength over time. However, the improvement was less compared to Group A possibly due to the absence or lower intensity of additional training components provided to Group A, resulting in comparatively smaller gains in muscle strength.

### 11. Comparison of Postoperative Quadriceps Strength

**Table 11. Independent t-Test for Quadriceps Strength (6 Months)**

Group	Mean (kg)	SD	t-value	p-value
Group A	42.8	5.6		
Group B	36.9	5.2	3.79	0.0004

The findings of the table reveal that when Independent t-Test was applied for analysing Quadriceps Strength (6 Months), it revealed that Postoperative quadriceps strength was significantly higher in Group A.

### 12. Y-Balance Test Comparison

**Y-Balance Test** It was done to evaluate dynamic balance, neuromuscular control, and lower limb stability, which are critical components for safe return to sports after ACL reconstruction.

**Table 12. Comparison of Dynamic Balance**

Group	Mean (kg)	SD	t-value	p-value
Group A	42.8	5.6		
Group B	36.9	5.2	3.79	0.0004

When comparing dynamic balance of the athletes, it was revealed that Group A demonstrated significantly better dynamic balance as compared to Group B. This may be because neuromuscular and proprioceptive exercises help improve joint stability, coordination, and postural control, leading to better dynamic balance compared to Group B.

### 13. IKDC Score Comparison

**International Knee Documentation Committee (IKDC) Score-** To assess subjective knee function, symptoms, and ability to perform daily and sports activities after ACL reconstruction

**Table 13. Comparison of IKDC Scores**

Group	Mean	SD	t-value	p-value
Group A	91.3	4.9		
Group B	85.2	5.4	3.92	0.0003

The findings of the table indicate that, upon comparison of IKDC scores, Group A demonstrated significantly superior knee functional outcomes. This may be attributed to a more effective rehabilitation protocol that enhanced quadriceps strength, knee stability, and overall functional performance. Additionally, improved neuromuscular control and progressive training may have contributed to better knee function in Group A compared to Group B.

#### 14. Lysholm Knee Score Comparison

**Lysholm Knee Scoring Scale** This is carried out to assess knee stability, pain levels, and functional performance during activities such as walking, running, and stair climbing.

**Table 14. Comparison of Lysholm Scores**

Group	Mean	SD	t-value	p-value
Group A	93.4	4.3		
Group B	87.1	5.1	4.01	0.0002

Findings of the table above reveal that by Comparing Lysholm Scores it can be seen that the prehabilitation group i.e. Group A achieved better functional knee performance. This may be possible because preoperative strengthening and neuromuscular training improved muscle strength, joint stability, and readiness for surgery. This enhanced physical condition may have facilitated faster recovery and better functional outcomes after surgery compared to the control group.

#### 15. Hop Test Performance

**Single Leg Hop Test** This test is used to evaluate functional performance, lower limb power, and limb symmetry, all of which are essential criteria for determining readiness to return to sport (Thomee et al., 2011).

**Table 15. Single Leg Hop Test (Limb Symmetry Index)**

Group	Mean (percent )	SD	t-value	p-value
Group A	93.8	5.2		
Group B	87.5	6.0	3.52	0.0009

The findings of the table above show that Athletes who performed prehabilitation achieved better functional symmetry. The Prehabilitation preparation probably reduced postoperative strength deficits between limbs, resulting in better functional symmetry.

## 16. ACL-RSI Psychological Readiness Score

### ACL – Return to Sport after Injury Scale (ACL-RSI)

This scale was used to evaluate the psychological readiness of athletes to return to sport after ACL reconstruction.

**Table 16. Comparison of ACL-RSI Scores**

Group	Mean	SD	t-value	p-value
Group A	84.6	6.3		
Group B	77.8	7.1	3.41	0.0012

The findings in the table above reveal Psychological readiness to return to sport was higher in Group A possibly because prehabilitation and structured rehabilitation improved knee strength, stability, and functional confidence. This likely reduced fear of reinjury and increased athletes' confidence in returning to sports activities.

## 17. Return to Sport Rate

**Table 17. Return to Sport Comparison**

Group	Returned to Sport	Not Returned	Total	Group
Group A	22	3	25	Group A
Group B	17	8	25	Group B

### Chi-Square Test

$\chi^2$ value	p-value
4.56	0.033

The findings of the table reveal that a significantly greater proportion of athletes in Group A returned to sport compared to Group B.

**Table 18. Summary of Outcome Measures**

Outcome Measure	Group A Mean	Group B Mean	Outcome Measure
Quadriceps Strength	42.8	36.9	Quadriceps Strength
Y-Balance Test	95.6	88.9	Y-Balance Test
IKDC Score	91.3	85.2	IKDC Score
Lysholm Score	93.4	87.1	Lysholm Score
Hop Test	93.8	87.5	Hop Test
Return to Sport (percent)	88percent	68percent	Return to Sport (percent)

The comparative analysis of outcome measures between Group A and Group B shows that Group A outperformed Group B across all assessed parameters. The mean quadriceps strength was greater in Group A (42.8) than in Group B (36.9). Likewise, dynamic balance was superior in Group A, as indicated by

higher Y-Balance Test scores (95.6 vs 88.9). Functional knee outcomes were also enhanced in Group A, with higher IKDC scores (91.3 vs 85.2) and Lysholm scores (93.4 vs 87.1). In terms of functional performance, Group A achieved better Hop Test scores (93.8) compared to Group B (87.5). Additionally, a higher proportion of athletes in Group A returned to sport (88%) compared to those in Group B (68%).

## Discussion

The present study examined the impact of prehabilitation on postoperative outcomes in athletes undergoing ACL reconstruction and found that the prehabilitation group achieved superior quadriceps strength, dynamic balance, functional knee scores (IKDC and Lysholm), hop performance, and return-to-sport rates. These results underscore the importance of preoperative conditioning in facilitating improved postoperative recovery.

The greater quadriceps strength observed in this study is in agreement with findings by Potts et al. (2022), who reported that preoperative strengthening enhances postoperative recovery outcomes. However, some studies have demonstrated only limited improvements during the early recovery phase, indicating that the effectiveness of prehabilitation may depend on factors such as program design and duration (Srinivasalu et al., 2022).

Functional knee outcomes were also significantly better in the prehabilitation group, which is consistent with studies by Logerstedt et al. (2012) and Shaarani et al. (2013), highlighting the predictive value of preoperative strength on postoperative knee function. Conversely, other research has reported variability in outcomes, particularly in the short term (Aryana et al., 2024; Abel et al., 2023).

The improvement in dynamic balance observed in this study supports existing evidence that prehabilitation enhances neuromuscular control and proprioception, thereby improving functional performance. However, inconsistencies in previous findings suggest that these outcomes may vary depending on the type, intensity, and duration of training protocols.

Likewise, better hop test performance in the prehabilitation group indicates improved functional symmetry and limb strength. Nevertheless, some studies have reported only minimal improvements, emphasizing the need for standardized prehabilitation protocols.

The higher return-to-sport rate in the prehabilitation group further highlights the role of prehabilitation in improving both physical recovery and psychological readiness. However, literature suggests that return-to-sport outcomes are multifactorial and may be influenced by rehabilitation approaches and psychological factors.

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