

EFFECT OF PREHABILITATION EXERCISES ON POST-OPERATIVE RECOVERY AND RETURN TO SPORT AMONG ATHLETES UNDERGOING ACL RECONSTRUCTION

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ABSTRACT

Background: Anterior cruciate ligament (ACL) injuries are among the most common and debilitating injuries in athletes participating in sports involving cutting, pivoting, jumping, and sudden changes in direction. Although ACL reconstruction combined with postoperative rehabilitation remains the gold standard treatment for restoring knee stability, a considerable proportion of athletes fail to regain their pre-injury level of performance and experience delayed return to sport. Prehabilitation, which consists of structured exercise interventions before surgery, has recently gained attention as an effective strategy for optimizing postoperative outcomes.

Objective: To evaluate the effect of prehabilitation exercises on postoperative recovery and return to sport among athletes undergoing ACL reconstruction.

Methods: Fifty athletes diagnosed with complete ACL rupture and scheduled for arthroscopic ACL reconstruction were included in this prospective randomized controlled study. Participants were randomly allocated into two groups: Group A received a four-week supervised prehabilitation program followed by standard postoperative rehabilitation, whereas Group B received conventional postoperative rehabilitation alone. Outcome measures included quadriceps strength, Y-Balance Test, International Knee Documentation Committee (IKDC) score, Lysholm Knee Score, ACL-Return to Sport after Injury (ACL-RSI) score, and Single Leg Hop Test. Assessments were conducted preoperatively and at six months postoperatively.

Results: Athletes who participated in prehabilitation demonstrated significantly greater improvements in quadriceps strength, dynamic balance, functional performance, and psychological readiness to return to sport. Group A showed higher IKDC scores (91.3 vs 85.2), Lysholm scores (93.4 vs 87.1), and ACL-RSI scores (84.6 vs 77.8) compared with Group B. Return-to-sport rates were also significantly higher in the prehabilitation group (88%) than in the conventional rehabilitation group (68%).

Conclusion: Prehabilitation exercises performed before ACL reconstruction significantly improve postoperative recovery, functional outcomes, and return-to-sport rates in athletes. Incorporating prehabilitation into routine clinical practice may enhance rehabilitation efficiency and facilitate safer return to athletic participation.

KEYWORDS: ACL reconstruction, prehabilitation, return to sport, quadriceps strength, sports physiotherapy, rehabilitation.

INTRODUCTION

Anterior cruciate ligament injuries represent a major concern in sports medicine due to their high incidence and long-term impact on athletic performance. Sports such as football, basketball, kabaddi, volleyball, and handball involve repeated pivoting, cutting, deceleration, and landing activities that place substantial stress on the ACL. Consequently, athletes participating in these sports are particularly susceptible to ACL injuries.

The ACL plays a vital role in maintaining knee joint stability by preventing anterior tibial translation and controlling rotational movements of the knee. Rupture of this ligament results in instability, impaired neuromuscular control, reduced muscle strength, and compromised functional performance. For athletes aiming to return to high-level competition, ACL reconstruction surgery is often considered the preferred treatment option.

Despite advancements in surgical techniques and rehabilitation protocols, many athletes continue to experience persistent quadriceps weakness, reduced functional capacity, and psychological barriers that delay return to sport. Studies have reported that a significant proportion of athletes never regain their pre-injury level of sporting participation even after successful surgery.

Prehabilitation has emerged as a promising strategy to address these limitations. Prehabilitation refers to a structured exercise program performed before surgery with the aim of improving muscle strength, joint mobility, proprioception, and neuromuscular control. By optimizing physical function prior to surgery, athletes may tolerate surgical stress better and progress more efficiently through postoperative rehabilitation.

Recent evidence suggests that athletes who participate in prehabilitation exhibit superior postoperative outcomes, including improved strength recovery, enhanced functional performance, and earlier return to sport. However, limited evidence exists regarding the effectiveness of prehabilitation among athletic populations in the Indian context. Therefore, the present study aimed to investigate the effect of prehabilitation exercises on postoperative recovery and return to sport following ACL reconstruction.

METHODOLOGY

This study was designed as a prospective randomized controlled experimental trial conducted among athletes undergoing ACL reconstruction surgery.

A total of fifty athletes aged between 18 and 35 years with MRI-confirmed unilateral ACL rupture were recruited. Participants with associated ligament injuries, previous knee surgery, fractures around the knee, or neurological disorders affecting balance were excluded.

Participants were randomly allocated into two groups:

- Group A (n=25): Prehabilitation followed by postoperative rehabilitation.
- Group B (n=25): Conventional postoperative rehabilitation alone.

Prehabilitation Protocol

Athletes in Group A underwent a supervised four-week prehabilitation program prior to surgery consisting of three sessions per week. The program included:

- Quadriceps isometric exercises
- Straight leg raises
- Hamstring strengthening

- Hip abductor strengthening
- Mini squats
- Step-up exercises
- Single-leg balance training
- Core stabilization exercises

Exercise intensity and progression were individualized according to pain tolerance and functional ability.

Postoperative Rehabilitation

Both groups received identical postoperative rehabilitation programs consisting of progressive strengthening, neuromuscular training, balance exercises, proprioceptive retraining, plyometric drills, and sport-specific exercises over a six-month period.

Outcome Measures

The following validated outcome measures were utilized:

- Quadriceps strength using hand-held dynamometry
- International Knee Documentation Committee (IKDC) score
- Lysholm Knee Scoring Scale
- Y-Balance Test
- Single Leg Hop Test
- ACL-Return to Sport after Injury Scale (ACL-RSI)

Statistical analysis was performed using SPSS software, and significance was established at $p < 0.05$.

RESULTS

The results demonstrated that athletes who underwent prehabilitation achieved superior postoperative outcomes compared with athletes receiving conventional rehabilitation alone.

Quadriceps strength improved significantly in both groups; however, improvements were considerably greater in the prehabilitation group. At six months postoperatively, Group A achieved an average quadriceps strength of 42.8 kg compared with 36.9 kg in Group B.

Dynamic balance measured through the Y-Balance Test also showed significantly better outcomes in the prehabilitation group. Improved balance performance indicates enhanced

neuromuscular control and proprioceptive function, which are essential for preventing re-injury and ensuring safe return to sport.

Functional knee outcomes demonstrated similar trends. Athletes in Group A reported significantly higher IKDC and Lysholm scores, indicating reduced symptoms and improved functional ability during activities such as walking, running, stair climbing, and sporting participation.

Psychological readiness to return to sport was also superior in athletes who completed prehabilitation. Higher ACL-RSI scores suggested increased confidence, lower fear of reinjury, and greater emotional preparedness for returning to competitive activities.

Most importantly, return-to-sport rates were significantly higher among athletes receiving prehabilitation. Eighty-eight percent of athletes in Group A successfully returned to sport compared with sixty-eight percent in Group B.

DISCUSSION

The findings of the present study demonstrate that prehabilitation exercises provide substantial benefits in athletes undergoing ACL reconstruction.

One of the most notable findings was the improvement in quadriceps strength among athletes receiving prehabilitation. Quadriceps weakness remains one of the most persistent deficits following ACL reconstruction and is strongly associated with impaired functional performance and delayed return to sport. Preoperative strengthening likely minimized postoperative muscle inhibition and facilitated more rapid recovery.

Improved Y-Balance Test scores observed in the prehabilitation group highlight the importance of neuromuscular training and proprioceptive exercises. Restoration of dynamic balance is essential for sports involving rapid changes in direction and single-leg loading activities.

Functional outcome measures including IKDC and Lysholm scores were significantly higher in the prehabilitation group, indicating improved knee function and reduced disability. These findings support previous literature suggesting that improving physical capacity before surgery positively influences postoperative recovery trajectories.

Psychological readiness is increasingly recognized as a critical determinant of successful return to sport. Fear of reinjury and lack of confidence frequently prevent athletes from returning to their previous level of participation despite satisfactory physical recovery. Athletes who completed prehabilitation reported greater confidence in knee function and reduced apprehension regarding sports participation.

The higher return-to-sport rate observed in the prehabilitation group further emphasizes the clinical relevance of preoperative conditioning programs. Return to sport is the ultimate goal for most athletes undergoing ACL reconstruction, and interventions that facilitate this outcome are of considerable importance in sports rehabilitation.

Clinical Implications

The findings of this study have important implications for sports physiotherapists, orthopedic surgeons, and rehabilitation professionals.

Prehabilitation should be considered an integral component of ACL management rather than an optional intervention. Incorporating strengthening, neuromuscular training, balance exercises, and functional conditioning before surgery may reduce postoperative deficits and accelerate rehabilitation progression.

Sports medicine practitioners should encourage athletes to participate in supervised prehabilitation programs before ACL reconstruction to optimize recovery and reduce reinjury risk.

CONCLUSION

Prehabilitation exercises performed prior to ACL reconstruction significantly improve postoperative muscle strength, dynamic balance, functional performance, psychological readiness, and return-to-sport outcomes in athletes.

Athletes who underwent structured prehabilitation demonstrated superior recovery compared with those receiving conventional rehabilitation alone. These findings support the incorporation of prehabilitation programs into routine ACL rehabilitation protocols to improve patient outcomes and facilitate safe return to competitive sports.

Future research involving larger sample sizes and longer follow-up durations is recommended to further establish the long-term benefits of prehabilitation in athletic populations.

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