

## Functional performance tests as indicators of returning to sports after anterior cruciate ligament reconstruction



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### ABSTRACT

**Background:** There is a lack of standardized objective criteria to accurately assess the ability of a patient to progress through the end stages of rehabilitation and safely return to their previous level of athletic activity after anterior cruciate ligament (ACL) reconstruction.

**Purpose:** To determine objective factors involved in returning to sports following ACL reconstruction.

**Methods:** Based on our inclusion criteria of a minimum 2-year follow-up, pre-injury sports activity level of Tegner 5 or greater, we retrospectively evaluated 67 patients who underwent ACL reconstruction. The patients were divided into “return-to-sports” ( $n = 51$ ) and “non-return” groups ( $n = 16$ ) by surveying participants using a questionnaire. Comparisons between the two groups were made using pre-operative and post-operative International Knee Documentation Committee questionnaires (IKDC), Lysholm score, and KT-2000 arthrometer. Flexor and extensor muscle strength, and functional performance tests (one-leg-hop test, co-contraction, shuttle run, and carioca tests) were used for assessment.

**Results:** Overall clinical results, including IKDC score, Lysholm score, and KT-2000 arthrometer, improved in all patients post-operatively and no significant difference was seen between the two groups ( $P > 0.05$ ). Although there was no significant difference in flexor or extensor deficits, one-leg-hop test, or shuttle run test, “return-to-sports” group obtained significantly better scores in the co-contraction and carioca tests ( $P < 0.05$ ).

**Conclusions:** Tests that assess rotational stability showed statistically significant differences between the two groups. Further prospective studies with larger cohort are needed to determine the factors associated with returning to sports after ACL reconstruction.

**Level of evidence:** Retrospective comparative study, Level III.

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### 1. Introduction

The goal of anterior cruciate ligament (ACL) reconstruction is for athletes to return to their previous level of athletic ability, which has been an indicator of treatment success for many surgeons [1,2]. In many cases, an ACL injury results in a premature end to a career in sports [3–5]. However, ongoing advances in graft selection, anatomical graft placement, and fixations have allowed athletes to more consistently return to sports participation after surgery [6,7]. The combined use of strong fixation and an appropriate rehabilitation program should restore knee function and normally allow a return to sports. However, the ability to make a return is determined by many factors, including postoperative knee function, including proprioception and muscle strength, associated meniscal, cartilage, or ligament injury, social factors, and psychological issues, such as fear of re-injury and motivation [1,8].

There are various studies that suggest muscle strength, knee stability, and functional performance tests as criteria that influence the return to sports after ACL reconstruction, but there is no consensus among investigators regarding which factors are important in determining a safe return to sports. This lack of knowledge makes it difficult for physicians to counsel ACL reconstructed patients with high expectations and to determine their likelihood of an eventual return to sport.

We retrospectively reviewed and divided ACL reconstructed patients into two groups: one group of patients who returned to their previous level of sports activity and another group who did not. Various tests assessing muscle strength, stability, and functional performance were reviewed and compared between the two groups. The purpose of this study was to determine objective criteria for patients to return in a timely fashion to sports after ACL reconstruction by evaluating these two populations in terms of differences in various test results. The hypothesis of this study was that the group who returned to their previous level of sports activity would have better outcomes in muscle strength, International Knee Documentation Committee (IKDC) subjective scores, muscle power, and functional tests.

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## 2. Materials and methods

In total, 468 patients who underwent primary ACL reconstruction by an experienced knee surgeon (JGK) between March 2002 and January 2008 were identified. Criteria for inclusion were young males who had a pre-injury Tegner activity score of 5 or higher and engaged in activity level of I or II according to Hefti et al. [9] who were available for follow-up for a minimum of 2 years after surgery, pre-injury sport participation frequency of two times or more a week, a normal contralateral knee on clinical examination, no associated ligament (except medial collateral ligament) injury or fracture, no history of prior knee surgery, and compliance and undergoing all our required tests and questionnaires. Exclusion criteria were females, age under 16 and over 30, associated fracture or multiple ligament injury, associated cartilage injury necessitating additional procedure, and lack of willingness to return to play after surgery (Fig. 1).

In total, 67 patients were recruited; the average final follow-up period was 34.4 months (range, 24–45 months).

All patients underwent the same follow-up protocol. Muscle strength and functional performance tests were done at 6, 12, 24, and 36 months after surgery. Additional functional performance tests after 36 months were done if the patients willingly consented to do so. We used the results of final follow-up for analysis.

A detailed questionnaire covering the patients' past physical activity level, participation in sports, and current situation was developed and information was gathered from all included subjects. Using this questionnaire, a thorough assessment of sports participation and engagement in the level of activity was made at 1 year after surgery and at the last follow-up. Depending on whether they had returned to their previous level of sports activity and maintained the level of activity at final follow-up, subjects were divided into two groups: the "return-to-sports" and "non-return" groups.

### 2.1. Surgical indications and technique

ACL reconstructions were done 4–8 weeks after injury when a full range of motion was established and there was no joint swelling. All surgeries were performed arthroscopically using an autogenous hamstring tendon by one experienced surgeon. Arthroscopic examinations were first performed and all meniscal resections or repairs and treatment for cartilage lesions were completed before ACL reconstruction. The ipsilateral hamstring was harvested. Four stranded gracilis-semitendinosus autografts were prepared by looping the graft over an Endobutton (Smith and Nephew, Andover, MA) and suturing the folded end with No. 2 Ethibond (Ethicon, Somerville, NJ), then suturing the looped end with No. 2 Vicryl (Ethicon). A transtibial technique was used. The tibial tunnel was made with an ACL tibial guide (Linvatec, Largo, FL) set at a 45–50° angle. The femoral tunnel was targeted at the 10 o'clock position for the right knee and the 2 o'clock position for the left knee, with a femoral guide through the transtibial tunnel. With a free hand technique, a guide pin was passed through the tibial tunnel towards the bony trough. Generally the guide pin was located distal and anterior to the anatomical center, and extension of the knee nudged the guide pin towards the proximal and posterior region of the anatomic center, but was bent at the intra-articular orifice of the tibial tunnel. Femoral reaming was done with an enough knee flexion which reduced the chances of blowing out the posterior wall and increasing the femoral tunnel length. When the reamer passes over the bending portion of the guide pin, the knee was extended. After passing through the bending point, the knee was flexed. The femoral tunnel was made to a depth of 35–40 mm and at 1–2 mm anterior to the posterior cortical end. The graft was inserted after confirmation of the insertion location of the RIGIDFIX (DePuy Mitek, Raynham, MA) cross pins by arthroscopically viewing the reconstruction site through the tibial tunnel. Femoral fixation was performed with an Endobutton and two cross pins and the graft was tensioned in full extension with 20 lb

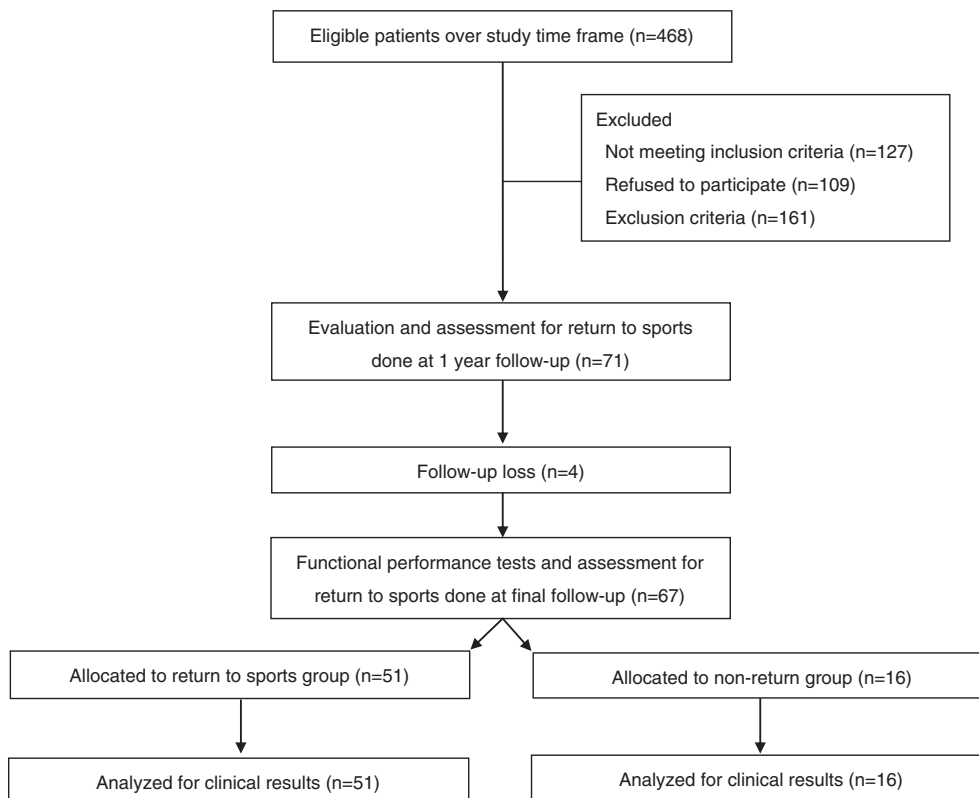


Fig. 1. Patients' flow diagram.

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