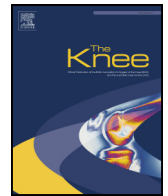




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The Knee



Self-reported outcomes are associated with knee strength and functional symmetry in individuals who have undergone anterior cruciate ligament reconstruction with hamstring tendon autograft

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ABSTRACT

Background: The aim of this study was to investigate the relationship between self-reported knee outcomes and limb symmetry indices (LSIs) for hip and knee strength, postural control and single-leg hop distance in individuals who had undergone an anterior cruciate ligament (ACL) reconstruction via hamstring tendon autograft (HTG).

Methods: A total of 72 participants with a history of unilateral ACL reconstruction via HTG (mean \pm standard deviation (SD) age: 28.0 ± 7.6 years; height: 178.4 ± 6.7 cm; mass 76.9 ± 14.9 kg) were included. International Knee Documentation Committee 2000 Subjective Knee Form (IKDC), Lysholm, Knee Osteoarthritis Outcomes Scores (KOOS) and Tampa scores were used to evaluate self-reported outcomes. Concentric and eccentric knee extensor and flexor, and hip strength, postural control and single leg hop distance were evaluated for performance-based outcomes. The relationships between the LSI scores and the performance measures were explored using the Pearson correlation coefficient.

Results: The IKDC, Lysholm and KOOS scores were positively correlated with knee extensor and flexor strength LSIs ($P < 0.05$, $r = 0.34$ to $r = 0.50$), and the Tampa score was negatively correlated with eccentric extensor LSI ($P = 0.02$, $r = -0.34$). Single-leg hop distance LSI was correlated with IKDC and Lysholm scores ($P = 0.003$, $r = 0.50$; $P = 0.04$, $r = 0.29$) respectively, while postural control was only correlated with the KOOS scores ($P < 0.001$, $r = 0.51$ to $r = 0.52$).

Conclusions: Compared to Lysholm and Tampa scores, KOOS and IKDC scores were more likely to be correlated with performance-based outcomes. Therefore, KOOS and IKDC scores may help clinicians in return to sport decision making when there is a limited time to perform extensive evaluations or access equipment.

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1. Introduction

Anterior cruciate ligament (ACL) injuries mainly occur during sports which include cutting and pivoting manoeuvres [1]. Individuals who suffer ACL injuries usually require ACL reconstruction (ACLR) if they wish to return to sport participation [1,2].

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Allografts, bone–patellar tendon–bone and hamstring tendon autografts (HTGs) are commonly used in ACLR [1,3–5]. However, the choice of HTG offers several advantages such as decreased postoperative pain, graft donor site morbidity, extension loss and postoperative quadriceps weakness [1,3–5].

The most common criterion in return to sport (RTS) decision making after ACLR consists of strength and lower-extremity functional performance testing with use of the limb symmetry index (LSI) and self-reported knee functions [6,7]. Recently, patients have been allowed to return to a competitive level of sports when they achieve 90% on the LSI in quadriceps strength and hop performance tests [8,9]. However, the use of self-reported scores such as the International Knee Documentation Committee 2000 Subjective Knee Form (IKDC), Knee Osteoarthritis Outcomes Scores (KOOS), Lysholm and Tampa scores offers an important evaluation of the patients' quality of life, satisfaction, function, and kinesiophobia and may be related to objective measures of RTS [10–13]. Therefore, it is suggested that RTS decisions should be made according to a combination of subjective and objective measurement scores [10,14].

The use of self-reported scores may help identify patients with neuromuscular impairments and activity limitations which may also be evaluated using isokinetic dynamometers and other performance-based test batteries when considering the RTS phase of ACLR rehabilitation [10,11,15,16]. Therefore, the use of simple questionnaires could help clinicians in the decision making of the patients' ability to RTS when there is limited time to perform extensive evaluations or access to equipment such as isokinetic dynamometers [11]. However, there are conflicting findings in the literature documenting the relationship between subjective and objective measurement outcomes after ACLR. Extensor strength, postural control and hop performance have been shown to be related to subjective scores [13,15,17]; however, some authors have failed to identify any relationship between objective outcomes and self-reported outcomes in individuals who had undergone ACLR [18,19].

Contradictory results among previous studies in ACLR population may be due in part to the wide variety in evaluation time after surgery, different graft used in the repair, patient characteristics and presence of concomitant injuries with ACL injury [20,21]. In particular, there is some evidence different neuromuscular adaptations may occur due to the graft used in the ACL repair [3,22]. Therefore, the aim of this study was to investigate the relationship between self-reported knee outcomes including the IKDC, KOOS, Lysholm and Tampa scores and limb symmetry indices for hip and knee strength, postural control and single-leg hop distance in male individuals who had undergone ACL reconstruction via HTG. It was hypothesized that individuals with better self-reported knee scores would also have better limb symmetry indices and performance scores.

2. Materials and methods

2.1. Participants

Seventy-two male participants with a history of unilateral ACLR (age: 28.0 ± 7.6 years; height: 178.4 ± 6.7 cm; mass: 76.9 ± 14.9 kg; body mass index: 24.2 ± 4.2 kg/m²; and pre-injury Tegner activity score: 7.3 ± 1.4) were included in this study. Inclusion criteria were age between 18 and 45 years; unilateral ACL reconstruction via hamstring tendon autograft combined with or without meniscal repair; uninjured contralateral extremity, no history of neurological disease or vestibular or visual disturbance; and a pre-injury Tegner activity score of at least five. Participants were excluded if they had an ACL revision, ACLR with patellar tendon autograft or allograft, posterior cruciate ligament injury and/or reconstruction, or had a previous injury or surgery to the contralateral limb. All patients were operated by the same surgeon (H.O.) with single-bundle anatomic ACLR using four-strand semitendinosus and gracilis tendon autograft, and went through the same rehabilitation programme after the ACLR. All patients were requested not to return to sport-specific training programmes before the end of six months after surgery. Written informed consent was obtained from all participants following study approval by the University Institutional Review Board.

2.2. ACLR rehabilitation

The ACLR rehabilitation programme started within one week of surgery and the patients were instructed to visit physical therapy three days a week until week 12 after ACLR. The early rehabilitation program (0 to four weeks) emphasized limiting hemarthrosis and oedema, obtaining full knee range of motion, achieving good quadriceps muscle control and normalization of walking. Then the rehabilitation program (four to 12 weeks) included progressive neuromuscular training including core, balance and strengthening exercises mostly performed on weight-bearing positions. The rehabilitation program until 12 weeks after surgery did not include any open kinetic chain quadriceps exercises for the reconstructed and the healthy limbs.

From 12th week to 24th week, all participants were instructed to perform the same training programme. This programme includes resistive hip and knee strengthening, plyometric running and balance exercises for both limbs three days per week during this period.

2.3. Data collection

Data collection was performed six months post-surgery in a single testing session, as the RTS tests are frequently performed at this time point.

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