



Strength recovery after anterior cruciate ligament reconstruction with quadriceps tendon versus hamstring tendon autografts in soccer players: A randomized controlled trial☆



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ABSTRACT

Background: The comparison between HT and QT grafts in strength recovery and function after an ACLR is scarce in the literature.

Methods: A total of 56 participants were enrolled in this randomized controlled trial and placed into two groups: HT or QT. The hamstring/quadriceps (H/Q) ratio was the primary end-point measured with a Genu-3 dynamometer. Peak torque, functional assessment (Lysholm knee scoring scale and Cincinnati Knee Rating System), and anteroposterior laxity (KT-2000™ arthrometer) were also assessed. An intention-to-treat analysis was performed.

Results: The results of the H/Q ratio analysis of the participants over time revealed significant differences at 60, 180, and 300°/s at three, six, and 12 months of follow-up (60°/s: $F = 5.3$, $p = 0.005$; 180°/s: $F = 5.5$, $p = 0.004$; 300°/s: $F = 5.1$, $p = 0.005$). Furthermore, they revealed significant differences at 60°/s, 180°/s, and 300°/s in the participants over time for peak torque in the extensor muscle strength at three and six months of follow-up, with higher values in the hamstring tendon group but not at 12 months of follow-up. There were no significant differences in functional endpoints or arthrometer assessments at 24 months of follow-up.

Conclusion: An ACLR with a QT graft showed similar functional results with a better isokinetic H/Q ratio compared to an ACLR with the HT at 12 months of follow-up in soccer players. This higher H/Q ratio observed with the QT could be an advantage of this graft over the HT for an ACLR.

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1. Introduction

The anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee. Playing soccer increases the risk of suffering this injury [1]. An ACL-deficient knee can lead to recurrent instability, meniscus tears, and osteoarthritis [2]. The ACL reconstruction (ACLR) is the standard injury treatment for those soccer players who wish to return to play [3]. The choice of the graft for an ACLR remains controversial; allograft or autografts can be used, but the use of an allograft should be avoided in soccer players because of the high re-rupture rate observed in young, active patients [4]. Many authors consider a bone–patellar tendon (BPT) autograft to be the gold-standard graft for an ACLR in contact athletes due to its biomechanical properties [5]. Concerns about the BPT autograft's donor site morbidity have led many surgeons to use a hamstring tendon (HT) autograft for an ACLR [6,7]. Nevertheless, HT autografts are associated with a flexion strength deficit in isokinetic testing 8–13.

A quadriceps tendon (QT) graft could be an interesting alternative for an ACLR in soccer players. Shani et al. [14] showed that the structural properties of the QT are significantly higher than those of the BPT. Previous studies have compared the QT and the BPT, showing a reduced incidence of donor site morbidity when the QT was used [15,16]. Besides, maintaining the hamstrings' integrity after an ACL injury could help to protect the knee in valgus pivoting sport activities [17,18]. Nevertheless, no randomized controlled trial has compared QT and HT grafts for an ACLR.

Strength recovery is one of the most important parameters considered to return to play after an ACLR [19]. This strength recovery might be even more important in the case of soccer players returning to their pre-injury activity level. Analyses of strength recovery after an ACLR with the QT are scarce in the literature. To date, the quadriceps/hamstrings (Q/H) ratio, which is considered a relevant muscle balance parameter, has not been reported in a comparative study involving QT autografts and other graft choices for an ACLR. Most surgeons allow patients to return to play without restrictions between six and nine months after an ACLR [20]. The flexion and extension strength recovery and the H/Q ratio after an ACLR with the QT could be important parameters for choosing the QT among other available grafts.

The purpose of this study was to prospectively compare the strength recovery and functional outcomes of an anatomic single bundle reconstruction with HT and QT autografts in competitive soccer players. The main hypothesis of this study was that an ACLR with the HT and ACLR with the QT yield similar knee stability, functional results, and extension muscle strength recovery with a significant deficit in the isokinetic hamstring muscle strength in patients who had an ACLR with the HT compared to patients who had an ACLR with the QT.

2. Methods

2.1. Design

This was a prospective randomized controlled trial (Clinical Trials.gov NCT0283279: <https://clinicaltrials.gov/ct2/show/NCT02832791?term=cantarero+villanueva&rank=3>). The trial was approved by the relevant Ethical Organization and was performed according to the Helsinki Declaration (last modification in 2000) and The Biomedical Research (14/2007). All participants provided a written informed consent, which was signed by a legal representative in the case of minor participants.

2.2. Participants

Fifty-six consecutive participants were enrolled by their surgeon from the Andalusian Mutuality of soccer players (Spain) for a year from July 2015. The inclusion criteria were i) having suffered an ACL injury with less than six months of evolution of the lesion at the time of diagnosis and ii) being competitive soccer players. The patients were excluded i) if they had had a previous joint injury or surgery on the affected knee, ii) if they had had any concomitant ligament injury, iii) if they had been removed more than 50% of either the lateral or medial meniscus, and iv) if they had had any articular cartilage lesion greater than Outerbridge grades I–II.

2.3. Randomization

The participants were randomized using two randomized number cycles with a computer. This sequence was introduced in numbered, opaque, sealed envelopes by an external researcher who was not a participant in the study. Once the participants were evaluated and were assigned an identification number, the surgeon checked their group.

2.4. Rehabilitation

The rehabilitation protocol was based on a previous study by Grinsven [21]. Therefore, both groups followed the same staged protocol (Table 1), except those patients with a concomitant meniscal repair, who had a restriction over 90° of flexion for four weeks. The rehabilitation was performed by the same team of physical therapists in both groups.

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