

The architecture of the ipsilateral quadriceps two years after successful anterior cruciate ligament reconstruction with bone–patellar tendon–bone autograft



Umile Giuseppe Longo^{a,b}, Giacomo Rizzello^{a,b}, Francesco Franceschi^{a,b}, Stefano Campi^{a,b}, Nicola Maffulli^{c,*}, Vincenzo Denaro^{a,b}

^a Department of Orthopaedic and Trauma Surgery, Campus Bio-Medico University, Via Alvaro del Portillo, 200, Trigoria, 00128 Rome, Italy

^b CIR (Centro Integrato di Ricerca), Campus Biomedico University, Via Alvaro del Portillo, 21, Trigoria, 00128 Rome, Italy

^c Centre for Sports and Exercise Medicine, Barts and The London School of Medicine and Dentistry Mile End Hospital, 275 Bancroft Road, London E1 4DG, England, United Kingdom

ARTICLE INFO

Article history:

Received 13 October 2012

Received in revised form 27 January 2014

Accepted 3 February 2014

Keywords:

Quadriceps

Anterior cruciate ligament

Pennation angle

Muscle thickness

Sports

Recovery

ABSTRACT

Background: We undertook a cross-sectional study to evaluate the pennation angle and muscle thickness of the vastus lateralis muscle in patients undergoing unilateral anterior cruciate ligament (ACL) reconstruction with bone–patellar tendon–bone autograft, and compared these values with the contralateral non-operated limb.

Methods: Twenty three consecutive athletic males who underwent ACL reconstruction using the central third of the patellar ligament were evaluated at 25.9 ± 1.5 months. The International Knee Documentation Committee (IKDC) score was administered, and angles of pennation and muscle thickness were measured by ultrasonography. **Results:** There was no significant difference in the pennation angle of the operated leg comparing to the contralateral leg ($12.5^\circ \pm 1.81^\circ$ in the operated leg; $13.25^\circ \pm 2.40^\circ$ after the test; $p = 0.117$). Quadriceps thickness in the operated leg was significantly decreased in all subjects compared to the contralateral leg (28.4 ± 5.3 mm in the operated leg; 32.7 ± 4.85 mm in the contralateral leg; $p = 0.007$).

Conclusions: Two years after surgery, there is no difference in pennation angle of the vastus lateralis when compared to the contralateral side in patients undergoing unilateral ACL reconstruction with bone–patellar tendon–bone autograft. There is a significant difference in quadriceps muscle thickness, which was less in the operated side on the operated side in all patients. Further studies are required to study the influence of muscle architecture on clinical outcome after ACL reconstruction surgery, and whether there are differences associated with the use of different grafts.

Level of evidence: Case–control study; level IV.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Reconstruction of the anterior cruciate ligament (ACL) is common. Several mid- and long-term follow-up studies report clinical success from 80% to 95% [1,2]. To assess the success of an ACL reconstruction, quantitative measurements of the pivot shift phenomenon, transverse plane rotational knee laxity, and patient satisfaction must be considered [3,4]. In addition, the long term outcome of the reconstruction in terms

of preventing or slowing down the progression of degenerative joint disease should be taken into account [2,5].

Muscle architecture is a primary determinant of muscle function: disuse atrophy is the basis for profound physiological changes of the muscles of immobilised limbs [6,7]. Ultrasound imaging accurately depicts fibre length and orientation, both in physiological and pathological conditions [7]. It is a valid tool to assess basic architectural parameters of the various components of muscles, including fascicle length, pennation angle, muscle thickness, and muscle and tendon length [8]. The pennation angle (θ) is the angle of insertion of muscle fibre into the tendon aponeurosis. The pennation angle decreases with age [7], and there is a definite relationship between fibre pennation and muscle size, suggesting that muscle hypertrophy involves an increase in fibre pennation angles [9], even though a definite relationship between pennation and force production capacity is not certain [10,11].

* Corresponding author at: Queen Mary University of London, Barts and The London School of Medicine and Dentistry, Centre for Sports and Exercise Medicine, Mile End Hospital, 275 Bancroft Road, London E1 4DG, England, United Kingdom. Tel.: +44 20 8223 8839; fax: +44 20 8223 8930.

E-mail address: n.maffulli@qmul.ac.uk (N. Maffulli).

Previous studies reported changes in muscle architecture in association with chronic rotator cuff tears [12] or following intramedullary nailing of the femur [13], and have investigated the muscle size of the quadriceps muscle in ACL injured subjects [14,15]. However, to date the architecture of the muscles of the leg after ACL reconstruction has not been well studied.

In this cross-sectional study, the pennation angle and muscle thickness of the vastus lateralis in patients who had undergone unilateral ACL reconstruction with bone–tendon–bone patellar tendon autograft were evaluated and compared to the contralateral side. Patient's satisfaction was evaluated by the IKDC score and correlated with architectural changes in the muscle.

The null hypothesis of the study was to find no difference in the architecture of the vastus lateralis between the operated and non-operated side.

2. Patients and methods

The ethics committee of our institution approved the study. Subjects gave their informed consent to participate in the investigation.

2.1. Patients

Twenty three consecutive male subjects (age 33 ± 7.7 years; height: 177.8 ± 6.5 cm; weight: 81.4 ± 11.3 kg; average years spent training: 15.6 ± 7.3 years; mean weekly duration of training: 4.4 ± 2.26 h) gave informed consent to participate in this study. Most of them played soccer (15 subjects), 1 played basketball, 1 boxed, 2 practiced various recreational sport activities, and 4 practiced no sport.

The participants were tested at a mean of 25.9 ± 1.5 months after ACL reconstruction. We excluded from our study patients with concomitant injuries (i.e., posterior cruciate ligament tear, chondral lesions, lateral collateral ligament injuries, or meniscal injuries), with inflammatory joint disease, or other surgery on the affected limb.

2.2. Surgical reconstruction with bone–patellar tendon–bone autograft

All procedures were performed by a fellowship trained knee sports surgeon using an autograft harvested from the middle third of the ipsilateral patellar tendon [16]. Bioabsorbable interference screws (Arthrex, Inc. Naples USA) were used for both femoral and tibial fixation of the graft.

2.3. Rehabilitation

All patients underwent the same rehabilitation protocol [16]. Immediately after surgery, patients commenced co-contractions of the quadriceps and hamstring muscles, and were allowed to weightbear with

the aid of crutches. Patients were encouraged to discard the crutches as soon as possible. An accelerated rehabilitation programme was instituted, focusing on achieving full extension by the 14th day after surgery. Jogging was commenced after six weeks, and return to competitive sport was planned at least six months after surgery, and only after knee stability had been confirmed on clinical examination.

2.4. Clinical evaluation

Before ultrasonography, a clinical evaluation was performed in all participants by two independent assessors. During this evaluation, the International Knee Documentation Committee (IKDC) score was obtained.

2.5. Ultrasonography

Angles of pennation (Fig. 1) and muscle thickness (Fig. 2) were determined by ultrasonography (Hitachi-Tokyo, Japan) with a 7.5 MHz probe (640×480 pixels) with the subject sitting on the examination couch with hips and knees flexed at 90° [11]. Subjects were asked not to contract their quadriceps. The same trained operator performed all measurements at the border between the lower one third and the upper two thirds of the distance between the anterior superior iliac spine and the base of the patella [11]. The point where these variables were measured was marked with a marking pen. We performed three measurement on the operated leg and three measurements on the contralateral leg. We measured the thickness of the quadriceps femoris (rectus femoris + vastus intermedius) with the probe placed in the transverse plane, and the angles of pennation of the vastus lateralis with the probe placed in the sagittal plane [18]. The measurements in the operated leg (group 1) were then compared with the contralateral (group 2).

2.6. Intra-observer variation

To calculate the intra-observer variation, the pennation angle and quadriceps thickness were measured bilaterally on a single subject, repeating the measurements 20 times over two weeks. The subject was a normal control and had no change in exercise routine over the two week period to avoid any time-related effect or bias. The coefficient of variation (CV) of pennation angle was 3.6% (left) and 4.3% (right), while the CV for the quadriceps thickness was 3% (both left and right).

2.7. Statistics

Statistical analysis was performed using the SPSS statistical package for Windows, release 13.0. Descriptive statistics were calculated, and values reported as mean \pm standard deviation. Comparison between

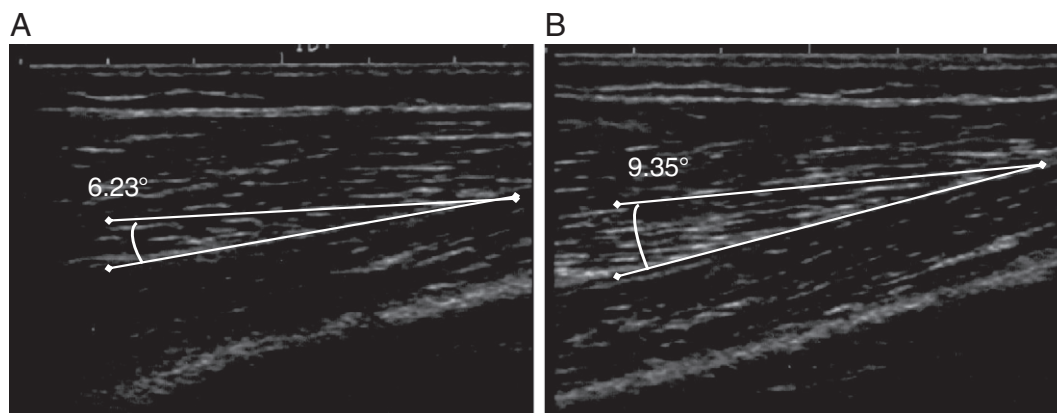


Fig. 1. Ultrasonographic measurement of angle of pennation.

Download English Version:

<https://daneshyari.com/en/article/4077464>

Download Persian Version:

<https://daneshyari.com/article/4077464>

[Daneshyari.com](https://daneshyari.com)