Orthopaedics & Traumatology: Surgery & Research 101 (2015) 539–542

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Original article

Muscle recovery after ACL reconstruction with 4-strand semitendinosus graft harvested through either a posterior or anterior incision: A preliminary study

D. Dujardin , N. Fontanin , A. Geffrier , N. Morel , C. Mensa , X. Ohl *

Service de chirurgie orthopédique et traumatologique, CHU Maison-Blanche, 45, rue Cognacq-Jay, 51092 Reims, France

ARTICLE INFO

Article history:
Received 3 October 2014
Accepted 2 March 2015

Keywords:
Anterior cruciate ligament reconstruction
Muscle strength
Quadriceps muscle
Hamstring muscle
Isokinetic strength testing
Posterior harvesting

ABSTRACT

Introduction: Harvesting of a 4-strand semitendinosis (ST4) graft during anterior cruciate ligament (ACL) reconstruction can be performed through either a posterior or anterior approach. The objective of this study was to evaluate the recovery of the quadriceps and hamstring muscles as a function of the graft harvesting method. We hypothesized that posterior harvesting (PH) would lead to better recovery in hamstring strength than anterior harvesting (AH).
Methods: In this prospective study, the semitendinosus was harvested through an anterior incision in the first group of patients and through a posterior one in the second group of patients. The patients were enrolled consecutively, without randomization. Isokinetic muscle testing was performed three and six months postoperative to determine the strength deficit in the quadriceps and hamstring muscles of the operated leg relative to the uninjured contralateral leg.
Results: Thirty-nine patients were included: 20 in the AH group and 19 in the PH group. The mean quadriceps strength deficit after three and six months was 42% and 26% for AH and 29% and 19% for the PH, respectively ($P = 0.01$ after three months and $P = 0.16$ after six months). The mean hamstring strength deficit after three and six months was 31% and 17% for AH and 23% and 15% for the PH, respectively ($P = 0.09$ after three months and $P = 0.45$ after six months). After three months, the PH group had recovered 12% more quadriceps muscle strength than the AH group ($P = 0.03$).
Conclusion: Our hypothesis was not confirmed. Harvesting of a ST4 graft for ACL reconstruction using a posterior approach led to better muscle strength recovery in the quadriceps only after three months.
Case control study: Level 3.

1. Introduction

Anterior cruciate ligament (ACL) rupture is a common sports injury. Although ACL reconstruction performed with a hamstring graft is a reliable technique, knee flexion strength is reduced in the postoperative phase [1–3]. To minimize this negative effect, surgeons can choose to harvest only the semitendinosus and leave the gracilis intact [4]. This corresponds to the 4-strand semitendinosus (ST4) technique where the tendon graft is harvested either through the standard anterior approach (AH) or a minimally invasive posterior approach (PH) in the popliteal fossa [5,6]. The purpose of this study was to compare the strength of the hamstring and quadriceps muscles as a function of the harvesting method after ACL reconstruction with a ST4 graft. We hypothesized that posterior hamstring harvesting will result in less loss of flexion force in the hamstring muscles after surgery.

2. Material and methods

2.1. Study design and patient population

This was a single-center, prospective study performed between September 2011 and May 2014 at the Orthopedic Surgery Department of the Reims (France) University Hospital Center in patients undergoing ACL reconstruction with an ST4 graft. All patients consented to participating in this study. The patients were enrolled consecutively into the study, without randomization.

Patients were included if they were above 18 years of age, participated in a pivoting sport (with or without contact), had a complete ACL rupture confirmed on MRI, had measurable instability or

* Corresponding author.
E-mail address: xohl@chu-reims.fr (X. Ohl).

http://dx.doi.org/10.1016/j.otsr.2015.03.017
1877-0568/

anterior laxity (defined as 3 mm difference relative to healthy side) on the KT 1000™ arthrometer (MEDmetric® Corporation, San Diego, CA) and had no previous surgery on the injured knee.

Patients were excluded if the collateral ligaments were injured, the ACL was partially torn, a cartilage injury was present or a fracture occurred in combination with the ACL injury. The presence of a meniscus injury was not grounds for exclusion: 50% of patients in the AH group had a meniscus injury and 63% in the PH group.

The graft was harvested through the classical anterior approach on patients operated between September 2011 and September 2012. The graft was harvested through a posterior approach in the patients operated between September 2012 and November 2013. One surgeon performed all the procedures.

2.2. Surgical technique

The ACL was repaired arthroscopically with the ST4 using an all-inside technique with double endobuttons (GraftLink® technique, Arthrex, Naples, FL, USA).

In the anterior harvesting group, a short incision was made three finger widths below the pole of the patella and two finger widths medial to it. The sartorius aponeurosis over the semitendinosus and gracilis was opened along healing lines to expose the upper portion of the semitendinosus. An open smooth stripper was used to harvest the entire semitendinosus muscle-tendon unit, which was cut at its bone attachment.

In the posterior harvesting group, the hamstring tendons were palpated in the medial and distal part of the popliteal fossa. A 2-cm horizontal incision was made immediately below the posterior knee fold. The fascia surrounding the ST was opened and the ST externalized. After cutting any adhesions, an open stripper was used to harvest the ST up to its myotendinous junction. Any remaining muscle fibers were removed from the tendon, which was then cut at its tibial insertion with a closed stripper.

The postoperative rehabilitation protocol was the same in both groups. It was suggested that patients undergo three rehabilitation sessions per week. The first phase of rehabilitation was three months long and consisted of partially protected weight bearing with a hinged splint for 30 days with unlimited passive knee mobilization and closed kinetic chain exercises. The second phase started after three months and consisted of quadriceps and hamstring strengthening in combination with open kinetic chain and proprioceptive exercises.

2.3. Isokinetic testing

Isokinetic testing was performed on an isokinetic testing machine (Con-Trex® – Medimex, Sainte-Foy-les-Lyon, France) by a rehabilitation physician. The main contraindications to isokinetic testing were the presence of an infection, greater than 20° flexion deformity and/or less than 100° knee flexion range, pain on VAS of ≥ 5/10, thigh muscle inhibition or unstable cardiovascular disease.

The patient warmed up for the testing by pedaling for 10 minutes on a stationary bicycle (submaximal effort). The isokinetic test protocol consisted of concentric/concentric testing of the knee flexors and extensors over three sets of trials separated by one minute rest: warm up and movement practice for five submaximal contractions at 240°/s; five maximal contractions at 240°/s; three maximal contractions at 60°/s with verbal encouragement. Either the operated or non-operated side was tested first, with the other side being done immediately after. The measured value was the peak moment (N/m) in the best of the three repetitions at 60°/s for the knee flexors and extensors. In this series, the test was considered valid if no pain was induced by the test and the coefficient of variation in the peak moments was ≤ 10%.

Table 1
Preoperative and intraoperative data for both groups.

Variables	AH ($n = 20$)	PH ($n = 19$)	P value
Age (years)	28 ± 8.2	24 ± 6.7	n/s
Female	8 (40%)	6 (32%)	n/s
Subjective IKDC score (100 max)	42	47	n/s
Time to surgery (months)	5.1 ± 3.3 (2–12)	4.1 ± 2.7 (1–12)	n/s
Preoperative laxity (mm)	7.3 ± 2.1	7.5 ± 1.2	n/s
Operative time (min)	84 ± 15	74 ± 19	n/s
Lateral meniscus injury	$n = 3$ 3 meniscectomy	$n = 6$ 5 meniscectomy 1 repair	n/s
Medial meniscus injury	$n = 7$ 3 meniscectomy 4 repair	$n = 6$ 5 meniscectomy 1 repair	n/s

AH: anterior harvesting; PH: posterior harvesting; n/s: not significant.

2.4. Data collection

The following preoperative and intraoperative data were collected: time between injury event and surgery, preoperative laxity (measured with KT 1000™ arthrometer), subjective IKDC score, operative time, diameter of graft used.

The following postoperative data were collected: joint range of motion, thigh circumference (10 cm above the patella), and complications.

The primary outcome measure was the quadriceps and hamstring strength deficit in the operated leg relative to the contralateral side at three and six months postoperative.

2.5. Statistical analysis

Quantitative variables were described by their mean and standard deviation values. Qualitative variables were described by their frequency and corresponding percentage. The groups were compared with Student's t-test for quantitative variable and the Chi^2 or Fisher's exact test for qualitative variables. The mean deficit in quadriceps and hamstring muscle activity was calculated for each group at the 3- and 6-month time points. An analysis of the strength deficit as a function of the harvesting technique was performed using an age-adjusted, generalized linear regression model. All statistical tests were performed with the SAS 9.2 software (SAS Institute, Cary, NC). The significance threshold was set a 0.05.

3. Results

3.1. Study population

Thirty-nine patients were included, 20 in the AH group and 19 in the PH group. The characteristics of the two groups and the clinical examination results at three and six months postoperative are given in Tables 1 and 2. The two groups were statistically comparable in terms of their preoperative characteristics and 3-month and 6-month clinical data (time to surgery, pain, quadriceps atrophy, flexion deformity, range of motion). Patients who underwent anterior graft harvesting were operated on for a mean of 84 minutes and those who underwent posterior harvesting were operated on for a mean of 74 minutes (difference not statistically significant).