FEMORAL TUNNELS' LENGTH CHANGES WITH KNEE FLEXION ANGLE IN ANATOMICAL ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Julio Cesar Gali[1], Heetor Campora de Sousa Oliveira[2], Bruno Asprino Ciâncio[2], Marcos Vianna Palma[2], Ricardo Kobayashi[2], Edie Benedito Caetano[3]

ABSTRACT

Objective: The objective of our study was to evaluate the effect that knee flexion angle while femoral tunnels are being drilled may have on the length of these tunnels, in anatomical reconstruction of the anterior cruciate ligament. Methods: We measured the lengths of anteromedial and posterolateral tunnels for the anterior cruciate ligament in 20 unpaired anatomical knee specimens (10 right and 10 left knees), all with the cartilage and cruciate ligaments intact. Tunnels were drilled with the knees flexed at 90º, 110º and 130º, through the accessory anteromedial portal, with a 2.5 mm drill. The statistical analysis was done by means of Friedman's variance analysis and the Mann-Whitney U test. Results: The mean anteromedial femoral tunnel lengths measured with the knees flexed at 90º, 110º and 130º were 33.7 (± 3.72) mm, 37.4 (± 2.93) mm and 38.8 (± 3.31) mm, respectively. For the posterolateral femoral tunnel lengths, the results were 32.1 (± 4.24) mm, 37.3 (± 4.85) mm and 38.4 (± 2.51) mm, respectively. Friedman's variance analysis showed that there was a significant difference between the lengths of the tunnels drilled with 90º and 110º of flexion angle, but showed that there was no significant difference between the tunnels drilled with flexion of 110º and 130º ($P < 0.05$). Conclusions: It is possible to drill the femoral tunnels through the accessory anteromedial tunnel with the knee flexed at 110º in such a way as to produce a tunnel of sufficient length for a good bone-graft interface.

Keywords – Anterior Cruciate Ligament; Knee; Femur; Tibia; Reconstructive Surgical Procedures

INTRODUCTION

Today, there is a trend towards changes in the technique of surgical reconstruction of the anterior cruciate ligament (ACL). Until recently, it was recommended that in the arthroscopic reconstruction of this ligament, the femoral tunnel should be constructed through the tibial tunnel, which predisposes towards a higher location in the intercondyle for the femoral tunnel, in a non-anatomical position[1].

The new tendency is to seek to reconstruct this ligament anatomically, defining this as a reconstruction that provides restoration of the ACL to its original dimensions, collagen orientation and insertion sites, in an attempt to replicate its anatomy. This might result in superior clinical results[2].

The ideal way to reach the anteromedial (AM) and posterolateral (PL) femoral insertion sites of the ACL is through an accessory anteromedial (AAM) portal[3]. However, this route may produce femoral tunnels that are shorter than the transtibial route[4], which may compromise the quality of the bone-graft interface[5].

The positioning of the tunnels for placement of the graft is the most critical factor influencing the results from ACL reconstruction[6,7]. It is potentially influenced

1 – PhD in Orthopedics and Traumatology from the USP School of Medicine; Voluntary Attending Physician in the Orthopedics and Traumatology Service, Sorocaba School of Medical and Health Sciences, Pontificate Catholic University of São Paulo, Sorocaba, SP, Brazil.
2 – Former Resident in the Orthopedics and Traumatology Service, Sorocaba School of Medical and Health Sciences, Pontificate Catholic University of São Paulo, Sorocaba, SP, Brazil.
3 – Full Professor and Head of the Orthopedics and Traumatology Service, Sorocaba School of Medical and Health Sciences, Pontificate Catholic University of São Paulo, Sorocaba, SP, Brazil.

Work performed at Sorocaba School of Medical and Health Sciences, Pontificate Catholic University of São Paulo, Sorocaba, SP, Brazil.

Correspondence: Julio Cesar Gali, Av. Eugênio Salerno 387, 18035-430 Sorocaba, SP. E-mail: juliogali@globo.com

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by, among other things, the angle of knee flexion at the time of drilling the tunnels, the locations of the portals and the anatomical variations between individuals[8].

Our hypothesis here was that the greater the knee flexion was while drilling the femoral tunnels, the longer these tunnels would be. Thus, the objective of our study was to evaluate the effect that knee flexion might have on the length of the femoral tunnels.

MATERIALS AND METHODS

We measured and compared the lengths of anteromedial and posterolateral femoral tunnels constructed in 20 anatomical knee specimens. There were 10 right and 10 left knees, which were not in pairs and were of unknown sex and age. All the specimens presented intact joint cartilage and anterior and posterior cruciate ligaments.

The specimens had been fixed in 10% formol when fresh, and had been conserved in a mixture of 2.5% phenol, 2.5% formol and 1% sodium chloride. They were subsequently kept in liquid glycerin for 60 days, before dissection.

Using an open route, we removed the original AM and PL insertions of the ACL and marked out their centers using a bone pick.

The tunnels were drilled at the sites of these markers, using 2.5 mm bits, through the AAM portal. The anatomical specimens were flexed to construct the tunnels at 90º, 110° and 130°. The degree of flexion was determined using a goniometer that was aligned with the femoral and tibial diaphyses. The drilling was always done by two people: one maintaining the desired flexion, while the other did the drilling at the AM and PL femoral anatomical sites of the ACL (Figure 1).

We sought to keep the drill bit not more than 4 mm from the cartilage of the medial femoral condyle (MFC), always through the same entry point, in order to simulate intraoperative situations of arthroscopic reconstructions.

We did not use guides for the drilling. After removing the ACL, we marked out the femoral insertion points of the AM and PL bands and directed the bit laterally and slightly obliquely, towards the lateral femoral cortical bone (Figures 2 and 3). After completing this, we measured the tunnel lengths in millimeters, using a depth measuring device.

The statistical analysis was done using Friedman's analysis of variance and the Mann-Whitney test.

Figure 1 – Frontal view of an anatomical left-knee specimen with a drill bit inserted through the accessory anteromedial portal. The goniometer indicates the degree of knee flexion.

Figure 2 – Anatomical left-knee specimen with a drill bit inserted posterolaterally into the lateral femoral condyle.

RESULTS

The mean length of the AM femoral tunnels at 90°, 110° and 130° of flexion were, respectively, 33.7 ± 3.7 mm, 37.4 ± 2.9 mm and 38.8 ± 3.3 mm. For the PL femoral tunnels, the lengths were 32.1 ± 4.2 mm, 37.3 ± 4.8 mm and 38.4 ± 2.5 mm (Table 1).

In no case was there any violation of the posterior cortical bone of the AM femoral tunnel. Nor was there any damage to the lateral collateral ligament or to the popliteal tendon.