Rev Bras Ortop. 2013;48(3):263-267

RBO REVISTA BRASILEIRA DE ORTOPEDIA
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Original Article

Tibial Insertions of the Posterior Cruciate Ligament: Topographic Anatomy and Morphometric Study

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ARTICLE INFO

Article history:
Received on January 22, 2012
Accepted on June 5, 2012

Keywords:
Tibia
Posterior cruciate ligament
Orthopedic procedures

ABSTRACT

Objective: To provide anatomical and morphometric basis of the posterior cruciate ligament's tibial insertions in order to assist the creation of anatomical tibial tunnels, in the ligament surgical reconstruction. *Material and methods:* The topographic anatomy and morphometry of the posterior cruciate ligament's anterolateral and posteromedial bundles' tibial insertions were analyzed in 24 anatomical knee pieces. The pieces were photographed by a digital camera and the images obtained were studied by the software ImageJ, where the bundles' insertion areas were measured in square millimeters, and the length of structures and the distances between significant points were measured in millimeters. *Results:* In 54.2% of the knees the insertion' shape was concave; in most pieces (41.6%) the form of insertion was oval. The average posterior cruciate ligament's tibial insertion total area was 88.33 ± 21.66 mm^2; the average anterolateral bundle's tibial insertion area was 46.79 ± 14.10 mm^2 and it was 41.54 ± 9.75 mm^2 for the posteromedial bundle. *Conclusions:* The anterolateral bundle has a tibial insertion area larger than the posteromedial bundle; the insertion areas of those bundles in our study, were smaller than the ones found in the literature. The variations in the posterior cruciate ligament's tibial insertion area suggest that there should be an indication for anatomical reconstructions of this ligament using single or double tibial tunnels according to individual characteristics.

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ISSN © 2013 Sociedade Brasileira de Ortopedia e Traumatologia. Published by Elsevier Editora Ltda. Este é um artigo Open Access sob a licença de CC BY-NC-ND
doi: 10.1016/j.rbo.2012.06.005

Introduction

The posterior cruciate ligament (PCL) originates from the lateral face of the medial femoral condyle (MFC) and crosses the knee joint in the posterior, lateral and distal directions. The PCL is inserted in the posterior and proximal tibia in the intercondylar area and extends into the adjacent posterior tibial surface for several millimiters.[1,2]

The PCL is split into two functional bundles; the anterolateral bundle (ALB) and the posteromedial bundle (PMB). The ALB is tight at flexion, while the PMB is tight at extension.[2]

In addition, the PCL is the primary stabilizer of the knees because it provides the central rotational axis3 and responds to 95% of the posterior displacement of the tibia over the femor.[4] It also limits the varus and valgus as well as the external rotation of this joint.[5]

PCL lesions alter the articular kinematics, which results in medial or generalized femorotibial osteoarthosis approximately 25 years after the lesion.[6]

In order to obtain articular stability and prevent secondary arthrosis, surgical treatment of these lesions for active patients is frequently indicated. Surgical reconstruction, however, requires thorough knowledge of anatomy to correctly place the graft.[7]

Our study was aimed at providing anatomical and morphometric details of tibial insertions of the PCL to help surgeons find the perforation points of the anatomical tibial tunnels during surgical reconstruction.

Materials and Methods

We studied the topographic anatomy and morphometry of tibial insertions of the PCL in 24 anatomical knee pieces, 12 on the right and 12 on the left. They were separate, and all of the articular cartilage and anterior and posterior cruciate ligaments were intact.

Preparation of the pieces before dissection was as follows: fixation with 10% formaldehyde, conservation in a mixture of 2.5% phenol, 2.5% formaldehyde, and 1%sodium chloride, and storage of the pieces in liquid glycerin for 60 days.

Initially, the synovial covering of the PCL, the fibrous expansions and the meniscofemoral ligaments were carefully removed (Fig. 1). Each bundle was then delicately removed with a scalpel, with a #11 blade, and dissection tweezers, and its limits were marked with small points of ink. In this manner, the bone insertions of the AL and PM bundles in the proximal tibia could be delimited.

After the details of the tibial insertions of the AL and PM bundles of the PCL were macroscopically observed, a Canon EOS Rebel T1i digital camera and reference marker were used to photograph all of the pieces. (Fig. 2)

The ImageJ program was used to measure the insertion area of the bundles in square millimeters, and the distances between the significant points were measured in millimeters.

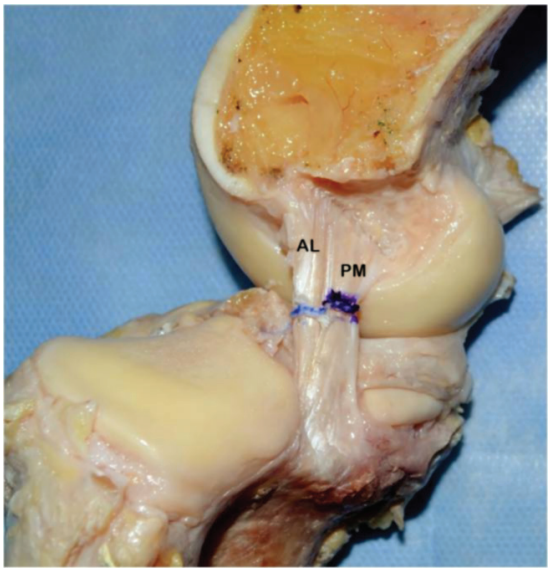

Fig. 1 - View of the anterolateral (a) and posteromedial (b) bundles of the cruciate ligament and its insertion after removing the meniscofemoral ligaments.

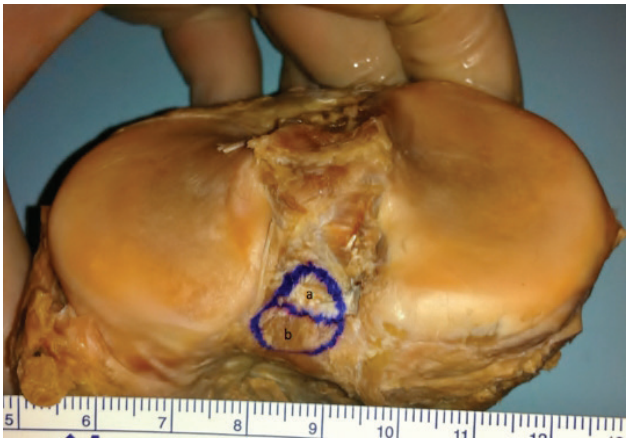

Fig. 2 - Macroscopic aspect of the tibial insertion areas of the anterolateral (a) and posteromedial (b) bundles of the posterior cruciate ligament in the posterior tibial intercondylar area of a right knee and the reference marker.

Results

The insertion of the PM bundle was distal and medial to the insertion of the AL bundle. In the macroscopic analysis, we noted topographic and geometric variations in the tibial insertions of the PCL.

In 13 knees (54.2%), the shape of the insertions was concave; eight pieces (33.3%) were planar, and three pieces (12.5%) presented a convex insertion area.

Regarding the geometric shape of the insertions of the PCL, we noted an oval shape in 10 knees, a square shape in eight knees (33.3%), and a trapezoidal (25%) shape in six dissected pieces.