Morphology of the Tibial Insertion of the Posterior Cruciate Ligament

INTRODUCTION:
The posterior cruciate ligament (PCL) has been described as the primary restraint to posterior tibial translation and consists of two functional bundles; the anterolateral (AL) and posteromedial (PM) bundles. Double-bundle PCL reconstruction has been demonstrated to better restore both normal knee kinematics and function; however, it is usually performed using either the tibial inlay or single tibial technique. To perform an anatomical double-bundle reconstruction, with two tibial tunnels, it is necessary to define the tibial insertion sites of the PCL and its bundles. The aim of this study is to correctly identify the PCL tibial insertion site and the related bony landmarks.

MATERIALS AND METHODS:
Twenty-one unpaired human cadaver knees were evaluated in this study (Fig 1). The AL and PM insertions were outlined using fine pins and all soft tissue was removed using a sodium hydroxide solution. The knees were photographed by a laser three-dimensional (3-D) digitizer camera and analyzed using specific software. The all 3-D measurements were analyzed on the tibial plane basis. The tibial plane was created on the surfaces of the tibia plateau and rectangle was fitted to the plateau edges along the posterior condylar axis (Fig 2). The surface area, slope angle, length and width of each insertion were calculated and their insertion centers were also defined automatically as the centroids (Fig 3). To obtain geometric data, their centers were projected onto the tibial plane vertically and located by anteroposterior, mediolateral and vertical dimensions (Fig 4). The geometric data and surface features of the tibial insertion sites of the PCL and its bundles were studied by macroscopic observation and by three-dimensional laser photography (Fig 5).

RESULTS:
The mean surface area of the anterolateral (AL) and posteromedial (PM) insertions were 93.1 ± 16.6 mm² and 150.8 ± 31.0 mm², respectively, and the distance between their centers was 8.2 ± 1.3 mm. The mean length and width of the AL insertion sites were 7.8 ± 1.5 mm and 9.2 ± 1.6 mm and of the PM insertion sites were 9.4 ± 1.4 mm and 15.0 ± 2.7 mm. The average distances from the anterior and medial margin of the tibial plane to the AL center were 83.4 ± 3.4 % and 47.1 ± 1.9 % and for the PM center were 95.5 ± 1.9 % and 43.8 ± 2.2 %. A clear change in slope angle, more than 10 degrees, was observed between the AL and PM slopes in 16 out of the 21 knees (Fig 6). The average angle between the AL and PM slopes was 14.5 ± 6.4 degrees.

DISCUSSION:
The tibial insertion site of the PCL is very complex; however, their shapes and positions are consistent in such a way that the two bundles are located in different planes on the posterior intercondylar fossa. There is a change of slope between the tibial insertion sites of the AL and PM bundles. The data of this study contributes to the understanding of PCL osseous anatomy and should assist surgeons in performing PCL surgery in a more anatomic fashion.