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The Knee



The anterolateral ligament is a distinct ligamentous structure: A histological explanation

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ABSTRACT

Background: The aim was to determine whether the anterolateral ligament (ALL) had a histological structure that defined it as a real ligament.

Methods: Histological examination of 30 ALL samples taken from fresh-frozen knees were performed. The ALL femoral insertion and its relationship with the lateral collateral ligament (LCL) were studied and the tibial insertion and its relationship with articular cartilage of the tibial joint surface were analyzed. For the ligamentous part, its histological structure and its differences with the articular capsule were studied.

Results: This connective tissue is composed of a dense fibrous core constituted by a network of oriented collagenous fibers. The periphery of this dense connective center is made up of loose fibrocollagenous tissue with vascular structures and focal deposits of adipose tissue. This part was in contact but different to the joint capsule.

With a perpendicular orientation of the collagen fibers relative to the bone, a fibrocartilaginous zone with an unmineralized hyalinized aspect, a mineralization front, its bone insertions presented a typical ligamentous insertion.

With a cleavage plane between ALL and LCL femoral insertion, the ALL appeared to have a femoral insertion distinct from the LCL. ALL tibial insertion was less characteristic with less organized connective tissue and was at a distance from the articular cartilage.

Conclusion: From its bony insertion to its tissue composition and organization, the ALL has all the histological characteristics of a ligamentous structure. Our study confirms that ALL can be considered a real and distinct ligament.

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1. Introduction

Increasing knowledge about the anterior cruciate ligament (ACL) has led to the development of new, more anatomical reconstruction techniques, although many clinical studies have shown that even these do not solve the problem of anterolateral rotational instability (ALRI). The result has been a renewed interest in these anterolateral structures in the hope of resolving the ALRI issue.

In 1879, Paul Segond described a fibrous, pearlescent, resistant band passing through the lateral surface of the knee which tightened during forced internal rotation of the knee. The role of this fibrous structure was then discussed in the study by Hughston et al. on knee instability [1]. Then Seebacher et al. proposed an anatomical classification of this lateral plane into

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three successive layers [2]. A few years later, LaPrade et al. described an anterolateral fibrous structure called the “mid third lateral capsular ligament” and later “the lateral collateral ligament complex” [3]. Recent studies by Vincent and Claes have at last defined the concept of the anterolateral ligament (ALL) [4,5]. There appears to be a consensus regarding its tibial insertion midway between the head of the fibula and Gerdy's tubercle (GT) [6,7] but no agreement exists in the literature regarding its femoral insertion. Consequently, its relationship with the insertion point of the lateral collateral ligament (LCL) also remains unclear [8,9].

Nevertheless, it is still unclear whether the ALL can be classified as a ligament or whether it is just a simple thickening of capsular tissue. A few studies have focused on its true histological structure [4,10–13], but most of these studied only the ligament body and not the areas of bone insertion and, to the best of our knowledge, no study has ever looked at the histological relationship between the ALL and LCL at their femoral insertion point.

Our hypothesis was that the ALL has the histological characteristics of a ligament. To prove this, we analyzed all the histological elements that would characterize it as a ligament: a ligamentous structure differing from that of the anterolateral capsule, a typical bone–ligament interface and a femoral insertion distinct from that of the LCL.

The aim of this study was, through a complete histological description, to determine whether the ALL had a histological structure that defined it as a true ligament.

2. Material and methods

2.1. Sampling

The specimens for the ALL study were taken from 30 fresh-frozen cadaveric knees obtained from 15 subjects (seven women and eight men). The mean age was 69 ± 10 years (range 55–89) at the time of death and mean height was 172 ± 8 cm (range 157–187). The subjects showed no signs of degeneration and were thawed out to room temperature for 24 h. Subjects with a history of ACL tears or reconstruction surgery, major deformities or severe knee osteoarthritis were excluded. All knees with an important anterior tibial drawer and an explosive pivot-shift test were considered to have had an ACL tear and were therefore excluded. When there was doubt about the integrity of the ACL, an anteromedial arthroscopy was performed.

The protocol used was that developed during previous anatomical studies [14]. The ALL was removed from each knee together with the femoral and tibial bone blocks so that we could study its bone insertion (Figure 1). The LCL was also removed without detaching it from its femoral insertion to allow the histological relationship of the ALL and LCL on the femoral bone block to be studied. On the tibial bone block, the tibial insertion of the ALL and its relationship with the lateral tibial articular cartilage could also be analyzed. The joint capsule was also removed without detaching it from the ALL in order to be able to differentiate the two structures.

2.2. Sample preparation

The macroscopic examination and orientation of the samples were performed by the sampler (surgeon) and pathologists according to a standardized protocol. Samples were examined microscopically by two experienced pathologists. All the samples were fixed in 10% neutral buffered formalin. After fixation, the ALL bony insertion areas were decalcified (10% nitric acid). All of the samples were embedded in paraffin blocks, then six-micrometer sections were cut with a microtome and placed on

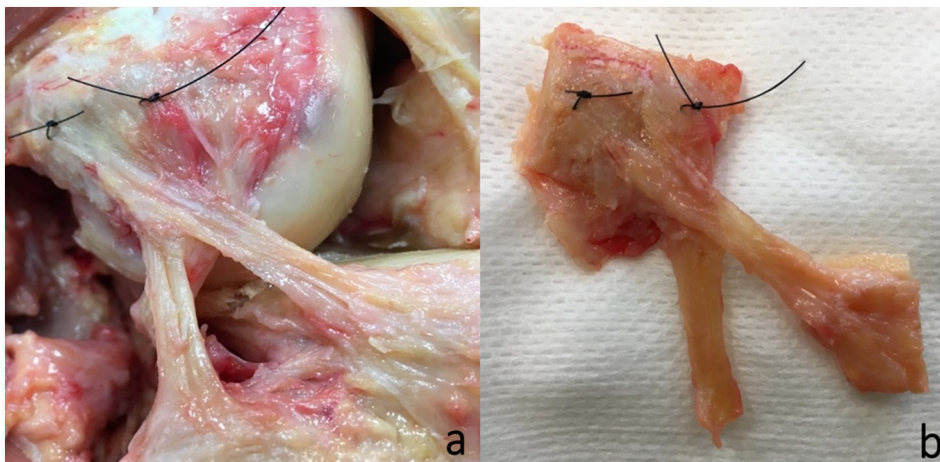


Figure 1. Sampling of anterolateral ligament (ALL) and lateral collateral ligament (LCL). (a) ALL and LCL dissection. (b) A sample with a femoral bone block carrying the ALL and LCL insertions and a tibial bone block carrying the ALL tibial insertion and lateral tibial articular cartilage.

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