F. D. Wadia · M. Pimple · S. M. Gajjar
A. D. Narvekar

An anatomic study of the popliteofibular ligament

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Abstract Our study was prompted by the varied reports in literature about the existence of the popliteofibular ligament as an integral part of the posterolateral corner of the knee. We performed 25 formalinised cadaveric knee dissections and identified the popliteofibular ligament. It was on an average 11.06 (5–16) mm in width and 11.8 (6–16) mm in length. Our study did not include a functional evaluation. We found the ligament to be a constant structure of the posterolateral knee complex, and recommend its repair in acute injuries as well as reconstruction in chronic injuries of the posterolateral corner of the knee.

Résumé Notre étude a été motivée par les rapports variés dans la littérature au sujet de l'existence du ligament poplitéo-fibulaire comme une partie intégrante du point d'angle postéro-externe du genou (PAPE). Nous avons exécuté vingt-cinq dissections de genoux cadavériques et avons identifié le ligament Poplitéo-Fibulaire dans tous les genoux. Il avait en moyenne une largeur de 11,06 mm (5–16) et un longueur de 11,8 mm (6–16). Notre étude n'a pas inclus d'évaluation fonctionnelle. Nous avons trouvé le ligament pour être une structure constante du PAPE du genou, et recommandons sa réparation dans les lésions fraîches aussi bien que dans les lésions chroniques de cette structure.

At the time of the study, all authors were attached to and working for K.B. Bhabha Hospital, Bandra, Mumbai, India. Dissections were performed in the anatomy department, K.E.M. Hospital, to which K.B. Bhabha hospital is affiliated.

F. D. Wadia · M. Pimple · S. M. Gajjar · A. D. Narvekar
Department of Orthopaedic Surgery,
K.B. Bhabha Hospital, Bandra (W), Mumbai 400050, India

F. D. Wadia (✉)
Sahakar, A3/23, 5th Road, Santacruz (East), Mumbai 400055, India
e-mail: farokh_w@yahoo.co.in
Tel.: +91-022-26129150

Introduction

The anatomy of the posterolateral corner of knee is complex and poorly understood; it was once considered the “dark side” of the knee [1]. The presence of the fibular attachment of the popliteus was mentioned by Higgins in 1894 and later by Taylor and Bonney [8], but then it was largely ignored. Scant reports have appeared in literature regarding the existence of the popliteofibular ligament since then.

A hunt through the standard anatomy textbooks, including Gray's Anatomy, revealed that not even a mention is made of the popliteofibular ligament where paragraphs have been written about the lateral collateral ligament, the arcuate ligament, and the popliteus.

This is underscored by the varying nomenclature applied to the popliteofibular ligament, which has been called the short external lateral ligament [6], the popliteofibular fascicles [9], the fibular origin of the popliteus [2], the popliteofibular fibres [2], and the popliteus muscle with origin from the fibular head [10].

Although the ligament has been recently re-discovered and re-described [2, 7, 8, 9, 10], we decided to carry out cadaver dissections to identify the precise anatomy of this ligament, justify its nomenclature, and speculate its function.

Materials and methods

Twenty-five formalin-preserved cadaveric knees were chosen for our study. Only one knee was chosen in each cadaver. A standard posterolateral approach was taken initially, but later the entire skin was dissected out for better exposure of the area. The common peroneal nerve was isolated. The interval between the biceps femoris and posterior border of intertendinous band was exposed and, if required, the band as well as the insertion area of the biceps was detached.

The lateral collateral ligament was then identified as a thick rounded tendon-like structure extending from the lateral epicondyle to the fibular styloid process (Fig. 1). The presence of the fabella was next noted in the lateral head of the gastrocnemius, and the width of the fabellofibular ligament was measured in those

Fig. 1 Lateral view of the dissected knee shows the lateral collateral ligament (*LCL*) in relation to the lateral head of the gastrocnemius muscle

Fig. 2 Posterior view of the knee showing the popliteus muscle (*Pm*) after reflecting the lateral head of the gastrocnemius medially

Fig. 3 Posterior view of the knee showing the popliteofibular ligament (*Pf*). On top is shown the insertion of the biceps femoris (*Bf*) detached from the fibula

Fig. 4 Posterolateral view of the knee showing the oblique orientation of the popliteofibular ligament (*Pf*) in contrast to the lateral collateral ligament (*LCL*)

knees in which it was present. The lateral head of gastrocnemius was then detached.

The popliteus muscle belly was identified (Fig. 2). Its inferior border was traced upwards until we identified a thick, prominent, flattened, band-like ligamentous structure extending from the musculotendinous junction up to the head of the fibula posterior to the lateral collateral ligament (Fig. 3). This, indeed, should be called the popliteofibular ligament, as it was a flattened, shiny ligament-like structure extending from these two anatomically defined areas. A thin, flimsy elastic band type of structure extended up to the lateral aspect of the tibia from the popliteus, which was the popliteotibial ligament.

The popliteus muscle also had insertions into the posterior capsule, the posterior horn of the lateral meniscus, and formed the ascending limb of the arcuate ligament. The fibres of the arcuate ligament were clearly distinguished from those of the popliteofibular ligament by their different orientation. The relationship of the common peroneal nerve to the deeper popliteofibular ligament was identified. This relationship was important in safeguarding the nerve during the lateral hockey-stick approach to the posterolateral structures.

Results

The popliteofibular ligament was present in all 25 knee specimens. It was thick, flattened, and fan shaped in almost all the knees and thick tendon-like structure in one knee. Orientation of this ligament was oblique proximally and vertical in its distal half. The angle made by the ligament averaged 60° with the popliteus muscle. This particular orientation was in contrast to the other ligaments in the vicinity, which had an almost vertical orientation (Fig. 4). This feature needs further dynamic evaluation to document the function of the popliteofibular ligament, which at this point can be speculated to have a posterior translational resistive function in addition to providing a posterolateral rotatory stabilising function [8].

The popliteofibular ligament was as wide as or even wider than the popliteus tendon. The width of various

Table 1 Measurements of the various ligaments at the posterolateral corner of the knee

Ligament	Present in	Average width (mm)	Range (mm)
Popliteofibular ligament	All knees	11.06	6–16
Popliteus tendon	All knees	10.05	6–13.5
Lateral collateral ligament	All knees	5.33	3–7
Fabellofibular ligament	21 knees	5.00	3–10.5

ligaments at the posterolateral corner of the knee as measured by a scale calibrated to an accuracy of 0.5 mm is shown in Table 1.

Discussion

The complex anatomy of the posterolateral corner of the knee is due largely to the evolutionary changes in the anatomic relationships among the fibular head, the popliteus, and the biceps femoris muscle. In early human embryo, both the tibia and the fibula articulate with the femur [4, 5]. As the knee evolves, the fibula and the attached lateral portion of the joint capsule move distally to form a new capsular layer between the distal part of the femur and the proximal popliteus muscle. In early evolution, when the fibula articulated with the femur, the popliteus tendon inserted on the fibular head. With subsequent downward migration of the fibula, the popliteus tendon acquired a femoral attachment while retaining its original fibular insertion. There also was an evolutionary change in the location of biceps tendon attachment from the lateral aspect of the capsule and the proximal tibia to the fibula [2, 4, 5]. The evolution of this region of the knee permits those modifications in the function of the knee necessary for the assumption of bipedal posture.

A recent literature review identified the popliteofibular ligament in all knees in the study by Shahane et al. [8] and in 98% of knees in the study by Sudasna et al. [2]. In a study of 115 cadaver knees, Watanabe et al. [10]

identified seven anatomic variants by including the presence or absence of what they termed the popliteus muscle with origin from the fibular head. They identified the “popliteofibular ligament” in 94% of knees.

In conclusion, we find the popliteofibular ligament to be a constant part of the posterolateral corner of the knee. A detailed biomechanical study needs to be undertaken to evaluate the function of this ligament. However, at this stage, we recommend that due respect be given to this ligament in acute and chronic injuries of the posterolateral corner of the knee.

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