Ligamentum Capitis Femoris ve Arterleri

The Ligament of Head of Femur and Its Arteries

Ligamentum Capitis Femoris / The Ligament of Head of Femur

Yalçın Kırıcı[1], Cenk Kılıç[1],Emin Öztaş[2]
[1]Departments of Anatomy, Gülhane Military Medical Academy, Ankara, Turkey.
[2]Histology-Embryology, Gulhane Military Medical Academy, Ankara, Turkey.

Özet

Amaç

Klinisyenler için ligamentum capitis femoris boyunca seyreden ve femur başını besleyen arter, aseptik avasküler nekroz hastalığından korunmada önemlidir. Bu çalışmanın amacı, arter'in seyrini, sayısını, ve ligament'in anatomik ve histolojik yapılarını araştırmaktı.

Gereç ve Yöntemler

Çalışma, 13 kadavradan alınan 26 ligament üzerinde uygulandı (8 erkek, 5 kadın). Ligament'in şekli ve uzunluğu incelendi. Sonra, ışık mikroskobu altında araştıtıldı.

Bulgular

Tüm vakalarda ligament mevcuttu. Çalışma yaşlı kadavralarda uygulanmış olmasına rağmen, tüm ligament'ler yoğun kollajen lifler ve bir kaç arter içeriyordu. Bu arterler kalındı. Histolojik incelemede tüm ligament'lerin dış yüzleri yoğun kollajen lifler ve sinoviyal içeriyordu.

Sonuç

Arterler ligament'in içerisinde seyretmiyordu. Üstelik, arterler ligament'in üst ve ön bölgesinde seyrediyorlardı. Bu nedenle, addüksiyon hareketinde ligament'in hasar görmeyeceğini ve kan akımının kesilmeyeceğini düşünmekteyiz.

Anahtar Kelimeler

Femur Başı, Ligamentum Capitis Femoris, Foveolar Arter.

Abstract

Aim

The artery supply to head of femur and running along with the ligament of head of femur (ligamentum capitis femoris) is important for the clinician in preventing aseptic avascular necrosis disease. The purpose of this study was to investigate the course and number of the artery and the anatomic and histologic structures of the ligament.

Material and Methods

The study was conducted on 26 ligaments of head of femur taken from 13 cadavers (8 males, 5 females). Shape and length of the ligament were examined. Then, it was investigated under light microscope.

Results

The ligament was found in all cases. Although, the study was conducted on elderly cadavers, all ligaments included dense collagen fibers and several arteries. These arteries were thick. On histological evaluation, outer surfaces of all ligaments were included dense collagen fibers and synovial membrane.

Conclusion

The arteries did not run into the ligament. Furthermore, they ran into superoanterior region of the ligament. Thus, we thought that the ligament was not injured at the adduction movement and blood stream was not interrupted.

Keywords

Head of Femur, Ligamentum Capitis Femoris, Foveolar Artery.

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Corresponding author: Cenk Kılıç, Gulhane Military Medical Academy Faculty of Medicine, Department of Anatomy, 06018, Ankara, Turkey. **Phone:** +90 312 304 35 08 **Fax:** +90 312 381 06 02 **E-mail:** ckilicmd@yahoo.com

Introduction

Acetabular branch of the obturator artery supplies to head of femur. This artery running along with the ligamentum capitis femoris is important for the clinician. Thus, we aimed to investigate the course and number of the artery. In addition, the anatomic and histologic structures of the ligament were characterized.

The ligamentum capitis femoris is an intracapsular ligament approximately 3.5 cm long. It is weak and appears to be of little importance in strengthening the hip joint [1]. It is a triangular flat band and its apex is attached in the pit on head of femur. Its base is principally attached on both sides of the acetabular notch, and blenders with the transverse ligament [2].

It varies in strength; occasionally its synovial sheath alone exists, without a core, rarely both ligament and sheath are absent [2]. The contribution coming from the artery of the ligamentum capitis femoris may be negligible or absent in some cases [3]. The ligamentum capitis femoris is located inside of the hip joint and is surrounded by a sleeve of synovial membrane [1].

Even though Catterall [4] reported that the arteries running along with the ligament supplied head of femur at preadolescent stage, Trueta and Harrison [3] demonstrated that epiphyseal and metaphyseal circulations were present in advanced years. Epiphysial and metaphysial arteries supply to head of femur. The epiphysis and the metaphysis usually receive blood from separate sources. The lateral epiphysial and both groups of metaphysial arteries usually arise from the medial femoral circumflex artery; the medial epiphysial artery is a continuation of the artery within the ligamentum capitis femoris which comes from the acetabular branch of the obturator artery [3].

According to Trueta [5] the foveolar artery (in the blood supply of head of femur) does not penetrate head of femur until the age of eight or nine.

The blood supply to the capital femoral epiphysis is interrupted. Bone infarction occurs, especially in the subchondral cortical bone, while articular cartilage continues to grow. Articular cartilage grows because its nutrients come from the synovial fluid [6].

The subsynovial layer consists of dense connective tissue containing numerous large cells. The major central portion of the ligament is formed by dense regular connective tissue. The blood vessels of the ligament are always surrounded by a layer of loose connective tissue. Adipose tissue firstly starts to spread in the postnatal period mainly occurring around the vessels. In the newborn child dense connective tissue is most abundant within the ligamentum capitis femoris. Thus it is considered to be especially strong. The artery of ligamentum capitis femoris is already present in 9 week-old fetuses. In 13 week-old fetuses, branches of the artery enter head of femur through cartilaginous channels and continuously maintain within head of femur during further development. With the growing age of the fetuses the number of branches of the artery increases. Anastomoses between the cartilaginous channels of this artery and the medial and lateral circumflexal femoral artery can be found neither prenatally nor postnatally [6].

Material and Methods

The ligamentum capitis femoris was studied in 13 subjects (8 males and 5 females) in Department of Anatomy, Faculty of Medicine, Gulhane Military Medical Academy, aged from 64 to 83 years by macroscopic and microscopic methods over a two-year period. Permission for cadavers had been obtained from the local ethics committee of Ankara Maternity and Health Academic and Research Hospital (Ref. No:5/16.10.03). Teratologic and secondary hip dislocations (4 subjects) were not included in this study. All muscles covering hip joints in all lower extremities were dissected. The ligaments, fatty tissue filling acetabular notch and acetabular fossa, and synovial membrane covering fatty tissue were removed. Then, the length of the ligamentum capitis femoris was measured in each specimen using a 0.1 mm sensitive caliper and the shape of the ligament was noted. The arterioles were examined under a stereomicroscope (Stemi 2000; Carl Zeiss, Jena, Germany). Their anatomic peculiarities were described, photographed and illustrated.

After photographical documentation, ligaments were removed and immediately immersed in a buffered 10% formalin solution. Each ligament from all cadavers was cut into 4 pieces. Four specimens were embedded in paraffin blocks. Tissues were then sectioned at 5 micron and stained with hematoxylin-eosin (H&E) and Masson's trichrome stain to assess the light microscopic structure. Vessels and fiber structures were evaluated by their morphologic appearance. Histologic studies showed differences in the amount of organized collagen and components of subsynovial tissue.

Results

The ligament was shown to be variable in length, diameter and shape. We measured that length of the ligament was 1.5-3.5 cm (mean 2.55 cm). We found that

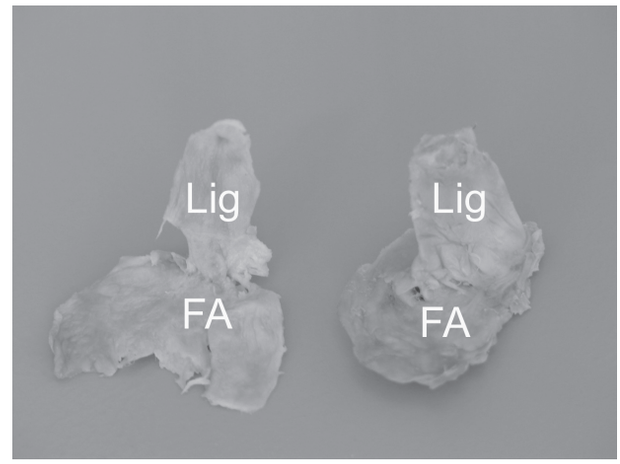


Figure1. Photograph taken from sideways of the ligamentum capitis femoris removed in the hip joint. Ligamentum capitis femoris (Lig) and adipose tissue filled up to the acetabular fossa (FA).

this length was 3.5 cm in only one case and the length was 1.5 cm another case. The length of the ligamentum capitis femoris was mostly 2.5-3.0 cm. We found that the twenty ligaments were thick. Shapes of 17 of the 26 ligaments (65.4%) were rectangular and shapes of remaining 9 ligaments (34.6%) were triangular. Shape of the ligament was different between left and right sides in three cadavers (Figure 1).

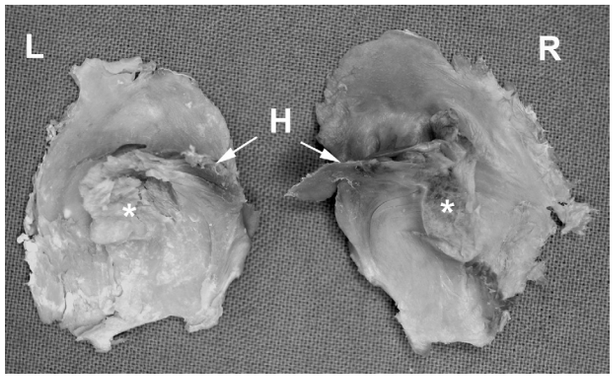


Figure 2. Photograph taken from upper side of the ligamentum capitis femoris removed in the hip joint. Left (L); rigth (R); hilum (H) and ligamentum capitis femoris (*).

There was not any variation in this ligament related to its attachment point. The ligament and synovial sheath were present in all cadavers on each side. We showed that

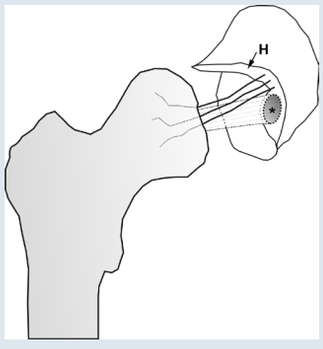


Figure 3. Schematic illustration of the artery accompanying the ligamentum capitis femoris in the hip joint. Hilum (H) and ligamentum capitis femoris (*).

the vessels ran in hilar region (superoanterior) (Figure 2). Connective tissue of collagen fibers of the ligament was separated to septums.

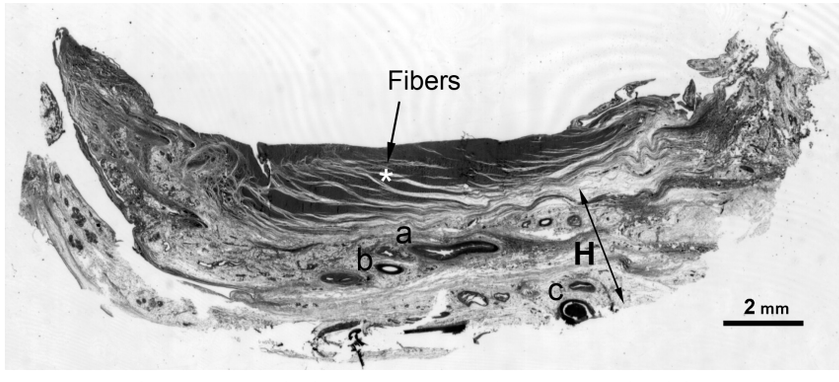


Figure 4. Histologic image of the ligamentum capitis femoris stained with hematoxylin-eosin (H&E). Scale bar: 2 mm. Hilum (H), artery (a), arteriol (b), capillary artery (C) and dense collagen fibers (*).

Number of vessels was 3-4 semi-quantitatively. Vessels did not run into the ligament. Arterioles located in the superior and inferior region of the ligament ran under the synovial membrane (Figure 3).

Vessels forming capillaries ran in septums between collagen fibers of the ligament (Figure 4). High amount of fatty tissue and several arteries and arterioles were present in acetabular fossa and acetabular notch.

Discussion

This study contributed to the knowledge regarding dense collagen fibers of the ligament, existence of synovial membrane covering it, its shape and artery running along with it.

The ligament was present in both sides of all cadavers. Rarely both ligament and sheath were absent [2]. Tan and Wong [7] reported that ligamentum capitis femoris was absent in 4 of the cadavers. In 3 of them, the ligament was absent unilaterally.

It was reported that length of this ligament was about 3.5 cm [1]. We found that this length was to be mean 2.5-3.0 cm with only one exceptional case of 3.5 cm.

Although it was reported that shape of this ligament was triangular [2]. We found that rate of rectangular shape was 65.4%. Shape of the ligament was different between left and right sides in three cadavers.

It was reported that this ligament appears to be of limited value in strengthening the hip joint [1]. Fritsch and Hegeman [6] reported that this ligament included plenty and dense collagen fibers. Tan and Wong [7] found that the ligament was strong in 26 of the 36 cadavers, weak in 9 and was torn in one. In our study, all ligaments included dense collagen fibers suggesting that all ligaments observed were strong.

Synovial membrane covering this ligament was present in all cadavers. It varies in strength; occasionally its synovial sheath alone exists, without a core, rarely both ligament and sheath are absent [2].

Tan and Wong [7] suggested that although the ligament transmits an artery to head of femur in the young, it does not appear to have any important mechanismed function in maintaining the stability of the hip joint. Arteries and arterioles ran between synovial membrane and the ligament, rather they ran into the ligament.Whereas Crelin [8] found the ligamentum capitis femoris to be very important in stabilizing the hip joint in fetuses and neonates. This ligament must play a role in fetal and neonatal hip joint stability [1].

The artery to head of femur is a branch of the posterior division of the obturator artery [1]. Chung [10] saw the artery of the ligamentum capitis femoris in 113 of 123 specimens, and there was no artery in 10 specimens (78 specimens the

artery only in the ligament, 20 specimens provided 1 deep vessel to the center of the head, 15 specimens 2 or more vessels to center of the head). We found that 3-4 arteries and arterioles underlying synovial membrane were present in all cadavers. One hundred and thirty-four stillborn specimens were arterially injected with latex and dissected to determine the origin of the foveolar artery. The obturator artery supplied this branch in 54.5% and the medial femoral circumflex artery in 14.9%. Separate foveolar branches arose from both these vessels in 6.7%, while in the remaining 23.9% an anastomotic connection between the obturator and medial femoral circumflex gave origin to the foveolar artery [11]. Arteries supplied head of femur are sourced from different arteries, and its anastomosis is important in preventing aseptic avascular necrosis disease.

Fritsch and Hegeman [1] reported that vessels of the ligament are surrounded to loose collagen fibers, which is in conformity with our study.

Although Trueta [5] reported that this ligament was not penetrated to head of femur until 8-9 year, Fritsch and Hegeman [6] reported that artery of this ligament was present at ninth week and this artery ran into head of femur at thirteenth week. We found that plenty arteries and arterioles running along with the ligament were present and these arteries ran into head of femur. It was reported that number of arteries running into the ligament is increased while fetus growth [6] and the artery was present at elderly ages [3].

There is a temporary interruption in the blood supply to the epiphyseal, physeal, and sometimes metaphyseal portion of the femur of the hip joint [4].

In venograms obtained in the early stage, Iwasaki [12] found several abnormalities in the morphology and course of the vein. It appeared that the blood vessels within the ligamentum capitis femoris play a compensatory role in reestablishing blood flow to the head. In order to examine the significance of the blood flow through the ligamentum capitis femoris in Perthes' disease, intraosseous venography was performed on 81 hips [12]. Atsumi et al. [13] concluded that normal vascular anatomy of the artery of the ligamentum capitis femoris was not related to the onset of Perthes' disease.

Fractures of the femoral neck close to the head often disturb the blood supply to the head. In some cases the blood supplied via the artery in the ligament of the head may be the only blood received by the proximal fragment of the head.

We found that the ligament and synovial membrane covering it were present in all cases. The arteries and arterioles running along with the ligament were present in between synovial membrane and the ligament. Arteries did not run into the ligament, further they ran into superoanterior region of the ligament. Thus, we thought that the ligament was not injured at the adduction movement and blood stream was not interrupted. Fractures of the femoral neck rapidly undergo aseptic avascular necrosis. Therefore, the patients should be operated at most within 12 hours. The arteries supplying head of femur is present and is functional even at elderly ages. We maintain that this condition prevents from aseptic avascular necrosis. The structure of the ligament and courses of arteries supplying head of femur are important. For this reason resources and courses of these arteries should be identified by arteriography priorty, and the patient should be informed about this condition. We think that additional studies are necessary in order to understand the blood supply to the head in the hip joint. The results confirmed the crucial role of radiography in the clinical evaluation.

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