

# MR Imaging of the Coronary Ligaments of the Knee Joint : Cadaveric and Clinical Study<sup>1</sup>

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**Purpose :** Our objective was to identify a coronary ligament of the knee joint on MR images.

**Materials and Methods :** We retrospectively evaluated 50 MR knee studies. Using MR imaging, the thickness and length of the anteroinferior portion of the capsule were measured and compared at the medial and lateral compartments. We also carefully dissected 5 fixed cadaveric knees and took photographs.

**Results :** The thickened synovial membrane (coronary ligament) of the anterior horn of the lateral meniscus appeared as a band of low signal intensity on MR images. On anatomic dissection of the knee joints, the inferior synovial attachment of the lateral meniscus was more redundant than the medial side.

**Conclusion :** Anatomic correlation revealed that the coronary ligament contributed to the band-like structure at the anteroinferior aspect of the lateral meniscus.

**Index Words :** Knee, MR

Knee, ligaments, menisci, and cartilage

## INTRODUCTION

The thick, convex border of each meniscus is connected to the deep surface of the fibrous capsule; the capsular fibers attaching the menisci to the condyles of the tibia constitute the medial and lateral coronary ligaments. The capsular attachments of the menisci are, however, different on each side. Prominent inferior lateral recesses are commonly seen on arthrographic studies(1). However there has been no report on the synovial membrane using MR imaging. A thorough knowledge of the normal anatomy of the synovial recesses is essential in order to interpret abnormalities of the knee.

The purpose of this study is to describe the nature of a band-like structure at the anteroinferior aspect of the lateral meniscus of the knee.

## MATERIALS and METHODS

Fifty MR knee studies were retrospectively evaluated including 10 cases with distended synovial recesses by effusion. Special attention was paid to the inferior recess of both menisci. Patient age ranged from 17 to 53 years (mean : 33.5 years) ; there were 37 men and 13 women.

Using MR, the thickness and the length of the anteroinferior portion of the capsule were measured, and medial and lateral compartments were compared. In the lateral compartments, it was possible to measure the length and thickness for all 50 cases. In the medial compartment, it was only possible to measure the length in the ten cases with distended capsules by joint effusion. Length of the capsule was measured from the anteroinferior border of both menisci to the tibial attachment at the mid-sagittal images of the menisci. Thickness of the capsular attachment of the lateral meniscus was measured at the thickest portion on mid-sagittal images of the menisci(Fig 1). For each length and thickness, the mean, the standard deviation, and the standard error were computed and compared.

We also carefully dissected 5 fixed cadaveric knees and took photographs. MR imaging was not performed

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on the cadaveric specimens.

The MR images were produced with a 1.5T unit (200 FX II, Toshiba, Nasu). Sagittal and coronal sections with proton density and T2-weighted images (repetition time[TR] msec/echo time[TE] msec = 1,800/30, 70) were used as the basis of our analysis. Field of view 15 cm, 5-mm-thick sections, one excitation, 256 × 192 data acquisition matrix and an extremity coil were used. All patients were examined in supine position with the leg in 10° flexion.

## RESULTS

The anterior component of the inferior lateral recess was easily recognizable and was measurable in all cases. On sagittal MR images, the anteroinferior capsular attachment of the lateral meniscus appeared as a band of low signal intensity (Fig. 1). In 50 patients, its length on MR images ranged from 7 to 13 mm (mean : 9.7 mm, standard deviation : 1.8, standard error : 0.3). Its thickness ranged from 1 to 3 mm (mean : 2.0 mm, standard deviation : 0.9, standard error : 0.2). Distension (10 cases) of the anterior component of the inferior lateral recess by effusion was seen as a cyst-like structure (Fig. 2).

Measurement of the anterior component on the medial side was only possible in a distended position because of effusion (Fig. 3). Length on MR images ranged from 2 to 3 mm (mean : 2.0 mm, standard deviation : 0.7,

standard error : 0.2). Measurement of the thickness was not possible due to its inadequate margin caused by proximity to adjacent structures.

On anatomic dissections, the anteroinferior capsular attachments of the lateral meniscus were more redundant than on the medial side (Fig. 4).

## DISCUSSION

The capsule of the knee is a complex structure which is outside of and parallel to the synovial membrane for most of its course. However, anteriorly its margin lies external to the synovium, with the extensor mechanism serving as its anterior margin (2).

The contour of the lateral meniscus is most accurately described as a large segment of a small circle. Its anterior horn is attached to the tibia immediately in front of the tibial spines. This, in effect, produces a strong point of central attachment with relatively weak peripheral posterior synovial anchors (3). The anterior horn of the medial meniscus is attached to the non-articulating area of the tibia in front of the anterior horn of the lateral meniscus (4). But the anterior attachment of the synovial membrane of the tibial condyles is similar on both sides. These differences make the antero-inferior synovial membrane of the lateral side more prominent. The lateral tibial surface is slightly concave and triangular in cross section, changing only slightly in size from the anterior to the posterior horn. A large

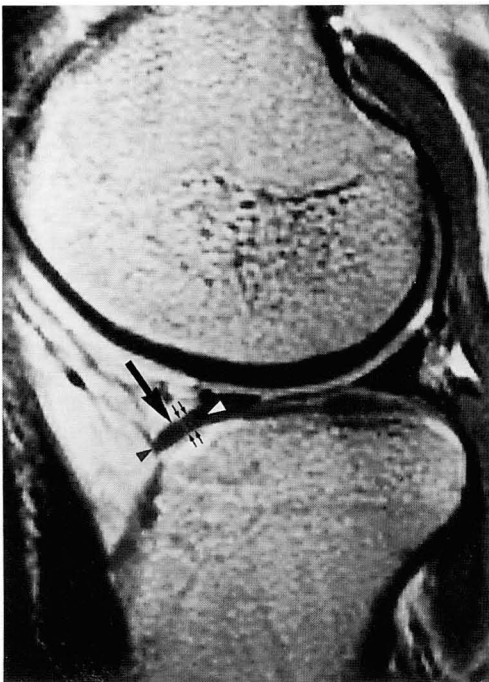


Fig. 1. The anterior component of inferior lateral recess shows a band-like structure (large arrow) at the anteroinferior border of the lateral meniscus. Arrowheads show a length of the coronary ligament, and a thickness by arrowheads.



Fig. 2. Distension of the recess by effusion shows a cyst-like structure.

narrow recess is frequently present at the undersurface of its anterior horn and mid-portion(5).

Using MR imaging, it is possible to observe not only the synovial recess but also the contour of the synovial membrane which wraps around it. The synovial membrane of the inferior lateral recess is enforced by the fibrous structure with the same histologic finding as the joint capsule.

As demonstrated here, the anterior component of the inferior lateral recess is most prominent. The redundant and thickened synovial membrane(coronary liga-

ment) forms a band-like structure at the anteroinferior aspect of the lateral meniscus on sagittal images. The distended synovial membrane with effusion is responsible for a cyst-like structure at the anteroinferior aspect of the lateral meniscus. On sagittal image, the distended synovial recess and extended coronary ligament by effusion mimics cystic lesions, such as a meniscal cyst or ganglion cyst. However, evaluation of the adjacent images shows the nature of the distended synovial recess.

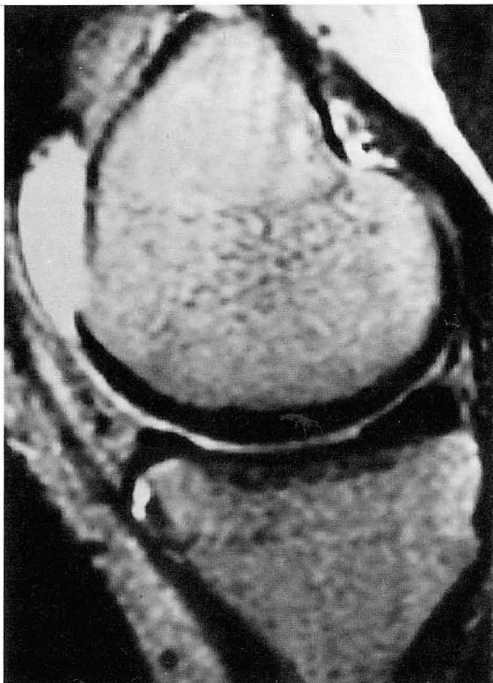
The lateral meniscus is the more mobile and has a range of movement as great as 1 cm. This mobility is explained by the presence of a large anterior meniscosynovial recess on the lateral side of the knee and the fact that the lateral meniscus is intrinsically more loosely attached to the tibia. The medial meniscus is much more firmly anchored than the lateral meniscus due to its attachment to the capsule and hence to the tibial collateral ligament. The lateral meniscus is attached only to the weak fibers representing the fibrous capsule on the lateral side of the joint and not at all to the fibular collateral ligament. Moreover, where the lateral meniscus is crossed by the popliteus tendon, the peripheral edge of the meniscus is not attached to the fibrous capsule(6, 7, 8).

The anterior component of the inferior medial recess and both posterior components are less prominent; they are only distinguishable in a position of marked distension of the joint capsule.

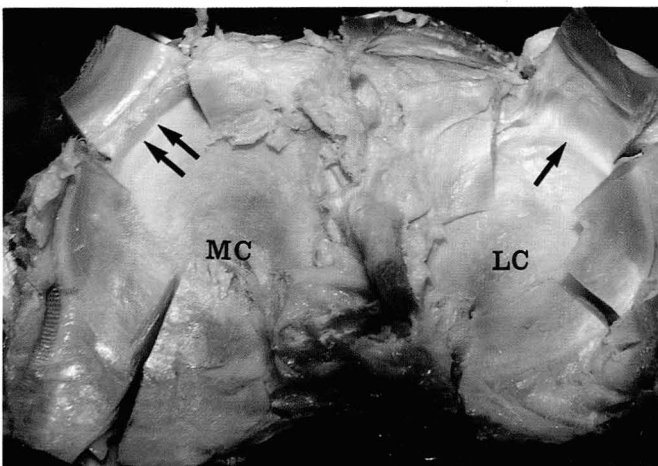
In summary, anatomic and MR correlation of the coronal ligament revealed that the ligament contributed to the band-like structure at the anteroinferior aspect of the lateral meniscus.

#### Acknowledgement

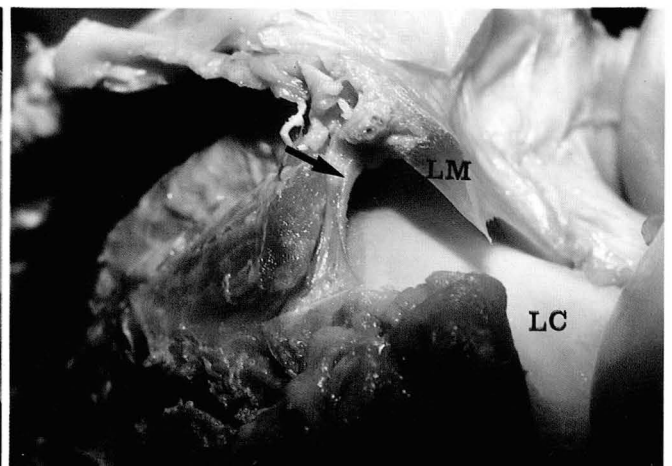
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**Fig. 3.** The anterior component of the inferior lateral recess shows a scanty fluid collection.



a



b

**Fig. 4.** a. On the cadaveric study, the medial and lateral menisci are lifted. The length of the lateral capsule(arrow) is more prominent than the medial side(arrows). LC : the lateral condyle of the tibia, MC : the medial condyle of the tibia.

b. Sagittal view of cut section of the lateral meniscus shows thick(arrow) and redundant joint capsule. LM : the lateral meniscus.

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## 슬관절 관상인대의 자기공명 영상:사체 및 임상연구<sup>1</sup>

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**목 적 :** 본 연구의 목적은 슬관절에 있는 전방 관상인대의 자기공명영상 소견을 분석하는데 있다.

**대상 및 방법 :** 슬관절의 자기공명영상을 시행하고 관상인대가 정상인 환자 50명을 대상으로 반월상 연골 중간을 지나는 시상영상에서 내, 외측의 전방 관상인대의 두께와 길이를 측정하여 비교하고 5구의 사체를 해부하여 이를 확인하였다.

**결 과 :** 반월상연골의 전방에 위치한 관상인대는 자기공명영상에서 저신호강도의 띠로 관찰되었으며 외측은 평균 9.7 mm, 내측은 2mm의 길이를 보였다. 내측의 경우 관절낭액이 없는 경우 관찰이 불가능하였으며 여분이 많은 외측은 관절낭액에 의해 쉽게 팽윤되었다. 사체 해부상 외측 반월상연골 전방의 활액막 및 관상인대가 내측보다 여분이 많았다.

**결 론 :** 슬관절의 관상인대는 여분이 많은 외측 반월상연골의 전방에서 저신호강도의 띠모양으로 관찰된다.