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Yamamoto, M

Hirohata, K

(Citation)
The Kobe journal of the medical sciences,37(4-5):209-226

(Issue Date)
1991

(Resource Type)
departmental bulletin paper

(Version)
Version of Record

(URL)
https://hdl.handle.net/20.500.14094/E0034252

Kobe J. Med. Sci. 37, 209/226, October 1991

ANATOMICAL STUDY ON THE MENISCO-FEMORAL LIGAMENTS OF THE KNEE

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INDEXING WORDS

Wrisberg's ligament ; Humphrey's ligament ; menisco-femoral ligament ; lateral meniscus ; knee joint

SYNOPSIS

The menisco-femoral ligaments are important accessory ligaments of the knee. They extend from the posterior horn of the lateral meniscus to the lateral aspect of the medial femoral condyle close to the femoral attachment of the posterior cruciate ligament.

Most of the authors reported that in some cases these ligaments are absent. But in the 100 knees that we carefully examined, obvious menisco-femoral ligaments were identified in all of the specimens.

When the anatomical relationship between the menisco-femoral ligaments and the lateral meniscus is considered, it can be easily speculated that the menisco-femoral ligaments draw the posterior horn of the lateral meniscus in anterior, medial and superior direction during flexion of the knee joint. Thus, the congruency between the lateral meniscus and femoral condyle and the stability of the knee joint increase.

Received for publication : August 21, 1991

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INTRODUCTION

When the posterior horn of the lateral meniscus is explored, in addition to fibers of the posterior cruciate ligament (PCL) which insert into the tibia, fibers which exist along the anterior or posterior surface of the PCL are also encountered. These fibers are known as the menisco-femoral ligaments and are important accessory ligaments of the knee joint. The group of the fibers running along the anterior surface of the PCL is called the anterior menisco-femoral ligament (AMFL; also known as Humphrey's ligament), and the one passing along the posterior surface is called the posterior menisco-femoral ligament (PMFL; also known as Wrisberg's ligament). Only a few reports with regard to these ligaments could be found in the previous reports and their morphology and function were not well analysed.

In this report we had examined 100 human cadaveric knee joints and discuss the incidence of the menisco-femoral ligaments, their morphology and importance of their function.

MATERIALS AND METHODS

We dissected 100 human cadaveric knees which were used in the student anatomy laboratory of the University of Cologne, Germany.

There were 48 male specimens and 52 female specimens. The average age was 73 years old ranging from 36 to 93.

The femoral side of the specimen was severed at the transepicondylar level and the tibial side immediately above the tibial tuberosity. All the soft tissues except the cruciate ligaments and menisci were removed and the distal femur was cut sagittally at the intercondylar notch. This technique permitted easy observation of the ligaments and their insertion sites.

In 5 knees, the insertions of PMFL, AMFL and PCL were marked with the radiopaque metals and lateral radiographs were taken to observe their relationship to the tibia. Radiographs were taken with the knee joints flexed at 30, 60, 90 and 120 degrees.

RESULTS

Knee joints were classified into 4 categories based on the presence or absence of the menisco-femoral ligaments.

Type I : Both AMFL and PMFL were present. Type II : Only AMFL was present. Type III : Only PMFL was present. Type IV : Both AMFL and PMFL were absent.

In the 100 knees examined, the incidence of the different types was as follows: Type I, 49 knees (49%); Type II, 27 knees (27%); Type III, 24 knees (24%); and Type IV, 0 knee (0%); thus, at least either the AMFL or PMFL was found in every knee. Typical examples of each type are shown in Figs. 1, 2 and 3.

As to the morphological assessment of the menisco-femoral ligaments, the PMFL was slightly longer and thicker than the AMFL (Table 1).

The sites of insertion of the menisco-femoral ligaments into the lateral aspect of the medial femoral condyle were also studied. We found that the AMFL inserted between the inferior margin of the proximal attachment of the PCL and the edge of the condylar cartilage. This is slightly posterior to the center of the insertion of the PCL. The PMFL, on the other hand, inserted more posteriorly than the AMFL at the superior margin of the insertion of the PCL (Fig. 4).

Table 1. The characteristics of the menisco-femoral ligaments

	Length	Thickness	Width
Ant. menisco-femoral lig.	28.30 (20.0-37.0)	1.72 (0.5-3.0)	4.47 (1.0-7.5)
Post. menisco-femoral lig.	31.24 (27.0-40.0)	2.21 (1.0-3.5)	3.84 (2.0-7.0)

(mm)

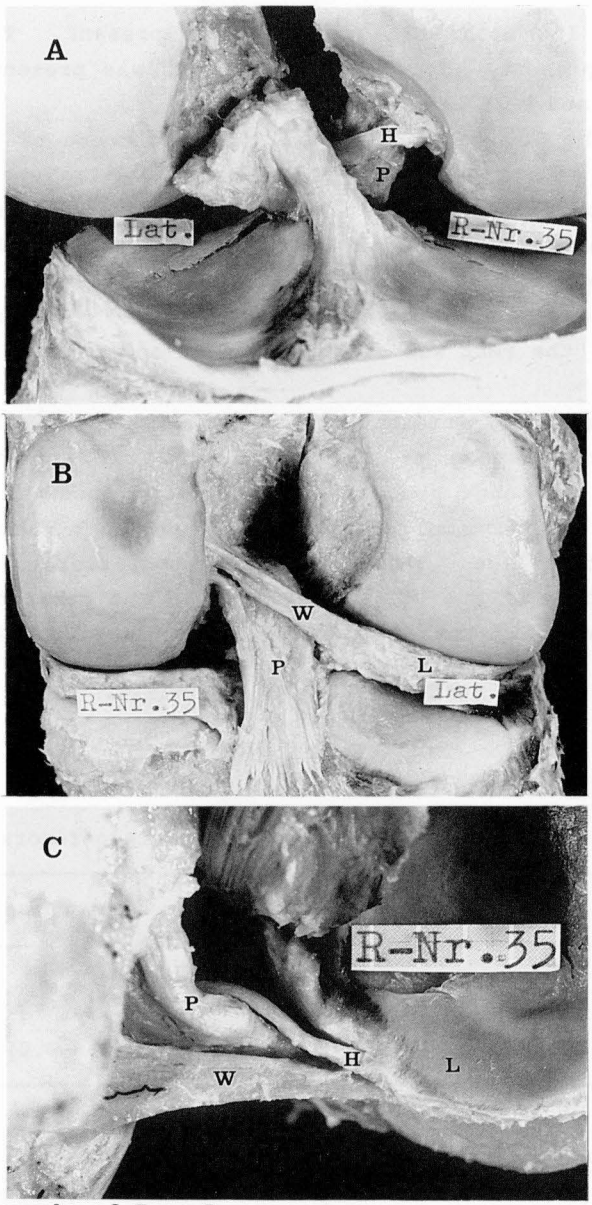

Fig. 1. An example of Type I

A. anterior view B. posterior view C. visualization of both anterior and posterior menisco-femoral ligaments from the top

H : Anterior menisco-femoral ligament (Humphrey's ligament)

W : Posterior menisco-femoral ligament (Wrisberg's ligament)

P : Posterior cruciate ligament

L : Lateral meniscus

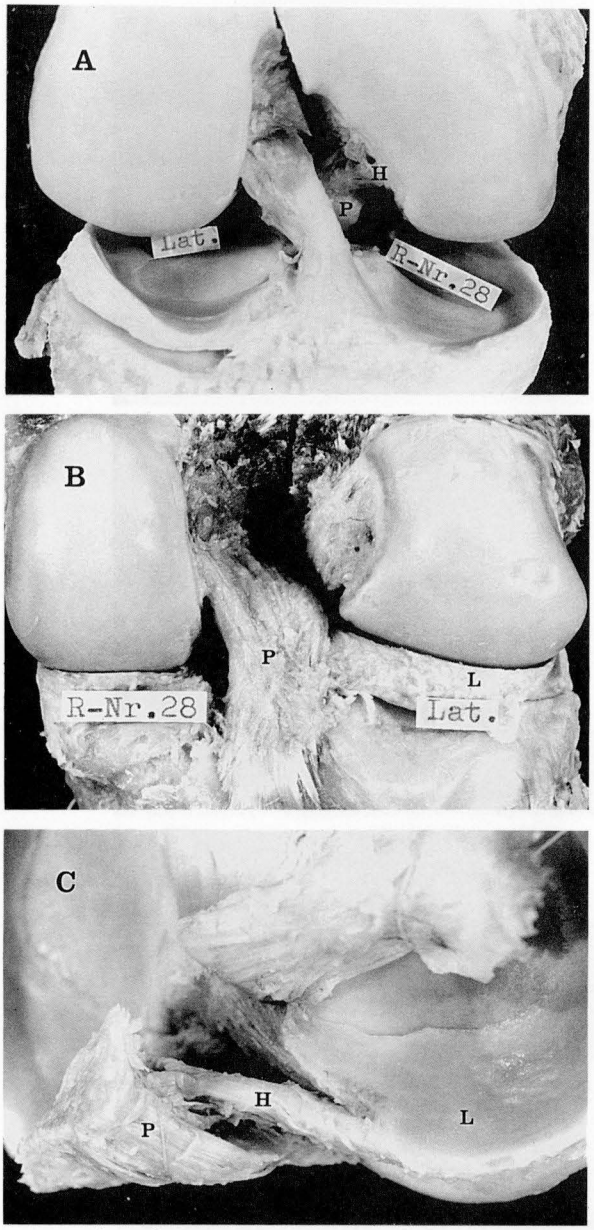

Fig. 2. An example of Type II
A. anterior view B. posterior view C. visualization of anterior menisco-femoral ligament from the top
H : Anterior menisco-femoral ligament
P : Posterior cruciate ligament
L : Lateral meniscus

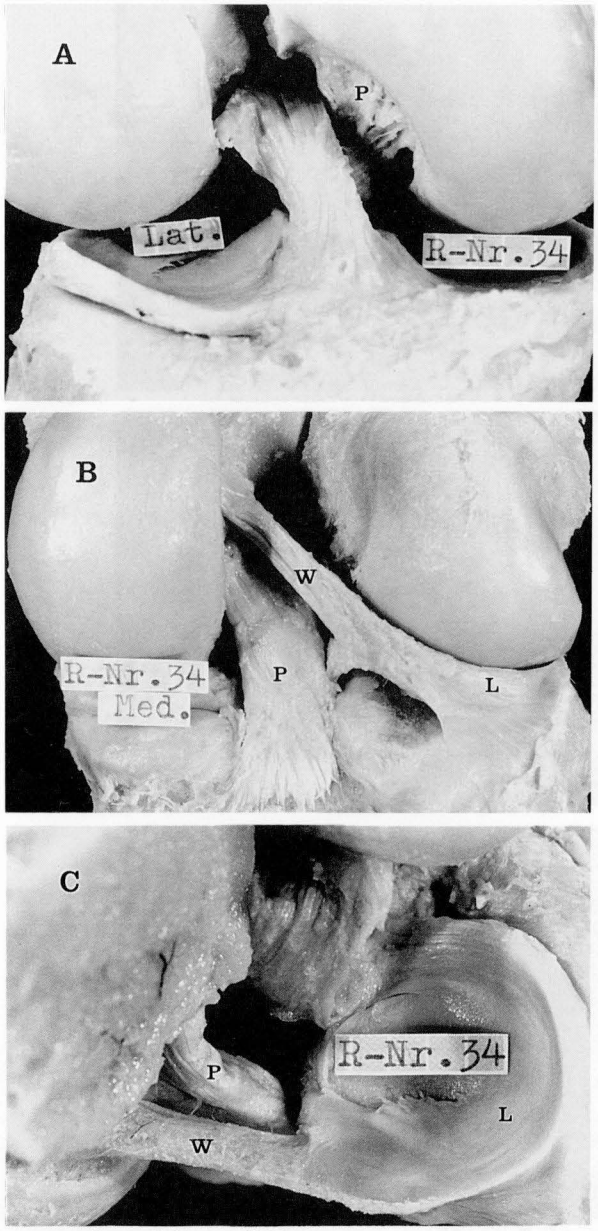

Fig. 3. An example of Type III
A. anterior view B. posterior view C. visualization of posterior menisco-femoral ligament from the top
W : Posterior menisco-femoral ligament
P : Posterior cruciate ligament
L : Lateral meniscus

In all specimens, the posterior horn of the lateral meniscus was attached to the proximal tibia. As the knee joint flexed, with the guide of menisco-femoral ligaments, the posterior horn of the lateral meniscus was observed to be pulled anteriorly, medially and superiorly, subsequently the tension of lateral meniscus increased. Thus, the congruency between the lateral meniscus and femoral condyle and the stability of the knee joint increase.

DISCUSSION

There are several previous reports with regard to the incidence of the menisco-femoral ligaments. Most of the authors reported that in some cases these ligaments were absent. Radoievitch[9] (1931) reported the incidence of the menisco-femoral ligaments as 94% of 105 knees, Brantigan et al.[1] (1941), 100% of 50 knees, Candiollo et al.[2] (1959), 80% of 50 knees, Heller[7] (1964), 71% of 140 knees and Wagner et al.[11,12] (1981), 70%. In Japan, Kodama[5] (1949) found the menisco-femoral ligaments to be present in 77% of 30 knees, Sumi[10] (1957), 92% of 50 knees, and Goto[3] (1960) reprorted 100% of 90 fetuses. A different term, lateral meniscal ligament, was used in the Japanese literature.

In all knees we carefully examined, obvious menisco-femoral ligaments were identified. Therefore, it appeared that at least one of the menisco-femoral ligaments should be present in any of the human knee joints.

Parsons[8] (1900) reported that in almost all animals he examined, the posterior horn of the lateral meniscus formed a bundle of fibers which did not insert into the tibia, but into the lateral aspect of the medial femoral condyle. He speculated that this special architecture was formed to buffer the rotational stress exerted at the posterior horn of the lateral meniscus of these animals.

Kaplan[4] (1957) reported that in the human knees, there were some cases in which the posterior horn of the lateral meniscus did not insert into the tibia and speculated that the abnormal movement of this posterior horn of the lateral meniscus could cause the development of lateral discoid meniscus. On the contrary, Goto[3] (1960) examined 100 fetuses and reported that the posterior horn of the lateral meniscus inserted into the tibia in

all cases, and he disagreed with Kaplan's acquired discoid lateral meniscus theory. In all specimens we examined, the posterior horn of the lateral meniscus also inserted into the tibia. Therefore, it appears that in human beings, not like animals, the posterior horn of the lateral meniscus has an insertion into the tibia (Fig. 5).

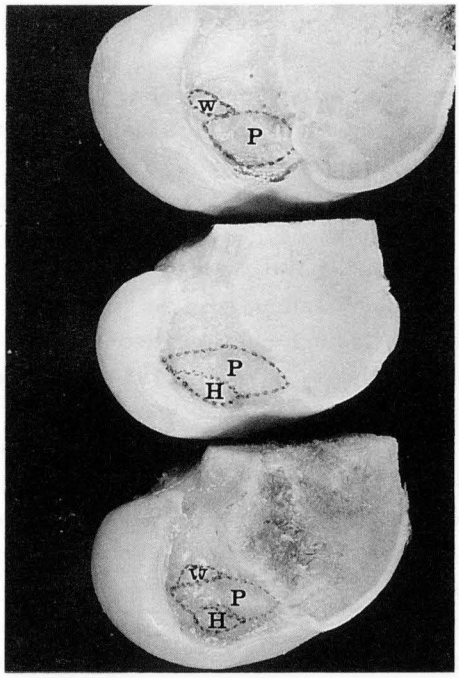

Fig. 4. The lateral surface of the medial femoral condyle showing the sites of insertion of MFL and PCL.
P : Posterior cruciate ligament
H : Anterior menisco-femoral ligament
W : Posterior menisco-femoral ligament

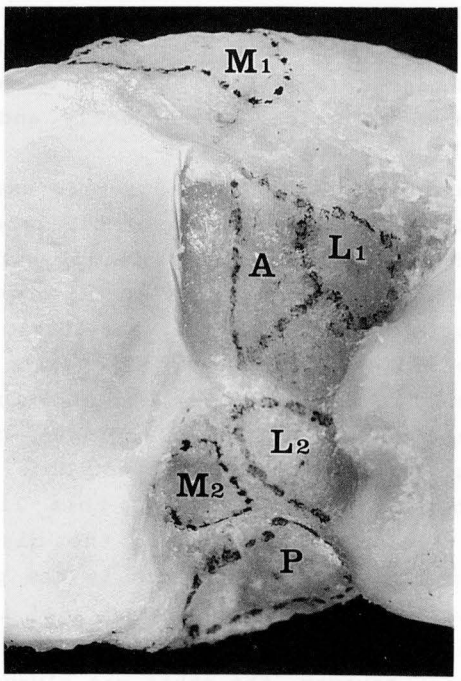

Fig. 5. Insertions of ACL, PCL and medial and lateral menisci into the right tibia.

- L_1: Insertion of the anterior horn of the lateral meniscus
- L_2: Insertion of the posterior horn of the lateral meniscus
- M_1: Insertion of the anterior horn of the medial meniscus
- M_2: Insertion of the posterior horn of the medial meniscus
- A : Insertion of the anterior cruciate ligament
- P : Insertion of the posterior cruciate ligament

With respect to the differentiation of the AMFL and PMFL, Kaplan stated that the PMFL's anterior branch is the AMFL. In our study, however, both ligaments were observed simultaneously in 49 knees out of 100. In these cases, two different bundles were observed at the point where they diverged from the posterior horn of the lateral meniscus (Fig. 6). Based on these findings, these two bundles seemed to exist independently and have no direct relationship.

When the menisco-femoral ligaments were examined after they had branched from the posterior horn of the lateral meniscus, we found that the PMFL ran along the posterior surface of the PCL. However, the PMFL and PCL could be easily separated from each other in all specimens and , in fact, absolutely separate bundles were found in some cases (Fig. 7). The AMFL passed along the anterior surface of the PCL. Since the anterior portion of the PCL is completely covered by fibrous tissue, it can be easily overlooked if sufficient dissection is not done. Especially when the AMFL is thin, identification of this ligament is often difficult and this may have caused the discrepancy in the incidence of menisco-femoral ligaments in the previous reports. Also the PMFL is thin in some specimens, and in such cases its function as a ligament is doubtful (Fig. 8). When one of the ligaments was thin, however, the other was always thick. Also in the specimens in which only one menisco-femoral ligament was found (Type II and Type III), their bundles were almost always thick.

There was one case in which some fibers were found to extend from the PMFL to the tendon of the popliteus muscle (Fig. 9). There were also some cases in which extra fibers were found extending from the posterior horn of the lateral meniscus to the PCL or ACL in addition to the PMFL (Fig. 10, 11).

There have been only few reports published regarding the function of the menisco-femoral ligaments. According to Heller[7] (1964), when the knee joint is flexed with the foot on the ground, the menisco-femoral ligaments function to increase the congruity between the lateral femoral condyle and the lateral meniscus by pulling the posterior horn of the lateral meniscus medially and slightly anteriorly. In our study as well, when the knee joint was flexed, the insertion of the menisco-femoral ligaments moved anteriorly and superiorly in relation to the tibia (Fig. 12).

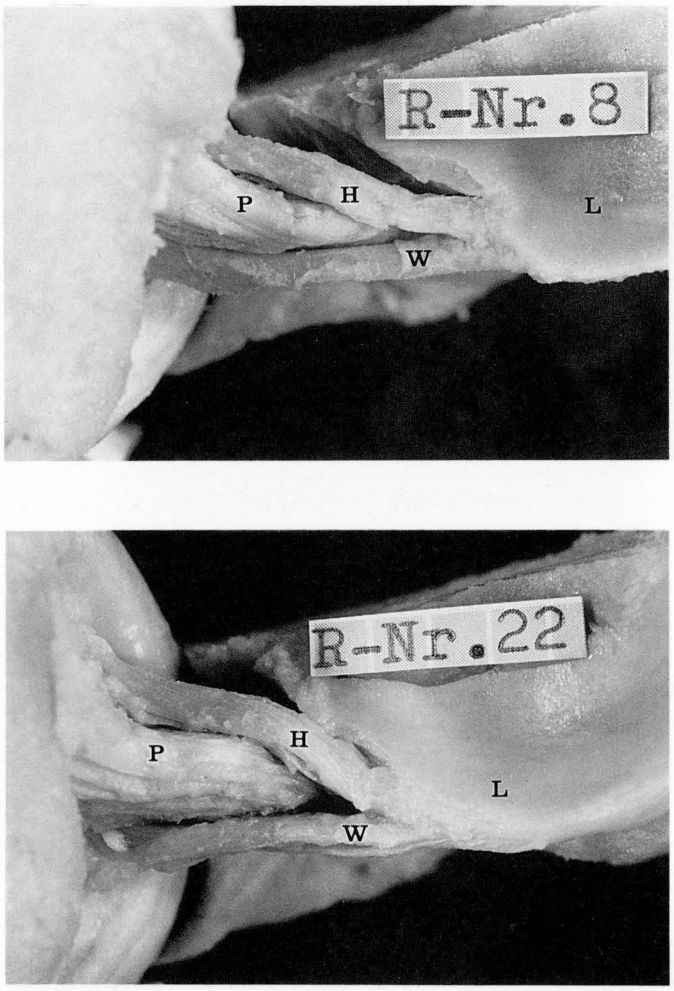

Fig. 6. Posterior horn of the lateral meniscus
Note that anterior and posterior menisco-femoral ligaments diverge from the posterior horn.
H : Anterior menisco-femoral ligament
W : Posterior menisco-femoral ligament
L : Lateral meniscus
P : Posterior cruciate ligament

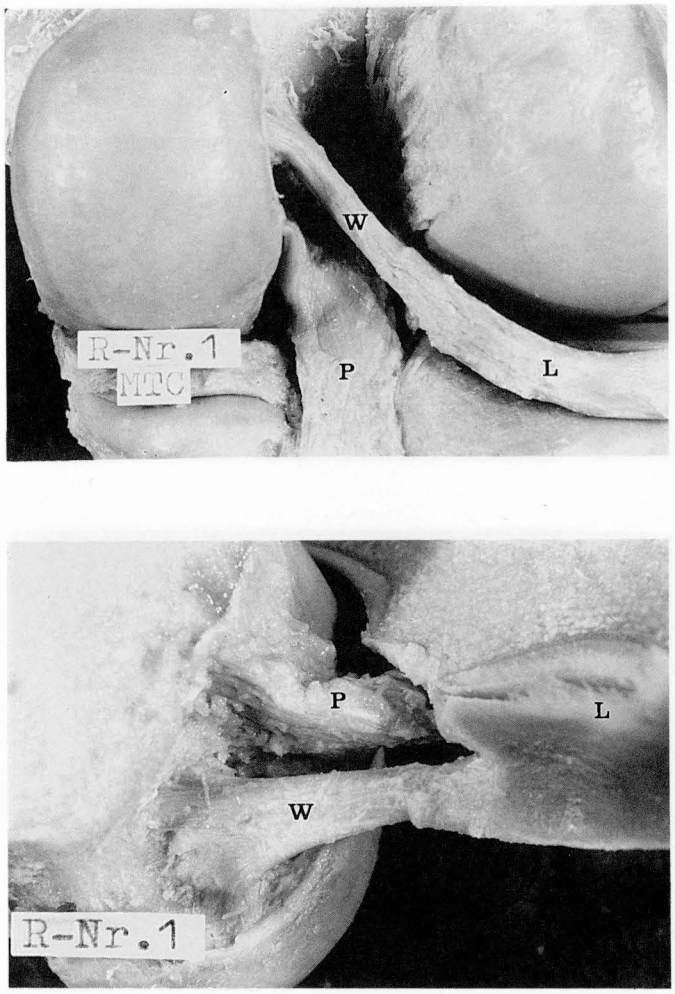

Fig. 7. Anatomical relationship between the posterior cruciate ligament and the posterior menisco-femoral ligament. Completely separate bundles can be identified in this case.
P : Posterior cruciate ligament
W : Posterior menisco-femoral ligament
L : Posterior horn of the lateral meniscus

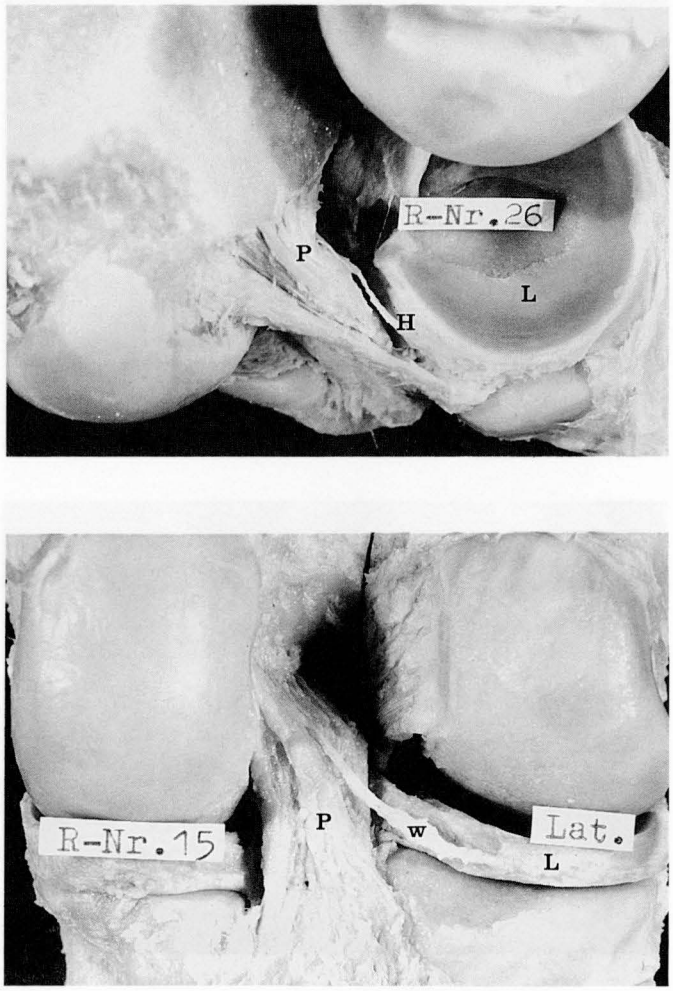

Fig. 8. Two examples which have thin menisco-femoral ligament
P : Posterior cruciate ligament
L : Lateral meniscus
H : Thin anterior menisco-femoral ligament
W : Thin posterior menisco-femoral ligament

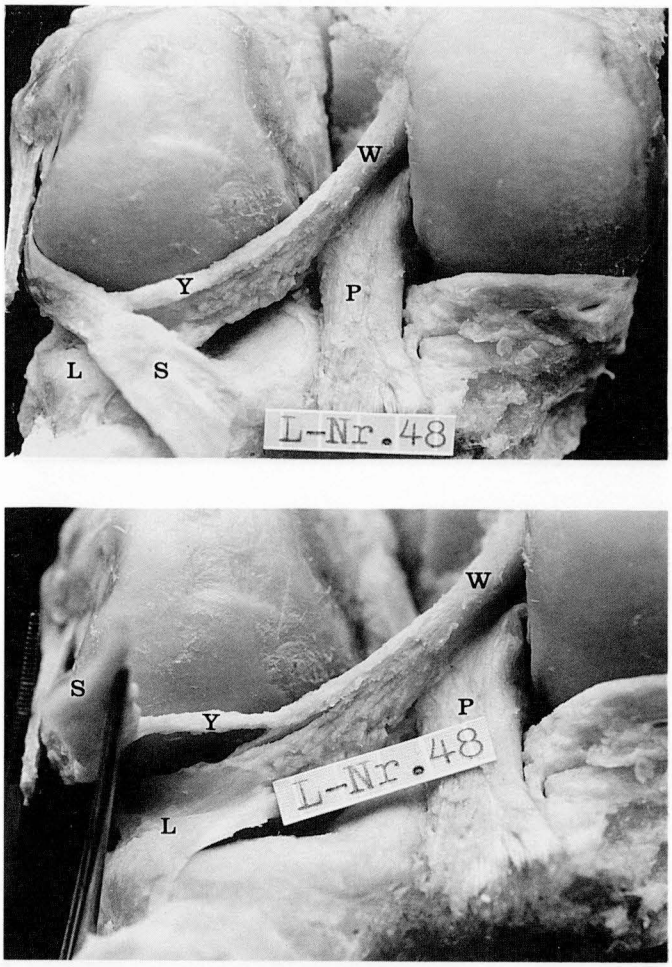

Fig. 9. A case in which the posterior menisco-femoral ligament sends fibers to the tendon of the popliteus muscle.

W : Posterior menisco-femoral ligament
P : Posterior cruciate ligament
S : Tendon of the popliteus muscle
L : Posterior horn of the lateral meniscus
Y : Fibers which extend from the posterior menisco-femoral ligament to the tendon of the popliteus muscle

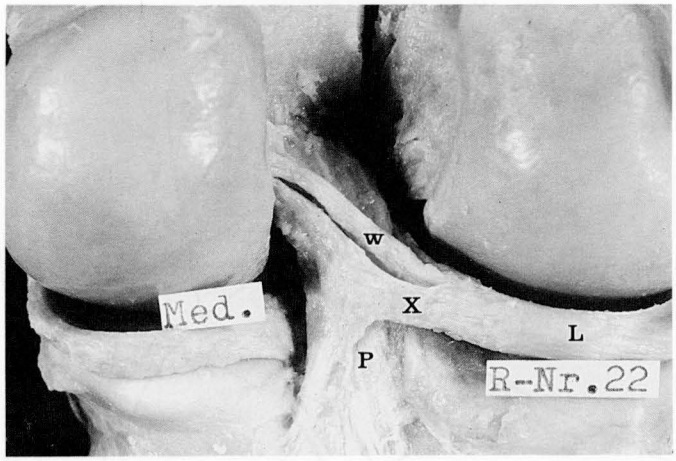

Fig. 10. Secondary fibers of the posterior horn of the lateral meniscus extending to the posterior cruciate ligament in addition to the posterior menisco-femoral ligament.

L : Lateral meniscus

P : Posterior cruciate ligament

W : Posterior menisco-femoral ligament

X : Fibers which extend from the meniscus to the posterior cruciate ligament

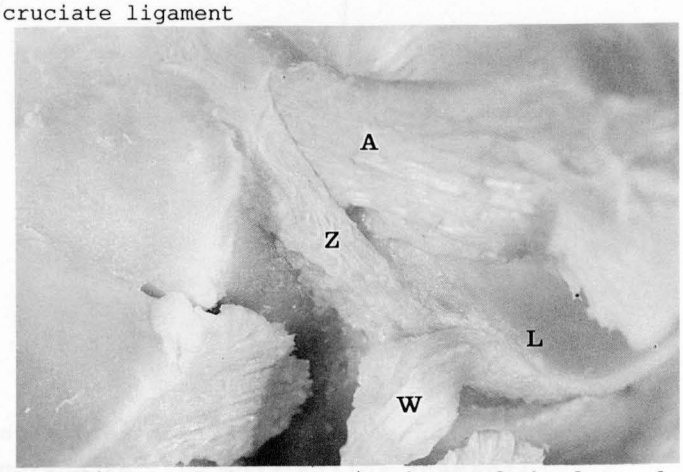

Fig. 11. Secondary fibers of the posterior horn of the lateral meniscus extending to the anterior cruciate ligament in addition to the posterior menisco-femoral ligament.

L : Lateral meniscus

A : Anterior cruciate ligament

W : Posterior menisco-femoral ligament

Z : Fibers which extend from the posterior horn of the lateral meniscus to the anterior cruciate ligament

Fig. 12. The center of insertion of each ligament shifts from full extension (○) to full flexion (△).
a : Center of insertion of the posterior menisco-femoral ligament
b : Center of insertion of the posterior cruciate ligament
c : Center of insertion of the anterior menisco-femoral ligament

When the anatomical relationship between the menisco-femoral ligaments and the lateral meniscus is considered, it can be easily speculated that the menisco-femoral ligaments draw the posterior horn of the lateral meniscus in anterior, medial and superior direction during flexion of the knee joint. Thus, the congruency between the lateral meniscus and femoral condyle and the stability of the knee joint increase.

If an internally rotating force is applied to the tibia at the knee joint, this will create an external rotation of the femur in relation to the tibia and the lateral meniscus will be compressed by the lateral femoral condyle. This will create a further increase in the tension of the menisco-femoral ligaments. With this mechanism, the posterior horn of the lateral meniscus will tear at the junction of the menisco-femoral ligaments. Since this mechanism seemed to be responsible for a fair number of tears in the posterior horn of the lateral meniscus, it is important to observe the menisco-femoral ligaments in treating this type of problems.

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