

# A Cadaveric Study of Meniscus, Meniscofemoral Ligament in Thai People - Its Size and Shape and Incidence\*

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**ABSTRACT:** Dissection of ninety-eight cadaveric knee joints of forty-nine cadavers were carried out. The size and shape of both medial and lateral menisci were investigated and recorded. Attention also paid to the incidence of meniscofemoral ligament (Ligament of Wrisberg and Humphrey) as well as lateral discoid meniscus.

There were seventy-nine of Ligament of Wrisberg (84.04%), whereas only five (5.32%) of Ligament of Humphrey were encountered. The presence of both ligaments in the same knee were found five times (5.32%). They were absent in five knee (5.32%). Seven lateral incomplete discoid menisci were encountered in four cadavers. There were three bilateral and one unilateral comprising a total incidence of 7.14 per cent. No medial discoid meniscus was found.

The measurement of medial menisci in their AP diameter and medio-lateral diameter were 38 and 29 mm.; their counterpart lateral menisci were 29 and 28 mm. respectively. The average width of anterior, middle and posterior segment of medial menisci were 7, 7, 13 mm.; whereas their counterpart lateral menisci were 9, 9, 9 mm. respectively. The average thickness of both medial and lateral menisci were 5 mm. in their thickest dimension.

## INTRODUCTION

The menisco-femoral ligament is one of the most important accessory ligaments of the human knee.<sup>1</sup> The accessory ligament is known either as the posterior menisco-femoral ligament of Wrisberg or the anterior menisco-femoral ligament of Humphrey. Poirier and Charpy (1892) were the first to describe and define it as "the third cruciate liga-

ment." The posterior menisco-femoral ligament of Wrisberg, when present, tends to control the lateral meniscus, pulling it backward in flexion and preventing it from sliding too far forward in hyperextension.<sup>2</sup> So, the lateral meniscus does not become distorted during rotation; it follows the lateral condyle of the femur by reason of attachments of the ligament of Humphrey and Wrisberg and the popliteus muscle. It is thus immune from injury during rotation.<sup>2</sup> The ligament of Humphrey and Wrisberg are strong structure especially the latter, and it is unfortunate that their names should have been dropped from current British nomenclature. However, Kaplan in 1956,<sup>3</sup> tried to find out the origin or eponyms of the "Wrisberg ligament" but failed. It should be noted that this ligament is rarely called Wrisberg's ligament in French, German or Russian literature, instead it is generally known as "The ligament of Robert." Kaplan then offered that it is useful to add the eponym for those whom may have the occasion to consult the non-English literature.

Functional anatomy of the meniscus had been clarified since Robert J. Johnson and Malcolm H. Pope reported their extensive study in 1978. The shape of the menisci were well described in many textbooks of anatomy<sup>4-6</sup> but there was only little discussion about its size and incidence of anomaly. Although the existence of discoid variety of the lateral meniscus had been known to anatomists since the first dissection — room specimen was described by Young (1889), it was not until the association of the congenital anomaly with snapping knee was pointed out by Kroiss (1910) that the condition become a clinical entity (Middleton, 1936).<sup>7</sup> Almost one century passed, the etiology of lateral discoid meniscus remain obscure.<sup>7-10</sup>

The purpose of this report is to study the intraarticular anatomy of the knee with special emphasis on the size, shape of medial and lateral meniscus and incidence of menisco-femoral ligament, as well as discoid meniscus in cadavers of Thai ancestry.

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## MATERIALS AND METHODS

Ninety eight knees from forty-nine cadavers were examined. The age range of cadavers were 21 to 100 with an average of 62 years. After removal the extensor musculature, the medial and lateral collateral ligament were cut transversely. The arcuate complex was detached and the knee flexed, exposing the anterior and middle thirds of the menisci and the anterior cruciate ligament. With this exposure thorough examination of any accessory ligaments in the anterior compartment of the knee was achieved. The anterior cruciate ligament was then carefully detached from its femoral attachment, exposing the anterior surface of the posterior cruciate ligament and the anterior menisco-femoral ligament when present. With the knee completely flexed, the tibia was then rotated medially which revealed the posterior horn of the lateral meniscus and the posterior menisco-femoral

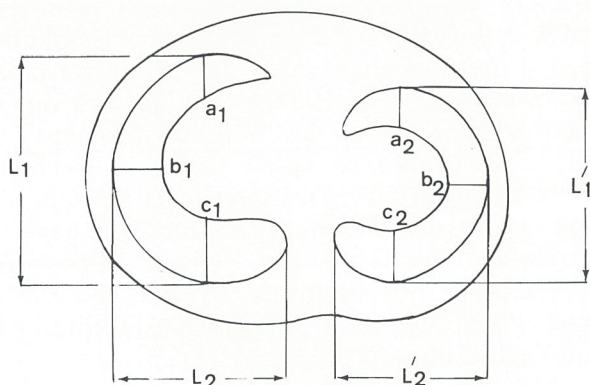


Fig. 1 Diagram shows the location of measuring point on each segment of the menisci.

$L_1, L'_1$  : AP diameter of medial and lateral meniscus respectively  
 $L_2, L'_2$  : ML diameter of medial and lateral menisci respectively  
 $a_1, a_2$  : Anterior segment of medial and lateral menisci  
 $b_1, b_2$  : middle segment of medial and lateral menisci  
 $c_1, c_2$  : posterior segment of medial and lateral menisci  
 (AP = anteroposterior, ML = mediolateral)

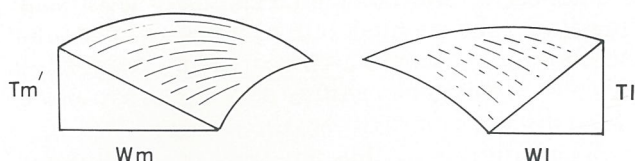


Fig. 2 Cross section of the medial and lateral menisci.

$T_m$  : Thickness of the medial meniscus  
 $T_l$  : Thickness of the lateral meniscus  
 $W_m$  : Width of the medial meniscus  
 $W_l$  : Width of the lateral meniscus

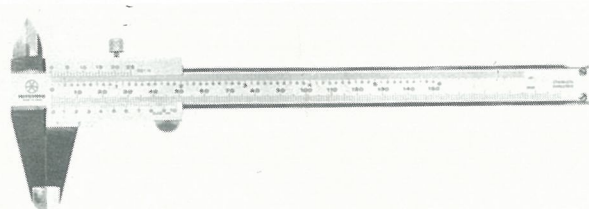


Fig. 3 Ruler made by Mitutoyo (Japan).

TABLE 1  
Incidence of Menisco-Femoral Ligaments.

Ligament (98 knees)	Number	Per cent
Anterior menisco-femoral (Ligament of Humphrey)	5	5.32
Posterior menisco-femoral (Ligament of Wrisberg)	79	84.04
Both (Humphrey & Wrisberg)	5	5.32
Total	89	94.68

ligament when present. After that both menisci were removed, the size of medial and lateral menisci were measured at 3 points, anterior, middle and posterior segment which locate at the mid-segment as shown in Figures 1 and 2. The ruler used for measurement was made by Mitutoyo (Japan) (Figure 3). Attention was also paid to the existence of discoid menisci.

## RESULTS

Of the ninety-eight knees examined, the menisco-femoral ligaments were encountered in eighty-nine knees (94.68%). There were 79 (84.04%) of posterior menisco-femoral ligament (Ligament of Wrisberg), and five (5.32%) of anterior menisco-femoral ligament (Ligament of Humphrey). The presence of both Ligament of Wrisberg and Humphrey were found in five knees (5.32%). They were absent in five knees (5.32%) (Table 1).

The measurement of medial menisci in their AP diameter and mediolateral diameter were 38 and 29 mm., their counterpart lateral menisci were 29 and 28 mm. respectively. The average width of anterior, middle and posterior segment of medial menisci were 7, 7, 13 mm.; whereas their counterpart lateral menisci were 9, 9, 9 mm. respectively.

TABLE 2  
The Average Size and Shape of Medial and Lateral Menisci (98 Knees).

Meniscus	Diameter		Ant.-segment		Middle segment		Post-segment	
	A-P	Mediolateral	Wi	Th	Wi	Th	Wi	Th
Medial	38	29	7	5	7	5	13	5
Lateral	29	28	9	3	9	5	9	4

Wi : Width (mm), Th : Thickness (mm)

Ant = Anterior, Post = Posterior, Wi = Width (mm), Th = Thickness (mm)

The average thickness of anterior, middle and posterior segment of medial meniscus were 5, 5, 5 mm.; whereas their counterpart lateral meniscus were 3, 5, 4 mm. respectively.

### Discoid Meniscus

Seven lateral incomplete discoid menisci were encountered in four cadavers. There were three bilateral and one unilateral, comprising a total incidence of 7.14 per cent. All of them, the posterior horn were attached to the medial femoral condyle by posterior menisco-femoral ligament. No medial discoid meniscus was encountered in this series.

The age of the cadaver which had unilateral lateral discoid meniscus was 41. The age of the cadavers which had bilateral lateral discoid menisci were 37, 67 and 78 (Figure 4). All of them were female.

## DISCUSSION

### 1. Menisco-femoral ligaments

Reports about the size and shape of meniscus, the incidence of menisco-femoral ligament and discoid meniscus appeared sporadically. This report is the first study of this kind in Thailand.

The incidence of posterior menisco-femoral ligament of Wrisberg and the anterior menisco-femoral ligament (ligament of Humphrey) in this series are 84.04 and 5.32 per cent respectively. The incidence of the former is much more common than the latter. Sometimes both of them are present in the same knee. The incidence of menisco-femoral ligament varies from 70-100 per cent (Table 3).<sup>1,2,11</sup> The low incidence may probably due to the destruction of the ligament during the process of dissection.<sup>3</sup>

We observed that the posterior menisco-femoral ligament is usually larger than the anterior one. The average size of the posterior menisco-femoral

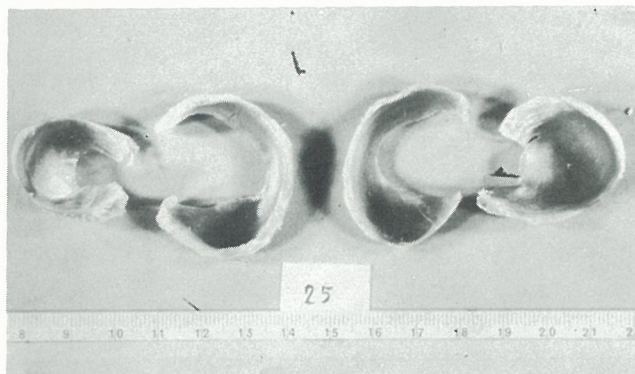


Fig. 4 A cadaver with bilateral lateral incomplete discoid meniscus.

ligament was measured 2 mm. in diameter except one which was 3 mm. or nearly one-third of the posterior cruciate ligament (Figures 5, and 6).

In the study of Heller and Langman<sup>1</sup> the size of the anterior menisco-femoral ligament was never larger than one-third of the diameter of the posterior cruciate ligament whereas the size of the posterior menisco-femoral ligament of Wrisberg was sometimes half of the diameter of the posterior cruciate ligament.

The posterior menisco-femoral ligament is often blended with the posterior cruciate ligament (Figure 7), but sometimes it is actually separated from the posterior cruciate ligament (Figure 8). It extends from the posterior horn of the lateral meniscus to the medial femoral condyle, in an oblique upward and medial direction and inserts just above the femoral attachment of posterior cruciate ligament. (Figure 8).

Since it is the most posterior of the intra-articular ligaments, it is never covered with synovial membrane. Watanabe<sup>12</sup> could demonstrate these ligaments through arthroscope.

As far as the function of both anterior and posterior menisco-femoral ligaments is concerned, it

TABLE 3  
Incidence of Menisco-Femoral Ligaments.

	Authors	Number of knees	Incidence (per cent)			Total
			Humphrey	Wrisberg	Both (H+W)	
1931	Radoiévitsh	150	*	*	*	94
1941	Brantigan & Voshell	50	34	60	6	100
1959	Candiollo & Gautero	50	*	*	*	80
1964	Heller & Langman	140	36	35	6	71
1975	Girgis-Marshall-Monajem	*	*	*	*	70
1987	Rojvanit & Pichaisak	98	5.32	84.04	5.32	94.68

\*No differentiation, H : Humphrey, W : Wrisberg

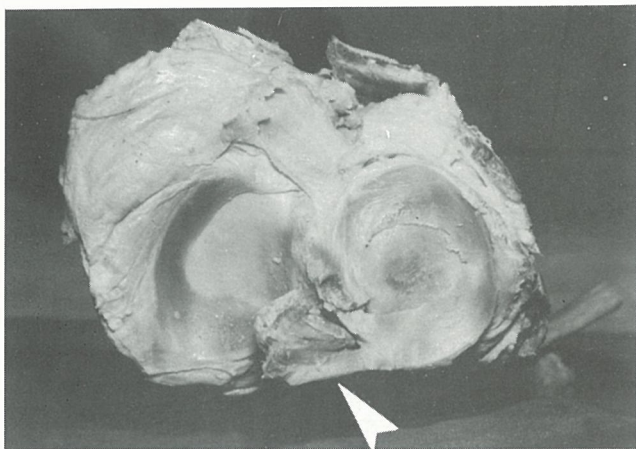


Fig. 5 The posterior menisco-femoral ligament. Its diameter is 3 mm. or nearly one-third of the posterior cruciate ligament (PCL).

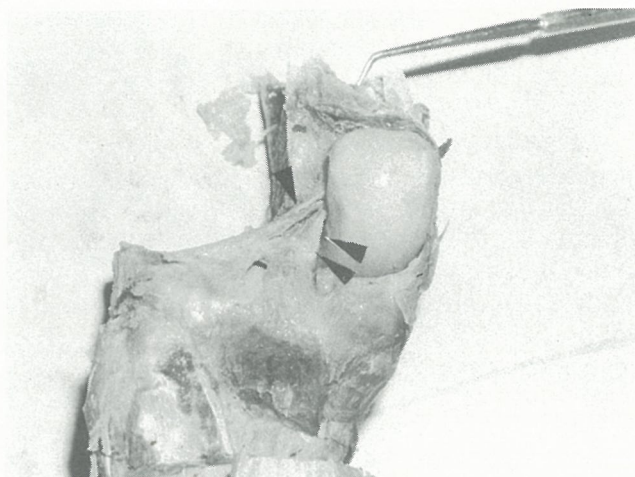


Fig. 7 The posterior menisco-femoral ligament (single arrow) often blended with the posterior cruciate ligament. (double arrow)

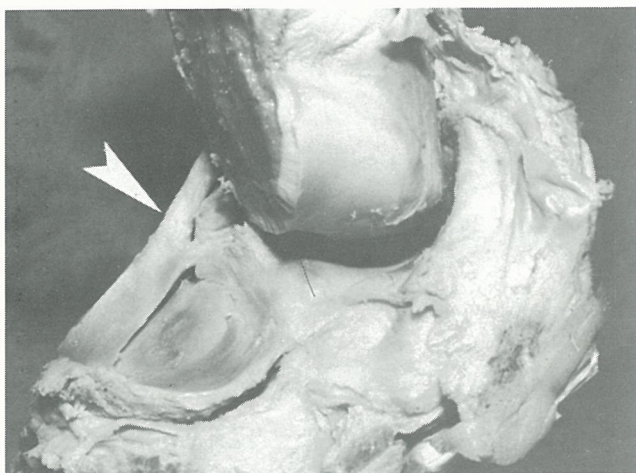


Fig. 6 Front view of the posterior menisco-femoral ligament whose diameter is 3 mm. It originates from posterior horn of lateral meniscus and inserts at medial femoral condyle just above the femoral attachment of PCL.

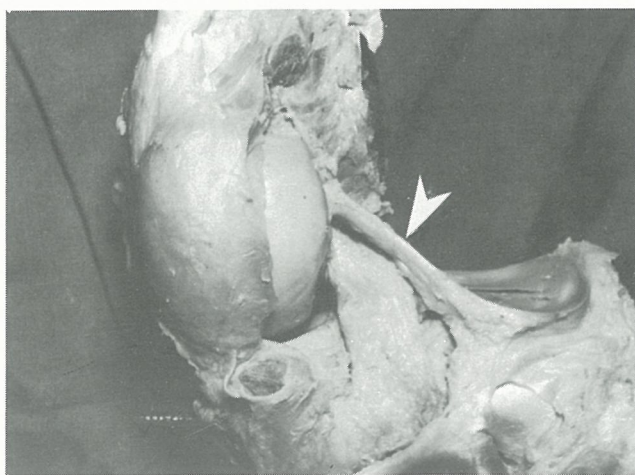


Fig. 8 The posterior menisco-femoral ligament is apparently separated from posterior cruciate ligament. Its insertion is just above the posterior cruciate ligament.

TABLE 4  
Incidence of Lateral Discoid Menisci.

Year	Authors	Number of specimens examined	Number of lateral discoid meniscus found	Per cent
1950	Nemoto	70 fetuses (140 knees)	22	16.0
1962	Matsushita	16 fetuses (32 knees)	2	6.3
1983	Clark & Ogden	109 fetuses 28 cadavers	None	0
1987	Rojvanit & Pichaisak	49 cadavers (98 knees)	7	7.14

have not been studied in this series. Heller and Langman<sup>1</sup> stated that in a standing position with the knee flexed and foot fixed as in skiing, the femoral condyles tend to slide forward over the tibial plateau under the influence of the body weight. When this occurs, the anterior meniscofemoral ligament and, to a lesser extent, the posterior meniscofemoral ligament become tight and pull the posterior horn of the lateral meniscus slightly medially and anteriorly. During extension of the knee from the flexed-position, the meniscofemoral ligaments become relaxed, allowing the posterior horn of the lateral meniscus to move laterally and slightly posteriorly, in this way accommodating the broader surface of the femoral condyle in the tibio-meniscal socket.<sup>1</sup>

## 2. Size and Shape of Meniscus<sup>13</sup>

As has been described by many authors, the shape of the medial meniscus is like the letter "C" while the lateral meniscus is like the letter "O". This series show that the average anteroposterior diameter of medial meniscus (38 mm.) is much more longer than the mediolateral diameter (29 mm.), but the figure on the lateral meniscus (29 mm., 28 mm.) appear to be very close to each other. The posterior segment of medial meniscus is widest (13 mm.) while the anterior and middle segment are nearly the same width (7 mm.). The thickness of medial meniscus is thoroughly the same in three segments (5 mm.).

Although it is stated in most textbooks<sup>4-6</sup> that the thickness of different segment of lateral meniscus are equally thick, we found that the middle segment was thickest (5 mm.). The thickness of the anterior and posterior segment were 3 and 4 mm. respectively. It should be noted that in our series the width of all three segments of lateral meniscus appear to be the same (9 mm.).

## 3. Discoid Meniscus<sup>7-9</sup>

There were seven incomplete lateral discoid menisci encountered in four cadavers. Three of them were bilateral and one unilateral comprising a total incidence of 7.14 per cent. It is well known that the incidence of discoid meniscus in Japanese is higher than other race, which is about 10 per cent and mostly bilateral. However according to the embryological study of the discoid meniscus by Kaplan in 1955<sup>9</sup> and Clark and Ogen in 1983,<sup>14</sup> their results were opposed to this finding. The incidence of lateral discoid menisci in various studies were compared as shown in Table 4.

The incidence of discoid menisci is so much different in races. This is apparently true between the Asian and the American. Smillie<sup>16</sup> reported 4.7 per cent lateral discoid meniscus out of 10,000 meniscectomies, while Watanabe<sup>20</sup> reported ninety-three lateral discoid menisci of 153 arthroscopic meniscectomies (60.8%). The incidence of lateral discoid meniscus is higher in female. In our series all four cadavers with lateral discoid menisci is also female with the average age of sixty-two. This was also supported by the report of Smillie in 1978. In his series, a total of 1,444 women undergoing meniscectomies, there were 156 (11%) lateral discoid menisci whereas only 318 in 8,556 meniscectomies (4%) was found in men.

There were no medial discoid meniscus encountered in this series. It is interesting to note that, there were only seventeen cases of medial discoid meniscus recorded in the past four decades between 1945 - 1984.<sup>10,17-20</sup>

## SUMMARY

1. The average measurement of the size and shape of the menisci in 98 cadaveric knees of Thai ancestry were reported (Table 2).

2. The incidence of anterior menisco-femoral ligament (Ligament of Humphrey) in this series is 5.32 per cent, and posterior menisco-femoral ligament (Ligament of Wrisberg or ligament of Robert) is 84.04 per cent.

3. The incidence of lateral discoid meniscus in this series is 7.14 per cent.

4. Literatures are reviewed and discussed.

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