

**Original article:**

## Morphometric Study of Human Adult Meniscus in Knee Joint

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### Abstract:

**Introduction:** The menisci of knee joint improve joint congruence and load distribution. The meniscus reduces the stress on the knee joint, Variations of inter horn distance of menisci can determine the possibility and kind of injury. The study of morphology of menisci will provide support to meniscal anatomy which is necessary for various surgical procedures, for arthroscopy of the knee joint.

### Aim and objective:

To evaluate the morphological and morphometric variations in human meniscus under the following parameters

- 1.To observe the incidence of different shapes of medial and lateral menisci
2. To measure inter meniscal horn distance.

**Materials and methods:** The study is done on unclaimed 25 human adult cadaver (18 male & 7 female) preserved after proper embalming done in the Department of Anatomy Stanley Medical College. The joint cavity was opened and morphological variations in the shape of the menisci (crescentic shape, C shape, U shape, V shape and discoid shape) were noted macroscopically. Inter meniscal horn distance of medial and lateral menisci measured and tabulated.

**Results:** Out of 50 medial menisci, 96% crescent shaped; 2% V shaped, 2% U shaped and no discoid medial menisci was found. Out of 50 lateral menisci, 94% C shaped, 4% sided U shape, and 2% incomplete discoid lateral menisci were found. The distances between anterior and posterior horn of medial meniscus (26.13 mm) were significantly higher than those of lateral meniscus (12.71 mm).

**Conclusion:** There is a simultaneous rise in osteoarthritis and meniscal injuries, with increasing incidence of sedentary lifestyle and obesity. The present study helps in studies on meniscus injuries.

**Key words:** Medial meniscus, Lateral meniscus, Discoid meniscus, Inter meniscal horn distance.

### Introduction

Knee joint is a complex synovial joint. The menisci are semilunar cartilages, which are crescent shaped, intracapsular, fibrocartilaginous laminae. They are wide, deep and prepare the tibial articular surfaces for receiving the femoral condyles. Peripheral borders of the menisci are thick, convex and attached. The free, inner borders are thin and concave. Meniscal tears are common. Proximal surfaces of the menisci are smooth and concave and are in contact with the articular cartilage of the femoral condyles. Distal surfaces of the menisci are smooth and flat, which rest on the tibial articular cartilage. Each menisci covers approximately two-thirds of the tibial articular surface.

The menisci provide stability. Medial meniscus is semicircle in shape and is broader posteriorly. The anterior horn of medial meniscus gets attached to the anterior tibial intercondylar area in front of the anterior cruciate ligament; the posterior fibres of the anterior horn are continuous with the transverse ligament of the knee. The posterior horn is fixed to the posterior tibial intercondylar area,

between the attachments of the lateral meniscus and posterior cruciate ligament. Its peripheral border is attached to the fibrous capsule and to the deep surface of the tibial collateral ligament.

Because of these attachments the medial meniscus is relatively fixed and moves much less than the lateral menisci. Lateral meniscus forms approximately four-fifths of a circle and covers a larger area than the medial meniscus. Its breadth is uniform except at its tapered horns. It is grooved postero laterally by the tendon of popliteus, which separates it from the fibular collateral ligament. Its anterior horn is attached in front of the intercondylar eminence, posterolateral to the anterior cruciate ligament, with which it partly blends. Its posterior horn is attached behind this eminence, in front of the posterior horn of the medial meniscus. A discoid lateral meniscus occasionally occurs, often bilaterally. The distinguishing features of a discoid lateral meniscus are its shape and posterior ligamentous attachments. The following classification of the abnormality is based on the work of watanabe et al (1979) (1). In mildest form, the partial discoid meniscus is simply a wider form of the normal lateral meniscus.

The acute, medial free edge lies between the femoral and tibial condyle but it does not completely cover the tibial plateau. A complete discoid meniscus appears as a biconcave disc with a rolled medial edge and covers the lateral tibial plateau. Most are asymptomatic and are often found by chance at arthroscopy. However, they may cause difficulty in gaining access to the lateral compartment arthroscopy. A discoid medial meniscus is extremely rare (2).

#### **Materials and methods:**

In this study 25 human adult cadaveric knees (18 female & 7 male) (50 menisci) meant for purpose of MBBS students were dissected and preserved in 10% formalin solution in the Department of Anatomy in Stanley Medical College were included in the study. Cadavers with abnormal knee joints like deformities, fractures, exostosis or traumatic injury and those menisci which showed structural changes like injuries or any degenerative changes were excluded.

Dissection of knee joint was carried out according to cunningham's manual. The joint cavity was opened, by a parallel incision on both sides of the joint capsule, by cutting the patellar ligament and collateral ligaments transversely. The femoral condyles were circumferentially detached and removed, exposing the menisci. The morphological variations of the shape of the menisci were noted macroscopically.

Classification of medial and lateral menisci were based on previous classification in the literature, regarding the medial menisci – the shapes were determined as crescentic shaped, C shaped, U shaped, V shaped and discoid shaped (complete and incomplete discoid). Complete discoid menisci will cover the tibial plateau circularly without any open area at the centre. Incomplete discoid will have an open area in the centre of menisci. Cresceteric type menisci will have thin anterior horn, thin posterior horn, and thin body. Menisci that resemble side C, side U and V are named as C shaped, U shaped and V shaped respectively. Inter meniscal distance between anterior and posterior horns of medial and lateral menisci were measured & the results were recorded.

**Results:**

**TABLE 1: INCIDENCE OF DIFFERENT SHAPES OF MEDIAL MENISCUS**

| Shape of medial meniscus | Number of specimens | Incidence |
|--------------------------|---------------------|-----------|
| Crescent shaped          | 48                  | 96%       |
| V shaped                 | 1                   | 2%        |
| C shaped                 | 1                   | 2%        |

**TABLE 2: INCIDENCE OF DIFFERENT SHAPES OF LATERAL MENISCUS**

| Shape of lateral meniscus | Number of specimens | Incidence |
|---------------------------|---------------------|-----------|
| C shaped                  | 47                  | 94%       |
| U shape                   | 2                   | 4%        |
| Incomplete Discoid shape  | 1                   | 2%        |

**Table 3: INTERHORN DISTANCE BETWEEN MENISCI**

|                     | Distance between anterior and posterior horn of medial meniscus | Distance between anterior and posterior horn of lateral |
|---------------------|---|---|
| Inter horn distance | 26.13 mm  | 12.71 mm  |

**Discussion:**

In the present study 50 adult menisci from 18 male, 7 female adult cadaveric knee joints were used. Menisci was studied under the following parameters: 1. morphology 2. morphometry. The difference in the shape of menisci occur due to the mesenchymal differentiation or early development of the vasculature in early embryonic life (3). The menisci arise from the differentiation of the mesenchymal tissue inside the limb bud and it becomes a clearly defined structure at eighth week of intra uterine life (4). Morphological variations of the menisci can determine its possibility of injury.

The main findings were as follows: Five morphological types of menisci were determined. Out of 50 medial menisci studied, 96% were crescent shaped; 2% were V shaped, 2% were U shaped and no discoid medial menisci was found. Out of 50 lateral menisci studied, 94% were C shaped, 4% were sided U shape, and 2% incomplete discoid lateral menisci were found. The distances between anterior and posterior horn of medial meniscus (26.13 mm) were significantly higher than those of lateral meniscus (12.71 mm). The results of this study presented variations, were tabulated.

**RESULTS OF MORPHOLOGICAL VARIATIONS OF HUMAN ADULT MEDIAL MENISCI**

| STUDY                             | CRESENT SHAPE | C SHAPE | V SHAPE |
|-----------------------------------|---------------|---------|---------|
| Murlimanju et al (2010) (5)       | 50%           | -       | 37%     |
| Chakravarthy et al (2018) (6)     | 41.6%         | 56.4%   | -       |
| Shashidar et al (2019) (7)        | 28%           | 70%     | -       |
| Evangelina Singh et al (2020) (8) | 74%           | 4%      | 10%     |
| Present study                     | 96%           | 2%      | 2%      |

**RESULTS OF MORPHOLOGICAL VARIATIONS OF HUMAN ADULT LATERAL MENISCI**

| Study                             | C Shape | U Shape | Incomplete discoid |
|-----------------------------------|---------|---------|--------------------|
| Murlimanju et al (2010) (5)       | 72%     | -       | 2%                 |
| Chakravarthy et al (2018) (6)     | 56.4%   | -       | -                  |
| Shashidar et al (2019) (7)        | 35-70%  | -       | -                  |
| Evangelina Singh et al (2020) (8) | 58%     | 20%     | 2%                 |
| Present study                     | 94%     | 4%      | 2%                 |

**INTERMENISCAL HORN DISTANCE BETWEEN ANTERIOR AND POSTERIOR HORNS OF MEDIAL AND LATERAL MENISCUS**

| Study                                     | Distance between anterior and posterior horns of medial meniscus | Distance between anterior and posterior horns of lateral meniscus |
|---|--|---|
| <b>Braz et al (2010) (9)</b>              | 25.88 mm   | 12.55 mm  |
| <b>Murlimanju et al (2012) (10)</b>       | 24.13 mm   | 11.3 mm   |
| <b>Mahmoud el-aasar et al (2018) (11)</b> | 25.80 mm   | 11.36 mm  |
| <b>Present study</b>                      | 26.13 mm   | 12.71mm   |

**Conclusion:**

The present study provides support to meniscal anatomy which concerns arthroscopy and surgical procedures of knee joint. The study also provides additional information about different shapes of medial meniscus and lateral meniscus to delineate meniscal anatomy regarding allograft meniscus transplantation (6). Therefore, it helps the professionals who work in treatment of meniscal injuries, to become aware of anatomical variations which exist in the menisci for rehabilitation process (12). The study concludes that most of the specimen shows crescentic medial meniscus (96%) and the most common shape of lateral meniscus was 'C' shape (94%). Incomplete discoid menisci were seen in 2% of lateral meniscus. Complete discoid medial menisci or lateral menisci were not observed in specimens.

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