

THE MENISCI OF THE KNEE JOINT IN HUMAN FOETUSES OF MANIPUR POPULATION- A MORPHOLOGICAL STUDY

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ABSTRACT

BACKGROUND

The menisci are two crescentic lamellae, which serve to deepen the surfaces of the articular fossae of the head of the tibia for reception of the condyles of the femur. The menisci share load and reduce contact stresses across the joint. Injuries are sustained more often by the medial than the lateral meniscus in the proportion of 4:1, 5:1 or even 20:1.

The objectives of this study were to estimate the different shapes of the medial and lateral menisci, and the incidence of discoid meniscus of the knee joint in human foetuses of Manipur population.

MATERIALS AND METHODS

After taking formal permission from the Institutional Ethics Committee and concerned parents, the study was carried out on 200 foetal knee joints. The skin with fibrous capsule and the ligamentum patellae were cut. The cruciate ligaments were also cut and the menisci were exposed. The morphological variants of the shapes of the lateral and the medial menisci were macroscopically noted and classified.

RESULTS

On the lateral menisci, 56% of them were C-shaped, 31% of them were crescent shaped, 8% were U-shaped and 5% were incomplete discoid. On the medial menisci, 79% were crescent shaped, 11% were C-shaped and 7% were V-shaped and 3% were incomplete discoid. No total discoid meniscus was observed in the study.

CONCLUSION

The majority of the knees showed C-shaped lateral meniscus and crescent-shaped medial meniscus.

KEYWORDS

Foetus, Knee Joint, Meniscus, Crescentic, Discoid.

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BACKGROUND

The menisci are two crescentic lamellae, which serve to deepen the surfaces of the articular fossae of the head of the tibia for reception of the condyles of the femur. The menisci share load and reduce contact stresses across the joint. The anatomical abnormalities and variations of the intra-articular structures of the knee joint have recently become significant because of new techniques such as arthroscopy, CT and MRI. In American football, knee is the most commonly injured joint.¹ Meniscal injuries accounts for 12% of all football knee injuries. Injuries are sustained more often by the medial than the lateral meniscus in the proportion of 4:1, 5:1 or even 20:1. The snapping knee syndrome is usually related with the type of the meniscus or to the presence of a tear of the meniscus. This syndrome appears more often in children and young adolescents, and it is usually related with the type of meniscus like discoid meniscus.²

Also, the investigations of these parameters are important in order to describe the morphological features for clinical diagnosis and for surgical procedures.³ In meniscus allograft transplantation, it has been stated that providing a meniscal allograft that matches the size and shape of the meniscus to the recipient's knee is the responsibility of the tissue bank providing the graft.⁴ Long-term complications of removal of a meniscus include cartilage degeneration and bone remodelling, this discovery changed considerably the therapeutic approach to this common work or sports injury.⁵ Hence, today a ruptured meniscus is repaired rather than removed, but this treatment is only feasible when the meniscus tissue is otherwise of good quality.⁶ The reported incidence of discoid meniscus ranges from 0.4% to 17% for the lateral and 0.06% to 0.3% for the medial side. The condition is more frequently reported in Asian countries. Discoid meniscus are often asymptomatic but can be associated with knee pain, a snapping or popping knee.⁷ The incidence of bilateral lateral discoid meniscus is up to 20% of the cases, whereas bilateral medial involvement is rare.⁸ Discoid type of lateral meniscus has been discussed in both anatomical and orthopaedic literature. Very few data are available related to classification of menisci according to their shapes or racial differences.⁹ The aim of the present study is to describe the morphology of the menisci and the incidence of discoid meniscus in foetal knee joints of Manipur population.

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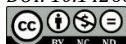
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MATERIALS AND METHODS

To carry out this cross-sectional descriptive study, 100 human foetal cadavers were collected from the Department of Obstetrics and Gynaecology, RIMS Hospital, Imphal with the permission of concerned authorities and parents. To carry out this study, a formal permission from the Institutional Ethical Committee was obtained. The study included 100 right and 100 left foetal knee joints from 100 fetuses without musculoskeletal system anomalies. The age of the foetus was determined from the crown-rump length (CRL) and obstetrical history, and fetuses ranged from 14 to 37 weeks of gestation (Table 1). Each knee was taken as a separate sample and not as one of a pair of samples in a fetus. All specimens were preserved in 10% formaldehyde solution. Skin of the knee joints with fibrous capsule and the ligamentum patellae was cut along with the collateral ligaments. The anterior and the posterior cruciate ligaments were also cut and tibial plateau were exposed. The morphological variants of the shapes of the lateral and the medial menisci were macroscopically noted and classified. The menisci were subgrouped as C shaped, U shaped, V shaped, crescentic and incomplete discoïd. Discoïd meniscus was classified according to Watanabe et al where if the meniscus occupied more than 80% of the tibial plateau it is considered as complete type and less than 80% but wider than usual is called as incomplete type and as a Wrisberg ligament.¹⁰

Description of Meniscus

Discoïd Meniscus

When the meniscus covers the tibial plateau circularly, the meniscus is said to be discoïd type.¹

Incomplete discoïd meniscus: The incomplete discoïd menisci had an open area at the centre of the menisci and they were all horseshoe shaped.³

Complete Discoïd Meniscus

The menisci which did not have any open area at the centre of the menisci were defined as the complete discoïd menisci.

Crescentic Meniscus

The menisci, which had thin anterior and posterior horns and a thin body, were defined as the crescentic (semilunar) type.

Sickle Shaped Meniscus

The menisci, which had thin anterior and posterior horns and a thick body, were defined as the sickle-shaped type.

Other Types

The menisci which resembled like sided U, sided V and C were named as sided U, sided V and C shaped, respectively.²

Age (in Weeks)	14-20	21-30	31-37
Number of foetuses	40	43	17

Table 1. Different Gestational Ages of the Foetus in the Study

RESULTS

From observations, five morphological types of the shape of menisci were determined. Observation on the Medial Meniscus (MM) found 79% were crescent shaped, 11% were C shaped, 7% were V shaped and 3% were incomplete

discoïd. (Table 2 and Figure 1-3). U shaped MM was not observed. No discoïd menisci were seen.

Shape	Total no. (Percentage)
Crescentic	79%
C-shaped	11%
V-shaped	7%
Incomplete Discoïd	3%
U- shaped	Nil

Table 2. Incidence of Different Shapes of Medial Menisci (n=200)

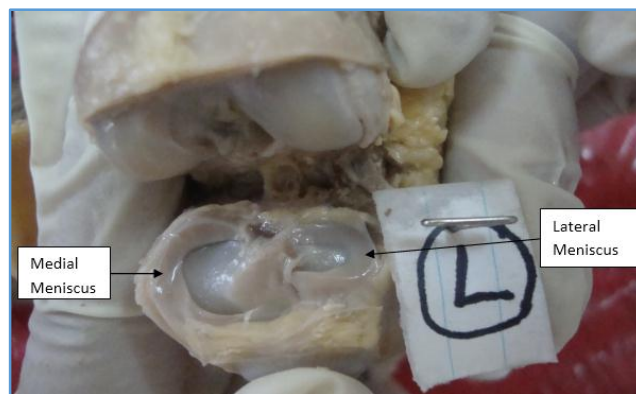


Figure 1. Left Tibial Plateau showing Crescent-shaped Medial Meniscus of a Foetus



Figure 2. Right Tibial Plateau showing V-shaped Medial Meniscus

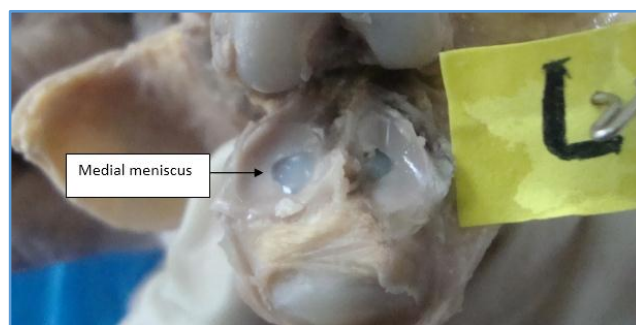


Figure 3. Left Tibial Plateau showing C-shaped Medial Meniscus

Among the Lateral Meniscus (LM), 56% were C shaped, 31% crescentic, 8% U-shaped and 5% were incomplete discoïd. (Table 3 and Figure 4-6). No complete discoïd meniscus was observed in our study.

Shapes	Total no. (Percentage)
C-shaped	56%
Crescentic	31%
U-shaped	8%
Incomplete discoid	5%
V-shaped	Nil

Table 3. Incidence of Different Shapes of Lateral Meniscus (n=200)

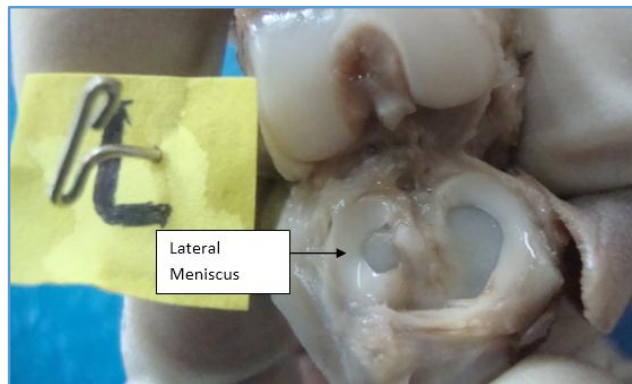


Figure 4. Right Tibial Plateau showing C-shaped Lateral Meniscus



Figure 5. Left Tibial Plateau showing U-shaped Lateral Meniscus

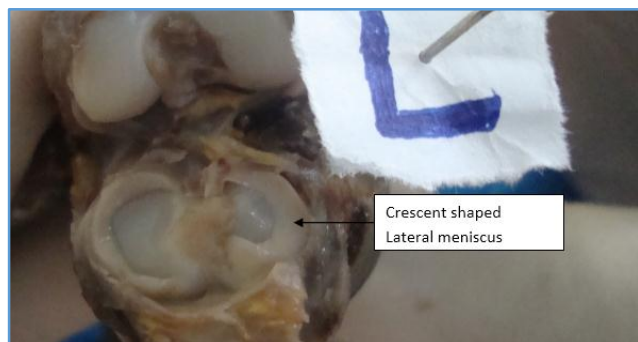


Figure 6. Left Tibial Plateau showing Crescentic Lateral Meniscus



Figure 7. Left Tibial Plateau showing Incomplete Discoid Lateral Meniscus. L - Lateral

DISCUSSION

The differences of the shape of meniscus may be due to the mesenchymal differentiation or to the development of the vasculature early in embryonic life.³ The meniscus arises from the differentiation of mesenchymal tissue within the limb bud and becomes a clearly defined structure by the eighth week of foetal development.¹¹ Variations of morphological differences of menisci can determine the possibility of an injury. However, the data related to the morphometric parameters of these structures are scarce.¹² There are marked differences in the contour and insertion between the lateral and the medial menisci which are important in relation to the injury mechanisms.¹³

Injuries to the meniscus are common in work, sports, everyday activities and can be disabling. Parsons noted that the medial meniscus always has a crescent shape but that the lateral meniscus may have either a crescent or a disc shape. In 1889, Young first described a discoid lateral meniscus in a cadaver specimen.¹⁴ The most common congenital abnormality of the meniscus in a man is a discoid meniscus with a frequency of 3% to 5% in the general population and slightly higher in Asian populations.¹⁵

Normal variants of the meniscus are relatively uncommon and are frequently asymptomatic, although there is a greater propensity for discoid menisci to tear. However, recognising these variants is important, as they can be misinterpreted for more significant pathology on MRI. The most common of these meniscal variants is the discoid lateral meniscus and the least common is complete congenital absence of the menisci. Normal variants of the meniscus include hypoplastic menisci, absent menisci, anomalous insertion of the medial meniscus, discoid lateral meniscus, including the Wrisberg variant and discoid medial meniscus.¹⁶ Anomalies of the meniscal shape have been reported in a man and are classified as hypoplasia or hyperplasia. The meniscal hyperplasias or discoid menisci, have been the object of many studies, because they are frequently the source of symptoms.¹³ Of the several reported congenital meniscal abnormalities, anomalous attachments of the meniscal horns and discoid menisci are the most frequent. They most frequently affect the lateral side of the knee. In 1967, first case of medial meniscal hypoplasia was reported. The association of simultaneous anomalies in the knee, in some cases is likely due to the common mesenchymal origin of some of these structures.¹⁷

There are reported cases of complete absence of the medial meniscus as described in thrombocytopenia-absent radius syndrome (TAR syndrome). The congenitally absent meniscus appears to influence the development of the distal femur and proximal tibia, the proximal medial tibia was convex and the distal medial femoral condyle was saddle shaped in these cases.¹⁸ A new case was reported of bilateral hypoplasia of the medial meniscus not in association with other knee anomalies in a young woman as a consequence almost all the medial tibial plateau surface was uncovered.¹⁹

Studies done by Brantigan et al²⁰ And Miller et al²¹ say that the medial meniscus is much larger in diameter and thinner at the periphery. Studies by Pollard et al²² and Shaffer et al²³ describe medial meniscus as semi-circular in shape with the posterior horn wider than the anterior horn. Study by Greis et al²⁴ mentions that medial meniscus is C shaped; posterior horn is larger than anterior horn in anteroposterior

dimension. Miller et al²¹ explained that the lateral meniscus is smaller in diameter, thicker about the periphery, and usually wider than medial.

In a study done by Gupta S et al,²⁵ medial meniscus was found to be crescent shaped (10%), U shaped (72%), sickle shaped (16%) and V shaped (2%). And, the lateral meniscus was subgrouped as C shaped (96%) and U shaped (4%). No discoid medial or lateral meniscus was found in the study.

Itagi V et al²⁶ found that in most of the specimens, the medial meniscus was crescentic in shape (96.66%). Commonest shape of the lateral meniscus was 'C' shape (88.33%). Incomplete lateral discoid menisci were observed in 5% of lateral meniscus. No complete discoid medial or lateral menisci were observed in specimens.

In a sample of 316 nonhuman primates, representative of 43 genera, the lateral meniscus morphology was studied. The lateral meniscus has a crescentic shape in Prosimii, in Platyrrhini (New World monkeys) and in Pongo pygmaeus. The lateral meniscus is disc-shaped, with a central foramen, in Catarrhini (Old World monkeys), in Hylobates, in Gorilla and in Pan troglodytes.²⁷

Kale et al³ observed in medial meniscus that 18.18% were crescentic, 22.72% V shaped, 9.09% U shaped, 36.36% sickle shaped and 13.63% C shaped. In lateral meniscus, they observed 13.63% crescentic, 9.09% C shaped, 77.27% discoid shaped (54.54% were incomplete discoid and 22.72% were complete discoid). Murlimanju BV et al² observed in medial meniscus that 50% were crescentic, 38.9% V shaped, 11.1% U shaped and in lateral meniscus 61.1% were C shaped and 38.9% crescentic. They did not observe any discoid meniscus. Murlimanju BV et al²⁸ also reported a complete type of discoid lateral meniscus, which was found on the left knee joint of an embalmed female foetal cadaver. On medial meniscus, most common finding was sickle shaped (36.36%) in Kale et al³, crescentic (50%) in Murlimanju BV et al² and crescentic (79%) in the present study. On lateral meniscus, the most common was incomplete discoid (54.54%) in Kale et al³, C shaped (61.1%) in Murlimanju BV et al² and C shaped (56%) in the present study. The finding of the present study is comparatively closer to the finding of Murlimanju BV et al.² The difference in the findings may be due to ethnicity of the study population.

Shape	Kale et al ³		Murlimanju BV et al ²		Present Study	
	Medial	Lateral	Medial	Lateral	Medial	Lateral
C-shaped	13.63	09.09	00	61.1	11	56
Crescentic	18.18	13.63	50	38.9	79	31
U-shaped	09.09	00	11.1	00	00	08
Incomplete discoid	00	54.54	00	00	03	05
Complete discoid	00	22.72	00	00	00	00
V-shaped	22.72	00	38.9	00	07	00
Sickle	36.36	00				

Table 3. Incidence of Different Shapes of Lateral Meniscus (n=200)

CONCLUSION

In the present study, the majority of the knees showed C-shaped lateral meniscus and crescent-shaped medial meniscus. Incomplete discoid lateral meniscus was observed in 8%. No total discoid meniscus was observed in the study. This study has provided further information on different

shapes of the medial and lateral meniscus especially the presence of incomplete lateral discoid menisci, which is a rare finding. This study is useful for the health professionals who work on the treatment of meniscal injuries to create an awareness of the anatomical variations that may exist in the menisci facilitating the rehabilitation process.

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