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MORPHOLOGY OF MENISCI OF KNEE JOINT IN ADULT CADAVERS OF NORTH KARNATAKA

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ABSTRACT

Introduction: The menisci are crescentic, intracapsular, fibrocartilaginous laminae deepening the articulation of the tibial surfaces that receive the femoral condyles forming the knee joint.

Objective: To assess the incidence of different shapes of the lateral and medial meniscus in north Karnataka population and discuss its clinical implications.

Methods: The cross sectional study included 120 menisci from 60 adult cadaveric knee joints which were preserved in 10% formalin. The morphological variants of the shapes of menisci were macroscopically noted and classified after methodical dissection procedure. The lateral menisci (LM) and medial menisci (MM) were classified as discoid and nondiscoid menisci. Further, the discoid menisci were divided into subgroups as the complete and incomplete discoid menisci. The nondiscoid menisci were subgrouped as crescentic (semilunar) shaped, C shaped, sickle shaped, sided U shaped and sided V shaped.

Results and Conclusion: From our observations, 96.66% of medial menisci were cresentic in shape, 1.66% showed sided V shaped and 1.66% showed sickle shape. Among the lateral menisci 88.33% were C shaped, 6.66% sided U shaped and 5% showed incomplete discoid. This study is useful for the health professionals who work with the treatment of meniscal injuries to create an awareness of the anatomical variations that may exist in the menisci facilitating the rehabilitation process.

Key Words: Discoid, Knee, Lateral meniscus, Medial meniscus, Shape

INTRODUCTION

Menisci are semicircular shaped fibrocartilagenous structures with bony attachments at the anterior and posterior aspects of tibial plateau and are wedged between the femoral condyles and the tibial plateau on the medial and lateral sides of the knee.[1] The knee joint is considered the largest articulation in the body. It is a double condyloid joint with 20° of freedom of motion. The condyles of the femur rest in unequal manner on the shallow concave surface of the tibia, therefore the knee joint depends on other structures to provide both static and dynamic stability which are achieved by a variety of soft tissue structures such as the medial and lateral collateral ligaments, anterior and posterior cruciate ligaments, the menisci, the capsule and the muscles crossing the joint.[2, 3] The functions of the meniscus include load transmission, shock absorption, stress reduction, improve joint stability, limit to extreme flexion and extension, proprioception, joint lubrication and nutrition.[4]

With the advent of new techniques such as arthroscopy, computed tomography and magnetic resonance imaging, the anatomical abnormalities and variations of the intraarticular structures of the knee joint have become important.[5] Long term complications of removal of a meniscus include cartilage degeneration and bone remodeling, this discovery changed considerably the therapeutic approach to this common work or sports injury.[6] 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.[7] Hence this study was undertaken with the objective to estimate the incidence of different shapes of the medial and lateral meniscus and discuss its clinical implications in the north Karnataka population.

MATERIAL AND METHODS

For this study, 120 menisci from 60 human knees, 29 right and 31 left, previously dissected and preserved with

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a solution of 10% formalin were used. Since the knee joints were removed from the cadavers thus presenting an isolated knee joint, it was not possible to determine whether the knees were from the same or different cadavers nor to determine other aspects related to weight, sex and height, even though these factors may influence certain anatomical variations. All cadaveric limbs available in the Department of Anatomy of J. N. Medical College during the study period were included in the study. Cadaveric lower limbs with abnormal knee joints such as deformity, exostosis, fractures or traumatic injury and all menisci that showed any structural change which prevent its morphological assessment such as injuries or advanced degenerative changes were excluded.

After the dissection of skin and muscles, the approach to the menisci was performed. The joint cavity was opened, anteriorly by a longitudinal incision on each side of the joint capsule and cutting the patellar ligament and the collateral ligaments transversely. In order to expose the menisci clearly, the joint capsule and the intraarticular ligaments were cut, and the condyles were circumferentially detached from their soft tissue attachments and removed, exposing the tibial plateau. The anterior intermeniscal ligament, if present, was then identified, either within or overhung by the retropatellar fat pad. [8] All dissections were performed in a systematic fashion and data were recorded on a standardized collection sheet.[9, 10] To minimize the error two observations were made by two authors.

Morphological variants of the shapes of the menisci were macroscopically noted and classified. The lateral menisci (LM) and medial menisci (MM) were classified as discoid and nondiscoid menisci. Further, the discoid menisci were divided into subgroups as the complete and incomplete discoid menisci. The nondiscoid menisci were subgrouped as crescentic (semilunar) shaped, C shaped, sickle shaped, sided U shaped and sided V shaped.

When the meniscus covers the tibial plateau circularly, the meniscus is said to be discoid type. [11] The incomplete discoid menisci had an opened area at the centre of the menisci and they were all horse shoe shaped.[9] The menisci which did not have any opened area at the centre of the menisci were defined as the complete discoid menisci. The menisci, which had thin anterior and posterior horns and a thin body, were defined as the crescentic (semilunar) type. The menisci, which had thick anterior and posterior horns and a thick body, were named as the thick horse shoe shaped type. The menisci, which had thin anterior and posterior horns and a thick body, were defined as the sickle shaped type. The menisci which resembled like sided U, sided V and C were named as sided U, sided V and C shaped, respectively. [12]

RESULTS

Study was done on 60 knee joints. In which 29 (48%) belonged to right knee joint and 31 (52%) were of left knee joint. In our study six morphological types of the shape of menisci were determined (Table 1). It was observed that 96.66% of medial menisci were cresentic shaped, 1.66% showed sided V shaped and 1.66% showed sickle shape. Among the lateral menisci 88.33% were C shaped, 6.66% sided U shaped and 5% showed incomplete discoid (Fig. 1).

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.[9] The meniscus arises from the differentiation of mesenchymal tissue within the limb bud and becomes a clearly defined structure by the eighth week of fetal development.[13] 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.[14] 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.[15]

Study on 22 fetal knee joints, reported that 73% of the cadavers they studied had the same shape of meniscus on each side. According to their observations, medial menisci showed 18.18% (crescent-shaped), 22.72% (sided V-shaped), 9.09% (sided U-shaped), 36.36% (sickle-shaped) and 13.63% (C- shaped). Discoid medial meniscus was not observed. In the same study, 13.63% of the LMs were crescent-shaped, 9.09% (C-shaped) and 77.27% (discoid-shaped). Among the discoid shaped 54.54% of the LMs were incomplete discoid and 22.72% were completely discoid.[9]

Normal variants of the meniscus are relatively uncommon and are frequently asymptomatic, although there is a greater propensity for discoid menisci to tear. However, recognizing 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 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.[15]

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.[16,18] 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]

Anomalous insertion of the medial meniscus (AIMM) has been illustrated and it is into the anterior cruciate ligament. The anomalous insertion passes from the anterior horn of the medial meniscus to either the mid or base of ACL or the intercondylar notch. The insertion site of the AIMM into the ACL is classified as Type 1 (inferior third), Type 2 (middle third), or Type 3 (superior third; intercondylar notch). The incidence AIMM with discoid MM is greater than with discoid LM.[16,20] A study reported a rare anatomical aberration case of double-layered lateral meniscus, where an accessory proximal hemimeniscus was overlying the body and posterior horn of the lateral meniscus in a male of Indian origin.[21] Although both menisci have been reported to have discoid shape, lateral tends to be more common than the medial meniscus. Bilateral lateral meniscus involvement is rare and co-existence of both medial and lateral discoid menisci in the same knee has been reported only twice.[22] One documented instance of familial transmission (father and two of his four children) of discoid meniscus was reported.[23] A case reported in Scotland where the discoid meniscus patient's daughter also had an abnormality of knee suggesting the inheritance playing a part in its transmission.[24]

Two cases with abnormal band of lateral meniscus, which were serpentine shaped and narrower than the accessory meniscus were reported.[25] A case gives description of a ring-shaped meniscus on the lateral side of the human knee without any other associated malformation. The rounded uniform rim with no evidence of a tear of that meniscus suggests that this finding is congenital in origin.[26]

The most frequently encountered abnormal meniscal variant in children is discoid meniscus.[27] Discoid lateral meniscus is more common among Asians than that among Caucasians. The incidence of discoid meniscus ranges from 0.4% to 17% for the lateral and 0.06% to 0.3% for the medial side.[28] It is still debatable whether this anatomic derangement necessarily leads to abnormal function or susceptibility to injury. The issue is complicated by the fact that several variants of the discoid meniscus have been described and that there is a continuous range of variation between normal, C-shaped menisci and those that extend completely across the lateral or medial joint space. Stable discoid meniscus is often an incidental finding in asymptomatic patients, which can become symptomatic in the presence of a tear. The most common tear pattern is the degenerative horizontal cleavage, that can result in pain, swelling and snapping of the affected knee. The abrupt change in the rapport between the meniscus and the femoral and tibial condyles leads to a snap sound.[28]

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 Platyrrhinii (New World monkeys) and in Pongo pygmaeus. The lateral meniscus is disc-shaped, with a central foramen, in Catarrhinii (Old World monkeys), in Hylobates, in Gorilla and in Pan troglodytes. [29]

CONCLUSION

From our study we can conclude 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. This study has provided further information on different shapes of the medial and lateral meniscus especially the presence of incomplete lateral discoid menisci in adults which is a rare finding. This study is useful for the health professionals who work with 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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Table 1: Incidence of different shapes of Medial and Lateral menisci in adults (n = 60)

SHAPES OF MEDIAL MENISCI	NUMBER OF SPECIMEN	INCIDENCE PERCENTAGE(%)
Cresentic	58	96.66
Sided V Shaped	1	1.66
Sickle Shaped	1	1.66
SHAPES OF LATERAL MENISCI		
C Shaped	53	88.33
Sided U shaped	4	6.66
Incomplete Discoid	3	5

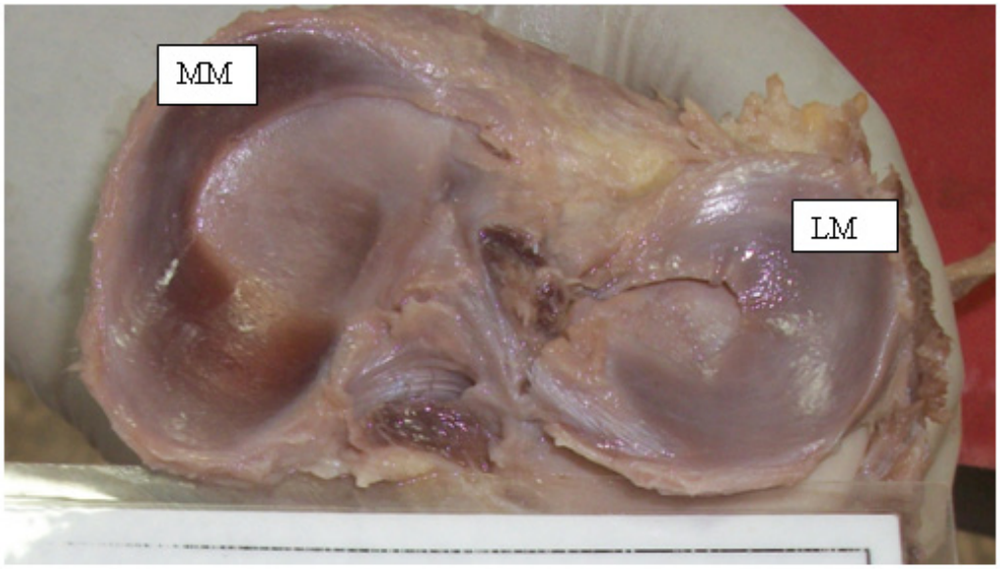

Figure 1: Incomplete discoid lateral meniscus of left knee joint.