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Original Research Article

MORPHOMETRY OF LATERAL MENISCUS: A CADAVERIC STUDY

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ABSTRACT

The objective of present study was done to provide a base line data of morphometric parameters of lateral meniscus. Variations of length and width of lateral meniscus may help to determine the possibility of injury of lateral meniscus. 100 normal lateral menisci were obtained during routine cadaveric dissection of knee joints. The inner circumference, outer circumference and width of right, left and total meniscus were tabulated. Lateral and medial meniscus act as cushions in legs. The lateral and medial menisci are important articular elements of knee joint, performing functions, like weight bearing, shock absorption. Their function is stabilization in every plane but they have important role in rotational movement.

KEY WORDS: Menisci, Knee joint, Articulation, Articular, Lateral meniscus.

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INTRODUCTION

Fibrocartlaginous discs are present in various synovial joints of body where they provide stability, lubrication, nutrition, shock absorption and thus facilitate the movements of these joints. A meniscus is crescent shaped fibrocartilaginous disc that partially divide the joint cavity, unlike other articular discs which completely separate the joint cavity. They are semi-lunar crescent shaped fibro-cartilages which serve to widen and deepen the tibial articular surfaces and thus provide structural integrity to the knee when it undergoes tension and torsion. Knee joint has a medial and lateral meniscus that absorbs stress and act as cushions between the bones at the knee. There are many differences in the anatomical features and insertion between the lateral and the medial menisci [1].

The menisci are considered main elements for a perfect articulation among the articular osseous surfaces of knee joint, performing, mechanical functions, such as supporting the

corporal weight, shock absorption, stabilization and rotational facilitation [2]. Their function is stabilization in every plane but they have important role in rotational movement [3].

The contour of the menisci varies from C - shaped (semicircular) to circular (Discoid). Variations of form, thickness and width of menisci can determine the possibility of injury. Since the menisci perform important mechanical functions, they are anatomical structures which are exposed to injury. The lesions may occur as part of a rotational trauma or bending or they may occurs as the evolution of a joint degenerative process, or an injury. Spontaneous injury may result from progressive structural failure without any correlation with trauma or a degenerative process. The latter is called meniscal injury due to fatigue. Whatever be the trigger for the injury, the morphology of lateral meniscus can be closely related to the injuries of lateral meniscus [4]. If need arise they can be replaced once injured. Replacement by arthroproper size of allograft is important. In knee joints with improper sized menisci, arthr meniscus can get damaged in isolation or along with the ligaments surrounding them i.e. anterior cruciate ligament and medial collateral ligament.

Due to lack of literature and experience regarding function of meniscus, it is removed from injured knee. After removing meniscus, there is increase in degenerative osteoarthritis. To reduce degenerative osteoarthritis, meniscus allograft was done after its sizing [5].

Keeping this in mind, during routine cadaveric dissections in the dissection hall, knees were opened to expose menisci and dimensions of lateral menisci were taken in freshly dissected knee joint. Based on general anatomy, the morphometric measurements of lateral meniscus of knee joint i.e. length of the outer circumference, length of inner circumference and width were taken for this study.

The lateral meniscus is more circular and accommodates the narrower lateral tibial plateau. The lateral meniscus is more circular and accommodates the narrower lateral tibial plateau. Inspite of smaller than medial meniscus, it covers greater area of lateral tibial plateau. However, it has more variability than medial meniscus in respect of size, shape, thickness and mobility.

Only the peripheral 20% to 30% of the menisci are vascularised and are supplied by the medial and lateral geniculate arteries [6].

MATERIALS AND METHODS

The study was conducted on 100 lateral menisci of knee joints dissected in the Department of Anatomy, Govt. Medical College, Patiala and at Gian Sagar Medical College & Hospital, Banur, to obtain baseline data of lateral meniscus for morphometric parameters and to correlate the site of injury with width of meniscus.

During routine cadaveric dissections, knee joints of cadavers were dissected out to procure the material for the study i.e. 100 grossly normal looking lateral menisci, out of 100, 53 were obtained from right and 47 were obtained from the left knee joints.

Exclusion: The menisci with an altered anatomy on gross appearance were not included in the study. Also the menisci which were dried and not in fresh state were not included.

The following parameters were recorded for the 100 apparently normal lateral menisci

1) inner circumference

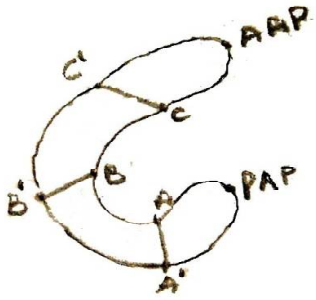
2) outer circumference

3) width(three segments) i.e anterior ,middle and posterior.

Method of taking circumference: Two points were marked on each lateral meniscus, one point on the anterior cornu called anterior apical point(AAP) and a second point on the

Fig. 1: Showing measurement of inner and outer circumference of lateral meniscus.

Fig. 2: Method of taking measurements of circumference and width of lateral meniscus.



posterior cornu called posterior apical point (PAP). The concave length (inner circumference) and convex length (outer circumference) of each lateral meniscus was measured from anterior apical point (AAP) to the posterior apical point (PAP) by a non-stretchable silk thread.

Method of taking width: The inner and outer circumferences were divided into four equal parts indicating 3 points on each circumference i.e. A,B and C on the inner circumference(IC) and A',B 'and C' on the outer circumference(OC). It divided each meniscus into four equal parts by three lines i.e. AA', BB' and CC'. Then the widths of the lateral meniscus at these three lines i.e. AA', BB', CC' were measured.

The data so obtained was collected, recorded, and tabulated & subjected to statistical analysis using student t test and p value was calculated of each parameter to know the statistical significance if any.

Each measurement were taken thrice to decrease observer errors. The results obtained were tabulated and analysed.

RESULTS

The measurement obtained on these lateral menisci are presented as under-:

MEASUREMENTS OF CIRCUMFERNCE

Table 1: Length of Inner circumference (in cm).

Rt lateral meniscus		Lt lateral meniscus		Total (Right & Left)	
Range	Mean±S.D	Range	Mean±SD	Range	Mean ± S. D.
2.4-6.8	5.2±0.8	3.8-6.7	5.48±0.6	2.4 – 6.8	5.37 ± 0.7

Table 2: Length of outer circumference (in cm).

Right		Left		Total	
Range	Mean±SD	Range	Mean±SD	Range	Mean ± SD
8-Dec	9.72±0.9	8.4-11.3	9.76±0.7	8-Dec	9.74 ± 0.8

MEASUREMENTS OF WIDTH IN SEGMENTS

Table 3: Measurement of width of Anterior segment (in cm).

Rt lateral meniscus		Lt lateral meniscus		Total(Right & Left)	
Range	Mean±SD	Range	Mean±SD	Range	Mean ± S. D.
0.7-1.5	1.0±0.2	0.8-1.4	1.05±0.1	0.7-1.5	1.05 ± 0.1

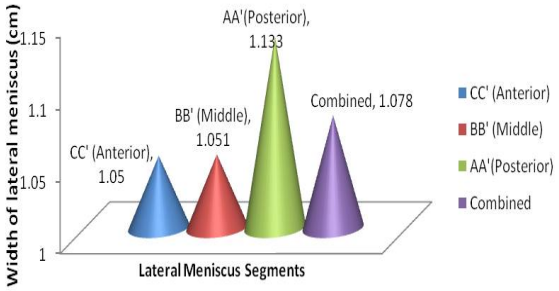
Table 4: Measurement of width of Middle segment (in cm).

Rt lateral meniscus		Lt lateral meniscus		Total(Right & Left)	
Range	Mean±S.D	Range	Mean±SD	Range	Mean ± S. D.
0.7-1.7	1.06±0.2	0.7-1.3	1.03±0.1	0.7-1.7	1.051 ± 0.202

Table 5: Measurement of width of Posterior segment (in cm).

Rt lateral meniscus		Lt lateral meniscus		Total(Right & Left)	
Range	Mean±S.D	Range	Mean±SD	Range	Mean ± S. D.
0.7-2.1	1.17±0.2	0.7-1.6	1.09±0.1	0.7-2.1	1.133 ± 0.245

Fig. 3: Showing mean of width of segments of Lateral Meniscus (cm).



It was concluded that the posterior segment is widest segment of the lateral meniscus followed by middle and anterior segment.

Table 6: Average width of menisci irrespective of segments (in cm).

Rt lateral meniscus		Lt lateral meniscus		Total(Right & Left)	
Range	Mean±S.D	Range	Mean±SD	Range	Mean ± S. D.
0.7-1.7	1.0±0.2	0.7-1.4	1.05±0.1	0,7-2.1	1.078±0.212

DISCUSSION

The results obtained from the present study were compared with the result obtained from earlier studies.

All the parameters taken by the authors who

have worked on lateral meniscus were not same as of present study, but where ever possible we have tried to compare the result with data obtained earlier.

Table 7: Comparison of inner and outer circumference of lateral meniscus with previous studies.

Authors	INNER CIRCUMFERENCE (in cm)	OUTER CIRCUMFERENCE (in cm)
PRESENT STUDY	5.37 ± 0.7	9.74 ± 0.8
CHINTAN et al. (2014) [2]	-	9.53±0.8
MURLIMANJU et al.(2012) [7]	5.06±0.5	9.02±0.9
BRAZ et al. (2010) [4]	-	9.28±0.7

In the present study minimum and maximum length of inner circumference in left lateral meniscus was 3.8 and 6.7 cm, and in right lateral menisci was 2.4 and 6.8 cm and for both sides taken together was 2.4 and 6.8 cm. The mean length of inner circumference was 5.483 ± .694 cm for left lateral meniscus and 5.248 ± 0.875 cm for right lateral meniscus. There was no statisticaly significant difference observed between the two sides. Total mean length for both sides taken together was 5.370 ± 0.789 cm.

Murlimanju et al [7] mentioned that the total mean length of inner circumference of lateral meniscus irrespective of the side was 5.063 ± 0.533 cm which is almost similar to present study.

In the present study minimum and maximum length of the outer circumference in left lateral menisci was 8.4 & 11.3 cm, and in right lateral menisci was 8 & 12cm and the total mean length of both the sides taken together was 8 & 12 cm respectively.

The mean length of the outer circumference was 9.767 ± 0.747 cm for left lateral meniscus, 9.724 ± 0.963 cm for right lateral meniscus and the total mean length taken for both sides was 9.746 ± 0.851 cm. The measurements obtained from present study are almost similar to the those by Braz et al (90) and Chintan et al but are slightly less than those obtained by Murlimanju et al .

In the present study, width of lateral meniscus were measured in three different points i.e anterior, middie and posterior third. The mean width of left lateral meniscus at anterior segment (CC') was 1.056, Middle segment (BB') was 1.035 and at Posterior (A A') segment was 1.090. For right lateral meniscus the range of the width observed at anterior (CC') was 1.084, Middle (BB') 1.068 and Posterior (AA') segment 1.179 cm.

The mean width of lateral menisci at CC'(anterior segment) was 1.050+0.178, BB' (Middle segment) was 1.051 ± 0.202 and at AA' (posterior segment) was 1.133 ± 0.245 indicating that posterior part is widest segment followed by middle and anterior segments. However by using Student t-test, no significant difference in width between of three points discussed was observed.

The results of present study are in accordance with earlier studies done by Dhanjaya et al [8] (36); Braz et al (90) and Erbaggi et al [9] (89). As in present study these studies also showed that the posterior third was the widest part of lateral meniscus but While Chintan and Almedia mentioned that middle segment was the widest part.

Table 8: Comparison of width of three segments (in cm).

AUTHOR	MEAN WIDTH OF TOTAL SEGMENTS TAKEN TOGETHER		
	Anterior	Middle	Posterior
PRESENT STUDY	1.05	1.05	1.13
CHINTAN et al. (2014 [2]	1.13	1.16	1.15
DHANJAYA et al. (2013) [8]	1.18	0.86	1.2
BRAZ et al. (2010) [4]	1.13	1.11	1.16
ALMEDIA et al (2004) [9]	1.18	1.19	1.14
ERBAGCI et al (2004) [10] on MRI	0.88	0.83	0.97

Table 9: Average width of lateral meniscus (in cm).

SR NO.	AUTHOR	AVERAGE WIDTH
1	Present Study	1.078
2	Almedia et al. (2004) [9]	1.176
3	Testut And Laterjet (1975) [11]	1.2 -1.3
4	Cailliet et al. (1976) [12]	1.2 -1.3
5	Hayashi et al. 1988 [13]	1.2-1.3
6	Motta et al. 1999 [14]	1.2
7	Braz et al 2010 [4]	1.138

The average width irrespective of segments of lateral meniscus was 1.078 ± 0.212 cm which is slightly less, but almost similar to those in previous studies.

These slight variations in data may be because of different methods of taking the readings,

observer errors or different instruments used for taking the readings. During this study all the efforts were made to decrease or minimise these errors. The populations on which these studies were taken were from different ethnic groups. Also the lifestyles of the persons whose lateral menisci were taken for studies might have been different which might be responsible for the slight differences in the obtained data.

It is known that the menisci are expendable structures; they have an integral role in normal knee joint mechanics. The physician treating a patient with a known or suspected meniscal tear needs to understand the structure and function of the meniscus and the factors involved in treating the patient with non-operative versus operative treatment. It can be assumed that the wider the meniscus, more susceptible it is to meniscal injuries. Such assumption could be justified by the fact that the greater the width of the meniscus, the more it is exposed to the actions of the femoral condyles [13]. Therefore, health professionals who treat the meniscal injuries should be aware of the possible anatomical variations that may exist in the meniscus, thus facilitating the rehabilitation process.

In USA meniscal injuries is one of the most common surgically treated knee injury. Meniscal injuries are more common in males as compared to females, irrespective of age. With increasing age meniscal tears are predominately degenerative and are commonly caused by daily activities like squatting or deep knee flexion. In younger patients, sports injuries are responsible for up to one third of meniscal tears and are primarily causative force is twisting or cutting movements, hyper flexion or trauma. Lateral meniscus tears are more common in patient with concomitant acute anterior cruciate (ACL) ligament injury [15].

The medial meniscus is more commonly injured than lateral meniscus. McMurray's test is used for diagnosing lateral meniscus tear.

. If a tear is detected, treatment depends on the type and size of the tear. Small tears can be treated conservatively. More severe tears of the lateral meniscus require surgical repair or removal, which are usually arthroscopically [16].

The difference in width and thickness of menisci may tell location and kind of injury. The narrow meniscus is less prone to ruptures than the wide because the narrow meniscus is liable to a less action of femoral condyle. In our study, the posterior third of lateral meniscus, was the widest part. So it is the part which is maximum prone to injury in our population. Also the data obtained may be of help to orthopaedician to decide the size of arther grafts that need to be prepared for replacement of lateral meniscus.

Conflicts of Interests: None

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