

Morphometric Analysis of the Menisci - A Cadaveric Study from a Teaching Hospital in Andhra Pradesh

Dr A. N. V. V. Veerraju¹, Dr.D.A.V.S.Sesi², Dr.K.Deepika³, Mrs.V.Vinila⁴

¹Associate professor, Department of Anatomy, Konaseema Institute of Medical sciences and Research foundation, Amalapuram.

²rofessor and Head , Department of Anatomy, Rangaraya Medical College, Kakinada

³Assistant professor, Department of Anatomy, Rangaraya Medical College, Kakinada

⁴Assistant professor, Department of Anatomy, Konaseema Institute of Medical sciences and Research foundation, Amalapuram

Abstract

BACKGROUND

This study was intended to conduct a morphometric analysis of the both the menisci of the knee joint. Which are comparatively more commonly prone to injury in knee joint during accidents.

METHODS

The present study was conducted on 50 adult human cadavers (29 males and 21 females) from the department of Anatomy, Rangaraya Medical College, Kakinada and department of Anatomy, Andhra Medical College, Visakhapatnam which were allotted to undergraduate students for their routine dissection.

RESULTS

The mean distance between the two horns of medial meniscus was 3.30cm in males and 3.01cm in females. The average width of the anterior, middle, and posterior 1/3rd of the medial meniscus was 0.86cm, 0.84cm and 1.56cm respectively in males and it was 0.83cm, 0.85cm and 1.43cm respectively in females. The mean thickness of the anterior , middle and posterior 1/3rd of the medial meniscus was 0.56cm, 0.57cm and 0.55cm respectively in males and it was 0.53cm, 0.54cm and 0.54cm respectively in females.

CONCLUSION

In the present study it was found that in both medial and lateral menisci maximum thickness was found at middle 1/3rd and it was the main point prone to greatest tension, and frequently prone to injury. The middle 1/3rd thickness of medial meniscus was less when compared with middle 1/3rd thickness of lateral meniscus.

Key words: Morphometric Analysis, Menisci.

Introduction

Menisci are the important anatomical structures in knee joint to perform mechanical functions and are most commonly prone to injury. These injuries can occur as of various injuries like bending, rotational trauma or as a part of progressive or senile degenerative process of knee joint, or as a sudden injury resulting in the structural damage. If it occurs because of sudden injury it was called as meniscal injury due to fatigue.

As there are significant differences present in the insertion and contour of the medial and lateral menisci ,which are mainly concerned in the mechanism of injury (Almeida, De Moraes, Tashimiro et al., 2004).^[1]

Aim of the Study

Morphometric analysis of both the lateral and medial menisci of the knee joint.

Methods

The present study was conducted among 50 adult human cadavers (29 males and 21 females) present in the department of Anatomy, Rangaraya Medical College, Kakinada and department of Anatomy, Andhra Medical College, Vishakhapatnam which were allotted to undergraduate students for their routine dissection. In total, 100

knee joints of lower limbs were dissected and studied and the specimens were recorded by taking photographs. The museum specimens available in the departments of anatomy, Rangaraya Medical College, Kakinada and Andhra Medical College, Visakhapatnam were also observed and studied. The photographs obtained from the departments of Orthopedics and Radiology, Government General Hospital, Kakinada were also used for the study. Permission was obtained from the Institutional ethical committee to conduct the present study.

Statistical Analysis

Date was entered in MS Excel and analyzed using SPSS software. Results were presented as tables.

Results

Medial Meniscus:-

In all the 100 knee joints, the structure of medial meniscus studied. The shape, alignment and attachments of it was in conformity with the standard text book description and there were no variations observed in all these features.

	Right			Left		
	Distance between horns (cm)	Outer Margin(cm)	Inner Margin(cm)	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)
Maximum	4.10	9.60	6.40	4.00	9.40	6.40
Minimum	3.00	8.60	4.40	3.00	8.60	4.60
Mean	3.29	8.96	5.22	3.31	8.97	5.28
Median	3.20	8.90	5.30	3.20	9.00	5.30
Mode	3.20	8.90	5.50	3.20	9.00	5.40
Standard Deviation	0.322	0.274	0.538	0.290	0.236	0.498
<i>Distance between Two Horns, Outer Margin and Inner Margin of the Medial Meniscus in Males</i>						
	Right			Left		
	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)
Maximum	3.30	9.10	5.5	3.30	8.80	5.60
Minimum	2.70	7.80	3.9	2.80	7.80	4.00
Mean	2.98	8.23	4.68	3.04	8.16	4.69
Median	3.00	8.20	4.80	3.00	8.20	4.70
Mode	3.00	8.20	4.90	3.00	8.20	4.80
Standard Deviation	0.188	0.343	0.424	0.150	0.269	0.411
<i>Distance Between Two Horns, Outer Margin and Inner Margin of the Medial Meniscus in Females</i>						

Table 1

Distance between Two Horns:-

The distance between the anterior and posterior horns is measured. The mean distance between the two horns of the medial meniscus in males on the right side was 3.29cm and on the left side was 3.31cm.

The mean distance between the two horns of the medial meniscus in females on the right side was 2.98cm and on the left side was 3.04cm.

Outer Margin Length:-

The length of the outer margin of the medial meniscus was measured. The mean length of the outer margin of the medial meniscus in males on the right side was 8.96cm and on the left side was 8.97cm.

The mean length of the outer margin of the medial meniscus in females was 8.23cm on the right side and was 8.16cm on the left side.

Inner Margin Length:-

The length of the inner margin of the medial meniscus was measured. The mean length of the inner margin of the medial meniscus in males on the right side was 5.22cm and on the left side was 5.28cm.

The mean length of the inner margin of the medial meniscus in females was 4.68cm on the right side and was 4.69cm on the left side.

	Right			Left		
	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)
Maximum	1.1	1.00	2.10	1.02	1.00	2.00
Minimum	0.62	0.62	1.20	0.72	0.68	1.30
Mean	0.85	0.83	1.58	0.87	0.84	1.54
Median	0.82	0.86	1.60	0.85	0.82	1.50
Mode	0.80	0.82	1.60	0.80	0.82	1.40
Standard Deviation	0.120	0.106	0.235	0.089	0.100	0.197
Study of Width of the Medial Meniscus in Males						
	Right			Left		
	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)
Maximum	1.00	1.02	1.80	1.00	1.00	1.80
Minimum	0.65	0.67	1.20	0.66	0.72	1.30
Mean	0.82	0.85	1.40	0.83	0.85	1.47
Median	0.85	0.86	1.40	0.83	0.86	1.40
Mode	0.85	0.82	1.40	0.88	0.86	1.40
Standard Deviation	0.096	0.093	0.155	0.088	0.070	0.148
Study of Width of the Medial Meniscus in Females						

Table 2

Medial Meniscus Width :

The medial meniscus width was studied at three parts, namely anterior , middle and posterior parts.

In males ,the average width of medial meniscus anterior 1/3rd on the right side was 0.85cm and on the left side was 0.87cm.

In males ,the average width of medial meniscus middle 1/3rd on the right side was 0.83cm and on the left side was 0.84cm.

In males ,the average width of medial meniscus posterior 1/3rd on the right side was 1.58cm and on the left side was 1.54cm.

In females ,The average width of the anterior 1/3rd of medial meniscus on the right side was 0.82cm and on the left side was 0.83cm.

In females ,The average width of the middle 1/3rd of medial meniscus on both sides was 0.85cm.

In females ,The average width of the posterior 1/3rd of medial meniscus on the right side was 1.40cm and on the left side was 1.47cm.

From the above findings, It was observed that in both genders the posterior 1/3 part of the medial meniscus was wider when compared to anterior 1/3 and middle 1/3 parts.

	Right			Left		
	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)
Maximum	0.65	0.72	0.68	0.64	0.72	0.62
Minimum	0.45	0.52	0.48	0.48	0.52	0.50
Mean	0.55	0.58	0.55	0.56	0.57	0.55
Median	0.55	0.57	0.56	0.56	0.56	0.54
Mode	0.55	0.58	0.56	0.56	0.56	0.56
Standard Deviation	0.055	0.060	0.054	0.045	0.039	0.033
Study of Thickness of the Medial Meniscus in Males						
	Right			Left		
	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)	Anterior 1/3 (cm)	Middle 1/3 (cm)	Posterior 1/3 (cm)

Maximum	0.62	0.60	0.62	0.62	0.60	0.60
Minimum	0.43	0.49	0.50	0.43	0.52	0.50
Mean	0.53	0.54	0.55	0.53	0.54	0.53
Median	0.52	0.54	0.54	0.52	0.54	0.53
Mode	0.50	0.54	0.56	0.48	0.54	0.52
Standard Deviation	0.060	0.038	0.033	0.059	0.023	0.028

Study of Thickness of the Medial Meniscus IN Females

Table 3

Medial Meniscus Thickness:

The mean thickness of the medial meniscus was studied as three parts namely anterior 1/3, middle 1/3 and posterior 1/3.

The mean thickness of the anterior 1/3 in males was 0.55cm on the right side and 0.56cm on the left side.

The mean thickness of the middle 1/3 in males was 0.58cm on the right side and 0.57 on the left side.

The mean thickness of the posterior 1/3 in males was 0.55cm on the both right and left sides.

The mean thickness of the anterior 1/3 in females was 0.53cm on the both right and left sides.

The mean thickness of the middle 1/3 in females was 0.54cm on both right and left sides.

The mean thickness of the posterior 1/3 in females was 0.55cm on the right side and 0.53 on the left side.

It is observed from the above findings that the thickness of the middle 1/3 is slightly more than the anterior 1/3 and posterior 1/3 parts of the medial meniscus.

Study of Shape of the Medial Meniscus

The medial meniscus present in various shapes like crescentic, sided V, sided U, sickle and C-shape. In the present study, 46 were of crescentic shape, 24 were of sided V shape, 14 were of sided U shape, 11 were of C-shape and 5 were of sickle shape, Discoid shape was not observed.

Lateral Meniscus

In all the 100 knee joints, the lateral meniscus was studied. The lateral meniscus arrangement and attachments of are in common with the description of standard text books and we didn't observe any variations.

The anterior horn of lateral meniscus is attached anteriorly in the intercondylar eminence. The anterior cruciate ligament is attached anteromedial to the attachment of anterior horn. The posterior horn of lateral meniscus is attached posteriorly in the intercondylar eminence the posterior horn attachment is anterior to the attachment of the medial meniscus posterior horn. The lateral meniscus peripheral margin is attached to the capsule of knee joint entirely except at the presence of the tendon of popliteus which is in posterolateral aspect.

	Right			Left		
	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)
Maximum	1.80	9.90	5.40	1.60	9.90	5.40
Minimum	0.90	8.10	3.40	1.10	8.40	3.60
Mean	1.41	8.90	4.71	1.40	8.90	4.75
Median	1.30	8.60	5.00	1.40	8.80	5.00
Mode	1.30	8.40	5.00	1.40	8.80	5.00
Standard deviation	0.271	0.653	0.554	0.153	0.491	0.501

Study of Distance between Two Horns, Outer Margin and Inner Margin of the Lateral Meniscus in Males

	Right			Left		
	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)	Distance between horns(cm)	Outer Margin(cm)	Inner Margin(cm)
Maximum	1.30	9.10	4.70	1.40	9.2	4.60
Minimum	0.80	7.80	3.40	0.80	7.8	3.40
Mean	1.07	8.48	3.99	1.07	8.51	4.00
Median	1.10	8.60	4.00	1.10	8.60	4.00
Mode	1.20	8.70	3.80	1.00	8.80	4.00

Standard deviation	0.155	0.499	0.437	0.149	0.461	0.346
Study of Distance between Two Horns, Outer Margin and Inner Margin of the Lateral Meniscus in Females						
Table 4						

Distance between the two Horns

The distance between the anterior and posterior horns of the lateral meniscus is measured. The mean distance between the two horns in males was 1.41cm on the right side and 1.40cm on the left side. The mean distance between the two horns in females was 1.07cm on both right and left sides.

Outer Margin Length:

The length of the outer margin of the lateral meniscus was measured.

In males, the mean length of the outer margin of the lateral meniscus was 8.90cm on both right and left sides.

In females, the mean length of the outer margin of the lateral meniscus on the right side was 8.48cm and on the left side was 8.51cm.

Inner Margin Length:

The length of the inner margin of the lateral meniscus was measured.

In males, the mean length of the inner margin of the lateral meniscus on the right side was 4.71cm and on the left side was 4.75cm.

In females, the mean length of the inner margin of the lateral meniscus on the right side was 3.99cm and on the left side was 4.00cm.

	Right			Left		
	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)
Maximum	1.10	1.05	1.15	1.10	1.88	1.10
Minimum	0.90	0.85	0.80	0.92	0.88	0.80
Mean	0.99	0.97	0.98	1.01	0.98	0.97
Median	1.00	1.00	0.95	1.02	1.00	0.98
Mode	1.05	1.00	0.95	0.92	1.00	1.10
Standard deviation	0.063	0.061	0.116	0.059	0.052	0.098

Study of Width of the Lateral Meniscus in Males

	Right			Left		
	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)
Maximum	1.20	1.10	1.15	1.14	1.10	1.12
Minimum	0.80	0.85	0.90	0.80	0.88	0.92
Mean	1.02	1.00	1.00	1.01	0.99	1.00
Median	1.00	1.00	1.00	1.00	1.00	1.00
Mode	1.00	0.95	0.95	1.00	1.10	0.96
Standard deviation	0.116	0.074	0.083	0.099	0.082	0.069

Study of Width of the Lateral Meniscus in Females

Table 5

Lateral Meniscus Width:

The width of the lateral meniscus was studied in three parts namely anterior, middle and posterior 1/3rds.

In males, the average width of anterior 1/3rd on right side was 0.99cm and on left side was 1.01cm.

In males, the average width of the middle 1/3rd on right side was 0.97cm and on left side was 0.98cm.

In males, the average width of the posterior 1/3rd on right side was 0.98cm and on left side was 0.97cm.

In females, the average width of the anterior 1/3rd on right side was 1.02cm and on left side was 1.01cm.

In females, the average width of the middle 1/3rd on right side was 1.00cm and on left side was 0.99cm.

In females, the mean width of the posterior 1/3 on both right and left sides was 1.00cm.

It was observed from the above findings that there was no significant difference in width of the anterior 1/3, middle 1/3 and posterior 1/3 parts of the lateral meniscus in both genders.

	Right			Left		
	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)
Maximum	0.62	0.66	0.64	0.62	0.64	0.62
Minimum	0.35	0.52	0.48	0.40	0.54	0.50
Mean	0.51	0.58	0.57	0.50	0.59	0.56
Median	0.49	0.60	0.56	0.50	0.60	0.56
Mode	0.48	0.62	0.56	0.50	0.56	0.56
Standard deviation	0.074	0.048	0.040	0.056	0.033	0.037
Study of Thickness of the Lateral Meniscus in Males						
	Right			Left		
	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)	Anterior1/3 (cm)	Middle1/3 (cm)	Posterior1/3 (cm)
Maximum	0.56	0.66	0.70	0.56	0.64	0.66
Minimum	0.36	0.50	0.48	0.40	0.52	0.50
Mean	0.49	0.60	0.58	0.50	0.60	0.58
Median	0.49	0.60	0.58	0.49	0.60	0.58
Mode	0.46	0.62	0.58	0.48	0.62	0.58
Standard deviation	0.057	0.044	0.053	0.045	0.033	0.038
Study of Thickness of the Lateral Meniscus in Females						

Table 6

Lateral Meniscus Thickness:

The average thickness of the lateral meniscus was studied in three parts namely, anterior, middle and posterior 1/3rd.

The mean thickness of the anterior 1/3 in males was 0.51cm on right side and 0.50cm on left side.

The mean thickness of the middle 1/3 in males was 0.58cm on right side and 0.59cm on left side.

The mean thickness of the posterior 1/3 in males was 0.56cm on right side and 0.57cm on left side.

The mean thickness of the anterior 1/3 in females was 0.49cm on right side and 0.50cm on left side.

The mean thickness of the middle 1/3 in females was 0.60cm on both right and left sides.

The mean thickness of the posterior 1/3 in females was 0.58cm on both right and left sides.

It was observed from the above findings that the mean thickness of the middle 1/3 rd is thickest followed by posterior 1/3 rd and anterior 1/3 rd of the lateral meniscus.

Study of Shape of the Lateral Meniscus

The lateral meniscus presents various shapes like crescentic, C-shape, incomplete discoid and complete discoid. In the present study, 36 were of crescentic shape, 52 were of C-shape, 8 were of incomplete discoid and 4 were of complete discoid shape.

Incomplete and complete discoid shapes were found only in lateral meniscus and their incidence was more seen in females.

Medial and Lateral Coronary Ligaments

In all the 100 knee joints, the medial and lateral coronary ligaments were consistently present and studied.

Their attachments were in common with the description of standard text books and didn't observe any variations.

The medial coronary ligament is attached to the outer margin of the medial meniscus and articular margin of the medial tibial condyle.

The lateral coronary ligament is attached to the outer margin of the lateral meniscus and articular margin of the lateral tibial condyle.

The lateral coronary ligament is deficient in the posterolateral aspect of the knee where it is related to popliteus tendon.

The fibers of the coronary ligaments are closely attached to the capsule.

	Right		Left	
	Length (cm)	Width (cm)	Length (cm)	Width (cm)
Maximum	3.64	0.30	3.60	0.31
Minimum	3.07	0.22	3.15	0.20
Mean	3.42	0.27	3.39	0.27
Median	3.43	0.26	3.40	0.28
Mode	3.36	0.26	3.40	0.25
Standard deviation	0.169	0.025	0.132	0.033
<i>Study of Length and Width of the Transverse Ligament in Males</i>				
	Right		Left	
	Length (cm)	Width (cm)	Length (cm)	Width (cm)
Maximum	3.50	0.30	3.42	0.30
Minimum	3.03	0.21	3.18	0.22
Mean	3.28	0.26	3.33	0.27
Median	3.37	0.27	3.38	0.28
Mode	3.39	0.27	3.39	0.29
Standard deviation	0.191	0.031	0.080	0.029
<i>Study of Length and Width of the Transverse Ligament in Females</i>				
Table 7				

Transverse Ligament

The transverse ligament was observed in 64 out of the 100 knee joints studied.

The attachment of transverse ligament is in common with the description of standard text books and didn't observe any variations.

It connects the anterior convex margin of lateral meniscus and the anterior horn of the medial meniscus.

The mean length of the transverse ligament in males was 3.42cm on right side and 3.39cm on left side.

The mean length of the transverse ligament in females was 3.28cm on right side and 3.33cm on left side.

The mean width of the transverse ligament in males was 0.27cm on both right and left sides.

The mean width of the transverse ligament in females was 0.26cm on right side and 0.27cm on left side.

All the parameters that are studied like distance between the two horns, length of the outer and inner margins, width and thickness of the anterior 1/3, middle 1/3 and posterior 1/3 parts of the medial and lateral menisci are compared in males and females. There was no significant difference between lengths of outer margin of both menisci in males.

The differences observed in all other parameters studied are statistically significant.

Comparative Study of the Right and Left Knee Joints

All the parameters that are studied like length and width of the cruciate ligaments, meniscofemoral ligaments, transverse ligament, the margins, width and thickness of the menisci are compared in right and left side.

There was no statistically significant difference was observed in all parameters between the right and left knee joints in both genders.

Comparative study of the Knee Joint in Male and Female

All the parameters that are studied like length and width of the cruciate ligaments, meniscofemoral ligaments, transverse ligament, the margins, width and thickness of the menisci are compared in the male and female knee joints.

It was observed that the differences in length and width of cruciate ligaments, anterior meniscofemoral ligaments, width of the posterior meniscofemoral ligament and length of the transverse ligament are statistically significant where as differences in length of the posterior meniscofemoral ligaments and width of the transverse ligament are statistically not significant.

The differences observed in width of the anterior 1/3 and middle 1/3rds and thickness of the posterior 1/3rd of the medial meniscus are not statistically significant where as differences in the width of the posterior 1/3rd, and thickness of the anterior and middle 1/3rds of the medial meniscus are statistically significant.

The differences observed in width of the anterior, middle and posterior 1/3rds and thickness of anterior 1/3rd and posterior 1/3rd of the lateral meniscus are not statistically significant where as difference in the thickness of the middle 1/3 part of the lateral meniscus is statistically significant.

Discussion

Comparison of Parameters of Menisci in Previous and Present Studies

In the present study, the outer circumference length of medial meniscus is 86.4 mm and that of the lateral meniscus was 87.3mm. In both the menisci statistically significant difference was not observed.

In the study conducted by Moore & Dalley (2006)^[2], the medial meniscus was bigger than lateral meniscus, but for referring to the sizes of the menisci authors didn't describe the values properly, which will confirm the lack of data on morphometric study of menisci in the literature. In the present study, the distance between both the horns of the lateral meniscus was 12.6 mm and that of the medial meniscus was 31.8 mm. which is in the favour of study conducted by Kapandji (2000),^[3] who reports that the horns of the lateral meniscus are closer together than those of the medial meniscus.

The shape of lateral meniscus is of almost complete ring, and of the medial meniscus is like a half moon, because the medial meniscus presents a more gap between the horns. There is no significant difference in the outer circumference of both menisci, but the medial meniscus is apparently larger which can be explained by the larger size of the medial condyle of the tibia and it also has a large gap between its horns. The lateral meniscus has a smaller gap between the horns which compensates the difference in size of the tibial plateau, and is bordered by the menisci. The lateral meniscus is less prone to injury, due to the greater proximity of the horns.

In the present study, no significant difference was found in the mean width between the 3 parts of lateral meniscus, with an average width of 9.9 mm. The posterior 1/3rd width of the medial meniscus is the widest followed by the middle and anterior 1/3rds, with an average width of 10.6 mm.

According to Motta et al (1999),^[4] the lateral meniscus has an average width of 12 mm and according to Hayashi et al. (1988)^[5] the normal display of the meniscus as 12 to 13 mm wide.

Almeida, De Moraes et al. (2004)^[1] reported that in the analysis of both the meniscus the posterior third of the medial meniscus was the widest.

This description is also in favour of Moore et al (2006), who also described that the medial meniscus is wider posteriorly.

In the present study, thickness of both the menisci were studied as three parts. In the Medial meniscus, the middle third was the largest (5.6 mm) followed by anterior 1/3rd and posterior 1/3rd (5.4 mm) with an average value of 5.47 mm. For the lateral meniscus, the thickness was maximum at middle third (5.9 mm) followed by the posterior 1/3rd (5.7 mm) and anterior 1/3rd (5.0 mm), with the average value of 5.53 mm.

According to Motta et al (1999), the mean thickness of lateral meniscus was 4-5mm, While Hayashi et al. (1988) describe that the normal thickness of meniscus was 6-8 mm.

In relation to the medial meniscus thickness, Almeida et al. (2004)¹ describe that the middle 1/3rd was the smallest followed by the anterior and posterior 1/3rd. It was thought that the thickness and width were inversely related with each other. The greater the thickness of one part, the smaller was the width, vice versa.

In a study which was done on the location of the meniscal ruptures, Rico et al (1997)^[6] observed that the medial meniscus is more frequently affected comparing both the menisci and topographically lesions/injuries were more frequent at the middle 1/3rd (51%) followed by the posterior 1/3rd (39%) and than the anterior 1/3rd (10%) which was very less common. According to Yazaki et al (1995),^[7] injuries to the anterior horn/anterior 1/3rd of the medial meniscus were comparatively less common, either alone or along with other parts.

In the lateral meniscus, it was seen that lesions/injuries of the middle 1/3rd of meniscus was more common, either alone or along with other parts (anterior & posterior 1/3rd).

Comparing the less occurrence of injury to the anterior 1/3rd of the menisci with that of the results found in the present study, it was thought that the wider the size of part of meniscus, the more susceptible to prone to meniscal injuries. This was explained by the common fact that the greater is the width of the part of meniscus, the more it can be exposed to the action of the condyles of femur.

In the present study, the thickest part was found is the middle 1/3rd of meniscus in both the medial and lateral menisci, which is commonly prone to injury. This can be explained by the fact that both the menisci have the two horns which are fixed points, while the remainder of menisci that is the middle third part is mobile, making it commonly prone to stress and strain, which can lead to injury.

The thickness of the middle 1/3rd of the medial meniscus was less when we compare with that of the middle 1/3rd thickness of lateral meniscus which will elaborate the increased incidence of injuries in the medial meniscus compared to the lateral meniscus. The lateral meniscus moves more and freely compared to the medial meniscus because of the closer attachment of its horns, thus the lateral meniscus will follow the movements of condyles of the femur over the tibia better.

Transverse Ligament

Transverse ligament plays an important role in steadying of the menisci during movement and in the prevention of hyper rotation.

The present study observations are comparable to the study conducted by Tubbs RS and Michelson.

Transverse ligament is a source of misinterpretation of oblique tears of anterior horn of the medial meniscus as described by Sintzoff et al. 1992.^[8]

Conclusion

In the present study we found that the thickest part of both the menisci was middle third and is a point of greatest tension. Hence in both menisci it was the most commonly injured region.

The average thickness of the middle one third of the lateral meniscus is more than that of the medial meniscus. This will explain the incidence of injuries, which were more in the medial meniscus when compared to lateral meniscus. Meniscal injuries are less frequent in the anterior part of both the menisci. Injuries of the posterior part of the medial meniscus are also common as it is wide and exposed to actions of the femoral condyles.

References

1. Da Silva Almeida KS, Arruda de Moraes SR, Tashiro T, da Silveira Neves E, Toscano AE, Rocha de Abreu RM. Morphometric study of meniscus of the knee joint. *Int J Morphol* 2004;22(3):181-4.
2. Moore KL, Dalley AF. Clinically oriented anatomy. 5th edn. Lippincott Williams & Wilkins 2006:688-93.
3. Kapandji, AI. Fisiologia articular. 5th edn, Vol. 2. Rio de Janeiro: Guanabara Koogan 2000.
4. Motta Filho LA, Motta LA, Motta Filho GR. Menisco lateral discóide: correlação anátomo-clínica. *Rev Bras Ortop* 1999;34(8):457-60.
5. Hayashi LK, Yamaga H, Ida, K, Miura T. Arthroscopic meniscectomy for discoid lateral meniscus in children. *J Bone Joint Surg* 1988;70(10):1495-500.

6. Carrieda Rico EG, Abrego Ayala CE. Localización de las rupturas meniscales en nuestro medio. *Rev Mex Ortop Traumatol* 1997;11(1):10-3.
7. Yazaki CM, Assis JR, Cundari AM. Estudo comparativo entre tomografia computadorizada e artroscopia nas lesões meniscais do joelho. *Rev Bras Ortop* 1995;30(6):409-16.
8. Sintzoff SA, Stallenberg B, Gillard I, Gevenois PA, Matos C, Struyven J. Transverse geniculate ligament of the knee: appearance and frequency on plain radiographs. *Br J Radiol* 1992;65(777):766-8.