ORIGINAL ARTICLE

MAGNETIC RESONANCE IMAGING STUDY OF NORMAL MENISCI

Rupali M. Pawar¹, M. Natarajan²

HOW TO CITE THIS ARTICLE:

Rupali M. Pawar, M. Natarajan. "Magnetic Resonance Imaging Study of Normal Menisci". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 19, May 12; Page: 5344-5351, DOI: 10.14260/jemds/2014/2596

ABSTRACT: AIMS: The purpose of this study is to determine dimensions of menisci on MRI. The standard dimensions of lateral and medial menisci shall help us to differentiate between normal and abnormal menisci, and this may be important for planning surgical interventions in knee joint. **METHODS AND MATERIALS:** 100 Indian patients with history of knee pain were subjected to MRI. None of the patients had any pathological signal intensity suggesting meniscal tear. Patients were scanned in supine position with knees extended. All patients were studied in sagittal and coronal planes. The Anterior horn, Posterior horn and Mid-body of menisci were examined in sagittal and coronal plane for the following parameters: Height and width of Anterior and Posterior horn of lateral and medial meniscus on sagittal plane. Height and width of mid-body of lateral and medial menisci on coronal plane. Height and width of anterior and posterior horn were measured on sagittal plane where the highest and widest meniscal size was observed. The mid-body was measured at the level of intercondylar eminence, in the coronal plane. **STATISTICAL ANALYSIS:** Comparison of variables was done with paired sample t-test. Two-tailed p-values <0.05 were considered as significant. The SPSS 10.0 program was used for the purpose of statistical analyses. Data, presented as mean +- SD. **RESULT:** Following results were seen: Height of anterior and posterior horn of medial meniscus was greater than lateral. Width of anterior horn and mid-body of lateral meniscus was greater than medial. Posterior horn of medial meniscus is the widest part and greater than lateral. In the anterior and posterior thirds, the medial meniscus was significantly more thick (p <0.05) than the lateral. Posterior third part of medial meniscus was the widest. (p <0.05). Results of this study showed an important relation between morphometric data of menisci and clinical data, i.e. it was seen that, more meniscal tears were seen where height and width of meniscus was less. This study shall also be useful for tissue banks and surgeons, for meniscal sizing during transplantation. **KEYWORDS:** knee joint, meniscus, intercondylar eminence.

INTRODUCTION: The knee joint is formed by condyles of femur and tibia and posterior articular surfaces of patella. Although the knee joint looks a simple joint, it is a complex joint. The purpose of this study is to establish standard measurement of medial & lateral meniscus in subjects by using Magnetic Resonance Imaging. For this purpose the height & width of the medial and lateral meniscus is measured. Previous attempts were made to measure the size of meniscus, by simple ruler measurements to more complex technique involving stereophotogrammetry & ultrasound.^{1,2} Stone et al³ developed & evaluated a MRI technique to measure volume of menisci in 1994. Reicher et al⁴ began a revolution in knee diagnosis in 1985 with MRI.

To establish these standard measurements, we have calculated the height and the width of medial meniscus and lateral meniscus in sagittal and coronal plane. In sagittal plane, anterior and posterior horns of the same meniscus are seen. So, height and width of anterior and posterior horns were calculated in sagittal plane. The height and width of midbody of both menisci were best seen in the coronal plane. So, it was calculated in coronal plane.

ORIGINAL ARTICLE

MATERIALS & METHODS: 100 Indian patients with age above 10 years with history of knee pain were subjected to MRI with an AIRIS II HITACHI model. Patients with non-specific knee ache were included in the study. None of the patients had any pathological signal intensity suggesting meniscal tear. Handedness and gender of the patient were not considered in this study.

Patients were scanned in supine position with knees extended. All patients were studied in sagittal and coronal planes with multi-slice; spin-echo (T1 weighted acquisition) and fast scan (T2-weighted images) techniques. Sagittal and coronal spin-echo T1-weighted images were acquired using the following parameters: 460/26 (TR/TE), slice thickness 3mm. T2-weighted images were also acquired using the following parameters: 450/15 (TR/TE), slice thickness 3mm.

For the purpose of study each meniscus was divided into three zones;

Anterior horn

Posterior horn and

Mid-body

Diagram representing the three zones of menisci: anterior, middle and posterior ⁵.

In order to study, sections were taken in sagittal and coronal plane. The height and width of anterior horn and posterior horn of menisci were measured in sagittal plane where the highest and widest meniscal sizes were observed. The mid-body was measured at the level of intercondylar eminence. The height and width of mid-bodies were best evaluated in the coronal plane.⁶ All the dimensions were taken in millimeters. The required images were saved on the machine. These were later transferred on a CD and a soft copy was made.

The Anterior horn, Posterior horn and Mid-body of menisci were examined in sagittal and coronal plane for the following parameters:

1. Height of Anterior horn and Posterior horn of the lateral meniscus in the sagittal plane.
2. Height of Anterior horn and Posterior horn of the medial meniscus in the sagittal plane.
3. Width of Anterior horn and Posterior horn of the lateral meniscus in the sagittal plane.
4. Width of Anterior horn and Posterior horn of the medial meniscus in the sagittal plane.
5. Height of Mid-body of the lateral and medial meniscus in the coronal plane.
6. Width of Mid-body of the lateral and medial meniscus in the coronal plane.

STATISTICS: The total data of 100 patients collected, was numbered as per the ascending order of age, and thus the master chart was made. The patients were later grouped and statistically evaluated for justifying the aims and objectives.

ORIGINAL ARTICLE

Comparison of variables was done with paired sample t-test. Two-tailed p-values<0.05 were considered significant. Both these tests were appropriately applied and graphically represented. The SPSS 10.0 program was used for the purpose of statistical analyses. Data are presented as mean +- SD.

The data collection was completed within the stipulated time given by the Ethics committee. After having done with the final formalities, the data was compiled together.

OBSERVATIONS AND RESULTS: The collected data was first arranged by their ascending age.

Comparison of variables was done with paired sample t-test. Two-tailed p-values<0.05 were considered significant. The SPSS 10.0 program was used for the purpose of statistical analyses. Data are presented as mean +- SD.

FREQUENCIES:

Statistics RAGE		
N	Valid	100
	Missing	0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
MAHH1	100	3	9	5.88	1.27
MMBH1	100	4	7	5.35	.67
MPHH1	100	3	8	5.91	.83
MAHW1	100	4	8	6.10	.96
MMBW1	100	4	9	6.30	1.30
MPHW1	100	5	13	8.50	1.68
LAHH2	100	4	7	5.30	.59
LMBH2	100	4	6	5.30	.61
LP HH2	100	3	7	5.60	.80
LAHW2	100	5	11	8.40	1.20
LMBW2	100	5	9	7.28	.85
LP HW2	100	4	10	6.82	1.18
Valid N (listwise)	100				

ORIGINAL ARTICLE

The dimensions of the medial meniscus and lateral meniscus are summarized in tables below.

	Anterior horn	Mid body	Posterior horn
	Anterior horn	Mid body	Posterior horn
Medial menisci	5.88±1.27	5.35 ± 0.67	5.91 ±.83
Lateral menisci	5.30 ± 0.59	5.30 ± 0.61	5.60 ±.80
Table I. Height of medial and lateral menisci (mm).			

Values are means ± SE, n = 100. Statistical significance (t- test) p<0.05.

	Anterior horn	Mid body	Posterior horn
Medial menisci	6.10 ±.96	6.30 ± 1.30	8.50 ± 1.68
Lateral menisci	8.40 ± 1.20	7.28 ± 0.85	6.82 ± 1.18
Table II. Width of medial and lateral menisci (mm).			

Values are means ± SE, n = 100. Statistical significance (t- test) p<0.05.

DISCUSSION: It is observed that, the data on the dimensions of semilunar cartilages varied. Testut & Latarjet in a more generalized description of the morphometry of menisci, mentioned that the average thickness of outer circumference is 8mm for the lateral meniscus and 6mm for the medial meniscus, and that the average width of menisci is 10-12mm.⁵ Motta Filho et al. (1999), on the other hand, described in their studies an average thickness of 4-5mm and an average width of approximately 12mm for the lateral meniscus. H.Erbagci⁷ found the values as posterior horn, 8.8mm, anterior horn as 9.70mm and mid body as 8.37mm of the lateral meniscus, and posterior horn of medial meniscus to be the largest part i.e. 11.71mm.

According to our study, we found that posterior and anterior horn and mid-body of the lateral meniscus are 6.82mm, 8.40mm, 7.28mm wide, respectively, and the posterior horn of the medial meniscus is the widest 8.50mm. Ikeuchi,⁸ measured cadaveric specimens of menisci and reported that the mean transverse width of the mid segment of lateral meniscus was 10.3mm. Ferrer-Roca et al⁹ measured surgical specimens of menisci and concluded that the values for the lateral meniscus was 11.6mm. Samoto et al ¹⁰ found that the mean value of the meniscal width of the lateral meniscus group was 10.1mm.

According to Cailliet (1976), the lateral meniscus shows an average width of 12-13mm, and the medial meniscus has an average width of 10mm ⁵. Hayashi et al. (1988),¹¹ talking about the necessity to reduce substantially the thickness and the width of discoid meniscus during the surgical procedure, describes, that the menisci show thickness and width of 6-8mm and 12-13mm, respectively.

According to Figueroa et al. (1999) the lateral meniscus is wider in the body⁵ than the medial meniscus. However, in this study it was observed the same.

On the other hand, the medial meniscus is described by Didio (2002), showing a posterior cornu quite wide and an anterior extremity sharp and thin. According to Almeida S,⁵ the medial meniscus was wider on the posterior third, followed by the middle third, and in the end by the anterior third. This description is according to the results of our statistical study that shows the medial meniscus to be wider on the posterior third, and thin anteriorly.

ORIGINAL ARTICLE

According to Smillie the lateral meniscus shows a width higher and more uniform than the medial meniscus. In this study, we found an average width for the medial meniscus of 6.96mm and for the lateral meniscus 7.50mm. However, Testut & Latarjet and Didio, mention that it is common for the medial meniscus to be a little wider than the lateral meniscus.

According to Smillie the morphological differences of menisci, in particular, in the thickness and width can determine the possibility of an injury, the location and the kind of injury. In the medial meniscus without tear, the posterior horn is wider and has greater height than the anterior horn. The same results were seen in my study.

SUMMARY & CONCLUSIONS: The MRI study was conducted on Indian patients aged above 10 years and with history of knee pain. After analyzing the data statistically and representing it graphically following results were seen:

1. The height of the anterior horn and posterior horn of the medial meniscus was greater than lateral meniscus.
2. The width of anterior horn and mid-body of lateral meniscus was greater than medial meniscus.
3. The posterior horn is the widest part of medial meniscus and greater than lateral meniscus.
4. There was no significant difference in the height of mid-bodies of both the meniscus.
5. Comparing the average values of medial meniscus with the values of lateral meniscus, it was observed that in the anterior and posterior thirds, the medial meniscus was significantly more thick ($p < 0.05$) than the lateral meniscus.
6. The individual analysis of each meniscus showed that, the posterior third part of the medial meniscus was the widest ($p < 0.05$).

The results of this study showed an important relation between the morphometric data of menisci and the clinical data, which would explain the incidence of injuries in specific points of each meniscus i.e. it, was seen that, more meniscal tears were seen where height and width of meniscus was less. It was also seen that, where height and width was less, early signs of osteoarthritis should be predicted.

It shall also be useful for tissue banks and surgeons, a fast and precise method for meniscal sizing during transplantation. This study can be considered as a basic tool for further detailed analysis on meniscal parameters such as age, gender and weight. We are working on age related changes in a meniscus.

REFERENCES:

1. Huiskes R, Kremers J, Lange A, Woltring HJ, Selvik G, Rens TJ. Analytical stereophotogrammetric determination on 3-Dimensional knee geometry. J Biomech. 1985; 18: pp 559-570.
2. Modest VE, Murphy MC, Mann RW. Optical verification of a technique for ultrasonic measurement of articular cartilage thickness. J Biomech 1989; 22, pp 171-176.
3. Stone KR, Stoller DW, Irving SG, Elmquist C, Gildengorin G. 3D MRI volume sizing of knee meniscus cartilage Arthroscopy. 1994 Dec; 10(6): pp 641-4.
4. Reicher MA, Hartzman S, Basset LW, Mandelbaum B, Duckwiler G, Gold RH. MR imaging of knee. Part II. Traumatic Disorders. Radiology 1987; 162:pp 547-551.

ORIGINAL ARTICLE

5. Almeida S K S, De Moraes A S R, Tashiro T, Neves S E, Toscano A E, De Abreu R R M. Morphometric study of menisci of the knee joint. *Int J Morphol*. 2004; 22(3): pp 181-184.
6. Dehevan KE, Arnoczky SP. Meniscal Repair. *JBJS* 1994 ;76: pp 140-151.
7. Erbagci H, Gumusburun E, Bayram M, Karakurum G, Sirikci A. The menisci: in vivo MRI measurements. *Surg Radiol Anat*. 2004 Feb;26(1):pp 28-32.
8. Ikeuchi H. Supplementary study of arthroscopic anatomy on knee joint. Part 2: Menisci *J Jpn Ortho Asso* 1978; 52: pp 11-24.
9. Ferrer-Roca O, Vilalta C. Lesions of the meniscus. Part I: Macroscopic and histologic findings. *Clin Orthop Relat Res*. 1980; Jan-Feb ;(146): pp 289-300.
10. Samoto N, Kozuma M, Tokuhisa T, Kobayashi K. Diagnosis of discoid lateral meniscus of the knee on MR imaging. *Magn Reson Imaging*. 2002 Jan; 20(1): pp 59-64.
11. Hayashi L K, Yamaga H, Ida K, Miura T. Arthroscopic meniscectomy for discoid lateral meniscus in children. *J Bone Joint Surgery*, 1988; 70A (10): pp 1495-500.

ABBREVIATIONS:

Fig.	Figure
LAHH2	Lateral meniscus anterior horn height
LAHW2	Lateral meniscus anterior horn width
LMBH2	Lateral meniscus mid body height
LMBW2	Lateral meniscus mid body width
LPHH2	Lateral meniscus posterior horn height
LPHW2	Lateral meniscus posterior horn width
MAHH1	Medial meniscus anterior horn height
MAHW1	Medial meniscus anterior horn width
MMBH1	Medial meniscus mid body height
MMBW1	Medial meniscus mid body width
MPHH1	Medial meniscus posterior horn height
MPHW1	Medial meniscus posterior horn width
mm	Millimeter
MRI	Magnetic Resonance Imaging
p	Probability
SD	Standard Deviation

lateral Meni

Medial Meni

midbody

ORIGINAL ARTICLE

AUTHORS:

1. Rupali M. Pawar
2. M. Natarajan

PARTICULARS OF CONTRIBUTORS:

1. Lecturer, Department of Anatomy, R.G.M.C. Thane, Kalwa,
2. Professor, Department of Anatomy, Seth G. S. Medical College & KEM Hospital, Parel, Mumbai.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Rupali M. Pawar,
#A-402, Jyoti Soc, Building No. 89,
Tilaknagar, Chembur.
Email: dr_rupalig@yahoo.co.in

Date of Submission: 08/04/2014.

Date of Peer Review: 09/04/2014.

Date of Acceptance: 28/04/2014.

Date of Publishing: 12/05/2014.