

Morphometry of Mitral Valve in South Indian Adult Hearts: A Cadaveric StudyD. Kaur^{1*}, K. Singh², N. Nair³, S. Panday⁴¹Associate Professor, Anatomy Department MAMC Agroha, Hisar -125047, India²Professor and Head pathology, Department MAMC Agroha, Hisar -125047, India³Former head and Professor, Anatomy Department of KMC Manipal, Karnataka, India⁴Assistant Professor, Department of PSM MAMC Agroha, Hisar -125047, India**Original Research Article*****Corresponding author**

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Abstract: Mitral valve situated between left atrium and ventricle It is composed of several elements namely: annulus, cusps, tendinous cords and papillary muscles. It is the most common valve to be involved in acute Rheumatic heart disease (RHD) and thus normal dimensions of mitral valve are important in evaluation and proper management of mitral valve diseases. It may help to design prosthesis of appropriate size. To measure the circumference of valve at annulus, length of attachment at the annulus and height from annulus to free margin in the center of anterior cusp and anterolateral (ALS), middle (MS) & posteromedial (PMS) scallops of posterior cusp. The study was carried out on 60 adult South Indian human heart specimens fixed in 10% formalin solution in cm with the help of vernier caliper and thread. Mean circumference was 9.30 ± 1.72 cm. Anterior cusp measurements: mean length at annulus and height were 3.18 ± 0.81 cm and 2.19 ± 0.72 respectively. Posterior cusp measurements: Mean lengths of ALS, MS & PMS were 1.41 ± 0.76 , 2.77 ± 0.98 & 1.29 ± 0.74 respectively. Mean heights of ALS, MS & PMS scallops were 2.19 ± 0.72 , 1.27 ± 0.44 & 1.29 ± 0.74 cm respectively. In the present study, we have measured the length and height of each scallop of posterior cusp which showed middle scallop being largest whereas other authors have measured the length and height of complete posterior cusp as such without considering the scallops. This makes our study unique.

Keywords: mitral valve, annulus, anterior cusp, posterior cusp, scallops, circumference.

INTRODUCTION

Mitral valve, situated between the left atrium and ventricle. The valve has an orifice with its supporting annulus, cusps and a variety of chordate tendineae and papillary muscles. The circular valve orifice is almost vertical in diastole and at 45° to the sagittal plane. It has two leaflets/cusps- anterior and posterior, each separated by two commissures and thus also named as bicuspid valve. When the valve is laid open, the anterior cusp is seen to guard one third of the circumference of the orifice and to be semicircular. The cusp has a deep crescentic rough zone, which receives various chordate tendineae. The posterior cusp usually has two or more minor indentations. It has wider attachment to the annulus than does the anterior cusp guarding two- third of the circumferential attachment. Further indentations usually divide the posterior cusp into a larger middle scallop (MS), and smaller anterolateral (ALS) and posteromedial (PMS) commissural scallop. Each scallop has crescentic rough zone receiving on its ventricular aspect the attachments of the chordate tendineae [1]. Effective functioning of

valve is very essential for proper functioning of heart. Valvular heart diseases constitute a major cause of cardiovascular morbidity and mortality worldwide and most common cause of it is Rheumatic heart disease (RHD) in developing nations [2]. Mitral valve being the most common valve to be involved in acute RHD according to the studies conducted by various authors [3]. Therefore, knowledge of normal dimensions of mitral valve is important in evaluation and proper management of mitral valve diseases. It may help to design prosthesis of appropriate size and surgeons can aim to insert them. The present study is undertaken to find out normal mitral valve circumference, number of cusps present, any variation in cusps, length at annulus and maximum height from the middle of annulus to the free margin of cusps, in south Indian cadavers.

MATERIALS AND METHODS

The study was carried out on 60 adult South Indian human heart specimens fixed in 10% formalin solution. The heart specimens were procured from autopsy specimens and from adult cadavers dissected

for undergraduate students in the Anatomy department of Kasturba Medical College Manipal. Hearts with gross and congenital anomalies were excluded from the study. Specimens were washed and cleared off from any clots. These specimens were numbered serially from 1 to 60. Following measurements were taken in cm with the help of digital vernier caliper capable of measuring up to 0.01mm and thread:

- Circumference at annulus after opening the valve at the commissure to prevent damage to the cusps [fig-1]
- Length of attachment of anterior cusp at the annulus
- Height of anterior cusp from the annulus to free margin in the center
- Length of attachment of ALS, MS & PMS of posterior cusp at the annulus
- Height of each scallop of posterior cusp from the attached to free margin in the center [fig-2].

Finally, data were analyzed using SPSS software.

RESULTS

In all heart specimens, mitral valve had two cusps: anterior and posterior. Posterior cusp was scalloped having three scallops ALS, MS and PMS as mentioned in texts [1]. No accessory cusps seen in any specimen.

Mean circumference was 9.30 ± 1.72 cm. Minimum and maximum circumference was 7.1 cm and 11.0cm respectively. Circumference of majority of specimens was in range of 9.10-10.00(46.66%)

followed by 8.1-9.0 (30.00%), 7.1-8.0(13.33%) and 10.1-11.00(10.00%) [table-1].

Mean length of anterior cusp at annulus was 3.18 ± 0.81 cm. Minimum and maximum length was 2.1cm and 4.0 cm respectively. Length of majority of specimens was in range of 3.1-3.5(45.00%) followed by 2.6-3.0 (25.00%), 3.6-4.0(23.33%), 2.1-2.5(5%) and 1.6-2.00 (1.7%) [table-2].

Mean height of anterior cusp from center of free margin to its attachment at annulus was 2.19 ± 0.72 . Minimum and maximum height was 1.00 cm & 3.1 cm respectively. Height in majority of specimens was in range 2.1-2.5(60.0%) followed by 1.6- 2.0(26.70%), 2.6-3.0(6.7%), 1.1-1.5(3.33%) and 3.1-3.5 (1.7%) [table-3].

Mean lengths of AL, M and PM scallops of posterior cusp at annulus were 1.41 ± 0.76 , 2.77 ± 0.98 & 1.29 ± 0.74 respectively. Minimum lengths of AL, M & PM scallops were 0.8, 0.7 & 0.6cm whereas maximum lengths were 2.6, 3.4 & 2.6 cm respectively [table-4].

Mean heights of AL, M & PM scallops of posterior cusp were 2.19 ± 0.72 , 1.27 ± 0.44 & 1.29 ± 0.74 cm respectively. Minimum heights of AL, M & PM scallops were 0.5, 0.8 & 0.6 cm. whereas maximum heights were 1.4, 2.0 & 2.0 cm respectively [table-5].

MS was the largest of all scallops with respect to length and height [table-6].

Table-1: Range of circumference

Range of circumference (cm)	Number of specimen (%)
7.1-8.0	8(13.33%)
8.1- 9.0	18(30.00%)
9.1-10.0	28(46.66%)
10.1-11.00	6(10%)

Table-2: Range of length of anterior cusp at the base of annulus

Range	Number of specimen (%)
1.6-2.0	01(1.7%)
2.1-2.5	03(5.00%)
2.6-3.0	15(25.00%)
3.1-3.5	27(45.00%)
3.6-4.0	14(23.33%)

Table-3: Height of anterior cusp from annulus to free margin

Range	Number of specimen (%)
0.6-1.0	01(1.7%)
1.1-1.5	02(3.33%)
1.6-2.0	16(26.70%)
2.1-2.5	36(60.00%)
2.6-3.0	04(6.7%)
3.1-3.5	01(1.7%)

Table-4: Length of scallops of posterior cusp at annulus

Range of length(cm)	AL	M	PM
	Number of specimen (%)	Number of specimen (%)	Number of specimen (%)
0.5-1.0	10(16.7%)	1(1.7%)	13(21.7%)
1.1-1.5	37(61.7%)	6(10.0%)	37(61.7%)
1.6-2.0	10(16.7%)	6(10.0%)	7(11.7%)
2.1-2.5	2(3.3%)	32(53.3%)	2(3.3%)
2.6-3.0	1(1.7%)	14(23.3%)	1(1.7%)
3.1-3.5	0(0.0%)	1(1.7%)	0(0.0%)

Table-5: Heights of scallops of posterior cusp in cm

Range of height	AL	M	PM
	Number of specimen (%)	Number of specimen (%)	Number of specimen (%)
0.5-1.0	26(43.7%)	7(11.7%)	31(51.7%)
1.1-1.5	34(56.7%)	34(56.7%)	25(41.7%)
1.6-2.0	0(0.00%)	19(31.7%)	4(6.7%)

Table-6: Average dimensions of anterior and posterior cusps

Parameter	Anterior cusp	Scallops of posterior cusp		
		AL	M	PM
Length at annulus	3.18±0.81	1.4±0.0.76	2.27±0.98	1.29±0.0.74
Height	2.19±0.74	1.07±0.44	1.41±0.48	1.08±0.54

Table-7: Comparison of circumference with previous studies

Previous studies	Mean ±SD, range in cm
Rusted <i>et al.</i> [9]	9.9
Louis A <i>et al.</i> [10]	10.2
Sakai <i>et al.</i> [11]	9.33
D Patil [12]	8.25
Deopujari <i>et al.</i> [13]	8.27±1.25, 4.70
Gunnal <i>et al.</i> [14]	9.12
Gupta C <i>et al.</i> [7]	9.11±0.44
Mishra PP <i>et al.</i> [1]	8.7±1.68
Ilankathir [8]	8.28
Muhammadi. S <i>et al.</i> [16]	9.43±1.44
Present study [7]	9.30±1.72

Table-8: Comparison of length at annular attachment and height from attached to free margin in the centre of anterior leaflet

Studies	Length at annulus	Height
Rusted <i>et al.</i> [9]	2.50	2.2
Louis A <i>et al.</i> [11]	3.5	2.7
D Patil [12]	3.32	1.92
Deopujari <i>et al.</i> [13]	3.82±0.76	-
Gunnal <i>et al.</i> [14]	-	1.96
Present study [7]	3.18±0.81	2.19±0.72

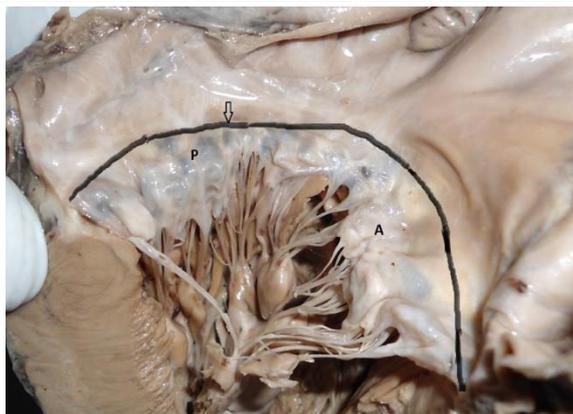


Fig-1: Circumference of mitral valve shown with curved line (arrow). A-Anterior cusp, P- posterior cusp

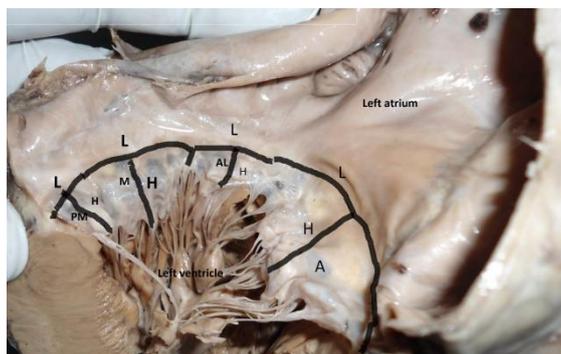


Fig-2: L-length at annulus, H-height from annular attachment to free margin in the center, A- anterior cusp, AL- anterolateral scallop, M-middle scallop, PM- Posteromedial scallop

DISCUSSION

Mitral valve dysfunction can be related to several factors and may involve any component of the valve like annulus and cusps [5, 6]. Various authors have used different methods for the morphometric analysis of mitral valve. In two-dimensional or three-dimensional echo-cardiography measurements were noted during the cardiac cycle. Gupta C *et al.* measured the valve parameters using scion image software [7]. In present study we have taken measurements manually.

To evaluate valvular stenosis, cardiac dilatation and cardiac hypertrophy, measurement of circumference is important [8]. In present study, annular circumference was measured and compared with other previous studies [table -7]. In present study, the mean circumference corresponds with the values reported by Gupta C *et al.* [7], Sakai *et al.* [11], Gunnal *et al.* [14] and Muhammadi *et al.* [16]. Michael in Gray's anatomy has reported the mean circumference to be 9.0cm in males and 7.2 cm in females [1]. Mishra PP *et al.* found mitral valve circumference between 7.5-10 cm in 55.83% [15]. In present study, Circumference of majority specimens were between 9.10-10.00 cm (46.66%) followed by 8.1-9.0cm (30.00%), 7.1-8.0cm (13.33%) and 10.1-11.00 cm (10.00%).

Various authors have reported accessory cusps in their studies [15]. In the present study, no accessory cusp was found in any of heart specimen. Table -8

shows that in present study, length of anterior cusp at annular attachment corresponds with the values reported by D Patil *et al.* [12] and height corresponds with that of Rusted *et al.* [9].

In the present study, we have measured the length and height of each scallop of posterior cusp [table-4,5 &6] which showed middle scallop being largest whereas other authors have measured the length at annular attachment and height of complete posterior cusp as such without considering the scallops [10, 12, 13]. This makes our study unique.

CONCLUSION

Mean circumference was 9.30 ± 1.72 cm. Circumference of majority of specimens was in range of 9.10-10.00(46.66%). In the present study, no accessory cusp was found in any of heart specimen. Mean length of anterior cusp at annulus and height was 3.18 ± 0.81 cm and 2.19 ± 0.72 respectively. Mean length of AL, M and PM scallops of posterior cusp were 1.41 ± 0.76 , 2.77 ± 0.98 & 1.29 ± 0.74 respectively. Mean heights of AL, M & PM scallops were 2.19 ± 0.72 , 1.27 ± 0.44 & 1.29 ± 0.74 cm respectively.

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