Section: Anatomy

Original Research Article

MORPHOLOGIC AND MORPHOMETRICAL STUDY OF MITRAL VALVE ANNULUS AND ITS CLINICAL IMPLICATIONS

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ABSTRACT

Background: The mitral valve annulus plays an important role in maintaining normal cardiac function. It supports proper coaptation of the valve leaflets and helps ensure one-way blood flow from the left atrium to the left ventricle. A detailed morphological and morphometrical study of the mitral valve annulus in human cadaveric hearts provides valuable baseline information for anatomists and cardiologists, which can be useful in valve repair procedures and in the design of prosthetic valves. **Objective:** To evaluate morphological and morphometrical parameters of mitral valve annulus. **Material and Methods:** the current cross sectional descriptive study analysed 50 human cadaveric hearts of unknown sex and age in department of anatomy GCS Medical college, Ahmedabad. A total 5o cadaveric heart was dissected. We examined various parameters like shape of annulus (circular, saddle, oval), anteroposterior diameter, transvers and the circumference for mitral valve annulus. **Results:** Out of 50 dissected hearts oval shape of mitral valve annulus was the most prevalent (58%). the mean circumference of the mitral valve annulus was 90.22± 1.01 mm. the mean value of anteroposterior and transvers diameter was 20.62 ±4.42mm and 25.15±4.95. **Conclusion:** This study reveals important morphological and morphometric parameters of the mitral valve annulus, providing valuable reference data. These findings may be useful for anatomical education, surgical planning for cardiologists, and in the design of prosthetic mitral valves and annulo plasty rings.

INTRODUCTION

The mitral valve is an essential component of the cardiac valvular apparatus that ensures unidirectional blood flow from the left atrium to the left ventricle. It consists of the mitral annulus, anterior and posterior leaflets, chordae tendineae, and papillary muscles,[1] which function together as a coordinated unit during the cardiac cycle. The mitral annulus consists of a collagenous ring belonging to the fibrous skeleton of heart where the lamina fibrosa of valve leaflets are attached and forms the fibrous ring that provides structural support to the valve leaflets and maintains the integrity of the valvular orifice.[2] Rather than being a rigid circular structure, the annulus is a dynamic and complex saddle shaped ring that undergoes continuous changes in size and configuration during systole and diastole.

The morphology and morphometry of the mitral annulus are of considerable anatomical and clinical importance. Morphological characteristics such as annular shape (oval, circular, or saddle shaped) and morphometric parameters including circumference, anteroposterior diameter, and transverse diameter influence the functional competence of the mitral valve.[3] Variations in these features can affect valve biomechanics and may predispose individuals to pathological conditions such as mitral valve prolapse, mitral regurgitation, and annular dilatation. Dilatation of the annulus can impair proper coaptation of the valve leaflets, resulting in valvular insufficiency.[4]

The annulus forms the anatomical boundary between the left atrium and left ventricle and serves as the attachment site for the mitral leaflets. Its mixed fibrous and muscular composition allows dynamic

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dimensional changes during the cardiac cycle, decreasing in size during systole to facilitate leaflet coaptation and enlarging during diastole to permit ventricular filling.[5] Because of this dynamic nature, alterations in annular morphology or dimensions may significantly affect valvular function.

Morphometric evaluation of the mitral annulus provides important quantitative information regarding its structural characteristics. Measurements such as annular circumference and anteroposterior and transverse diameters are particularly useful for understanding anatomical variations and for guiding clinical interventions. In recent years, the increasing use of mitral valve repair and replacement procedures has highlighted the importance of accurate annular measurements for selecting appropriate prosthetic valves and annuloplasty rings, thereby improving surgical outcomes.[3]

Clinically, abnormalities of the mitral annulus are associated with conditions such as mitral annular calcification, degenerative mitral valve disease, and functional mitral regurgitation.[6] Although modern imaging modalities such as echocardiography, computed tomography, and magnetic resonance imaging are widely used to assess annular dimensions, anatomical studies based on direct measurements continue to provide essential baseline data for comparison.[7]

Therefore, a detailed morphological and morphometric analysis of the mitral valve annulus is necessary to enhance anatomical knowledge and support clinical practice.[3] The present study aims to evaluate the morphological patterns and morphometric dimensions of the mitral valve annulus and to highlight their clinical implications in relation to mitral valve disease and surgical management.

MATERIALS AND METHODS

Study design: Cross sectional Descriptive cadaveric study

Study place: Department of Anatomy, GCS medical college Ahmedabad.

Sample size: 50 sample adult human cadaveric hearts

Materials- Cotton thread, Vernier Caliper, Dissecting instruments, Plastic scale

Collection of specimens: The heart was preserved by embalming. The specimen was in good condition after removal from body. During dissection and retain their true features. Total of 50 hearts (irrespective of age and sex) were included in study.

Inclusion:

Human adult cadaveric heart specimens without any gross deformity.

Exclusion

Hearts with evidence of congenital anomalies or decomposed.

Hearts with previous history of cardiac surgery. Such as coronary artery bypass surgery or valvular surgery.

Dissection of specimens

The position and orientation of the heart and its chambers were first confirmed. The left atrium was opened by making an incision between the right and left inferior pulmonary veins, and the superior portion of the left atrial auricle was carefully dissected. After opening the chamber, the heart was cleared of blood clots and thoroughly washed under running tap water. The mitral valve was then inspected from the atrial aspect. In each heart, a detailed examination of the mitral valve annulus was carried out.

The following Morphological and Morphometric features of mitral valve annulus were studied namely shape, circumference, Anteroposterior and transverse diameter.

1. Shape of annulus is observed by naked eyes and differentiated in different shapes. (saddle, oval, circular)
2. Circumference measures by help of cotton thread, measuring scale. Circumference of mitral annulus was taken by keeping a thread in the sulcus margin and measured with scale.
3. Antero posterior diameter- distance from anterior to posterior margin of mitral annulus taken by digital Vernier Caliper
4. Transverse diameter- distance between the medial and lateral margin of mitral annulus was taken by digital Vernier calliper

Each measurement was taken twice independently by two observers, and the mean value was used for analysis to reduce inter-observer variability. All data were recorded in an Excel sheet.

RESULTS

Table 1: Mean dimensions of mitral valve annulus (in mm)

Measurements	Mean±SD	Range
Circumference	90.22±1.01	70.2-120.4
Anteroposterior	20.62±4.42	17.2-35.90
Transverse	25.15±4.95	14.61-26.12

The morphometrical analysis among 50 specimen revealed the mean dimensions of the mitral valve annulus were analysed and expressed as mean ± standard deviation along with their observed ranges. The mean circumference of the annulus was 90.22 ± 1.01 mm, with values ranging from 70.2 to 120.4 mm. The anteroposterior diameter had a mean value of 20.62 ± 4.42 mm, with a range of 17.2 to 35.90 mm. The transverse diameter showed a mean measurement of 25.15 ± 4.95 mm, and the observed values ranged from 14.61 to 26.12 mm. These measurements provide quantitative information

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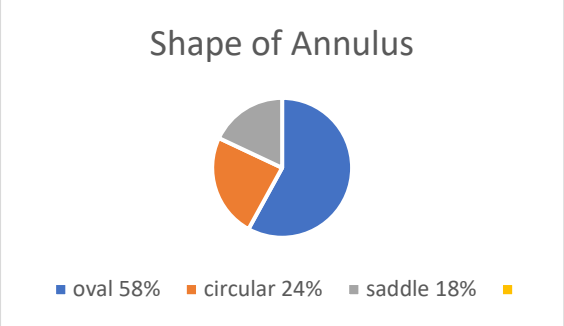
regarding the morphological dimensions of the mitral valve annulus.

Table 2: Shape of mitral annulus

Shape	Number	Percentage
Oval	29	58%
circular	12	24%
saddle	9	18%



valve The shape of the mitral valve annulus was assessed based on its shape. Among the examined 50 specimens, the oval shape was the most commonly observed, present in 29 cases (58%). The circular shape was identified in 12 cases (24%), while the saddle-shaped configuration was observed in 9 cases (18%). These findings indicate that the oval configuration predominates in the studied samples, with circular and saddle shapes occurring less frequently. Such variations in annular shape may have anatomical and clinical relevance in understanding the functional dynamics of the mitral valve.

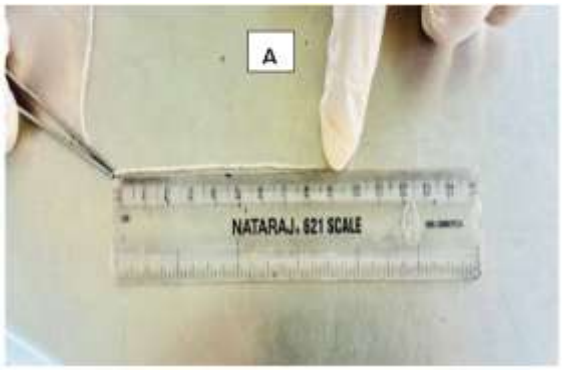


Figure A: Circumference

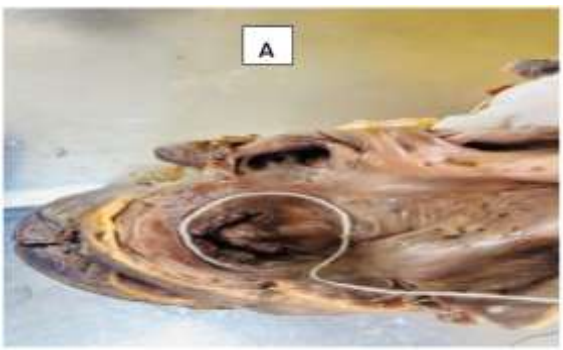


Figure A: Circumference

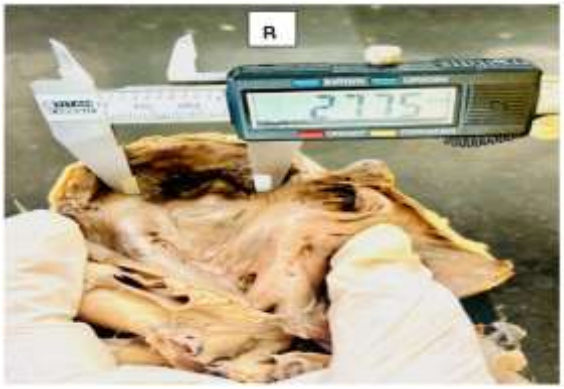
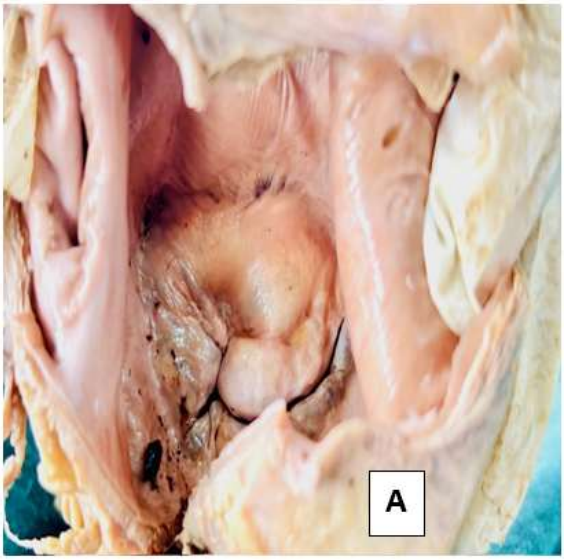


Figure B: Transverse diameter

Figure C: Anteroposterior diameter



SADDLE

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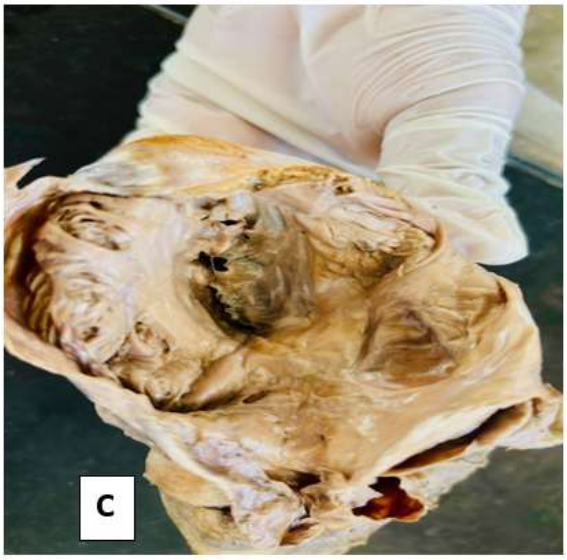
CIRCULAR



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DISCUSSION

Author	Circumference	Antero posterior	Transverse
Present study(2026)	90.22±1.01	20.65±4.42	25.15±4.95
Deepak N. khedekar et al al. (2025)[9]	92.6±5.2	27.1±2.4	31.8±2.9
Kalangiri et al.(2024)[3]	95.6±6.4	29.5±2.6	32.4±2.8
Shruthi et al.(2019)[6]	70.98±1.83	-	-
Sriambica K. et al.(2018)[8]	88.8±1	-	-
Charanya N. et al. (2017)[4]	88.6±0.86	-	-
Agata et al. (2017)[7]	89.90±12.6	-	-
Mishra P. et al.(2014)[10]	87.5±2.6	-	-

Morphometric analysis of the mitral valve annulus is important for understanding its anatomical variations and clinical significance, particularly in mitral valve repair and replacement procedures. In the present study, the mean circumference of the mitral valve annulus was 90.22 ± 1.01 mm, with mean anteroposterior (A–P) and transverse diameters of 20.65 ± 4.42 mm and 25.15 ± 4.95 mm, respectively. When the findings of the present study were compared with previous studies, the mean annular circumference observed was found to be comparable with several earlier reports. The circumference reported by Kalangiri et al,[3] (2024) was 95.6 ± 6.4 mm, which is slightly higher than that observed in the present study. Similarly, Deepak N. Khedekar et al,[9] (2025) reported a mean circumference of 92.6 ± 5.2 mm, which is also close to the values obtained in this study. In contrast, studies conducted by Agata et al. (2017),[7] Sriambika K. et al,[8] (2018), Charanya N. et al. (2017),[4] and Mishra P. et al10. (2014) reported circumferences of 89.90 ± 12.6 mm, 88.8 ± 1 mm, 88.6 ± 0.86 mm, and 87.5 ± 2.6 mm, respectively, which are very similar to the findings of the present study. However, Shruthi et al. (2019),[6] reported a comparatively lower mean circumference of 70.98 ± 1.83 mm, which may be attributed to differences in sample size, population characteristics, or measurement techniques.

Regarding the diameters of the annulus, the present study showed an anteroposterior diameter of 20.65 ± 4.42 mm and a transverse diameter of 25.15 ± 4.95 mm. These values were comparatively lower than those reported by Kalangiri et al3. (2024), who observed an A–P diameter of 29.5 ± 2.6 mm and a transverse diameter of 32.4 ± 2.8 mm. Similarly, Deepak N. Khedekar et al,[9] (2025) reported slightly higher measurements, with an A–P diameter of 27.1 ± 2.4 mm and a transverse diameter of 31.8 ± 2.9 mm. The difference between the anteroposterior and transverse diameters observed in the present study suggests that the mitral annulus is generally elliptical in configuration rather than perfectly circular, which is consistent with the widely accepted anatomical description of the annulus.

Variations in the morphometric dimensions of the mitral annulus reported in different studies may be attributed to several factors, including ethnic differences, age distribution, sample size, and methodological variations in measurement techniques.[3] Despite these variations, the results of the present study fall within the range of previously reported values and contribute additional anatomical data regarding the morphometry of the mitral valve annulus.

CONCLUSION

Precise knowledge of mitral annular dimensions and its shape is clinically important for appropriate selection and sizing of prosthetic valves and

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annuloplasty rings during mitral valve surgery. Accurate morphometric data contribute to better surgical planning and may help reduce postoperative complications. The findings of the present morphometric study provide valuable baseline anatomical information on the mitral annulus. Such data can assist clinicians and cardiothoracic surgeons in improving the diagnosis, management, and surgical outcomes of patients with mitral valve diseases.

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