International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Morphometric Analysis of the Mitral Valve in Embalmed Human Hearts and Its Clinical Implications

Jayaprakash T[1], Pallavi[2]

[1]*Associate Professor, Department of Anatomy, Sri Madhusudan Sai Institute of Medical Sciences and Research, Chickballapur, Karnataka, India*

[2]*Associate Professor, Department of Anatomy, Father Muller Medical College, Mangalore, Karnataka, India*

OPEN ACCESS

Corresponding Author:

Dr. Pallavi
Associate Professor, Department of Anatomy, Father Muller Medical College, Mangalore, Karnataka, India

Received: 08-03-2026
Accepted: 29-03-2026
Available online: 12-04-2026

ABSTRACT

Introduction: Congenital and acquired valvular heart diseases commonly involve the mitral valve, frequently necessitating surgical repair or replacement. Given the structural complexity of the mitral valve apparatus, precise morphometric data are essential for accurate assessment of pathology, surgical planning, and prosthetic valve design.

Materials and Methods: This cadaveric study was conducted on 50 formalin-fixed adult human hearts in the Department of Anatomy, Father Muller Medical College, Mangalore. Hearts without gross morphological abnormalities were included. The left atrium and left ventricle were opened by lateral incision to expose the mitral valve.

Annular circumference, annular diameter, and the length and height of the anterior and posterior mitral valve leaflets were measured using standard techniques. Descriptive statistical analysis was performed and results were expressed as mean ± standard deviation.

Results: The mean mitral annular circumference was 10.29 ± 1.28 cm, with a mean annular diameter of 3.27 ± 0.41 cm. The anterior leaflet showed a mean length of 4.51 ±

0.68 cm and height of 2.03 ± 0.32 cm. The posterior leaflet demonstrated a mean length of 5.46 ± 0.91 cm and height of 1.16 ± 0.29 cm.

Conclusion: The study provides reliable baseline morphometric data on the mitral valve, contributing to literature. Surgical interventions on the mitral valve complex demands an accurate knowledge of its normal anatomy and its dimensions. The present study provides a database of valvular morphometry in comparison with many published data of different geographical and racial origin. This will help manufacturers to develop synthetic prostheses and also cardiac surgeons to undertake valve reconstructive surgeries successfully.

Keywords*: Mitral valve, morphometry, valve replacement, valve prosthesis.*

INTRODUCTION

Mitral valve disease is the most common valvular disorder encountered in clinical practice[1]. The Valve morphology and functionality are altered by congenital anomalies, such as mitral valve prolapse, or acquired through age-related degenerative changes, i.e., stenosis[2]. Surgical management with valve replacement is the current standard of care in the above clinical conditions.

In the recent era, mechanical valves and biological substitutes, such as homo grafts, auto grafts, and hetero grafts, are available[3]. Knowledge of morphometric data of valves among the different populations, age, and gender is required for the prosthetic designing. Considering the complexity of mitral valve, cadaver-based research findings are remarkable in comparison with recent developments such as CT, MRI or echocardiographic findings. The knowledge gained from cadaveric morphometric studies helps in clinical diagnosis of cases in correlation with the radiographic findings. The aim

of our present study was to analyze the morphometric of mitral valve by measuring its annular circumference, length and height of anterior and posterior leaflets of cadavers.

MATERIALS AND METHODS

The present study was conducted on 50 isolated, formalin-fixed human hearts obtained from adult cadavers in the Department of Anatomy, Father Muller Medical College, Mangalore. Hearts from adult cadavers without any gross morphological abnormalities were included in the study.

All specimens were thoroughly washed under running water to remove residual blood clots and debris. The left atrium and left ventricle were opened by making a lateral incision along the left border of the heart using a scalpel, thereby adequately exposing the interior of the chambers for proper visualization of the mitral valve leaflets.

Morphometric measurements were obtained using a cotton thread and a measuring ruler. The following parameters were assessed and all measurements were recorded in centimeters.

- Annular circumference (C): Measured at the base of the mitral valve leaflets by placing the cotton thread along the boundary of the annulus and adjusting it to conform to its shape.
- Length of the anterior and posterior mitral valve leaflets: Measured along the annular attachment.
- Height of each leaflet: Measured from the base to the free edge along the central axis of the leaflet.

Statistical Analyses

Descriptive statistical analysis was performed for all parameters, and the results were expressed as mean ± standard deviation (SD)

RESULTS

Table 1: Morphometric measurements of mitral valve leaflets and annular circumference (n =50)

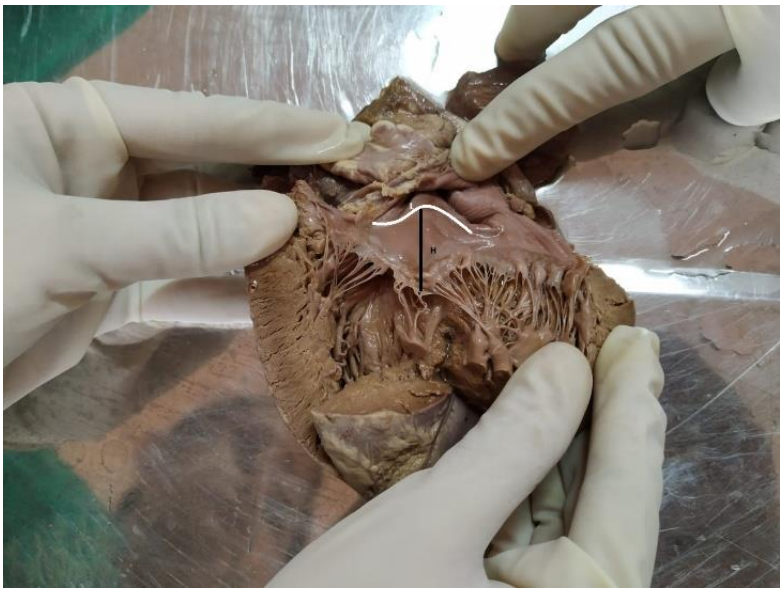
	Anterior leaflet (cm)	Posterior leaflet (cm)	Annular circumference (cm)
Length (Mean ± SD)	3.51±0.68	4.46±0.91	9.29±1.28
Height (Mean ± SD)	2.03±0.32	1.16±0.29	
Range	3.40–5.40		8.40–15.60

The mean length of the anterior leaflet was 3.51 ± 0.68 cm**,** while that of the posterior leaflet was 4.46 ± 0.91 cm**.** The mean height of the anterior and posterior leaflets measured 2.03 ± 0.32 cm and 1.16 ± 0.29 cm**,** respectively.

The mitral annular circumference ranged from 8.40 cm to 15.60 cm**,** with a mean value of 9.29 ± 1.28 cm**.** The length of the anterior leaflet ranged from 3.40 cm to 5.40 cm**,** and its height ranged from 1.20 cm to 2.50 cm**.**

Table 2: Comparison of mitral valve leaflet dimensions and annular circumference with previous studies

Author	Sample size	Mean Length of leaflet in cm		Mean Height of leaflet in cm		Annular circumference in cm
		Anterior	Posterior	Anterior	Posterior	
Shruthi B Net.al.,	60	2.97±0.70	3.02±0.77	1.72±0.54	1.68±0.51	7.98±1.83
Padhy N et.al.,	58	2.94±0.81	4.52±0.78	2.55±0.27	1.2±0.17	9.84±1.24
Badal Singh et.al.,	52	2.98	4.02	2.03	1.12	8.13
Ilankathir S et.al.,	50	3.23	4.82	2.42	1.28	8.29
Ganga N V et.al.,	20	1.2-1.6	1.1-6.0	0.71-2.23	0.54-2.15	6.25-10.51
Gunnal S A et.al.,	116	-	-	1.96±0.41	1.51±0.38	9.12±1.36
Sriambika K et.al.,	50	-	-	1.90±0.26	1.00±0.16	8.80±1.00
Gupta C et.al.,	18	-	-	-	-	9.11±0.44
Lama C P et.al.,	50	-	-	-	-	9.22±1.49
Present study	50	3.51±0.68	4.46±0.91	2.03±0.32	1.16±0.29	9.29±1.28



Pic 1: Showing the length (L) & Height (H) of the leaflet

Pic 2: Measuring the annular circumference

DISCUSSION

The cadaveric studies delineate the true anatomical relationships, dimensions, and variations of complex cardiac structures such as the mitral valve[2,3]. The results from the studies from various geographical areas helps in the analysing the computational imaging studies for clinicians.

The present study offers detailed morphometric characterization of the mitral valve leaflets and annulus, placing these findings in the context of previously published data (Tables 1 and 2). The results demonstrate a clear geometric asymmetry between the anterior and posterior leaflets: the posterior leaflet exhibited a greater mean length (4.46 ± 0.91 cm) compared to the anterior leaflet (3.51 ± 0.68 cm), whereas the anterior leaflet was taller (2.03 ± 0.32 cm vs**.** 1.16 ± 0.29cm)[6–8].

The elongated posterior leaflet provides enhanced annular coverage during systole and the taller anterior leaflet contributes to effective co aptation and resistance to left ventricular pressures[6,7]. Comparable patterns have been consistently reported in previous cadaveric and imaging-based studies[6,7,9].

The mean annular circumference in this study (9.29 ± 1.28 cm) aligns closely with values reported by Padhy et al.[3], Gunnal et al.[7]. The discrepancies between studies can be attributed to the differences in specimen preservation, measurement landmarks, and inclusion criteria

These morphometric data have direct clinical and translational implications, including mitral valve repair, prosthetic valve design, annuloplasty ring selection, imaging interpretation, and trans catheter interventions. Accurate knowledge of leaflet dimensions and annular circumference is essential for procedural planning, minimizing patient–prosthesis mismatch, and ensuring optimal surgical and device outcomes[6,7,10].

Strengths and Contribution to Literature

A key strength of this study is its systematic morphometric assessment and comprehensive comparison with existing literature. The consistency of findings reinforces the anatomical validity of the results and enhances their translational applicability. This work provides a reliable reference for both clinical and research purposes, supporting anatomically informed approaches in mitral valve interventions.

CONCLUSION

This study provides high-quality morphometric data on mitral valve leaflets and annular circumference that are concordant with and additive to existing literature. The observed structural asymmetry and dimensional variability support patient-specific, anatomically driven approaches in surgical and interventional cardiology. These data serve as a valuable baseline reference for diagnostic evaluation, surgical planning, and the development of next-generation mitral valve devices.

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