

Morphometric Study of Mitral Valve in South Karnataka-Cadaveric Study**Ravi Bhaskar¹, Hemalatha Bangera², Pradeep Kumar³, Anjana Shidaraddi⁴**¹Associate Professor, Department of Anatomy Sapthagiri institute of medical sciences and research center, Bengaluru²Assistant Professor, Department of Anatomy Father Muller Medical College, Mangalore³Assistant Professor, Department of Cardiology Sapthagiri institute of medical sciences and research center, Bengaluru⁴Assistant Professor, Department of Anatomy Sapthagiri institute of medical sciences and research center, Bengaluru

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Conflict of interest: Nil

Abstract:**Background:** The mitral valve (M.V) is a complex structure that is altered by various diseases. Mitral valve prolapse and regurgitation are the main causes of MV replacement. Hence, the morphometric study of M.V. has great clinical importance.**Method:** 45 (fourth five) non-pathological cadaveric human hearts were studied. The left atrium was opened along the left border of the heart so as to expose the mitral valve. Different parameters of M.V. were studied with a mean value (\pm SD).**Results:** The maximum circumference of the MV was 9.8, the minimum was 8.3, and the length of the anterior platelet was 2.3 cm and the posterior was 1.8 (cm). Thickness of anterior platelet 0.3 (cm) post leaflets 0.3 (cm) minimum length of ant. Leaflet: 1.4 cm, 1.2 (cm) post leaflet. The minimum thickness of the anterior leaflet was 0.1 cm, while the post leaflet was also 0.1 cm. The number of papillary heads was 55.5%, while the number of single muscle heads was 48.8%. The maximum length of papillary muscle was 2.3 cm, and the minimum was 1.3 cm.**Conclusion:** The present pragmatic morphometric study of M.V. is useful for radiologists, cardiologists, and cardiac surgeons to rule out the normal parameters with the present findings to diagnose the functions of M.V. in cardiac disease patients.**Keywords:** mitral valve, papillary muscles, mitral annular calcification (MAC), cadaveric heart.

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Introduction

The mitral valve "is named after its appearance, like the mitral of Bishop." It is situated between the left atrium and left ventricle, forming the inlet of the ventricle and the outlet of the atrium [1]. It is also called the bicuspid atrium. It is also called a bicuspid valve due to its possession of two cusps i.e. anterior and posterior. As tomographic techniques are increasingly used to diagnose cardiac diseases. Hence, morphometric study of the mitral valve is important for cardiologists, radiologists, surgeons, and clinicians [2]. Moreover, a tiny instrument inserted in the mitral valve enhances or regulates the contraction of the mitral valve (MV) during systole and diastole.

Mitral valve consists of four major components: the annulus, leaflets, chordaetendineae, and papillary muscles [3]. If anyone among these is abnormally congenitally or acquired, it leads to dysfunction of the mitral valve, causing a varied number of diseases

because regurgitation of MV is a quite common clinical entity that is likely to increase in the future due to predicted demographic changes [4].

It is also associated with poor long-term survival. Moreover, mitral annular calcification (MAC) is quite common in type II DM and obese individuals. Hence, an attempt is made to evaluate the morphometric study of MV in cadavers.

Materials and Method:

45 (forty-five) non-pathological, dissected cadavers present in the dissection theaters of both Sapthagiri Institute of Medical Sciences and Research Centre, Bangalore-560090, and Father Muller Medical College, Mangalore, were studied.

Inclusion Criteria: The dissected heart preserved in formation was selected for study.

Exclusion Criteria: Pathological hearts with congenital anomalies, torn during dissection were excluded from the study.

Method

Cadaveric hearts were washed and opened along the left border through the atrio-ventricular valve. The cavity of the left atrium was opened. The left atrio-ventricular orifice was cleared by removing clots. The maximum and minimum diameter of the opening was measured with a vernier caliper. Then the cavity of the left ventricle was opened and cleared to study the mitral valve complex. The circumference of the mitral valve was measured. The number of

heads of papillary muscles and the length of the papillary muscles of the mitral valves were also noted.

The duration of the study was March 2022 to February 2024.

Statistical analysis: Mean values (\pm SD) of circumference of mitral valve length and thickness of leaflets, number of heads of papillary muscles, and length of papillary muscle mean values were recorded.

The statistical analysis was carried out using SPSS software. The ratio of male and female cadaveric hearts was 3:1.

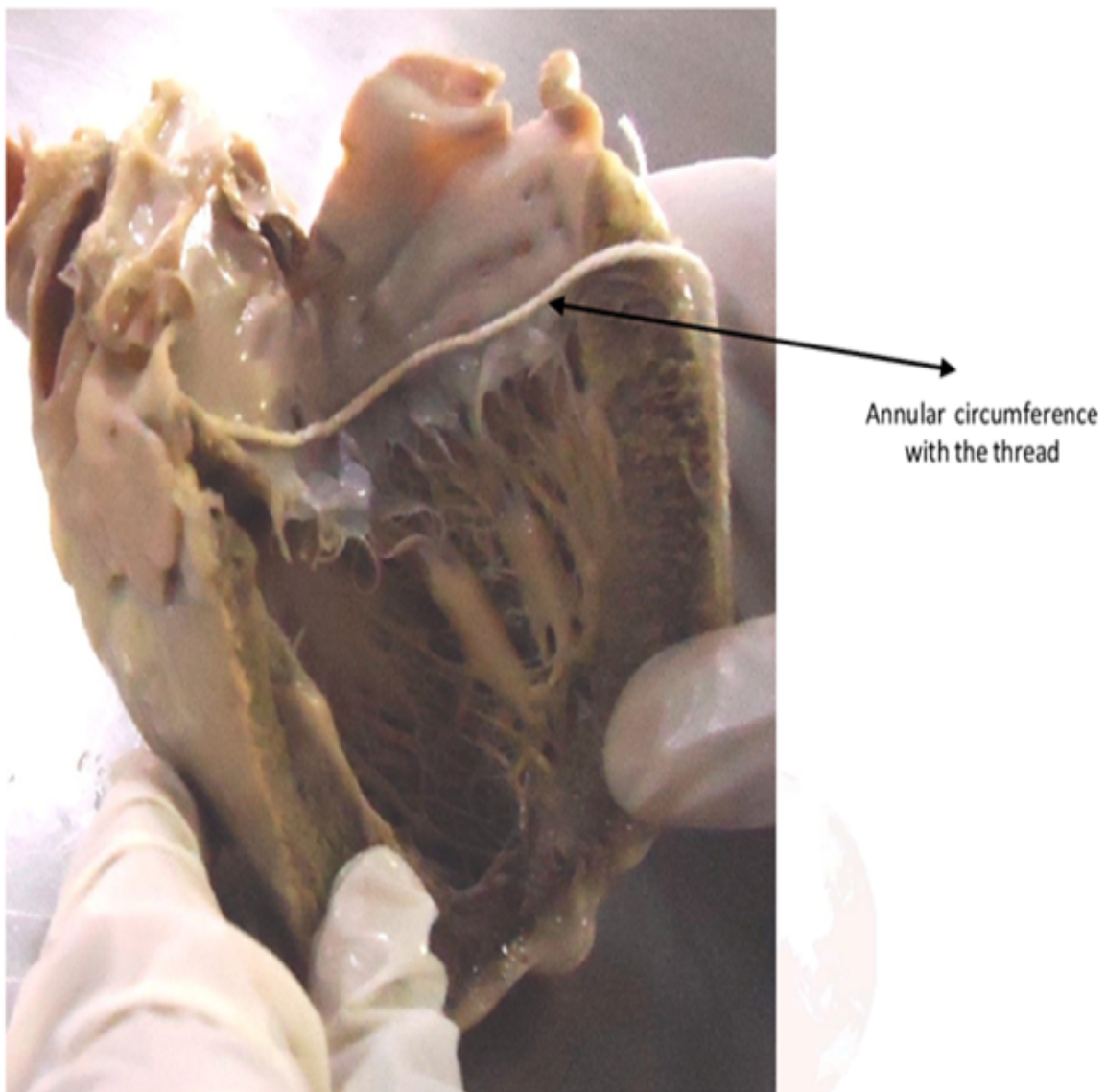


Figure 1: Measuring the annular circumference of mitral valve

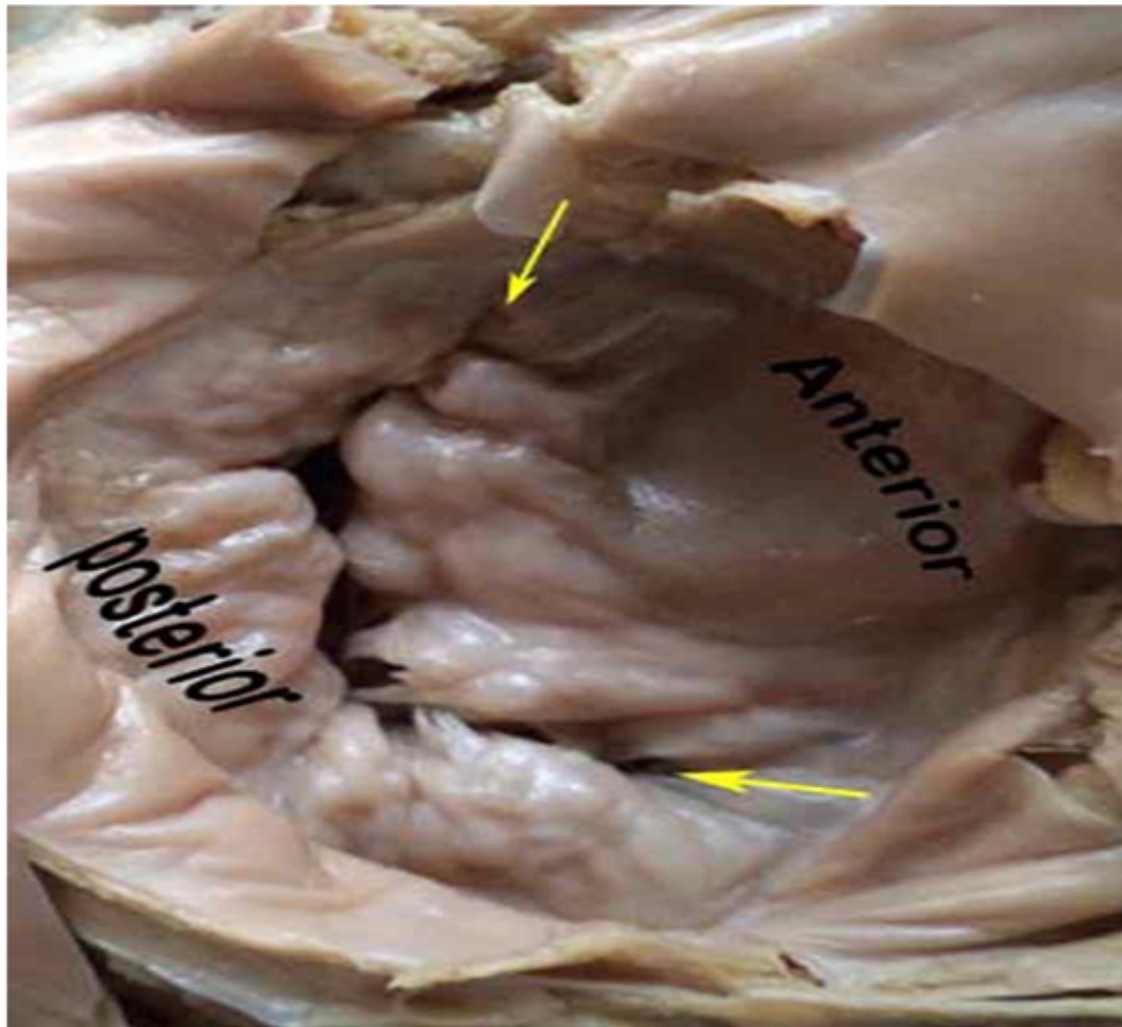


Figure 2: Mitral Valve observed from the atrial side in normal anatomical position of the heart. The major commissures (arrows) separate the two leaflets

Observation and Results

Table 1: In the comparative study of the present study with previous studies, The maximum circumference of mitral valve 11.5, minimum was 8.5, mean value was 10 (± 0.9) in Chiechi and Lee circumference, 8.2 minimum circumference, mean value 8.97 (± 0.7) in the study of Kulkarni and Makandar in 2012.

But in present study maximum circumference was 9.8 (cms) minimum 8.3 (cm), mean value 8.98 (± 0.8).

Table 2: Study of length and thickness of anterior and posterior leaflets the maximum length of the ant leaflet was 2.3; the post-leaflet was 1.8.

The minimum length of the ant leaflet was 1.4; the post-leaflet was 1.2.

Mean value 1.9 (± 0.2) in ant leaflet, 1.5 (± 0.2) in post-leaflet

In the study of thickness, 0.3 cm was ant.leaflet, 0.3 minimum thickness was 0.1 cm in ant and post. leaflet, and the mean value was 0.2 (± 0.1) cm in ant. Leaflet and 0.2 cm in post. leaflet.

Table 3: Study of the number of heads of papillary muscles observed in mitral valve

In anterolateral papillary, 25 (55.5%) were single, 10 (22.2%) were double, 7 (15.5%) were triple, and 3 (6.6%) were more than three.

Number of heads posterior of papillary muscles: 22 (48.8%) single, 12 (26.6%) double, 8 (17.7%) triple, and 3 (6.6%) more than three

Table 4: Study of the length of the papillary muscles of the mitral valve (in cm)

- Maximum length: 2.3 cm in antero-lat papillary muscle 2.0 in postmedial papillary muscle
- Minimum length of papillary 1.3 in antero-lateral papillary, 1.2 cm in postero-medial papillary muscles

- The mean value in antero-lat. papillary muscle was 1.9 (± 0.2), and the mean value in postero-medial papillary mean 1.7 (± 0.2).

Table 1: Comparative study of circumference of Mitral valve orifice in formalin preserved hearts (in cms)

Name and Year	Maximum	Minimum	Mean value (\pm SD)
Chiechi and Lee 1956	11.5	8.5	10 (± 0.9)
Kulkarni PR, Makandar. UK 2012	9.7	8.2	8.97 (± 0.7)
Present study 2024	9.8	8.3	8.98 (± 0.8)

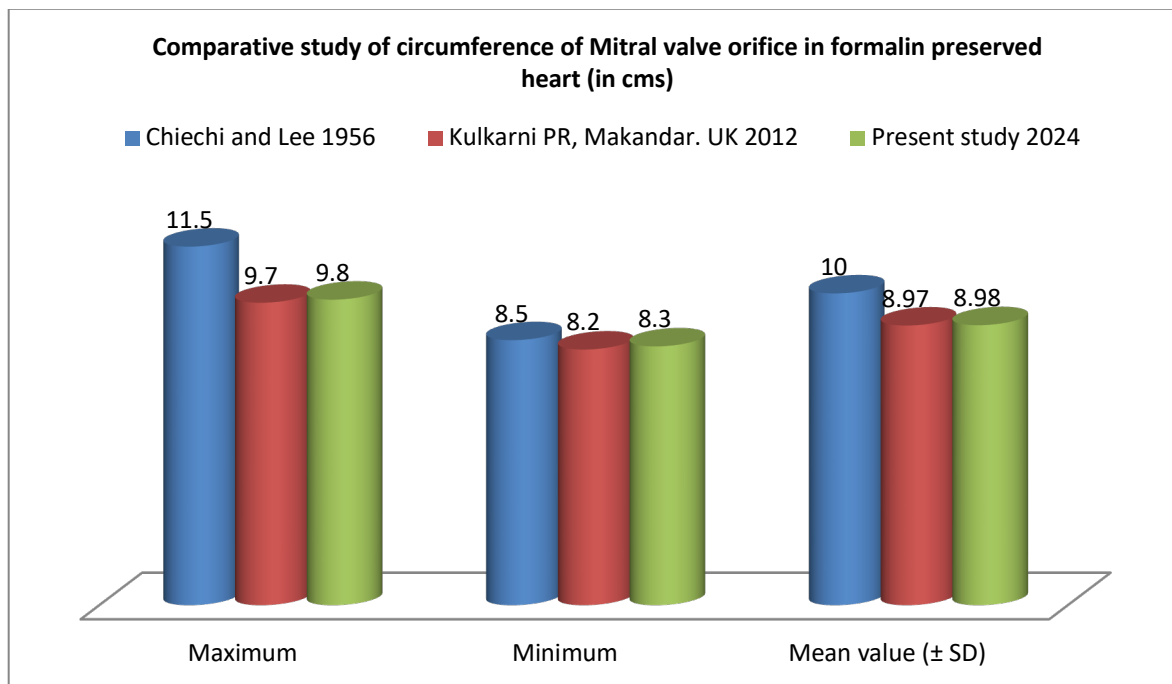


Figure 3: Comparative study of circumference of Mitral valve orifice in formalin preserved heart (in cms)

Table 2: Length and thickness of Anterior and Posterior leaflets (in cms)

Parameters	Length (cms)		Thickness (cms)	
	Ant. Leaflet	Post leaflet	Ant. Leaflet	Post leaflet
Maximum length	2.3	1.8	0.3	0.3
Minimum length	1.4	1.2	0.1	0.1
Mean value (\pm SD)	1.9 (± 0.2)	1.5 (± 0.2)	0.2 (± 0.1)	0.2 (± 0.1)

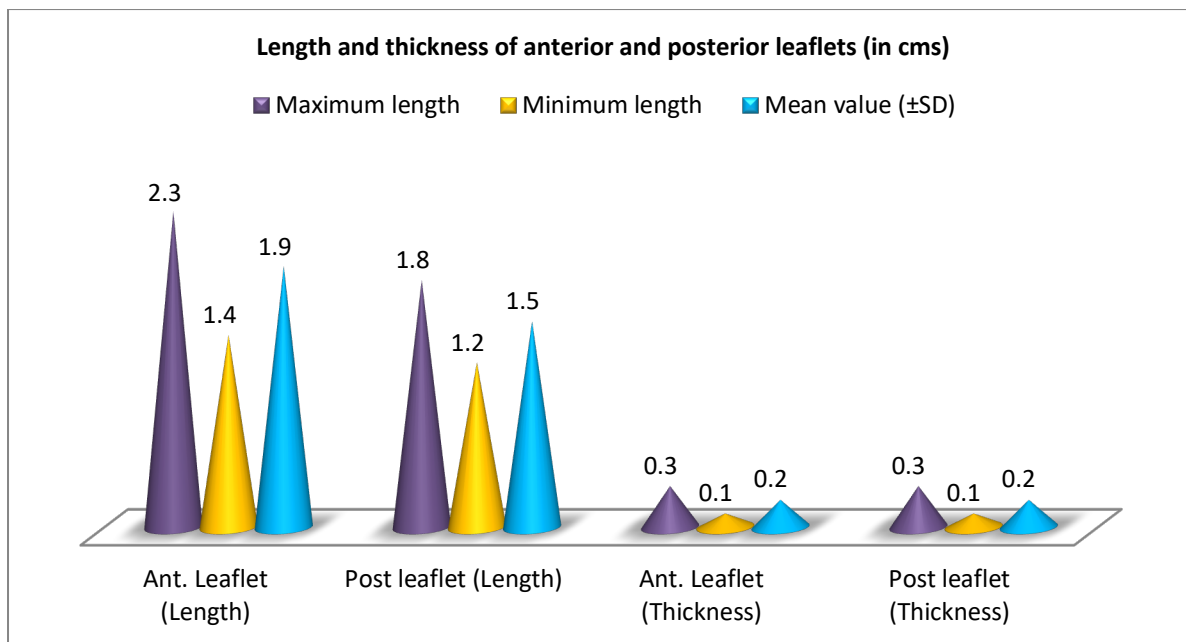


Figure 4: Length and thickness of anterior and posterior leaflets (in cms)

Table 3: Study of number of heads of papillary muscles observed in Mitral valve (Total No. of cadavers: 45)

Antero-lateral papillary muscle			Postero Medial papillary muscle		
No. of Heads	No. of Specimen	Percentage	No. of Heads	No. of Specimen	Percentage
Single	25	55.5	Single	22	48.2
Double	10	22.2	Double	12	26.6
Triple	7	15.5	Triple	8	17.7
More than triple	3	6.6	More than triple	3	6.6

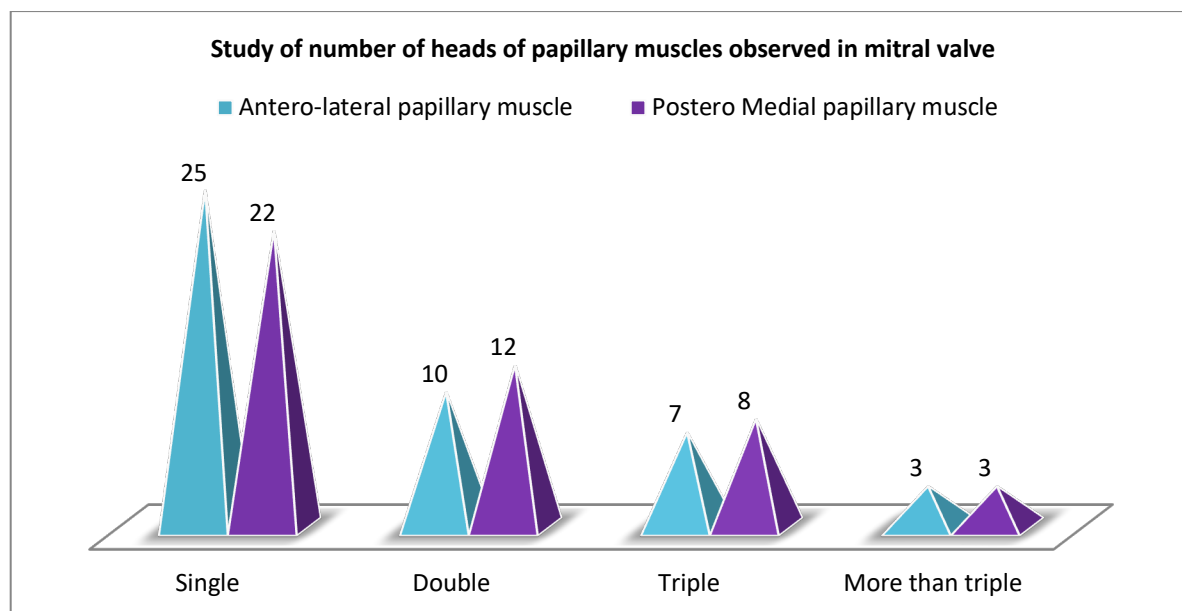


Figure 5: Study of number of heads of papillary muscles observed in mitral valve

Table 4: Study of length of papillary muscles of mitral valve (in cms)

Details	Length of antero-lateral papillary muscle	Length of posterior-medial papillary muscle
Maximum length	2.3	2.0
Minimum length	1.3	1.2
Mean value (± SD)	1.9 (±0.2)	1.7 (±0.2)

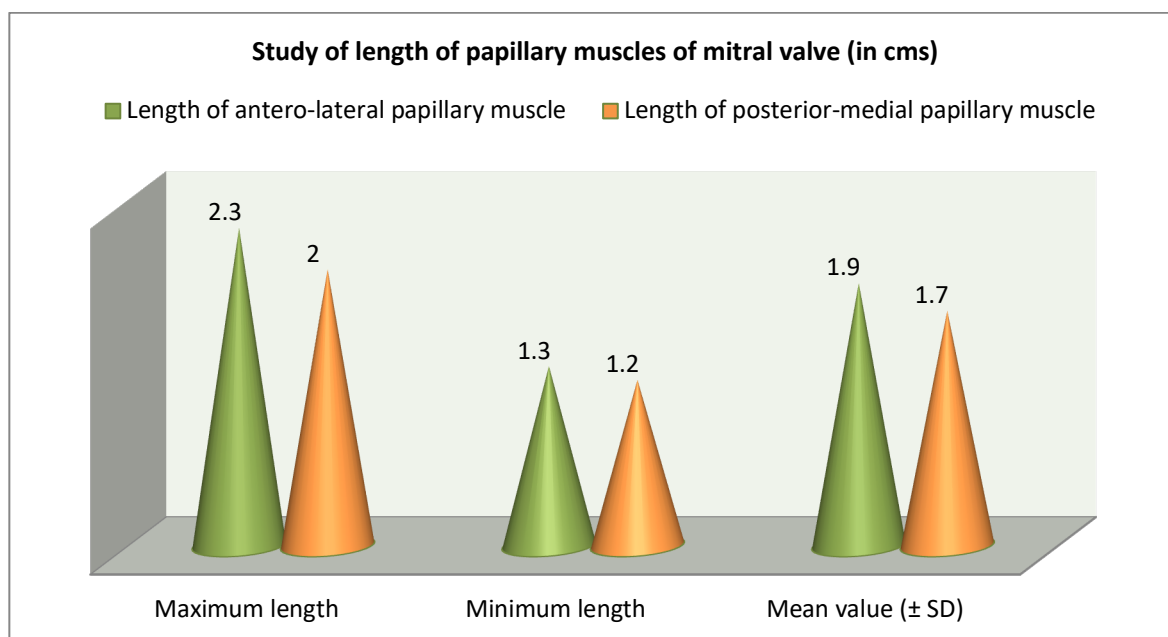


Figure 6: Study of length of papillary muscles of mitral valve (in cms)

Discussion

In the present morpho-metric study of the mitral valve in cadavers the maximum circumference of MV was 9.8 cm, and the minimum circumference was 8.3 cm. mean value was 8.98 (± 0.8) (Table 1). In the study of the length and thickness of anterior and posterior leaflets (cms), anterior leaflet maximum length 2.3, minimum length 1.4, and mean value 1.9 (± 0.2).

In posterior leaflet maximum length was 1.8 (cm), minimum length was 1.2 (cm), mean valve 1.5 (± 0.2). The maximum thickness 0.3 (cm) in anterior leaflet, minimum 0.1, mean value 0.2 (± 0.1). The thickness of the posterior leaflet maximum was 0.3, minimum 0.1, and the mean value was 0.2 (± 1.1). (Table 2).

In the study of the number of heads of papillary muscle observed in the MV, 25 (55.5%) single, 10 (22.2%) double, 7 (15.5%) triple, 3 (6.6%) medial papillary, and muscle: 22 (48.8%) single, 12 (26.6%) double, 8 (17.7%) triple, 3 (6.6%) more than 3 heads (Table 3). In the study of length of papillary muscles of MV (in cms) – length antero lateral papillary muscle maximum 2.3 (cms), minimum 1.3 (cms) mean value 1.9 (± 0.2).

The length of postero-medial papillary muscle – the maximum length was 2.0 (cms) the minimum length was 1.2, with a mean value 1.7 (± 0.2) (Table 4) (Figure 1 and 2). These findings are more or less in agreement with previous studies [5,6,7].

The mitral valve (MV) develops from the cushion tissue and myocardium of the ventricle. Abnormal splitting of the cushion tissue may result in an increased number of cusps [8]. The technique of cusps

commissuroplasty can be used to reconstruct atrio-ventricular valves that have been damaged by endocarditic damage to the commissure and adjacent cusps. An increase in the number of cusps and their improper approximations will be more likely to cause various valvular disorders.

Mitral valve repair is considered the gold standard to treat mitral regurgitation. The re-emergence of the edge-to-edge approximation of the leaflets is commonly called the Alfieri technique. This technique helps for suturing anterior and posterior leaflets at a single point midway between the circumferences of leaflets, creating the double orifice. This technique for mitral valve repair is a simple solution for the complex problems of MV [9]. Congenital increase in the number of cusps may increase the chances of mitral valve regurgitation with disturbances in edge-to-edge cusp closure. It is also reported that there were variations in quantities of cusps because small accessory cusps are always found between two major cusps of MV. It impairs normal blood flow and leads to the regurgitation of blood [10].

Conservation MV repair with preservation of annul papillary muscle continuity by retaining the sub-valvular apparatus is possible if there is a proper approach to MV with complete anatomical knowledge.

Summary and Conclusion

Present study of M.V. in cadaveric hearts, the M.V. was exposed, and the length, breadth, and thickness of the M.V. were noted. The arrangement of M.V. and its contents are important for clinicians, surgeons, and echocardiologists because M.V. is approached in orthogonal, cross-sectional, and short axial planes.

Moreover, the AV (atrio-ventricular) bundle is more or less directly related to M.V. Hence, a morphometrical study is important for cardio-thoracic surgeons to avoid damage to the A.V. bundle during surgery.

Limitation of study: Owing to the tertiary location of the research center, the small number of cadaveric hearts, and the lack of the latest technique, we have limited findings and results.

This research work has been approved by the ethical committee from the institution.

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