

Morphometric and Morphological Analysis of Height of Commissures of Normal Adult Human Formalin Fixed Mitral Valve

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Abstract

Human mitral valve have two commissures namely anterolateral and posteromedial. These commissures have been useful to cardiothoracic surgeons at the time of mitral valve surgeries. Therefore, a study was conducted in the department of anatomy to analyze the height of both the commissures in fifty normal human adult formalin fixed mitral valve. The main objective of this study was to statistically analyze the heights of the commissures and to know the difference in various international studies performed. Average height of anterolateral commissure is 0.65 ± 0.14 cm in males and 0.60 ± 0.14 cm in case of females. The average height of the posteromedial commissures measures 0.72 ± 0.18 cm in male and 0.70 ± 0.18 cm in the female hearts. The measurements of height of anterolateral commissures in Indian formalin fixed hearts are less in comparison to their measurements in western subjects.

Keywords: Anterolateral commissure, Posteromedial commissure, Mitralvalve, Formalin fixed

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Introduction

The mitral valve has two leaflets which are notably different in shape and circumferential length. The corresponding terms for anterior and posterior are "aortic" and "mural". It is the aortic leaflet that is in fibrous continuity with the aortic valve. The aortic leaflet has a rounded free edge and occupies a third of the annular circumference, whereas the other leaflet is long and narrow, lining the remainder of the circumference (Fig. 1)



Fig. 1: The atrial aspect of the mitral valve shows the arrangement of the two leaflets between the commissures. The free edge of the mural leaflet has two clefts (red arrows) giving this leaflet the appearance of three scallops

The aortic leaflet hangs like a curtain between the left ventricular inflow and outflow tracts. According to Roberts WC, Perloff JK, when the valve is closed, this leaflet appears to form the greater part of the atrial floor but is approximately equal in area to the mural leaflet^[1]. It meets the mural leaflet to form an arc shaped closure line, or zone of apposition, that is obliquely situated relative to the orthogonal planes of the body.

With the leaflets meeting, the view of the valve from the atrium resembles a smile. Each end of the closure line is referred to as a commissure. These are

designated the anterolateral and posteromedial commissures. Harken et al., (1952) described that the mitral valve consists of a continuous veil attached around the entire circumference of its orifice with two regularly placed indentations called commissures^[2]. Rusted et al., (1952) pointed out that the tips of the papillary muscles could be used as a guide to identify the anterolateral and posteromedial commissures^[3]. Chiechi et al., (1956) reminded that commissures in Latin meant a joint or juncture. They mentioned that anatomically and histologically junctional tissue was not different from the rest of the valve tissue^[4]. On the other hand when the rheumatic infection took place, the fibrous tissue reflections led to the fusion of the opposite cusps and produced a commissure. For this reason they did not agree with the classical view. Consequently they opined that the commissure ought to be considered as a phenomenon uniquely and exquisitely pathologic. The two major leaflets were joined at an either extremity by a cuff of valvular tissue called junctional tissue. This junctional tissue became

differentiated into one or two minor cusps, the anterior and posterior accessory cusps.

Ranganathan et al., (1970) defined the commissural areas by noting the presence of fan shaped chordae tendinae. The posteromedial commissural chordae were present in all the 50 cases studied by them. The stem of these chordae pointed towards the centre of posteromedial commissures in all the 50 cases. The fan shaped chordae were present at the anterolateral commissures in 49 cases. The stem of the anterolateral commissural chorda pointed towards the centre of the commissural areas in 44 hearts whereas it pointed towards anterior cusp in 5 hearts. They opined that this anatomic variation should be remembered since in such cases a commissurotomy may tear some part of the anterior leaflets. The posteromedial commissural chorda however was always central in location and so would be a more accurate guide in commissurotomy. Thus, it forms a reliable guide for identification of respective commissures in addition to the direction of the stem of the commissural chorda as suggested by Ranganathan et al., (1970)^[5].

Table 1: Height of Commissures (in cm.)

Commissure	Rusted et al (1952)		Chiechi et al (1956)		Ranganathan et al (1970)	
	Male (25)	Female (25)	Male (60)	Female (45)	Male (26)	Female (24)
Anterolateral	0.50- 1.30 (0.80)	0.40- 1.10 (0.70)	0.60-1.20 (0.80)	0.60-1.10 (0.70)	0.50-1.30 (0.80)	0.50-1.00 (0.70)
Posteromedial	0.50-1.30 (0.80)	0.30-1.00 (0.70)	0.50-0.90 (0.70)	0.40-0.80 (0.60)	0.60-1.20 (0.80)	0.40-1.10 (0.80)

Material and Method

The present study was conducted on fifty formalin fixed human adult hearts of both sexes obtained from Department of Anatomy. The hearts showing any indication of valvular disease were discarded. The mitral leaflets with the annulus, chordae, and papillary muscles were removed, and the valve was flattened out in a single plane by dividing its ring at the anterolateral commissure and by half splitting the papillary muscle mass as described by Louis A. Du Plessis and Paul Marchand. The morphological and morphometric data of the commissures was studied. The opened out valves were placed on the view box and the measurements of various parameters were taken with the help of surgical silk thread, a divider and a metric ruler measuring up to 0.5 mm.

Transillumination with the help of view box was used to bring out distinctive features of the valvular tissue especially the measurements of rough zones and clear zones.

The following measurements were taken as per methods described by Ranganathan N, Lam JHC, Wigley ED et al:

The commissures were identified and their heights were recorded.

Materials used for measuring the mitral valve in formalin fixed hearts

1. View Box
2. Metric Ruler Calibrated to 0.5 mm.
3. Surgical Silk Thread.
4. Divider
5. Dissecting Instruments
6. Plastic Scale Calibrated to 1 mm.



Fig. 2: Splayed Open Mitral Valve viewed from Atrial Aspect



Fig. 3: Measurement of Height of Commissure with the help of Transillumination by using divider

Statistical Analysis:

- Unpaired student's t test was applied for statistical analysis.
- p value < 0.05 at 95 % C.I. was considered to be statistically significant.

hearts of adult female ranged from 0.30-0.95 cm. with an average of 0.70 ± 0.18 cm.

Observations and Result

The anterolateral and posteromedial commissures were identified and their heights were measured:

The height of the anterolateral commissure in formalin fixed hearts of adult male ranged from 0.35-0.75 cm. with an average of 0.65 ± 0.14 cm. The height of the anterolateral commissure in formalin fixed hearts of adult female ranged from 0.30-0.80 cm. with an average of 0.60 ± 0.14 cm.

The height of the posteromedial commissure in formalin fixed hearts of adult male ranged from 0.30-1.15 cm. with an average of 0.72 ± 0.18 cm. The height of the posteromedial commissure in formalin fixed

Table 2: Height of commissures of mitral valve

Commissures	Male (n=25)			Female (n=25)			t test	Degree of freedom	p value
	Range (in cm.)	Average (in cm.)	Std. Dev. (SD)	Range (in cm.)	Average (in cm.)	Std. Dev. (SD)			
Antero-lateral	0.35-0.75	0.65	± 0.14	0.30-0.80	0.60	± 0.14	1.26	48	0.212800
Postero-medial	0.30-1.15	0.72	± 0.18	0.30-0.95	0.70	± 0.18	0.39	48	0.696179
t test	-1.5349			1.0963					
Degree of freedom	45			45					
p value	0.1318			0.2787					

As the $p > 0.05$, for height of the anterolateral and posteromedial commissures in case of males, so the values are not statistically significant.

As the $p > 0.05$, for height of the anterolateral and posteromedial commissures in case of females so the values are not statistically significant.

As the $p > 0.05$, for height of the anterolateral commissures in case of both males and females, so the values are not statistically significant.

As the $p > 0.05$, for height of the posteromedial commissures in case of both males and females, so the values are not statistically significant.

Discussion

The measurements of average height of anterolateral commissures in the adult male formalin fixed hearts in the present study is less than that observed by

Rusted et al., (1952), Chiechi et al., (1956) and Ranganathan et al., (1970). The measurements of average height of anterolateral commissures in the adult female formalin fixed hearts in the present study is less than that observed by Rusted et al., (1952), Chiechi et al., (1956) and Ranganathan et al., (1970). The measurements of average height of posteromedial commissures in the adult male formalin fixed hearts in the present study is less than that observed by Rusted et al., (1952) and Ranganathan et al., (1970) but more than that observed by Chiechi et al., (1956). The measurements of average height of posteromedial commissures in the adult female formalin fixed hearts in the present study is more than that observed by Chiechi et al., (1956), equal to that observed by Rusted et al., (1952) but less as observed by Ranganathan et al., (1970).

Table 3: Height of commissures (in cm.)

Commissure	Rusted et al (1952)		Chiechi et al (1956)		Ranganathan et al (1970)		Present study (2013)	
	Male (25)	Female (25)	Male (60)	Female (45)	Male (26)	Female (24)	Male (25)	Female (25)
Anterolateral	0.50- 1.30 (0.80)	0.40- 1.10 (0.70)	0.60-1.20 (0.80)	0.60-1.10 (0.70)	0.50-1.30 (0.80)	0.50-1.00 (0.70)	0.35-0.75 (0.65)	0.30-0.80 (0.60)
Posteromedial	0.50-1.30 (0.80)	0.30-1.00 (0.70)	0.50-0.90 (0.70)	0.40-0.80 (0.60)	0.60-1.20 (0.80)	0.40-1.10 (0.80)	0.30-1.15 (0.72)	0.30-0.95 (0.70)

Summary and Conclusions

The study of the heights of commissures of mitral valve in the 50 formalin fixed hearts obtained from the Department of Anatomy is summarized and concluded below:

- Average height of anterolateral commissure is 0.65 ± 0.14 cm in males and 0.60 ± 0.14 cm in case of females ($p > 0.05$ was calculated which indicate that the values are statistically not significant).
- The average height of the posteromedial commissures measures 0.72 ± 0.18 cm in male and 0.70 ± 0.18 cm in the female hearts ($p > 0.05$ was calculated which indicate that the values are statistically not significant).
- The measurements of height and width of anterolateral commissures in Indian formalin fixed hearts are less in comparison to their measurements in western subjects
- Present data's obtained can be used by cardiothoracic surgeons for mitral valve surgeries in human population particularly in central India.

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