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## A Morphometric Study on the Septomarginal Trabeculae in South Indian Cadavers

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### Article

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#### ABSTRACT

Most of the human hearts presents a specialized bridge known as Septomarginal trabecula which extends from the right side of the ventricular septum to the base of anterior papillary muscle. For the present study we took 30 human hearts. We studied the thickness of the septomarginal trabecula, the height of its attachment to the ventricular wall by considering the supraventricular crest as the landmark, length of septomarginal trabecula and type of attachment to the septal wall. We found that in most of the cases, the septomarginal trabecula originated about upper or middle third of the ventricular wall. The thickness varied from less than 1mm to more than 5mm. We also found variation in the way of attachment of the septomarginal trabecula to the ventricular wall. Some of the septomarginal trabecula branched before attaching to the base of the anterior papillary muscle. We decided to study this because of its role in the haemodynamics and conduction of electric impulses in heart.

#### INTRODUCTION

The trabeculae carneae (fig 1) is a constant feature of the anatomy of human heart, which connects interventricular septum and anterior wall of the right ventricle. The trabeculae carneae constitute numerous muscle bundles running longitudinally or obliquely, located on the inner surface of the ventricles <sup>[1]</sup>. King named it "the MODERATOR BAND", since according to his concept the trabeculae limited the excessive expansion during diastole of the right ventricle <sup>[2]</sup>.

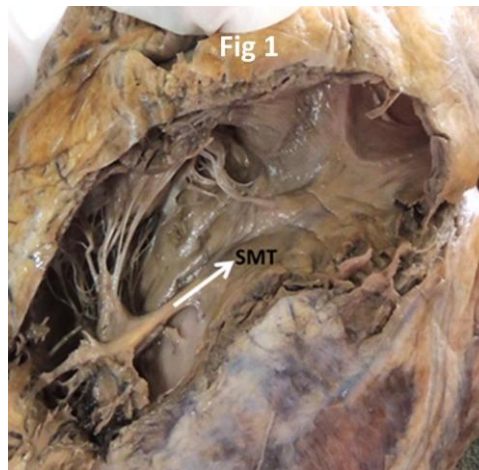


Figure 1: Showing the Septomarginal trabeculae

The word "Septomarginal Trabeculae" was named by Tandler based on its attachment <sup>[3]</sup>. The trabeculae carneae begin to form at a rather early stage of prenatal development – their delicate structure can be observed at the 4th – 5th week of fetal age [4]. Firstly, two

layers start to develop within the primary myocardium: a compact one (the parietal layer) and a spongy one (the medial layer). Intense division of cardiomyocytes of the spongy layer leads to the formation of the typical trabeculae. The local, radical concentration of these elements forms papillary muscles, which further, within the area of atrioventricular outlets, transform into bundles known as chordae tendineae<sup>[5]</sup>. At the 9th week of fetal age one can already distinguish the Septomarginal trabeculae and the anterior papillary muscle of the right ventricle<sup>[6]</sup>.

The analysis of the functional characteristics and probable clinical implications of the pathology of the moderator band seem to be very interesting. It is believed that along with crista supraventricularis it separates that blood's inflow and outflow, playing a significant role in employing the right ventricle of blood during systole. Consequently, the hypertrophy of those structures which often accompanies congenital defects can cause some haemodynamic disorders in the right ventricle of the heart<sup>[7]</sup>. There are numerous studies confirming the presence of bifurcations of the right branch of His' bundle, as a constant element of the Septomarginal trabecula<sup>[8]</sup>.

We decided to study the Septomarginal trabeculae due to its role in haemodynamics and conduction of electrical impulses in the heart. As well as cardiac disorders such as double chambered right ventricle<sup>[9, 10]</sup> and arrhythmias<sup>[11]</sup> have made it to add contributions towards the morphological and morphometric variations in the Septomarginal trabeculae.

## METHODS AND MATERIALS

The study has been carried on 30 formalin fixed human hearts of both the sexes in the Department of Anatomy, Kasturba Medical College, Manipal.

The incision was given from the apex of the right ventricle, along its lateral margin and through the posterior leaflet of the tricuspid valve. Then the right atrium was opened along the lower margin of the auricle. After opening the ventricle, its interior was carefully inspected.

The thickness of Septomarginal trabeculae, its length, height of its attachment to the septal wall by considering supraventricular crest as the landmark were measured by the digital Vernier Calipers, the mode of its attachment to the septal wall and its branching pattern were observed.

The variations were noted and photographed. The variations were classified and compared with the earlier reports.

## RESULTS

The Septomarginal trabeculae emerging due to differentiation of the lower pole of the crista supraventricularis is the first trabeculae carneae forming at the atrioventricular outlet. Its occurrence was confirmed in all studied heart specimens.

### A) Thickness of the Septomarginal trabeculae

Out of 30 heart specimens, the thickness less than 1mm was found to be in 1 heart specimen. Thickness ranging between 2 to 5mm in 12 heart specimens ( fig. 2 ) and thickness more than 5mm in 17 specimens ( fig 3).

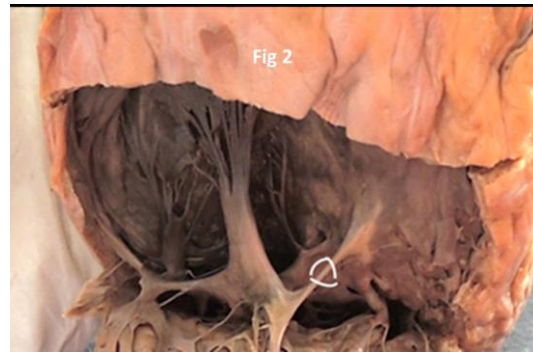
B) Length of the Septomarginal trabeculae was measured by taking the distance between its attachments from the ventricular septum to the base of the anterior papillary muscle. The length of Septomarginal trabeculae ranging between 5 to 10mm was reported in 3 specimens, between 10 to 20mm in 26 specimens and more than 20mm in 1 heart specimen [fig 3].

C) The height of the attachment of Septomarginal trabeculae to the ventricular wall: This was measured by considering the supraventricular crest as the landmark to its attachment with the ventricular septum.

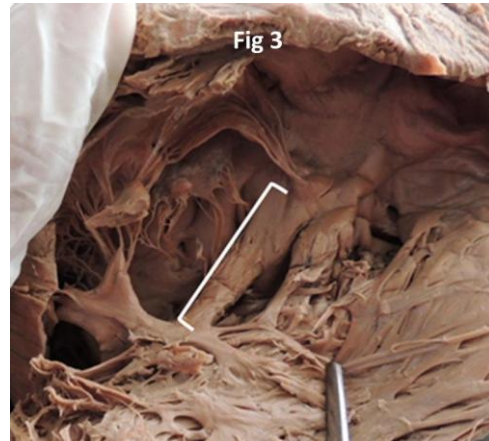
According to the results we classified them into two groups, one ranging less than 20 mm was found to be in 2 specimens and the other ranging more than 20 mm was found to be in 28 heart specimens.

### D) The branching pattern

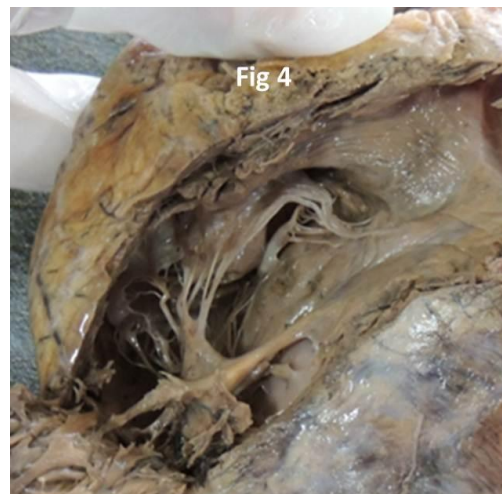
Based on our observations we classified the Septomarginal trabeculae into single and double type.



**Figure 2: Showing that the thickness of Septomarginal trabeculae was less than 1mm**



**Figure 3: Showing the thickness of Septomarginal trabeculae more than 5mm and length more than 20mm**



**Figure 4: Showing the single Septomarginal trabeculae- simple type**

Single type: in the present study, in 28 cases there was one Septomarginal trabeculae connecting the interventricular septum to the base of the anterior papillary muscle. This single type was subdivided into simple and complex type based on its branching pattern towards the anterior papillary muscle. Out of these 28 single Septomarginal trabeculae, 18 Septomarginal trabeculae[fig 4] did not show any branching pattern towards its attachment to the papillary muscle. In 10 specimens, the septal attachment showed no branching whereas the papillary component showed branching towards its attachment to the papillary muscle[ fig 5, 6, 7 ]

Double type: In 2 specimens, there were 2 Septomarginal trabeculae attached to the interventricular septum and joined separately to the base of the papillary muscle[ fig 8].

E) The mode of its attachment with the septal wall

Thick and adherent is found in 20 specimens[fig 3]. Thin and adherent in 10 specimens[fig 8].

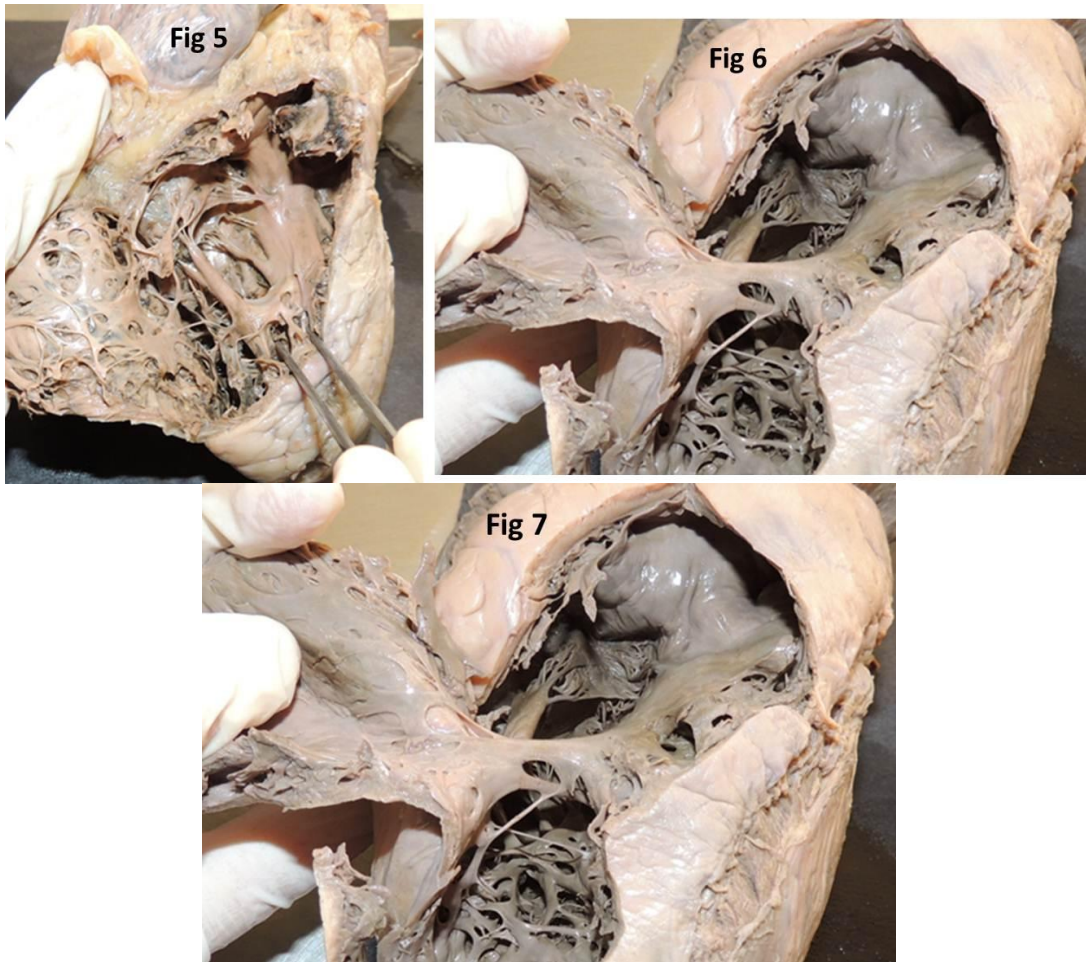


Figure 5,6,7: Showing complex type of Septomarginal trabeculae.

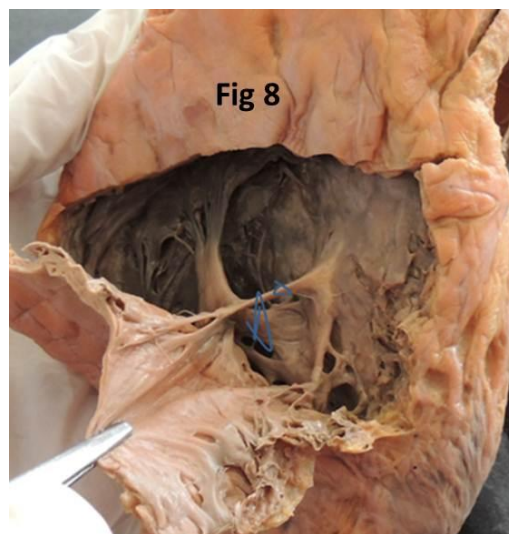


Figure 8: showing double type of Septomarginal trabeculae

## DISCUSSION

The trabeculae carneae as poorly developed structures, appear for the first time in the right ventricles of birds heart <sup>[12]</sup>. Gradual proliferation and concentration of a net of them, creating a complex spatial arrangement, can be observed in primates. One of them, most often the largest and deriving from the crista supraventricularis as its elongation is the Septomarginal trabeculae <sup>[1]</sup>.

In the study done by, Kosinski et al <sup>[13]</sup> in 100 heart specimens, Thickness of Septomarginal trabeculae less than 1mm was not reported. This is reported in our study. Thickness ranging between 2 to 5mm was reported in 63 specimens and Thickness more than 5 mm in 37 specimens. In the study done by Loukas et al <sup>[14]</sup> in 100 heart specimens the mean thickness of the band is reported to be  $4.5 \pm 1.8$  mm.

In a study done by Loukas et al in 100 hearts, he reported that mean length –  $16.23 \pm 2.3$  mm, ranging from 11.3 to 24.3 mm. In the present study we found 3 specimens in which the length of Septomarginal trabeculae less than 10mm

In the study done by Bandeira et al <sup>[15]</sup>: In single Septomarginal trabeculae, simple type is reported in 32.2% and complex type in 67.7%. In the present study, out of 28 specimens, simple type is found to be 64.2%, and complex type 35.71% Weinberg <sup>[16]</sup>, classified the mode of attachment to the septal wall as 3 types: Single, with thick adhesion to the wall. Several filaments, among which the true Septomarginal trabeculae would be the largest of them. Bridge type, connected directly to the anterior papillary muscle without any ramifications. In the present study, we found only the thick adherent type and the thin adherent type. Filamentous type was not reported.

The Septomarginal trabeculae is an important structure not only in terms of its morphology and phylogenesis, but also from the clinical view point.

The knowledge of its formation and topography is important in the context of cardio- surgical procedures.

The structure may profoundly impede the course of closing low located defects in the interventricular septum <sup>[13]</sup>

A developed Septomarginal trabeculae limits the operating field and disturbs the proper localization of the foramen as well as hindering procedures at the stage of stitching <sup>[14, 17]</sup>

Due to the conduction fibres present within the Septomarginal trabeculae, its removal while dressing ventricular septal defect may involve iatrogenic complications e.g. Heart block <sup>[14,18]</sup>

A substantial role of the trabeculae was observed during the ablation treatment due to ventricular tachycardia. It proves that both in the trabeculae and papillary muscles there may occur arrhythmogenic foci <sup>[19]</sup>

A few reports confirm the occurrence of additional conductive ways within the Septomarginal trabeculae, being a morphological substrate of tachycardia <sup>[20]</sup>

The Septomarginal trabeculae may cause misdiagnoses during visual examinations or constitute a site of clot or bacterial vegetation <sup>[21,22,23]</sup>

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