

# Neural Anatomical Study of the Anterior Papillary Muscle Using AChE Staining techniques:

A Discourse on the Anatomy of the APM and Chordae Tendinae.

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## Introduction

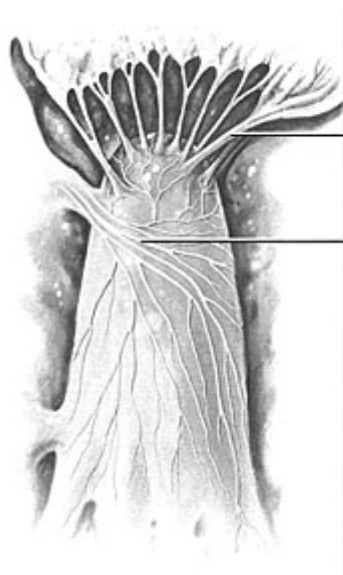
The usual studies of the Anterior Papillary Muscle (APM) describe it as a cone-shaped muscle arising from the side wall of the endocardial surface of the Left Ventricle (LV). We have examined the APM carefully and have recorded the presence of several different types of anatomical form. These varied from cone-shaped to cylindrical, which can be considered anomalous at the present time. The cylindrical forms presented with flat upper surfaces with Chordae Tendinae (CTs) arising primarily from the periphery.

## Procedure

Canine hearts were examined. All hearts were arrested in diastole. Using the Acetylcholinesterase (AChE) and Hematoxylin and Eosin (H&E) staining, a number of Anterior Papillary Muscles and Chordae Tendinae were stained. We adjusted the Karnovsky technique, replacing the iron compound with H&E.

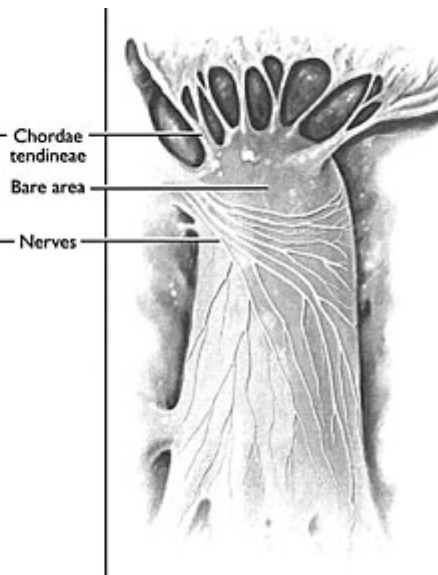
## Illustration

Example 1: Cone-shape



This is what has been normally recognized in configuration. We have since named this a "cone-shaped" APM. Note: Nerves cover top of cone.

Example 2: Cylindrical (anomalous)



Example 2 is what we find to be anomalous to example 1, thusly named "cylindrical". Note: Collar effect of nerves around flat surface.

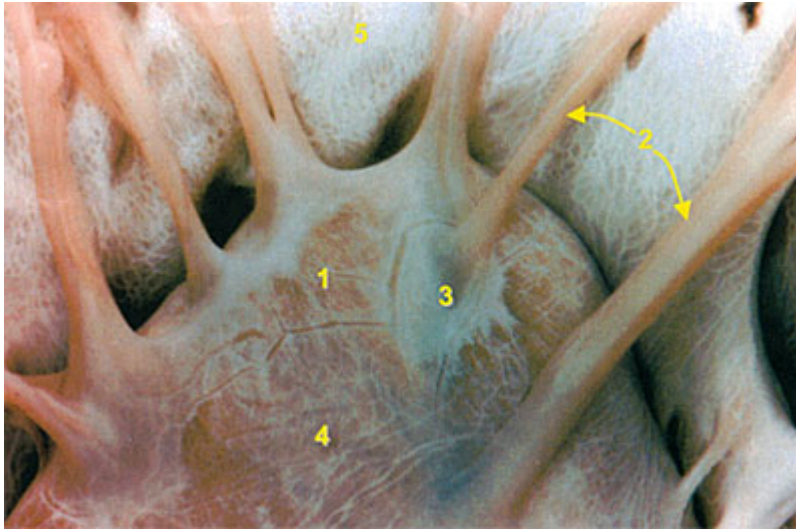
**Image 1**



Normal appearance of APM in a side view of Left Ventricle

1. The APM is fused to the left lateral wall without obvious connective tissue. The LV wall and the APM form the thickest portion of the heart. Trabeculae Carneae aid in holding the LV to the heart wall.

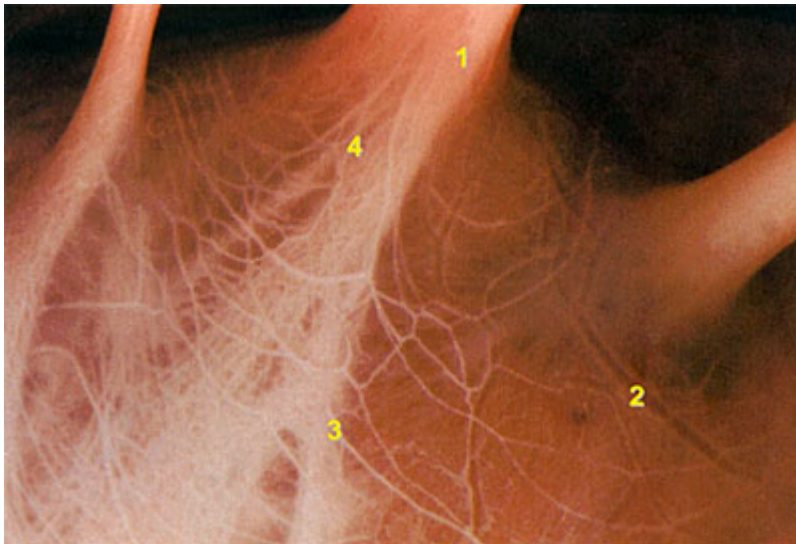
**Image 2**



Typical Cone-shaped surface

1. Upper surface gently rounded.
2. CTs at intervals.
3. Nerves and muscles intertwine between CTs.
4. Surface smooth.
5. LV well stained, web-shaped pattern behind muscle.

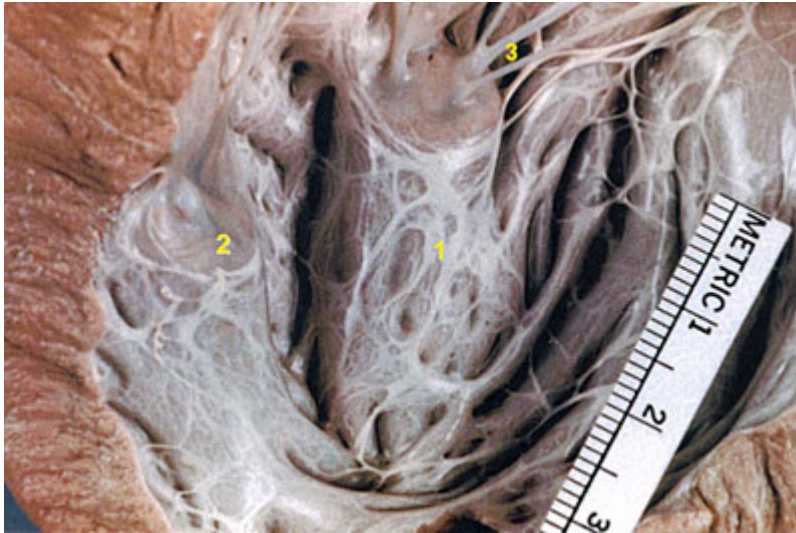
**Image 3**



Close-up of origin of CT rising from cone-shaped APM

1. Chordae Tendinae.
2. Few small vessels seen on APM.
3. Nerves are clearly visible at base of CT.
4. Only a few nerves arise on the surface of the CT.

**Image 4**



Anomalous cylindrical APM

1. APM is in the center of the image.
2. A second partial APM appears on the left side.
3. CTs arise chiefly peripheral to the flat superior surface.

**Image 5**



Close-up of anomalous cylindrical APM

1. APM was partially duplicated during heart development.
2. Trabeculae Carneae appear to divide the APM throughout its entire length.

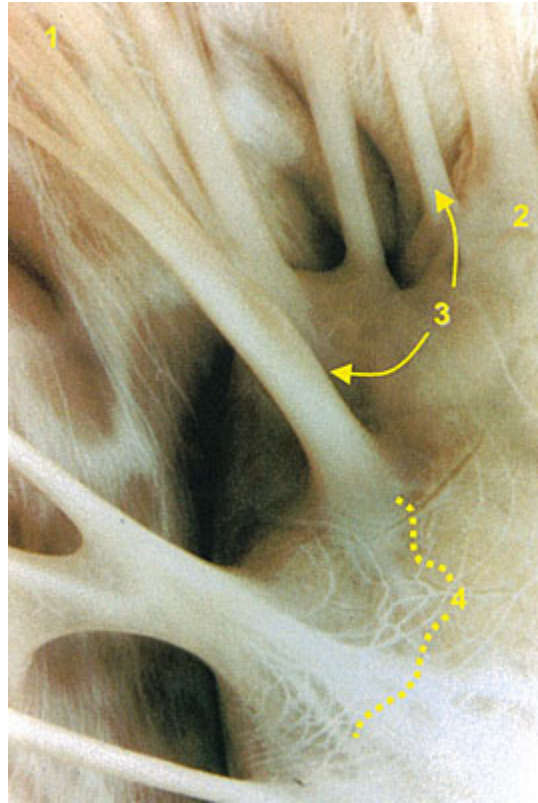
**Image 6**



Another example of anomalous cylindrical APM

1. A flat, tilted upper surface is evident.
2. Only a few CTs arise from flat surface.
3. Most CTs arise from the periphery of the flat surface.
4. Staining indicates heavy innervation on the anterior surface, but not on the flat surface of the cylinder.

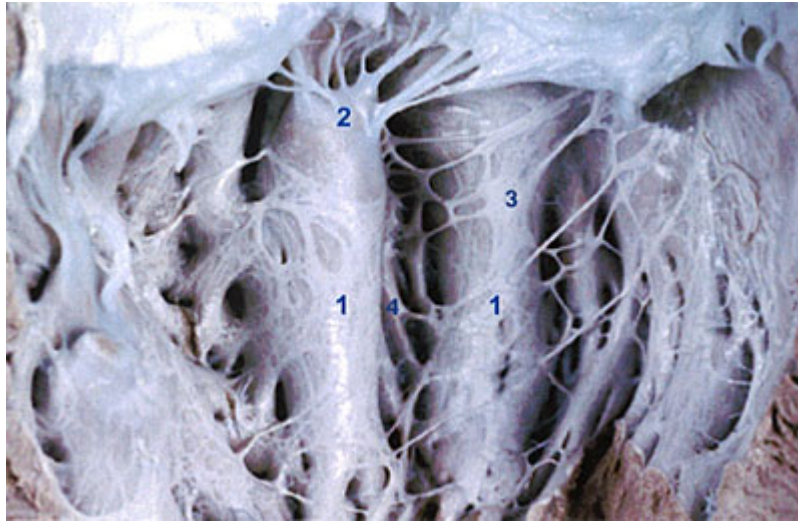
**Image 7**



Complex upper surface of an APM

1. Left side of APM.
2. Upper surface partially cone-shaped.
3. CTs arising from both upper and lower surfaces.
4. Nerves meandering between all CTs.

**Image 8**



Another duplication of APM in the left ventricle

1. Normal LV configuration has only one APM, here we find two.
2. Left APM is cone-shaped as described in example 1 of illustration.
3. Right APM is cylindrical with no apparent CTs on top but several on anterior surface extending to myocardium.
4. Trabeculae Carneae are present between APMs.

### **Findings**

The shape of the APM, typically described as cone-shaped, sometimes was found to be cylindrical with a flat, slightly angled superior surface: one or two CTs might be found arising from the center of this surface. The CTs were seen arising not only from the superior surface of the APMs, but also from the indentations and elevated areas. Other CTs arose from the periphery. The CTs varied in length from 1cm to 4cm. The diameter varied from 0.2mm to 5mm. The configuration at the origin often was wedge-shaped. The innervations of the surface of each APM varied depending on the shape of the APM. Whereas nerve fibers traversed the anterior surface of both shapes of APM and descended obliquely, they differed greatly on the superior surfaces. Cone-shaped superior surfaces displayed nerves, whereas those of cylindrical APMs were bare.

Photography: Vernon, R.; Berry, W.

Illustration: Ehlert, D.; Dils, J.

Acknowledgements

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