DOI: 10.7860/JCDR/2025/76720.20636

Case Report

Anatomy Section

An Unusual Bilateral Membranous Variant of Triplicate Pitted Pectoralis Major Muscle: A Case Report

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ABSTRACT

The variations in the attachments of the pectoralis major not only affect its function but also reflect on its ability to be used as flaps. Membranous origins of this muscle not only add to its stress but also contribute to its inherent tears. The present report unravels the membranous as well as variant tri-muscular origins of this muscle bilaterally, with implications for its role in reconstructive procedures. Although varied classifications of this muscle exist in the literature, the present case finding is unique due to the gaps of separation that were found between the strata of this muscle, which is quite a rare phenomenon. Variations in the membranous and triplicate origins of the pectoralis major are indeed rare findings that warrant the need for larger, separate morphological typing studies in order to delineate its intricate patterns. Membranous variants of the pectoralis major are prone to shearing stress and internal tears, which pose threats to flap reconstruction procedures involving this muscle; thus, the present case report represents a significant finding.

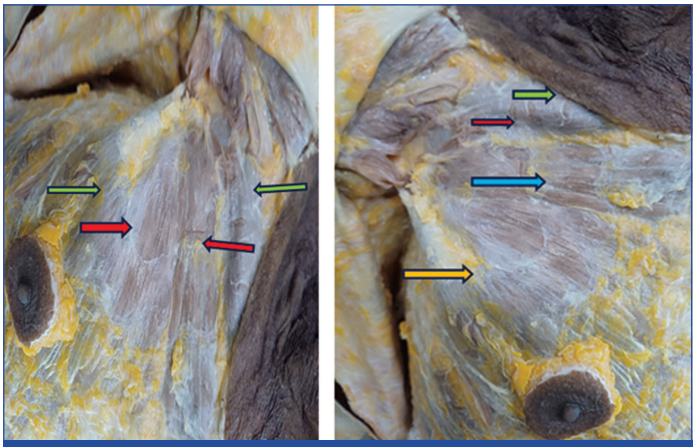
Keywords: Membrane, Muscle flap, Origin, Pectoral girdle, Sternum

CASE REPORT

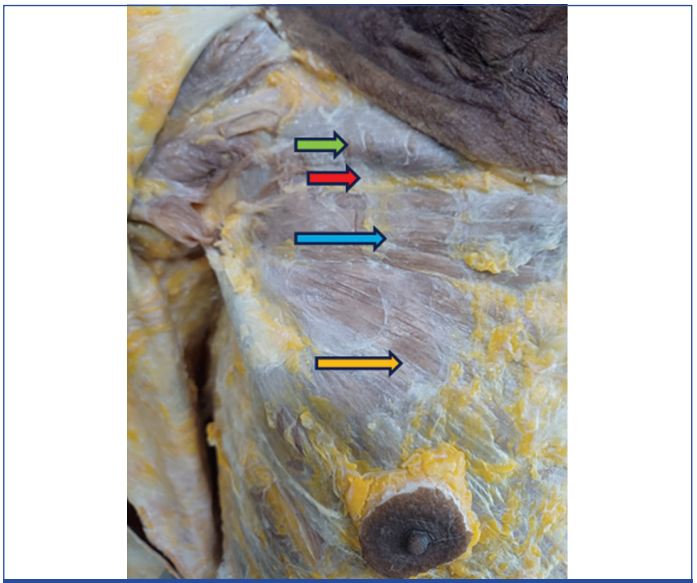
This finding was observed while routinely dissecting a 69-year-old male cadaver. The cadaver was procured for the anatomy laboratory within 14 hours of death. The cause of death, according to the medical records, was myocardial infarction; however, no significant chronic medical illnesses were found. This cadaver had been embalmed using a 10% formalin solution (containing 37% formaldehyde gas dissolved in water). It was a lean cadaver with no signs of external injury and no history of chronic or serious illnesses.

Routine dissection of the pectoral region in this cadaver was performed according to the procedural steps outlined in Cunningham's dissection manual [1]. Bilateral incisions over the pectoral region were made by incising the skin from the sternoclavicular joint to the acromion laterally, and then from the former to the xiphoid process of the sternum vertically. Another incision was then made diagonally from the sternoclavicular joint to the inter-axillary fold line, ensuring that the nipple-areolar complex was not disturbed by encircling it in order to leave it as a landmark for later repositioning of the skin flaps [1]. The skin flaps over the pectoral region were reflected from the medial to the lateral side, and the superficial fascia, mixed with fat over the pectoral region, was then cleared to expose the pectoralis major muscles on both sides without disturbing the nipple-areolar complexes.

It was observed that the origins of the pectoralis major muscles on both sides of the chest from the sternum were membranous rather than fleshy [Table/Fig-1]. The clavicular origins of the muscles on both sides were fleshy, not membranous. The middle fleshy parts of both muscles showed a triplicate pattern of muscle arrangement. On the left-side, a distinct triplicate pattern was seen with pits of separation between them [Table/Fig-2]. However, on the right-side, the separation pits were not distinctly prominent, although the triplicate arrangement of fleshy muscle was evident [Table/Fig-3]. The insertions of these muscles into their respective humeri were normal, as was their nerve supply. The membranous origins of the muscles from the sternum also unusually extended onto the costal cartilages of the first six ribs.



[Table/Fig-1]: Membranous sternocostal origins of pectoralis major (green arrow: fleshy part; red arrow: membrane).
[Table/Fig-2]: Separation pits between right triplicate layers of right pectoralis major muscle (green arrow: upper head; red arrow: separation gap; blue arrow: middle head and yellow arrow: lower head). (Images from left to right)

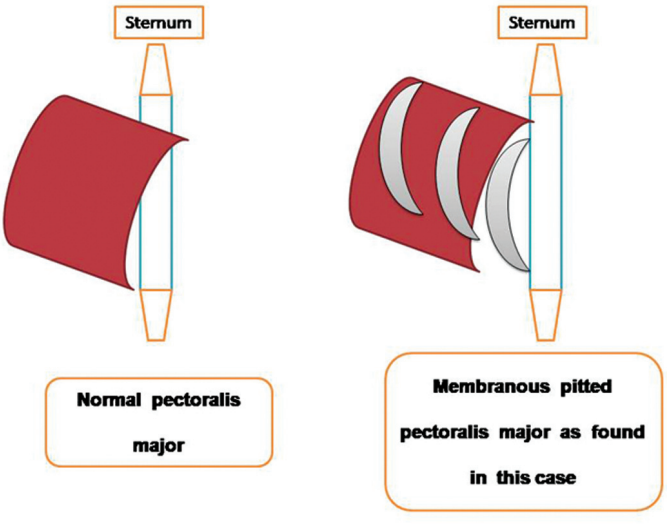


[Table/Fig-3]: Separation gaps between right triplicate layers of right pectoralis major muscle (green arrow: upper head; red arrow: separation gap; blue arrow: middle head and yellow arrow: lower head).

DISCUSSION

The pectoralis major is one of the key muscles of the pectoral girdle, with its primary role being to adduct the arm at the shoulder joint, in

addition to facilitating flexion and medial rotation of the arm [2]. This fleshy muscle typically originates entirely from the lateral margins of the sternum, adjoining the first six costal cartilages, as well as from the medial ends of the superior portions of the clavicle. It usually inserts into the lateral lip of the bicipital groove of the humerus and is innervated by two pectoral nerves: the medial pectoral nerve and the lateral pectoral nerve [3]. If this muscle is found to deviate from its normal morphology, it may have implications not only for its functions but also for surgical procedures involving flaps related to the pectoral girdle [4]. Although the insertion of this muscle determines its primary mode of action, it is the origin of this muscle that plays a crucial role in determining the injuries associated with it, particularly concerning flap reconstruction procedures [5]. In present cadaver, a deviant morphology of the pectoralis major was reported, especially regarding its origin. A schematic diagram comparing the normal pectoralis major with the one observed in present case is depicted in [Table/Fig-4].



[Table/Fig-4]: Schematic comparison between normal and pitted pectoralis majors.
Source: This image is a genuine original work of authors and prepared by authors

Variations in the attachments, as well as the fleshy parts of the pectoralis major, have implications in breast surgery, myocutaneous flap repositioning procedures, and breast reconstruction surgeries [5]. Haladaj R et al., found a separate clavicular head of the muscle, with the remaining bulky fleshy parts intact, thereby rendering the muscle with a bi-muscular presentation [2]. In present cadaver, the pectoralis major was found to comprise a tri-muscular presentation of the muscle, with a separate upper clavicular head, an intermediate costal head, and a lower costal head. Totlis T et al., discovered an additional quaternary head of the muscle; however, in this cadaver, the muscle contained only three heads arranged in a step-by-step fashion, with separation gaps between each stratum that resembled a ladder [6]. This unique arrangement has not been previously reported in the literature. Song H et al., found a supernumerary head of the biceps and an additional head of the flexor digitorum profundus originating from the clavicular head of the pectoralis major [7]. However, in present cadaver, the observed findings did not show any trace of other muscles originating from the pectoralis major. Instead, the pectoralis major appeared to split into three fleshy compartments, whose origins from the sternum and the corresponding intercostal cartilages of the first six ribs were membranous rather than fleshy. Moreover, the findings revealed by Haladaj R et al., and Song H et al., pointed to a predominantly intercostal area of the muscle, while this report revealed a mixed clavicular and sternocostal area consisting of medial membranous and lateral fleshy parts [2,7]. Flap reconstruction surgeries are likely to be affected by the unique medial and lateral separations found in present cadaveric report, as tears during the removal of flaps are likely to occur due to tissue laxity [6,7].

As reported by ElMaraghy AW and Devereaux MW, membranous origins of the pectoralis major are more prone to tears [8]. Since, cadaver revealed a membranous origin of the muscle, it was possible to have compartments within this muscle, as reflected by the layers of stratification, which could help the muscle overcome the pitfalls of tears. Zielinska N et al., reported a fourth kind of muscle that is part of the main pectoralis major, which they labeled as the pectoralis minimus [9]. However, present cadaver did not reveal an accessory belly to the muscle; moreover, those findings of the pectoralis minimus were observed in human foetuses, and since, the present observation was made on an adult cadaver, such findings could not be extrapolated from it.

The importance of findings related to the membranous origin of the muscle in present cadaver indicates that flap reconstructions and repositioning could become significantly more difficult, as the grip needed to handle the muscle may be reduced, further increasing the possibility of internal wear and tear [10]. Hence, it is of utmost interest for plastic surgeons to familiarise themselves with the intrinsic origins and types of this muscle to avoid tears during surgical procedures involving it. Shearing stress and tears are inherently prone to occur in membranous pitted variants due to tiny gaps between the fiber layers of the muscle [10]. Bruna-Majia A et al., reported that agenesis of the pectoralis major was the cause of tears during reconstruction procedures [11]. However, the findings in present cadaver suggest the possibility that not all tears are associated with definitive agenesis; rather, membranous origins of a muscle without proper compartmentalisation could also lead to difficult tears during surgeries. The findings in present cadaver are compared with those of other variants observed by researchers in [Table/Fig-5] [2,6-9,11].

Authors name	Place and year	Heads of the muscle	Type of insertion	Membranous component
Haladaj R et al., [2]	Poland, 2019	Separate large clavicular head	Normal	Nil
Totlis T et al., [6]	Greece, 2012	Quarternary head	Twisted	Nil
Song H et al., [7]	South Korea, 2019	Supernumerary head of biceps along with clavicular head	Normal	Dominant
ElMaraghy AW and Devereaux MW [8]	Canada, 2012	Membranous heads with tears	Normal	Nil
Zielinska N et al., [9]	Poland, 2023	Pectoralis minimus	Normal	Nil
Bruna-Majia A et al., [11]	Chile, 2024	Agenesis of muscle	Twisted	Nil
Present case	India, 2024	Pitted heads with three distinct entities	Twisted	Dominant

[Table/Fig-5]: A comparison between other variants of pectoralis major with the present finding [2,6-9,11].

CONCLUSION(S)

The findings in present cadaver revealed a bizarre tri-layered pectoralis major muscle on both sides, with an unusual membranous sternocostal origin. Separation gaps between the triplicate layers were clearly observed. Flap removal and reconstruction procedures would have implications regarding the morphology of this uncommon variant of the muscle.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Nov 08, 2024
- Manual Googling: Dec 13, 2024
- iThenticate Software: Dec 28, 2024 (7%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Nov 07, 2024**
Date of Peer Review: **Dec 03, 2024**
Date of Acceptance: **Dec 30, 2024**
Date of Publishing: **Feb 01, 2025**