

Original research article

## A Cadaveric Study of Morphological Variation of Pectoralis Major Muscle

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### Abstract

**Introduction:** Many case reports have described anatomical variants of the pectoralis muscle. However, there has been little information published regarding this topic. So, the present study attempts to examine the different types of variations of pectoralis major muscle in terms of its origin, insertion, and nerve supply.

**Methods:** The research was carried out on 40 cadavers ( 32 male and 8 female) in the department of anatomy, B.J .G. M. College, Pune from 2013 to 2014.

**Results:** During dissection, out of the 40 cadavers, in a male cadaver left pectoralis major muscle variation was observed. Origin of the pectoralis major was found to be normal. However, a tendinous slip arising from deep lamina of pectoralis major muscle near its insertion on lateral lip of intertubercular sulcus of humerus was found. This tendinous slip along its course, was found to cross the musculocutaneous nerve, median nerve, brachial vessels, and ulnar nerve from lateral to medial side and blend with medial intermuscular septum 2.5 cm above the medial epicondyle of humerus. Then, it was found to be inserted on the medial epicondyle of the humerus. In all specimens of pectoralis major, the innervation by medial and lateral pectoral nerves was observed to be constant.

No other variations were noted in the specimens of pectoralis major muscle.

**Conclusion:** Anatomical knowledge of variations of Pectoralis Major muscle is important for plastic surgeons during reconstructive surgeries, neurologists, radiologists, orthopaedic surgeons, physiotherapists.

**Key words:** pectoralis major muscle variations, chondro-epitrochlearis

### Introduction

Pectoralis major is a thick, fan-shaped muscle. It arises from the anterior surface of the sternal half of the clavicle (clavicular head); half the breadth of the anterior surface of the sternum down to the level of the sixth or seventh costal cartilage (sternal head); the first to the seventh costal cartilages (first and seventh often omitted); the sternal end of the sixth rib; and the aponeurosis of external oblique (rectus head).

The clavicular fibres are usually separated from the sternal fibres by a slight cleft. The muscle converges to a flat tendon, approximately 5 cm wide, that is attached to the lateral lip of the

intertubercular sulcus of the humerus. The innervation of the muscle is by medial and lateral pectoral nerve. [1]

A commonly noted anomaly of this muscle is its complete absence.

Mosconi and Kamath [2] have described bilateral asymmetric deficiency of the pectoralis major muscle. Bergman and colleagues [3] described many different anomalies associated with pectoralis major, such as *chondroepitrochlearis muscle* (CEM), *chondrofascialis*, *pectoralis quartus*, *sternalis*, and *axillary arch muscle* (Achselbogen of Langer) [4] out of which the latter is the most frequently reported anomaly.

The prevalence of chondroepitrochlearis has been reported to be 0.5 percent by Flaherty et al [5] in a sample size of 200, over 20 years meanwhile a prevalence rate of 2.5% was reported by Aruna et al [6].

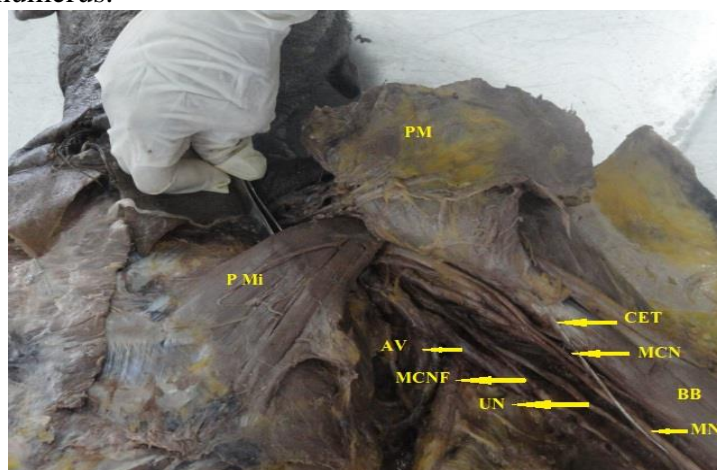
So, the present study attempts to examine the different types of variations of pectoralis major muscle in terms of its origin, insertion, and nerve supply.

### Material and Methods-

A prospective study was conducted from 2013 to 2014 in the department of anatomy, B.J.G.M.College, Pune. Material for present study comprised of 10% formaldehyde solution fixed cadavers. Sample included 40 cadavers (32 male and 8 female) owing to which 80 pectoralis major muscles were dissected out, according to Cunningham's manual [7]. Pectoralis major muscle was studied in detail regarding its origin, insertion and innervation and its variation.

### Result-

During dissection, out of the 40 cadavers, in a male cadaver, left pectoralis major muscle variation was observed. Origin of the pectoralis major was found to be normal. However, a tendinous slip arising from deep lamina of pectoralis major muscle near its insertion on lateral lip of intertubercular sulcus of humerus was found. This tendinous slip along its course, was found to cross the musculocutaneous nerve, median nerve, brachial vessels, and ulnar nerve from lateral to medial side and blend with medial intermuscular septum 2.5 cm above the medial epicondyle of humerus. Then, it was found to be inserted on the medial epicondyle of the humerus.

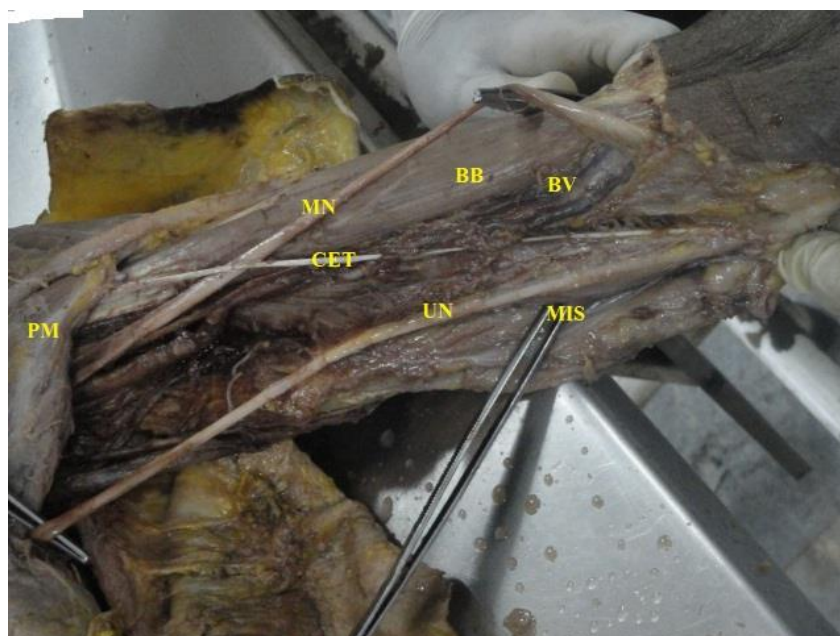


**Fig 1** A cadaveric dissection of pectoralis major (PM) of left upper limb showing a tendinous slip chondro-epitrochlearis (CET) arising from deep lamina of PM near its insertion on lateral lip of intertubercular sulcus of humerus. This tendinous slip along its course, was found to

cross the musculocutaneous nerve(MCN), median nerve (ME), and ulnar nerve (UN) from lateral to medial side.

Abbreviations-

P Mi-Pectoralis Minor, BB-Biceps brachii, AV- Axillary vein, MCNF-Medial cutaneous nerve of forearm



**Fig 2** shows a cadaveric dissection of pectoralis major (PM) of left upper limb. A tendinous slip chondro-epitrochlearis(CET)arises from deep lamina of PM near its insertion on lateral lip of intertubercular sulcus of humerus. This tendinous slip along its course, was found to cross the median nerve (ME), brachial vessels (BV) and ulnar nerve (UN) from lateral to medial side and blend with medial intermuscular septum (MIS) 2.5 cm above the medial epicondyle of humerus. Then, it got inserted on the medial epicondyle of the humerus.

In all specimens of pectoralis major, the innervation by medial and lateral pectoral nerves was observed to be constant.

No other variations were noted in the specimens of pectoralis major muscle.

### Discussion-

Absence of pectoralis major has been described extensively, both as an isolated anomaly, and in association with congenital syndromes. Poland syndrome was first described in the literature in 1962 as a condition characterized by unilateral absence of pectoralis major and cutaneous syndactyly of the ipsilateral hand. [8] Cases of congenital absence of pectoralis major were reported on living subjects by Lee and Chun. [9] In a Cadaveric study, Dr K. Sushma [10] found that the clavicular fibres of the left Pectoralis major were well developed whereas the sternocostal fibres were absent.

Many variants of insertion of Pectoralis Major included attachment to coracoid process (chondrocoracoideus), into either lesser tubercle or greater tubercle (costohumeralis), into the medial epicondyle (chondroepitrochlearis or costoepitrochlearis), and into the deep fascia of arm (chondrofascialis). [11]

Venieratos et al [12] reported an accessory left-sided chondrocoracoideus muscle as an extension of abdominal portion of Pectoralis major. This muscle originated as three slips

from 5th to 6th ribs and inserted into coracoid process after fusing with the short head of biceps. Another variant reported by Shetty et al [13] was the costodorsalis, a muscular slip originating from the sixth rib near the costochondral junction running along the lower border of PM muscle crossing the axilla and merging with the latissimus dorsi muscle.

Bergman [3] describes the chondro-epitrochlearis anomaly as a muscular slip which arises from one or more ribs, crosses the axilla and inserts into the medial intermuscular septum or medial epicondyle of the humerus. It was first described by Duvernoy (who named it) in 1855, as cited by Wood [14]. This chondro-epitrochlearis variation may be unilateral or bilateral.

In our study, we found unilateral chondro-epitrochlearis muscle on the left side similar to Padavinangadi [15], Kotian SR [11], R. B. Trobs [16] et al while Fitzgerald [17], Voto et al [18], Spinner et al [19], Loukas [20], Rachana S et al [21] found it on the right side. Palagama et al [22], S Aruna et al [6], Di Gennaro [23] found this finding bilaterally.

The findings in our study were most similar to the one described by Sushma Kotian et al [11], in which they found a tendinous extension of left pectoralis major arising from deep lamina of the muscular bilaminar tendon close to its insertion to the humerus and attached to the medial intermuscular septum of the arm and finally to the medial epicondyle of the humerus. Tracing this tendinous extension slip proximally, no separate extension was observed. Rai R et al [24] described three nerves arising from the lateral cord of brachial plexus supplying the pectoralis major muscle. In our study, innervation of all the specimens of pectoralis major muscle was found to be usual.

Embryologically, the pectoral musculature is derived from ventral limb bud masses which arise from the C4-C8 and T1 myotomes during fifth week of intrauterine life [25]. On 47th day, the costal head of pectoral mass splits into pectoralis minor and sternocostal part of pectoralis major muscle [26]. The pectoral muscles assume their final forms through a combination of migration, fusion, and apoptosis of muscle cell precursors [27]. The present variation may be due to incomplete apoptosis of broad insertion of pectoralis major muscle. Samuel et al [28] reported limitation of the abduction of the arm due to chondroepitrochlearis. Infraclavicular ulnar nerve entrapment due to a chondroepitrochlearis muscle was noted by Spinner RJ et al [19]. Fitzgerald [17] reported clinical presentations of chondroepitrochlearis in a one-year-old male child. A fibrous band was extending from the chest to his right arm, forming a web-like structure in the axilla. This abnormal muscle was likely to present with an axillary pterygium constituting a cosmetic deformity.

In the present study, chondroepitrochlearis tendinous slip along its course, was found to cross the musculocutaneous nerve, median nerve, brachial vessels, and ulnar nerve. It may cause neurovascular compression. So, it is important to be familiar with the morphological variations of pectoralis major muscle.

### **Conclusion-**

A sound anatomical knowledge of variation of Pectoralis major is important because it may have a role in ulnar nerve entrapment, may restrict the abduction of shoulder joint, or may result in cosmetic deformity. Such knowledge is important for plastic surgeons during reconstructive surgeries, neurologists, radiologists, orthopaedic surgeons, physiotherapists.

### **References-**

1. Standing Susan. Gray's Anatomy – The Anatomical Basis of Clinical Practice. 41st ed.

- Elsevier Churchill Livingstone, New York;2016;819
2. Mosconi T, Kmath S. Bilateral asymmetric deficiency of the pectoralis major muscle. *Clin Anat.* 2003;16(4):346-349.
  3. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. *Compendium of Human Anatomic Variation.* Munchen, Baltimore: Urban and Schwarzenberg 1988.
  4. Daniels I. R., Della Rovere G. Q. The axillary arch of Langer—the most common muscular variation in the axilla. *Breast Cancer Research and Treatment.* 2000;59(1):77–80.
  5. FLAHERTY G, O'NEILL MN, FOLAN-CURRAN J. Case report: bilateral occurrence of a chondroepitrochlearis muscle. *Journal of Anatomy.* 1999;194(2):313–315.
  6. Aruna S, Rajila R, Vaithianathan G. Bilateral Chondroepitrochlearis Muscle: Incidence, Phylogenetic and Clinical Significance. *J Clin Diagn Res.* 2011;5(1):31–34
  7. Romanes GJ. *Cunningham's Manual Of Practical Anatomy.* 16th edi, vol 1. New York: Oxford Medical Publications; 1998:30-33
  8. Clarkson P. Poland's syndactyly. *Guys Hosp Rep.* 1962;111:335-46.
  9. Y.H. Lee and S.I. Chun. Congenital absence of pectoralis major: a case report and isokinetic analysis of shoulder motion. *Yonsei medical journal.* 1991;32(1), 87-90.
  10. Dr K Sushma et al. Absence of Pectoralis major. *IOSR-J of Dental and Medical Sciences.* 2014;13(3), 1-2.
  11. Kotian SR, Bhat KM. Pectoro-epicondylaris: A rare extension of the pectoralis major muscle. Pectoro-epicondylaris: Una rara extensión del músculo pectoral mayor. *Rev Argent Anat Clín* 2013;5:29-32.
  12. Venieratos D, Samolis A, Piagkou M, Douvetzemis S, Kouroutzoglou A, Natsis K. The chondrocoracoideus muscle: A rare anatomical variant of the pectoral area. *Acta Med Acad* 2017;46:155-61.
  13. Shetty SD, Nayak SB, Kumar N, Somayaji SN, Rao KG. Costodorsalis-an additional slip of pectoralis major muscle-a case report. *Int J Morphol* 2011;29:409-11.
  14. Wood J. Variations in human myology observed during the winter session of 1867-68 at King's College, London. *Proceedings of the Royal Society of London.* 1867;16:483–525
  15. Padavinangadi A, Kumar N, Rao MK, Nayak SB. Unilateral Existence of Chondroepitrochlearis: Its Embryological Perspectives and Clinical Implications. *J Clin Diagn Res.* 2016;10(7):1–2.
  16. Tröbs RB, Gharavi B, Neid M, Cernaianu G. Chondroepitrochlearis Muscle – A Phylogenetic Remnant with Clinical Importance *Klin Padiatr.* 2014;227(4):243–246.
  17. Fitzgerald RR. A case showing the chondro-epitrochlearis muscle. *J Anat.* 1936; 70:273–274.
  18. Voto SJ, Weiner DS. The Chondroepitrochlearis Muscle. *J Pediatr Orthop.* 1987;7(2):213–214.
  19. Spinner RJ, Carmichael SW, Spinner M. Infraclavicular Ulnar Nerve Entrapment Due to a Chondroepitrochlearis Muscle. *J Hand Surg.* 1991;16(3):315–317.
  20. Loukas M, Louis RG, Kwiatkowska M. Chondroepitrochlearis muscle, a case report and a suggested revision of the current nomenclature. *Surgical and Radiologic Anatomy.* 2005;27(4):354–356.
  21. Rachana Suresh, N Hema, R Srinivas. Thoracobrachialis- A Cadaveric Study of a Morphological Variation of Pectoralis Major with a Novel Nomenclature and Classification of the Chondroepitrochlearis Muscle. *Academia Anatomica International.* 2020; 6 (2):1-11.
  22. Palagama SPW, Tedman RA, Barton MJ, Forwood MR. Bilateral Chondroepitrochlearis Muscle: Case Report, Phylogenetic Analysis, and Clinical Significance. *Anat Res Int.* 2016(1):1-8