

## Chondroepitrochlearis - an Extremely Rare Variant of Pectoralis Major Muscle - a Case Report

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**Abstract.** Chondroepitrochlearis muscle, a truly rare muscle of pectoralis major muscle, was discovered in the right upper extremity of a 78-year-old Thai female. This demonstrates the first report of the anomaly in Thai. Chondroepitrochlearis was a muscular slip that originated from the inferior border of the right pectoralis major muscle, external abdominal oblique muscle, costal cartilages, or costochondral junctions. This muscle was superficial to biceps brachii muscle. It became a musculotendinous slip at the middle of the arm and then ran down to insert at the medial epicondyle of the humerus. Moreover, some tendinous parts also merged with the medial intermuscular septum. In addition, ulnar nerve and medial cutaneous nerve of the arm were observed at posterior to this tendinous slip. In a clinical aspect, there was no sign of ulnar nerve entrapment at this region. Nerve and arterial supplies of chondroepitrochlearis muscle were medial pectoral nerve and lateral thoracic artery, respectively.

### 1. Introduction

Muscular variations have been frequently reported on the pectoral and upper extremity region. One of a rare muscular variant in this region is chondroepitrochlearis muscle. It was cited by J. Wood "Chondro-epitrochlearis of Duvernoy" [1]. Most reports of this muscle are case reports and authors named it in different ways; costoepitrochlearis, thoracoepicondylaris, chondrofascialis, chondrohumeralis, chondrobrachialis, or costohumeralis, to indicate its attachment [2]. It has been defined that chondroepitrochlearis is a muscular slip arising from the lower ribs, the inferolateral aspect of the pectoralis major, or the aponeurosis of external oblique muscle which after crossing the axilla inserts on the medial intermuscular septum or the medial epicondyle of the humerus [2]. Its prevalence rate was 0.5-0.84% [3-4]. Chondroepitrochlearis muscle in the Thai population has not been reported. This muscular variant had a high chance of concurrent with the axillary arch muscle [3].

It is noticeable that this muscle variant can cause interesting clinical presentations and lead to misdiagnosis. The purposes of this report were to present an extremely rare variant in the Thai population and to explain its characteristics and clinical importance in aspects of ulnar nerve entrapment or restrict shoulder abduction.

### 2. Case Report

During conventional cadaveric dissection for Master's degree of Anatomy, an additional musculotendinous slip on the inferolateral side of the right pectoralis major muscle in a 78-year-old female embalmed cadaver was observed. After postgraduate students dissecting the pectoral region and removing the upper extremities away from the body in conventional fashion, the skin and subcutaneous tissue of the upper extremities were removed and cleaned. After that, the incidentally an obvious muscular slip that attached to the lower border of right pectoralis major muscle was

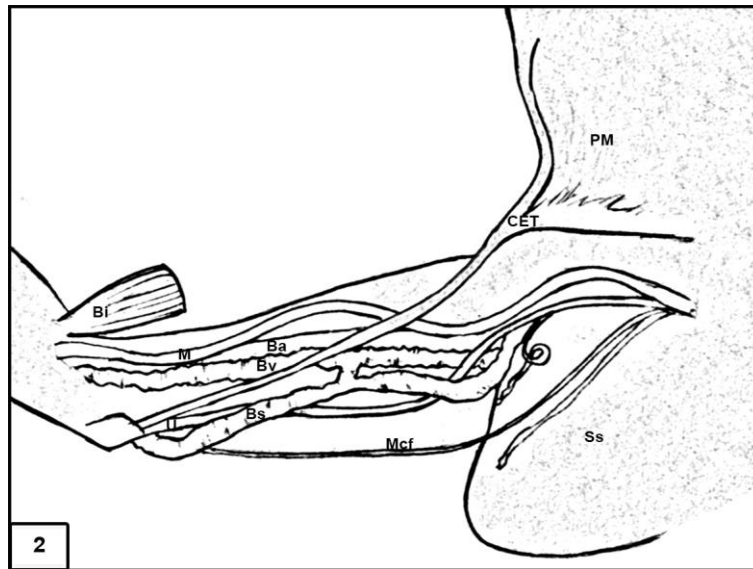
found. This muscular slip descended downward laterally at the medial side of the arm, joined with the tendinous slip at the middle of the arm, and blended with medial intermuscular septum before inserted onto medial epicondyle of the right humerus. According to these characteristics, it was compatible with chondroepitrochlearis muscle which is an extremely rare muscular variant of the pectoralis major muscle (Fig. 1, 2).

Unfortunately, the muscular slip was cut. We could neither provide the photo of complete attachment of the muscle nor measure its length. In this present case, we confirmed that the unilateral chondroepitrochlearis muscle comprised of a muscular slip and a tendinous slip with a verbal report from students who did the dissecting that the slip arose from the inferior border of pectoralis major muscle, the external abdominal oblique, costal cartilages, or costochondral junctions. It ran separately along the lower edge of pectoralis major toward the axilla to join with the tendinous slip. The tendinous slip joined with the deep surface of the tendinous insertion of pectoralis major before it attached to the lateral lip of the bicipital groove of the humerus (Fig. 1, 2, 3). It descended downward superficially to biceps brachii muscle on the medial side of the arm and joined with the muscular slip at the middle of the arm and became musculotendinous slip. At this area, the musculotendinous slip crossed the median nerve, brachial vein, and brachial artery and further became tendinous fiber to blend with the medial intermuscular septum of deep brachial fascia and to attach at the medial epicondyle of the humerus. The ulnar nerve and medial cutaneous nerve of forearm passed down posterior to this tendon. There was no connection between chondroepitrochlearis muscle and ulnar nerve. Moreover, the slender tendon of chondroepitrochlearis did not show compression sign on the ulnar nerve. The muscular slip at the middle of the arm was measured approximately 6 cm in length and 0.7 cm. in width. Measuring the tendinous slip, its total length and width were around 18 cm. and 0.4 cm., respectively. An atypical insertion of a pectoralis major was also observed. Normally, a pectoralis major typically twisted its distal fiber to insert cranially to its proximal fiber. In our study, there was the untwisted right pectoralis muscle in its insertion site. Moreover, no axillary arch muscle was demonstrated in our present case. In addition, there was no evidence of muscular variations or anomalies in the left axilla and upper extremity. Furthermore, the right chondroepitrochlearis muscle was supplied by medial pectoral nerve and branch of the lateral thoracic artery.

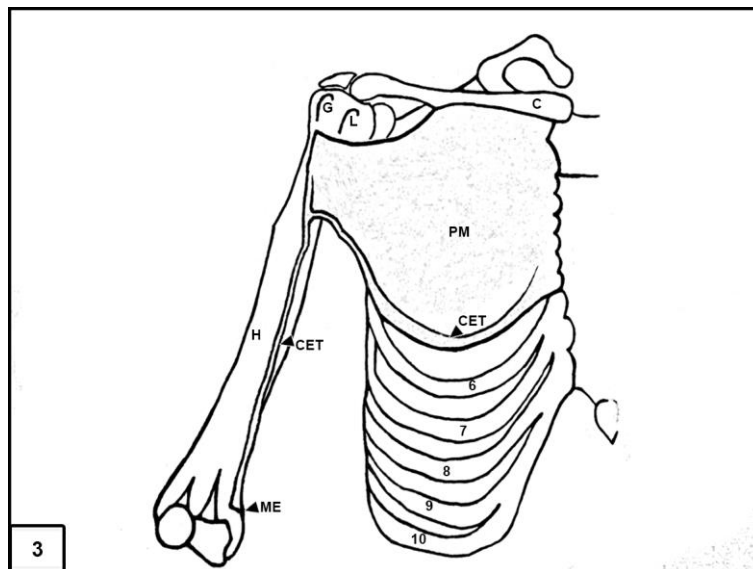


**Fig. 1.** Dissection of the right upper extremity region showing the chondroepitrochlearis muscle with its relation. Abbreviation: PM = pectoralis major, CET = chondroepitrochlearis, Bi = biceps brachii muscle, M = median nerve, Ba = brachial artery, Bv = brachial vein, Bs =

basilic vein, U = ulnar nerve, Mcf = medial cutaneous nerve of forearm, Ss = subscapularis muscle.



**Fig. 2.** Schematic diagram showing the chondroepitrochlearis muscle of right side in relation of neurovascular bundles. Abbreviation: PM = pectoralis major (cut and reflected), CET = chondroepitrochlearis, Bi = biceps brachii tendon, M = median nerve, Ba = brachial artery, Bv = brachial vein, Bs = basilic vein, U = ulnar nerve, Mcf = medial cutaneous nerve of forearm, Ss = subscapularis muscle.



**Fig. 3.** Schematic diagram showing the entirely reconstruction of chondroepitrochlearis muscle of right upper extremity. Abbreviation: PM = pectoralis major, CET = chondroepitrochlearis, ME = medial epicondyle, H = humerus, C = clavicle, G = greater tubercle, L = lesser tubercle.

### **3. Discussion**

#### **3.1 Nomenclature**

Chondroepitrochlearis muscle is a very rare muscular variation in the upper extremity. In 1955, it was first described by Duvernoy (who named it) that has been cited by J. Wood in 1967 [1, 3]. The name of this muscle was to indicate its attachment specifically [1, 3]. However, the latter half; epitrochlearis, was not characterized by its insertion according to most reports that inserted on the medial epicondyle of the humerus [3-4]. Thoracoepicondylaris was previously mentioned for its appropriate name [5]. Recently, it has been suggested that “Chondroepicondylaris” is a suitable name for anatomical characteristics and features more precisely [6].

#### **3.2 Embryology and phylogeny**

Shoulder girdle muscles connect the upper limb to the trunk and provide stability and mobility of the upper limb. Embryologically, shoulder or pectoral girdle musculatures are derived from three sources. First, trapezius muscle and sternocleidomastoid muscle derived from lateral plate mesoderm of the occipital area. Second, the deep muscles like serratus anterior muscle and rhomboidei muscle derived from myotome. Third, the superficial muscles as pectoralis major muscle and latissimus dorsi muscle developed from wing bud [7]. It has been established that the formation of pectoral girdle muscles needs a specific gene to generate and migrate myogenic cells [8-9]. Interruption of these processes would affect the formation of limb muscles [10]. Especially, the mechanism of superficial shoulder girdle muscles formation is more complex, myogenic cells after migrating from somite to limb bud, those forming pectoral muscles migrate back to the trunk and latter give rise to superficial pectoral girdle muscles called “in-out” mechanism [11]. Molecular investigation of pectoral girdle development shows that the Tbx 5 gene acts as a regulator of limb and girdle musculature [12]. Apoptosis is a crucial process in normal limb development, in order to shape the limb using the bone morphogenetic proteins (BMPs) to trigger an apoptotic cascade. Chondroepitrochlearis muscle is possibly an atavistic remnant of the original pectoralis major seen in quadrupeds supported by its nerve supply which is the same with the lower fibers of pectoralis major muscle [13-14]. Moreover, it has been reported that the persistent chondroepitrochlearis muscle results in the failure of apoptosis which have to occur at the right time during myoblasts formation [15]. Incidentally, this muscular variant has been associated with certain chromosomal defects which namely trisomy 13 with a D/D translocation, and 18-Trisomy syndrome as evidenced by the autopsy [16-17]. Previously, it has been postulated that the genetic code for atavistic muscles is normally repressed during embryogenesis, but that trisomy 18 causes depression of these genetic loci [18].

#### **3.3 Nerve and blood supplies**

Chondroepitrochlearis muscle is a muscular slip which can arise from lower ribs [3-4, 14], the inferolateral edge of pectoralis major muscle [5, 1], or external abdominal aponeurosis [13]. After crossing axilla, it usually inserts on the medial epicondyle of the humerus, medial intermuscular septum, or both [3-5, 14]. According to previous literature, this muscle is mostly innervated by medial pectoral nerve [5, 19-20] or branches of ansa pectoralis [14, 21]. Some reports have been demonstrated dual innervations including medial pectoral nerve and branch from the junction between medial and lateral roots of median nerve [3, 22], or branches of ansa pectoralis and intercostobrachial nerve [23]. The arterial supply is via the lateral thoracic artery [19-20, 24] or via a branch of the thoracoacromial trunk [5].

#### **3.4 Clinical significances**

The studies by different authors respecting the chondroepitrochlearis muscle present more in the unilateral side [5, 14, 19, 22, 25-26, 31-32], in male cadavers or subjects [19, 22, 25-26, 31], and in the right arm [22, 25-26, 31]. In contrast, there is less number in bilateral sides [3, 6, 20-21, 27]. Moreover, presently in males are more frequent than female [20, 21, 27]. According to some

literature which has been reported in live subjects, the presence of chondroepitrochlearis muscle may cause interesting clinical manifestations; including muscle entrapment, neurovascular entrapment, and surgical aspect [5, 28-32]. Chondroepitrochlearis muscle can cause a restriction in shoulder abduction and may resist the flexion of the biceps muscle before complete resolution resulted in a surgical release [28-32]. It has the potential to cause neurovascular entrapment due to its course and relation to the neurovascular bundle in the axilla. Ulnar nerve entrapment resulting in this muscle has been reported [22, 32], but our specimen demonstrated no connection between chondroepitrochlearis muscle and ulnar nerve.

Besides, a vascular complication of chondroepitrochlearis muscle has been reported as well and been misdiagnosed to hemangioma at birth [32]. The patient suffered from pain exacerbating during daily activities, cold hand, itching, paresthesia, and lymphedema [32]. Later, an abnormal structure on the lateral border of the pectoral muscle had been palpable, the chondroepitrochlearis was suspected [32]. Confirming by bilateral dynamic ultrasound and duplex, the doctors found the intermittent axillary vein compression caused by this muscle. After minimally invasive surgery under lymphofluoroscopy, the symptoms disappeared [32]. In a surgical aspect, during axillary lymphadenectomy, the chondroepitrochlearis muscle which crosses the axilla may find in the surgical field, confuse surgeons, and also impede the approach of the axilla contents [4, 32]. Furthermore, it can cause lymphedema which is a postoperative complication. Thus, surgeons should be aware of this muscle.

#### 4. Conclusion

In the present case, this rare muscular variant; chondroepitrochlearis muscle, was found with untwisting of insertion of pectoralis major muscle in the right upper extremity. It is usually associated with axillary arch muscle, but it was not observed in this cadaver. A chondroepitrochlearis muscle can cause muscular entrapment, cosmetic defects, neurovascular entrapment, obstruction and confusion of the surgical field in the axillary region. As a result, awareness of this muscle may help neurologists, radiologists in their diagnostic approach and also help physiotherapists, orthopedic surgeons, plastic surgeons or even breast surgeons in their treatment strategy

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