

# Study of sternalis muscle in north Indian population- a cadaveric study

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## Abstract

**Background:** Sternalis is anatomic variant of anterior thoracic region generally encountered on routine dissection, imaging procedures or surgeries. Although here is sufficient text available regarding presence and extent of sternalis muscle but state of confusion still exist regarding its nerve supply. **Aim:** In our study we have tried to find out the incidence of presence of sternalis muscle in north Indian population and through fine dissection, we have focused on the innervation received by the muscle. **Materials and Method:** 48 human cadavers including both male and female were dissected at Veer Chandra Singh Garhwali Government Institute of medical Science & Research, Pauri- Garhwal and Sarojini naidu Medical College Agra. Special emphasis was laid on innervations and through fine dissection, detailed picture about innervations was recorded. For cases with doubt, histological examination was done and final observations were recorded. **Result:** Sternalis muscle was reported in 4 out of 48 cadavers. All cases presented with unilateral type of sternalis muscle. Three were present in male while one in female cadaver. In one cadaver, it was innervated by medial pectoral nerve while in two, innervations were provided by intercostals group of nerves. Only one cadaver presented with dual nerve supply. **Conclusion:** in north Indian region, incidence of sternalis is 8.3 percent with dual innervation in single cadaver.

**Keywords:** Sternalis, Pectoral nerves, Intercostal nerves, Cadavers, Innervations.

## Introduction

Term sternalis was mentioned in 1964 by Turner in his book "Anatomes elenchus Accuratissimus" [1]. It has been variously termed since then as Episternalis, Persternalis, Rectus Thoracis, Rectus Sterni and Superficial Rectus Abdominis. It has attracted the attention of many Anatomists, Radiologists. It is an anatomical variant of anterior thoracic region with incidence of 3-8% approximately [2, 3]. Sternalis muscle has been classified as Unilateral and Bilateral [4]. Unilateral incidence of Sternalis Muscle has been found in 4.5% subjects and Bilateral in less than 1.7 percent of the subjects [5]. Sternalis is a long, thin, flat muscle with origin at infraclavicular part of anterior

chest wall, running superficial to medial part of pectoralis major muscle [6]. Although, there is uniform opinion about the site and attachments of sternalis muscle, innervations issue is still a point of debate [2].

It can get nerve supply by Pectoral nerves [7] or can be innervated by anterior branches of the intercostals nerves [8]. It can get innervations from the combination of above two set of nerves altogether [9]. The functional significance of sternalis muscle is unknown but its knowledge is essential for anatomists, Radiologists and surgeons for the sake of reconstruction surgery and correct interpretation of mammograms. [6]. At times Sternalis is encountered as an irregular focal density in craniocaudal mammograms medially and may produce difficulties in mammographic interpretations [10, 11].

Manuscript received: 16<sup>th</sup> April 2017  
Reviewed: 25<sup>th</sup> April 2017  
Author Corrected: 3<sup>rd</sup> May 2017  
Accepted for Publication: 10<sup>th</sup> May 2017

Many studies have suggested occurrence of sternalis muscle in fetuses with anomalies often fatal. Anencephaly, cleft palate and spina bifida are the common anomalies recorded in various studies with sternalis muscle.

## Material & Methods

**Study design:** This was a descriptive study carried out in Department of Anatomy, Veer Chandra Singh Garhwali Government Institute of Medical Science & Research, Srinagar, Pauri- Garhwal, Uttarakhand and Sarojini Naidu Medical College, Agra.

**Inclusion criteria:** Cadavers received in Department of Anatomy from various sources (Unclaimed dead bodies provided by Government agencies and donated dead bodies) were studied. Both male and female cadavers were included in the study. Only adult cadavers were studied.

## Results

Out of 48 cadavers 4 cadavers found to have sternalis muscle. All sternalis muscles found were unilateral. Out of 4 unilateral sternalis, One was found in a female cadaver. The detailed observations of the sternalis are as follows:

**Cadaver No.1 with sternalis muscle-** Unilateral sternalis muscle was present on right side in the male cadaver. It was running just over the right margin of manubrium-sterni. Upper end with tendon was blended in the tendon of right sternocleidomastoid muscle.

Moved slightly laterally and lower end got insertion in the aponeurosis of external oblique which is covering the rectus abdominis (Fig.1) Sternalis muscle was 198 mm long with breadth of 55 mm and thickness of 3.2 mm. On further dissection and clearing, it was noticed that one branch of medial pectoral nerve supplied the muscle.



**Fig-1: Right sided unilateral sternalis muscle with its extent and attachments**



**Fig-2: Cadaver with right sided unilateral sternalis muscle and CTEV**



**Fig-3: left sided incomplete unilateral sternalis muscle**

One more remarkable point associated with same cadaver was that, it suffered with Congenital Talpies Equino Varus (C.T.E.V.). (fig. 2).

**Cadaver No.2 with sternalis muscle-** Unilateral sternalis muscle was present on the left pectoral region of male cadaver. It was incomplete scattered in two parts. First part was just lying lateral to manubrium while second part was noticed over 3<sup>rd</sup> to 5<sup>th</sup> costal cartilage.(Fig-3) It mimicked like some blood clot and to differentiate it from blood clot, sample was taken and histology slides were prepared. On light microscopic examination, it was confirmed as skeletal muscle that is Sternalis muscle. Both upper and lower parts of the muscle were lying freely over Pectoralis major and margin of sternum in fascia over it. No tendinous attachments were established. Upper part was 58mm long, 12 mm wide and 2.6 mm thick while lower part was 42 mm long, 9 mm wide and 2.8 mm thick. Lower part was getting innervations via intercostals nerve. Nerve supply for upper part was not found.

**Cadaver No. 3 with sternalis muscle-** The unilateral sternalis was present over the right pectoral region of female cadaver. It ran right below the tendon of sternocleidomastoid of right side just over pectoralis major on side of sternum. It ended by blending in to the aponeurosis of external oblique running over rectus abdominis. It was 154mm long 42mm wide and 2.6mm thick.

On further fine dissection, a branch of medial pectoral running in between fibres of pectoralis major muscle was seen which was supplying the muscle along with 3<sup>rd</sup> intercostals nerve. The dual nerve supply is shown in fig.no.4.





**Fig-4: dual nerve supply of sternalis muscle from intercostals and pectoral nerves**



**Fig-5: sternalis muscle getting innervations from intercostal nerve**

**Cadaver no.4 with sternalis muscle-** The unilateral sternalis muscle was situated on the right side of the male cadaver. The upper end was attached to the tendon of sternocleidomastoid and lower end was attached to 5<sup>th</sup> and 6<sup>th</sup> costal cartilage and external oblique aponeurosis covering rectus abdominis.

Muscle travelled over margin of sternum. It was 163mm long 34 mm wide and 2.8mm thick with tendon at upper end and belly at lower end. On fine dissection it was found that 4<sup>th</sup> intercostal nerve is supplying the muscle (fig.5)

## Discussion

General incidence varies between races [12]. In European population it varies from 2-3% [13] to 6.4% [14], about 11% in Africans, [13] and from 1% [15] to 13.1% [13] in Asian population. In Indian context it varies from 2% [16] to 8% [17,18]. In our study the overall incidence of Sternalis muscle stood at 8.33%. The incidence of unilateral Sternalis muscle in comparison to bilateral Sternalis muscle is twice as reported [19]. In our study we found only unilateral Sternalis muscle and no bilateral case was recorded. There was a significant difference in presence of Sternalis muscle on right and left side. 3 cases of Sternalis muscle were reported on right side where as only 1 was recorded on left side. The incidence of

Sternalis muscle was recorded equal in males and females as reported by Barlow [14] while few studies recorded it more in females (8.7%) than in males (6.4%). The higher reporting of incidence in females may be confounded by high rates of surgery and medical imaging for breast related conditions in females [2]. In north Indian region the lack of female cadavers for dissection can also be a confounding factor for this higher incidence reported in females. In our study in 7.692% male cadavers Sternalis muscle was present in comparison to 11.11% in female cadavers.

Many theories regarding embryological origin of Sternalis muscle have been laid down. Many say it can

be cranial extension of rectus abdominis or caudal continuation of sternocleidoid or displaced pectoral muscle fibers or remnants of panniculus carnosus [2, 7, 14, 20]. No single theory completely explains occurrence of Sternalis muscle. As per Gray's Anatomy, Sternalis muscle /rectus sternalis is superficial vertical slip that ascends upwards from lower costal cartilage and rectus sheath to attach to the upper sternum or costal cartilage or sternocleidomastoid [21].

There is much discussion & debate about innervations of Sternalis muscle. Many reported it as pectoral nerves and others as intercostal nerves. In our first case with right sided unilateral Sternalis muscle, we found the innervation was provided by a branch of medial pectoral nerve. Researchers [7,22,23] reported innervations of Sternalis muscle from either medial or lateral pectoral nerves. In our second and fourth male cadavers with Sternalis muscle we found that muscle was innervated by inter costal nerve. Similar observations were found in other studies [4,6,24-27]. In our third female cadaver with Sternalis muscle we reported dual nerve supply from branches of both medial pectoral nerve and third intercostal nerve [7]. 55% Sternalis muscle were supplied by pectoral nerve, 43% by intercostal nerve and 2% from both pectoral and intercostal nerves. Dual nerve supply was also reported to be 4.8%, from intercostal nerves 26.7% and pectoral nerves 68.5% by [14]. Fine nerve fibres may lay difficulty in dissection and identification of innervations of Sternalis muscle [7, 28].

Sternalis muscle is often associated with anomalies as nearly 50% incidence of Sternalis muscle is reported in anencephaly by [29]. As per Harish and Gopinath, 2003 [30]; presence of Sternalis muscle is associated with anomalies of the skull and adrenal gland. Two fetuses with anencephaly and three with spina bifida were reported with Sternalis muscle by Harper [31].

Anencephaly fetuses were observed by Sheppard [26] with Sternalis muscle, out of them 6 have had underdeveloped pectoralis major (sternomastoid part), 1 have had cleft palate and 7 have had spina bifida. In our study one male cadaver with right sided unilateral Sternalis muscle was having Congenital Talipes Equinovarus (C.T.E.V.). Till today no such case of Sternalis muscle with C.T.E.V was reported.

No certain motor function has been reported from previous literature. It is proposed that Sternalis muscle

may contribute to proprioceptive function [32]. Kirk [33] reported that in a living case with Sternalis muscle where it contracted with active trunk flexion and arm adduction.

Most researchers emphasized the importance of and need for increased knowledge and awareness of Sternalis muscle [33]. Nuthakki et al 2007[35] and Gokter et al 2006[36] on mammography and MRI identified Sternalis muscle cases. Young lee et al 2006 found 86 cases of Sternalis muscle through CT chest scans [5]. Other authors also reported that proper identification of Sternalis muscle may avoid unnecessary exploratory surgery as it may mimic carcinoma on imaging [23,37].

Harish and Gopinath [38] recorded 8 out of 1152 patients undergone radical mastectomy. Few researchers suggest that Sternalis muscle must be removed in radical mastectomy in breast Carcinoma due to its closeness [39] while few are using it as tissue expanders material for breast reconstitution after mastectomy [40]. Our study reported the Sternalis muscle cases on pure dissection of cadavers.

## Conclusion

In our study we found 4 cadavers with unilateral sternalis muscle out of 48 cadavers dissected. It was present only in one female cadaver rest all were males. One sternalis muscle was supplied by branch of medial pectoral nerve, two with intercostal nerves and dual nerve supply was also reported in one cadaver with sternalis muscle. We found male cadaver with right sided sternalis muscle suffered with Congenital Talipes Equinovarus (C.T.E.V.).

The knowledge of sternalis muscle is crucial, especially among peoples involved in imaging of pectoral region. It is often associated with many congenital anomalies as seen in one of our case. This could help in finding out more cases of sternalis muscle.

**Funding: Nil, Conflict of interest: None**

**Permission of IRB: Yes**

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**How to cite this article?**

Soni S, Bhardwaj K, Garg S. Study of sternalis muscle in north Indian population- a cadaveric study. *Int J Med Res Rev* 2017;5(05):448- 454. doi:10.17511/ijmrr. 2017.i05.02.  
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