

Two Cases of Sternalis Muscle in Humans: Clinical Considerations

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Received July 29, 2024; Accepted January 27, 2025.

Key words: Sternalis muscle – Sternalis – Pectoral region

Abstract: The sternalis is an occasional muscle of the pectoral region with a reported incidence of around 7.8%. Higher rates of occurrences have been noted in females and in Asians. The muscle becomes clinically relevant as the muscle can be mis-interpreted as a pathological mass. Routine dissection was performed in a 68-year-old male and a 65-year-old female donated cadavers in the pectoral region. Gross anatomical features were meticulously noted, photographed and measurements were recorded with digital Vernier callipers. In the male cadaver, a long, slender, flat bi-tendinous sternalis was found, and in the female cadaver, tripartite sternalis possessing three distinct bellies was observed. Both the sternalis was right sided and were supplied by 2nd, 3rd and 4th intercostal nerves. Single bellied and tripartite sternalis are rare and they need to be recognized in the diagnostic images and during surgeries to avoid confusion.

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<https://doi.org/10.14712/23362936.2025.9>

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Introduction

The rectus sternalis or simply sternalis is an occasional muscle found in the pectoral region of humans lying superficial to the pectoralis major. The sternalis muscle often has continuity with the rectus abdominis muscle and the external oblique aponeurosis. Superiorly the muscle is attached with the sternal origin of the sternocleidomastoid muscle or to the pectoral fascia. The earliest description of the sternalis muscle was by Cabrolio, a French surgeon in 1604. Detailed morphology of the muscle was elaborated by Du Puy in 1726 (Raikos et al., 2011; Snosek et al., 2014). The muscle has been reported across all races and known by other names such as the sternalis, the rectus thoracis, rectus sterni, superficial rectus abdominis, episternalis, parasternalis, presternalis, sternalis brutorum etc. The reported incidence is approximately 7.8% with higher rates of occurrences in females and in Asians (Raikos et al., 2011; Snosek et al., 2014). Unilateral sternalis is more common than bilateral. Pectoral or intercostal or both these nerves often innervate the muscle. It was Cunningham in 1884, who systematically traced the nerves supplying the sternalis back to the medial pectoral nerve. The muscle becomes clinically relevant as the muscle

can be wrongly interpreted as a pathological mass (Snosek et al., 2014). Two cases of right sided sternalis muscle – one single bellied and one tripartite, both supplied by 2nd, 3rd and 4th intercostal nerves in a male and a female cadaver are presented here.

Case report

During routine dissection of the pectoral regions of a male cadaver aged 68-years and a female cadaver aged 65-years, right sided sternalis muscles were observed. Gross anatomical features were meticulously noted, photographed and measurements were recorded with digital Vernier callipers.

Case 1

A long flat bi-tendinous muscle was observed in the right parasternal region of the male cadaver. The muscle was identified as the sternalis and it belonged to the type I [1] as per the classification system of Jeleu et al. (2001). Superior tendinous portion originated from the pectoral fascia overlying the manubrium of the sternum followed by a flat fusiform muscle belly and eventually inserted via a thin flat tendon merging with the pectoral fascia, perimysium

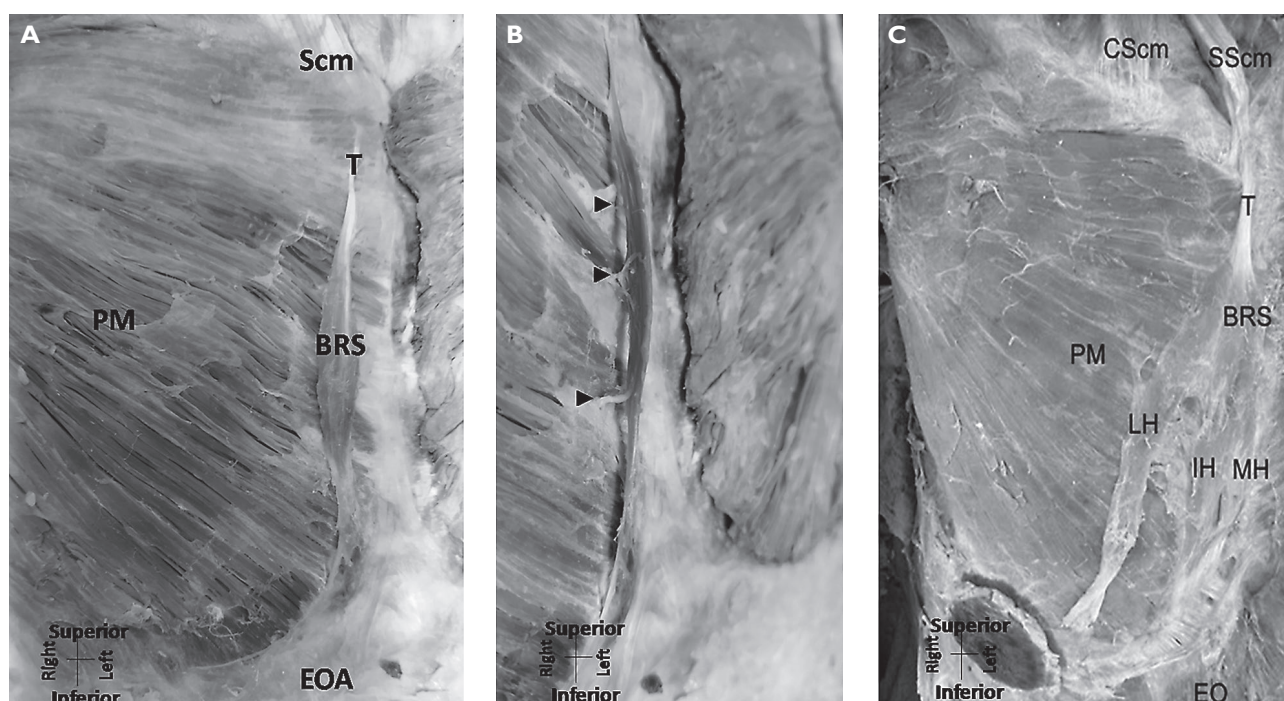


Figure 1: Photograph of simple and mixed sternalis muscle in two cases. A) Right sided single bellied sternalis muscle in case 1. B) Sternalis muscle in case 1 seen innervated by intercostal nerves. C) The mixed type of right sided multiple bellied sternalis muscle in case 2. Scm – sternocleidomastoid; CScm – clavicular head of sternocleidomastoid; SScm – sternal head of sternocleidomastoid; T – tendon of sternalis; BRS – belly of sternalis; LH – lateral head; IH – intermediate head; MH – medial head; EO – external oblique muscle; EOA – external oblique muscle aponeurosis; PM – pectoralis major muscle; black arrowheads indicate the intercostal nerves supplying the sternalis muscle.

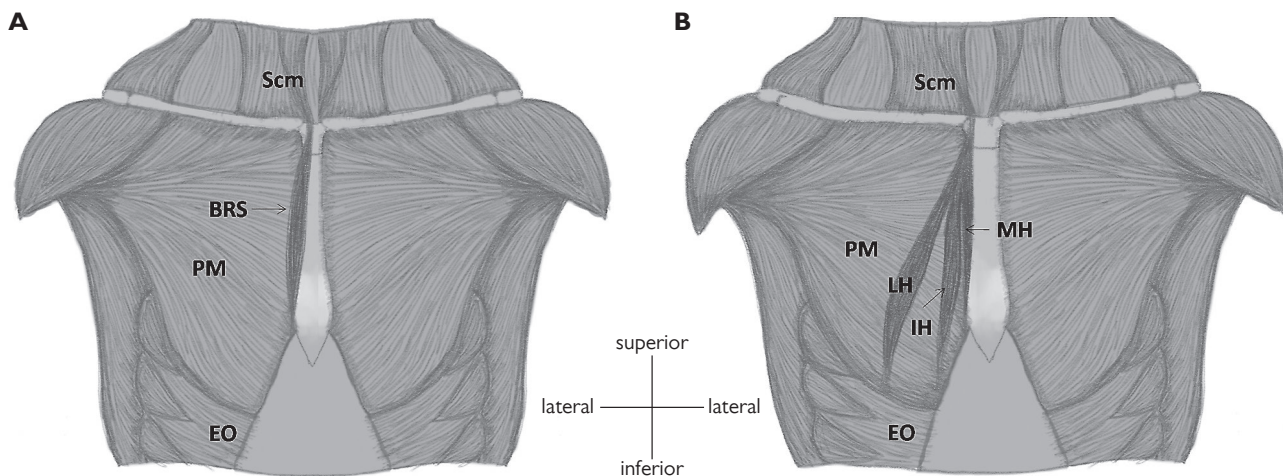


Figure 2: Morphology and location of two variants of unilateral sternalis muscle observed in this report. Scm – sternocleidomastoid; BRS – belly of sternalis; PM – pectoralis major muscle; EO – external oblique muscle; LH – lateral head; IH – intermediate head; MH – medial head.

covering the external oblique and the rectus abdominis muscle (Figure 1A and B). Muscle fibres were directed cranio-caudally. The superior tendon, muscle belly and the inferior tendon measured 3.5×0.47 cm, 4.6×2.3 cm and 3.1×0.54 cm respectively in the greatest dimensions. The muscle was innervated by the branches of 2nd, 3rd and 4th intercostal nerves.

Case 2

In the female cadaver, a right sided sternalis with unique tripartite configuration was observed. It had three distinct bellies originating from a common tendinous origin at the sternal head of the sternocleidomastoid muscle. The bellies were diverging in nature and were arranged as follows: a medial head directed towards the xiphoid process, an intermediate head coursing vertically downward towards the external oblique aponeurosis and a lateral head directed inferolaterally towards the right nipple (Figure 1C). Each of these heads had a well-defined muscle belly and was positioned between the superficial fascia and the pectoral fascia. The dimensions of the medial, intermediate and the lateral head were 1.02×4.12 cm, 1.87×4.62 cm and 1.17×4.92 cm respectively. All the bellies of this muscle were supplied by the branches of 2nd, 3rd and 4th intercostal nerves. Illustrative sketch of the two variants of sternalis has been provided for easy understanding (Figure 2A and B).

Discussion

The prevalence of unilateral and bilateral sternalis is 67% and 33%, and among unilateral cases more instances have been noticed on the right side. Since its first description in 1604, the various morphology

of the muscle with different neurovascular supply has been reported. Initially sternalis variants were classified into type I and type II categories by Jelev et al. (2001), which was expanded by Ge et al. (2014) and re-classified into three major types and three subtypes. Later Snosek et al. (2014) modified the classification system, but, for categorization of the present two cases we are referring to the Jelev et al. (2001) and the Ge et al. (2014) classification systems. The sternalis in the male cadaver can be categorized into type I [1] variety according to the Jelev et al. (2001) system and type I A as per the Ge et al. (2014) system. The second case of tripartite sternalis in the female cadaver partially resembles type I [2] variety according to the Jelev et al. (2001) proposed classification system and type III A as per the Ge et al. (2014) proposed system. The tripartite configuration observed in the female cadaver does not exactly match to any of the previously described variety. However, it resembles partially to a recently described new variant of sternalis by Dudgeon et al. (2017) which they named as the triple subtype.

Sternalis muscle is often found associated with other coexisting anomalies. Recently bilateral sternalis muscle has been reported with co-occurrence of asymmetrical bilateral extensor carpi radialis intermedius and with aberrant pectoral muscle (Shekhawat et al., 2023; Boadum and Lu, 2024). Regarding origin of sternalis, Cunningham hypothesized that the muscle is a displaced portion of the pectoralis major disposed anterior to it due to rotation. Still some others believed that the sternalis had formed from the rectus sheath. On the other hand, many authorities consider that the sternalis could be a derivative of panniculus carnosus of lower

Table 1: Mini literature review about the recently reported normal and symptomatic sternalis variants and their notable features

Authors and the population studied	Sample size and study type	Notable findings
Demirpolat et al. (2010); Turkish	52,930, retrospective radiologic study	Sternalis was detected in 10 females out of the 52,930 examined mammograms which were identified as a small, asymmetric opacity at the medial posterior edge of the breast.
Mehta et al. (2010); Indian	88, cadaveric study	1 in 88 cadavers revealed unilateral sternalis (incidence = 1.14%).
Raikos et al. (2011); European	45, cadaveric study	1 in 45 revealed unilateral left sided sternalis (incidence = 2.2%).
Shiotani et al. (2012); Japanese	948, retrospective radiologic study	Sternalis was more frequent in females (13.0%) compared to males (8.4%) with an overall incidence of 10.5%.
Anjamrooz (2013); Iranian	cadaveric case	Described biceps sternalis.
Ge et al. (2014); Chinese	6,000, retrospective radiologic study	Sternalis was detected in 347 out of 6,000 (incidence = 5.8%).
Gruber et al. (2016); European	clinical case	Symptomatic sternalis in a 51-year-old female.
Dudgeon et al. (2017); American	clinical case	Bilateral sternalis in a 96-year-old female.
Davimes et al. (2018); African	cadaveric study	Incidence of unilateral sternalis 2.25%.
Al-Alami and Altamimi (2020); Jordanian	1,709, retrospective radiologic study	Revealed 5.9% incidence of sternalis.
Shekhawat et al. (2023); Indian	cadaveric case	Bilateral sternalis on the right side.
Boadum and Lu (2024); American	cadaveric case	Bilateral sternalis was observed.

mammals. Developmental origin could be either from the hypaxial myotomes or dermomyotomes (Paraskevas and Raikos, 2010). A mini literature review about the sternalis muscle reported during the last 15 years with their notable features is presented in Table 1. The nerve supply whether from the brachial plexus or from the intercostal nerve is still debated. In our cases the 2nd, 3rd and 4th intercostal nerves supplied both the muscles.

Sternalis, especially unilateral, may mimic a mass lesion in imaging studies, more commonly a breast lump and can confuse clinicians. Pain due to sternalis has also been reported in a few cases which could be due to compression of nerve branches while coursing through the muscle. Gruber et al. (2016) described an interesting case of clinically symptomatic sternalis muscle in a female patient who presented with pain upon pressure. The sternalis muscle has the potential for utility as an autograft. As the sternalis is an occasional muscle, clinicians may not be aware about the muscle. A recent survey examined the awareness about the sternalis muscle among clinicians in Jordan. Surprisingly, very small fraction of the cohort could recognise the muscle from given anatomy dissection images and computed tomography images (Al-Alami and Altamimi, 2020). Hence it is pertinent to re-introduce this rare muscle once again, which is in fact already known in medical literature for over the last 400 years.

Conclusion

Considering the fact that the pectoral region is being subjected to imaging studies and surgical procedures, it is possible that the aberrant muscle can be mis-interpreted for pathological mass. Thus, the knowledge about this aberrant muscle is very relevant for clinicians. The tripartite sternalis with single head of origin in the female cadaver of this report does not exactly resemble any known variety. Hence, we recommend amendment and inclusion of a separate category in the existing classification system of sternalis muscle.

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