

Rectus Sternalis- An Uncommon Variant of Chest Wall Musculature

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Case Report

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Abstract: Rectus sternalis is a rare muscle found in the anterior chest wall superficial to the pectoralis major muscle. We report a case of rectus sternalis on the right anterior thoracic wall of a 55-year-old female cadaver. The incidence of a unilateral rectus sternalis was found to be twice as that of a bilateral muscle. Rectus sternalis develops from the ventrolateral lip of somitomere along with other muscles such as infrahyoid muscles. Rectus sternalis when present may interfere with the interpretation of mammograms while screening for breast cancer. The muscle may be confused with a relapsed tumour after mastectomy. Knowledge of rectus sternalis is essential for accurate interpretation of mammograms by the radiologists.

Keywords: Breast carcinoma, Mammoplasty, Panniculus carnosus, Rectus sternalis.

INTRODUCTION

Rectus sternalis is an uncommon anatomic variation of chest wall musculature. Rectus sternalis muscle is described as a long, slender, flattened muscle situated inferior to the clavicle, superficial to the medial part of pectoralis major muscle, and running parallel to the sternum[1]. It was named “sternalis” by Cabrolus in his book *Anatomes Elenchus Accuratissimus* in 1604. Elaborative description about the muscle was provided by Du Puy in 1726[2]. Different names have been assigned to this muscle such as *accessories ad rectum*, *parasternal*, *pectoris rectus*, *abdominal-guttural abdomino-cutaneous*, *sternalis brutorum*, *cutaneous pectoris* or *praesternalis* muscle[3]. The incidence of muscle was higher in the females (8.7%) compared to the males (6.4%)[4]. The incidence of a unilateral rectus sternalis was found to be twice that of bilateral rectus sternalis[5].

The aim of this case study is to report a rare muscle and its attachments which may be of help to the surgeons in interventional procedures and preventing errors in diagnosis of tumours in the pectoral region.

CASE REPORT

During routine dissection for teaching undergraduate students, the rectus sternalis was observed on the right anterior chest wall as a long, slender muscular mass in a 55-year-old formalin-embalmed female cadaver.

Rectus sternalis muscle was present parallel to the right border of the sternum, partially overlapping it. The muscle was present between the superficial fascia and pectoralis major.

Rectus sternalis extended from the right external oblique aponeurosis, inferiorly, to the right sternoclavicular joint, superiorly. The muscle had an inverted “V” shape aponeurotic origin, inferiorly; a belly in the middle; and a long, tendinous insertion, superiorly [Fig-1].

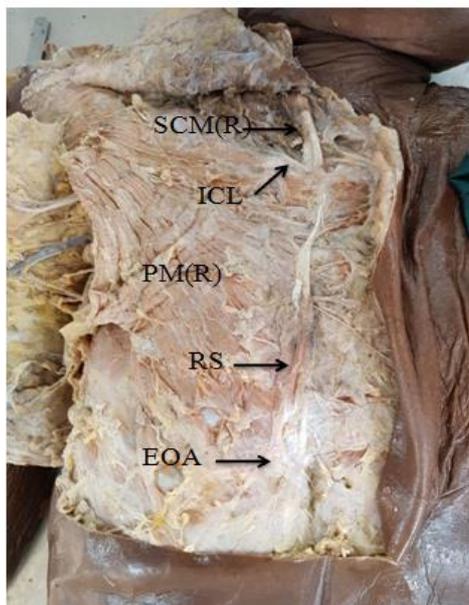


Fig-1: Image showing the Rectus sternalis muscle

SCM(R)- right sternocleidomastoid muscle,
ICL – interclavicular ligament,
PM(R) – right pectoralis major muscle,
RS- rectus sternalis muscle,
EOA – external oblique aponeurosis

The inferior end presented as an inverted ‘V’ shaped flattened aponeurosis, with a long right limb and a relatively short left limb. The right limb was attached to the external oblique aponeurosis over the right 7th

costal cartilage. The left limb was attached to the sternum over the right side of the anterior surface of xiphoid process [Fig-2].

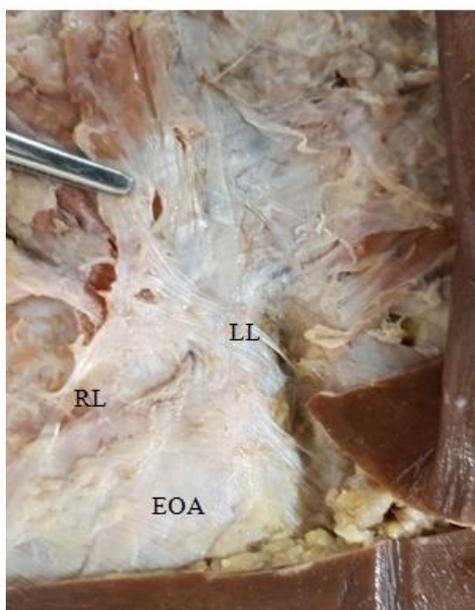


Fig-2: Image showing the attachments in the lower end of rectus sternalis muscle

EOA – external oblique aponeurosis,
RL-right limb,
LL –left limb

The superior end presented as a long, slender, glistening tendon that continued with the right sternocleidomastoid muscle over the right

sternoclavicular joint. The superior end had a muscular slip attached to the right pectoralis major muscle over the right 4th costal cartilage and had a similar muscular

slip attached to the left pectoralis major muscle over the left 3rd costal cartilage. Few slips of the tendon were

found to be inserted into the interclavicle ligament [Fig-3].

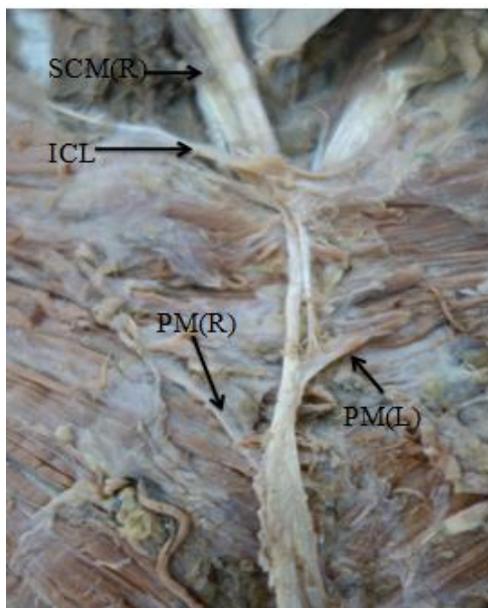


Fig-3: Image showing the extensions of the tendon into SCM (R) and ICL and communications to PM (R) & PM (L)

SCM(R)- right sternocleidomastoid muscle,
ICL – interclavicular ligament,
PM (R) (L)– right and left pectoralis major muscle

The muscle received its blood supply from right fourth intercostal artery. The fleshy, ribbon-like muscle belly was found to be supplied by the anterior

cutaneous branches of the right fourth intercostal nerve [Fig-4].



Fig-4: Image showing nerve supply of the rectus sternalis muscle ICN- intercostal nerve

The dimensions of the different parts of the muscle are presented in Table- 1

Table-1: showing dimensions of different parts of the muscle

EOA- External oblique aponeurosis muscle			
1.	Length		
	(i)	Overall length	14.4cm
	(ii)	Muscle belly	4.2cm
	(iii)	Two ends of the muscle	
		(a)	Superior tendinous end
		(b)	Inferior aponeurotic end
			6.5cm
			3.7cm
2.	Width		
	(i)	Muscle belly	1.24cm
	(ii)	Superior end	4.9mm
	(iii)	Inferior end	
		(a)	Right limb (EOA attachment)
		(b)	Left limb (Sternal attachment)
			3.5mm
			3.81mm

DISCUSSION

Rectus sternalis muscle was studied by many authors in the past; however description of the muscle provided in the standard anatomy books is insufficient [6]. Jelev *et al.* studied the incidence of rectus sternalis among different geographical subpopulation and classified the rectus sternalis into various types based on the location, attachments, number of bellies and termination [7].

Rectus sternalis is an uncommon muscle, having regional and racial variation. The incidence of the muscle was found to be 4-7% in Caucasians population, 8.4% in Africans, 11% in the Asian population, 1% in Taiwanese population and 1% in the Turkish population [7]. Among the Indian population, cases of unilateral rectus sternalis were observed more often than the cases of bilateral rectus sternalis [8]. In a separate cadaveric study done over a period of three years, the incidence of unilateral rectus sternalis was found to be 3.3% [9]. Bala *et al.* reported a case of

unilateral rectus sternalis associated with the ipsilateral congenital defect of the pectoralis major [10].

With respect to the origin and insertion of rectus sternalis, Gray's Anatomy 41st edition describes the muscle as a vertical slip that ascends from the rectus sheath and lower costal cartilages to blend with sternum, sternocleidomastoid and upper costal cartilages [6]. In the present case, the inferior end presented as an inverted 'V' shaped flattened aponeurosis, with a long right limb, that is attached to the external oblique aponeurosis, over the right 7th costal cartilage, and a relatively short left limb that is attached to the xiphoid process, on the right side of the anterior surface. The superior end attached to the right sternocleidomastoid muscle over the right sternoclavicular joint. Few slips of the tendon were found to be inserted into the interclavicular ligament.

The superior and inferior attachments of the rectus sternalis observed by various authors are summarized in Table 2 and 3, respectively.

Table-2: showing superior attachments of rectus sternalis reported by various authors

Sl. No.	Author	Superior attachments
1	Bhat <i>et al.</i> [11]	Sternocleidomastoid muscle, pectoral fascia and sternum
2	Kabay <i>et al.</i> [12]	3 rd rib
3	Kumar <i>et al.</i> [13]	sternoclavicular joint
4	Kalpana <i>et al.</i> [14]	2 nd costal cartilage
5	Puthuraj <i>et al.</i> [15]	3 rd and 4 th costal cartilages

Table-3: showing inferior attachments of rectus sternalis reported by various authors

Sl. No.	Author	Inferior attachment
1	Bhat <i>et al.</i> [11]	External oblique aponeurosis, pectoral fascia, 8 th costal cartilage, lower fibre of serratus anterior
2	Raikos <i>et al.</i> [16]	10 th , 11 th and 12 th costal cartilage
3	Kalpana <i>et al.</i> [14]	sternochondral joint and xiphisternum
4	Saeed <i>et al.</i> [17]	5 th costal cartilage, 5 th rib and 3 rd intercostal space
5	Puthuraj <i>et al.</i> [15]	6 th , 7 th and 8 th costal cartilage
6	Georgiev <i>et al.</i> [18]	3 rd and 4 th costal cartilage

Kida *et al.* reported rectus sheath as inferior attachment of rectus sternalis which was associated with the congenital partial absence of the pectoralis major [19]. With respect to superior attachment, our findings were partly similar to Bhat *et al.* and Kumar *et al.* With respect to inferior attachment of the muscle, our findings were partly similar to that Bhat *et al.* Saeed *et al.* and Kalpana *et al.*

However, Jelev *et al.* suggested the following criteria for the identification of rectus sternalis: a) the muscle should be located beneath the superficial fascia of the anterior thoracic wall and above the pectoral fascia .b) the muscle should arise from sternum or infraclavicular region. c) The muscle should be inserted into the rectus sheath, aponeurosis of external oblique aponeurosis, lower ribs or lower costal cartilages. d) The muscle should receive the nerve supply from pectoral or anterior intercostal nerves [7]. In comparison to the identification criteria suggested by Jelev *et al.* our case had the superior attachment with only the sternum and inferior attachment with the external oblique aponeurosis; however, it did not have the attachment with lower ribs, lower costal cartilage and rectus sheath. Moreover, in our case, the superior end had a muscular slip attached to the right pectoralis major muscle over the right 4th costal cartilage and had a similar muscular slip attached to the left pectoralis major muscle over the left 3rd costal cartilage. This feature fits into the type I4 of the classification suggested by Jelev *et al.* and such a feature of the rectus sternalis muscle was not observed commonly.

Standard textbooks in anatomy describe the origin of a muscle as the fixed, central/ proximal end and the movable distal end as the insertion [20, 21]. If we compare the description regarding the nomenclature of origin and insertion given in the Gray's anatomy with the identification criteria suggested by Jelev *et al.* the former described that the origin of the muscle was from the lower end, i.e. from the rectus sheath and lower costal cartilages and insertion at the upper end, i.e. the sternum, sternocleidomastoid and upper costal cartilages, in contrast the later suggested that the origin of the muscle was from the upper end, i.e. from the sternum or infraclavicular region and insertion at the lower end, i.e. into the rectus sheath, external oblique aponeurosis, lower ribs or lower costal cartilages.

Kalpana *et al.* reported that the anterior cutaneous branch of the third intercostal nerve supplied rectus sternalis [14]. Cutaneous branches of the medial pectoral nerve supplying the rectus sternalis was observed by Pillay *et al.* [22]. Soni *et al.* reported a case of rectus sternalis, which had a dual nerve supply, i.e. by cutaneous branches of the intercostal and medial pectoral nerves. Incidentally, the same cadaver had congenital talipes equino varus [23]. Sarikcioglu *et al.* reported a case of rectus sternalis, where some fibres of

the muscle were also attached to the sternocostal part of the left pectoralis major tendon [24].

According to Saddler, rectus sternalis belongs to a group of the ventral longitudinal sheet of muscles that take origin at the ventrolateral lip of hypomere; others being infrahyoid muscles in the neck, rectus abdominis in the abdomen[6]. Shinohara *et al.* proposed three laws of nerve-muscle specificity; among them the law of separation suggests the common myotomal origin of pectoralis major and rectus sternalis [25]. Novakov *et al.* suggested that the abnormal splitting, degeneration and incomplete shifting of myotomes may result in the formation of rectus sternalis muscle [26]. The rectus sternalis muscle was considered to be a vestigial remnant of *Panniculus carnosus*, a subcutaneous muscle present in the animals. This view was supported by its position being superficial to pectoralis major muscle and supplied by anterior cutaneous branches of intercostal nerve. Nevertheless, the deeper location of the muscle than the platysma, nerve supply by a nerve other than the intercostal nerve and the fact that the muscle was seen only in humans refutes the aforementioned view [27].

For anatomists, the rectus sternalis muscle can be a "functionally inconsequential" muscle having only morphological, developmental and atavistic significance, but it is important for the surgeons and radiologists [8]. During the initial evaluation for the diagnosis of breast cancer or during postoperative assessment for the recurrence of breast cancer, this muscle may appear as an irregular medial density in the mammograms, mimicking a tumour [28]. If there is confusion, the rectus sternalis muscle can be differentiated from the tumour of the breast by CT or MRI scan [9]. During radiotherapy for breast cancer, the dose required to irradiate the internal mammary nodes has to be modified in the presence of rectus sternalis muscle [29]. Rectus sternalis muscle can be used in reconstruction surgeries of the breast, anterior chest wall, head and neck [30]. There can be an altered electrical activity during electrocardiography due to the presence of rectus sternalis [16]. Rectus sternalis may also be confused with the hernia of the pectoralis major [11, 31]. During the augmentation mammoplasty, even though the rectus sternalis muscle acts as a hindrance during the sub-muscular pocket dissection for the placement of the prosthesis, it can be used to cover the medial-most part of the prosthesis [32].

CONCLUSION

Rectus sternalis is a rare muscle that one may come across during the dissection of the anterior thoracic wall. Knowledge regarding the location, extent and attachments of rectus sternalis is important for surgeons and radiologists for accurate diagnosis, as rectus sternalis muscle may interfere with the mammographic findings of breast cancer. Rectus sternalis muscle can be useful in reinforcing the medial

part of the breast prosthesis. The present case report adds to the existing knowledge of rectus sternalis muscle with respect to its varied origin, insertion and extensions compared to the cases reported in the past.

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