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Original Research Article

A STUDY OF MORPHOLOGICAL VARIATION OF PECTORAL REGION MUSCLE 'RECTUS STERNALIS' IN SOUTH GUJARAT REGION

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ABSTRACT

Introduction: Rectus Sternalis muscle is an uncommon anatomical variant located over the human anterior pectoral wall, superficial to the Pectoralis major. Rectus Sternalis is highly variable in appearance about width, breadth and length. Its simulated appearance as breast mass on mammography demands acquaintance of its incidence and various configurations amongst radiologists and clinicians for correct diagnosis and better postoperative management of breast cancer patient in its presence. Till now Rectus Sternalis is mainly described as case report and there are no study documented showing incidence and morphological features of Rectus sternalis in South Gujarat Region.

Materials and Methods: The study was carried out in 40 properly embalmed cadavers of Indian origin in Anatomy Department, SMIMER, Gujarat. Dissections of pectoral regions of these 40 cadavers were performed, to know the presence of Rectus Sternalis muscle and its morphology was noted.

Result: Out of 40 dissected cadavers, we found presence of Rectus Sternalis muscles in 2 cases. The muscles were parasternal and superficial to pectoralis major muscle on anterior wall of chest. It was unilateral in one case while bilateral and continuous with Sternocleidomastoid in another cadaver.

Conclusion: Current study has determined an incidence of the Rectus Sternalis muscle to be 5% and supported its origin from Sternocleidomastoid muscle. Findings of this study will add knowledge to south Gujarat radiologist about variable appearance of rectus sternalis and help in better interpretion of great number of mammography done every year. It will help clinician dealing pectoral region for interventional and diagnostic procedures in avoiding surgical complications and to decide better postoperative radiotherapy and reconstructive surgery management in breast cancer patient.

KEY WORDS: Rectus Sternalis Muscle, Pectoralis Major Muscle, Cadaver.

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INTRODUCTION

The sternalis muscle is an uncommon anatomical variant located on the human anterior pectoral wall, superficial to the Pectoralis major [1]. This long and flat muscle arises from the lower costal cartilage and rectus sheath to blend with sternocleidomastoid or to attach to the upper sternum or costal cartilage [2]. Sternalis was reported by Cabrolio (1604) in his book "Anatom-

-es Elenchus Accuratissimus" andsalso described by Du Puy (1726) [3].

Boerhaave gave a detailed description of this muscle. Various synonymous from its initial discovery are given like musculus sternalis, presternalis, rectus sternalis, sternalis brutorum or thoracicus. It is also referred as the episternalis, rectus thoracis, superficial rectus abdominis, abdomino- guttural, abdomino-cutaneous, sternalisbrutorum, and also known as cutaneous pectoris [4].

There are various theories for Rectus sternalis origin. Various researcher has described its origin either from sternocleidomastoid muscle or rectus abdominis [5], pectoralis major [6], panniculus carnosus [7] or external oblique muscle [8]. In Gray's anatomy it has been described as 'Rectus Sternalis', a variation of pectoralis major and in Langman's Essential Medical Embryology as 'Sternalis', a derivative of rectus column [9].

Rectus sternalis is presented with varied frequencies amongst different ethnic groups and also exhibited great variation in terms of its height, width, and thickness. One of the most clinical significance of Rectus Sternalis is its simulated appearance like breast tissue mass during mammography. Now a days mammography is most widely used screening test for breast cancer so clinician should be well versed with different type of configuration presented by Rectus Sternalis to prevent misdiagnosis and unnecessary cancer work up. The incidental finding of a Rectus sternalis muscle in mammography, CT, or MRI studies must be documented in a patient's clinical records, because of prospect of it as plastic reconstruction flap in case of the head, neck,and anterior chest wall [10]. Even its presence modifies intra operative and postoperative treatment guideline for breast cancer patient. Till now Rectus Sternalis is mostly stated in literature as case report and there are no studies showing incidence of Rectus Sternalis in South Gujarat Region. So this study illustrates incidence and morphological characteristic of Rectus Sternalis in South Gujarat region and discuss about its embryological origin and its clinical relevance which will help south Gujarat region clinician dealing pectoral region for better patient management.

MATERIALS AND METHODS

The study was carried out on 40 properly embalmed & formalin fixed cadavers of Indian origin in dissection hall of Anatomy Department, SMIMER Medical college, Surat, Gujarat. Routine dissection of pectoral region was performed according to standard dissection guideline (Cunningham). After cleaning the dissected region and removing superficial fascia, any muscular variation in the paramedian region of the anterior chest-wall was carefully observed and followed for its details like origin, insertion and morphological features and photographs were taken. The length and breadth of the muscle were measured using a caliper.

RESULTS

Out of 40 dissected cadavers, two cadavers showed presence of Rectus sternalis muscle in Pectoral region. These muscles were located on the anterior thoracic wall parallel to the sternum and as a vertical strip perpendicular to the pectoralis major. These muscles were superficial to pectoralis major muscle and situated between anterior thoracic superficial fascia and pectoralis fascia. The superficial fascia was cleared to visualize the traces of the muscle. In both cases Rectus sternalis muscles attachment and measurement are as per Table 1.

Table 1: Results of both muscles.

Case	Unilateral/ Bilateral	Attachment		Maximum Length (cm)	Maximum Breath (cm)
		Superior	Inferior		
Case 1	Unilateral (Right)	Right sternoclavicular joint	Right sixth Costal cartilage	16	3.5
Case 2	Bilateral				
	Right Slip	Right sternoclavicular joint	Right fourth Costal cartilage	9	2
	Left Slip	Lower part of Left Sternoclavicular joint	Left sixth Costal cartilage and aponeurosis of External Oblique muscle	12	3

In case 1 (Fig.1) Rectus sternalis was unilateral on right side as a vertical flat ribbon like strip located parasternally in the Pectoral region. Muscle showed tendinous part above and fleshy part below.Inferioriorly its attachment was

below to right sixth costal cartilage and after slightly oblique course along right margin of sternum it got attached superiorly nearer to right sternoclavicular joint as a tendon.

Fig. 1: Showing Presence of Right sided Rectus Sternalis muscle.

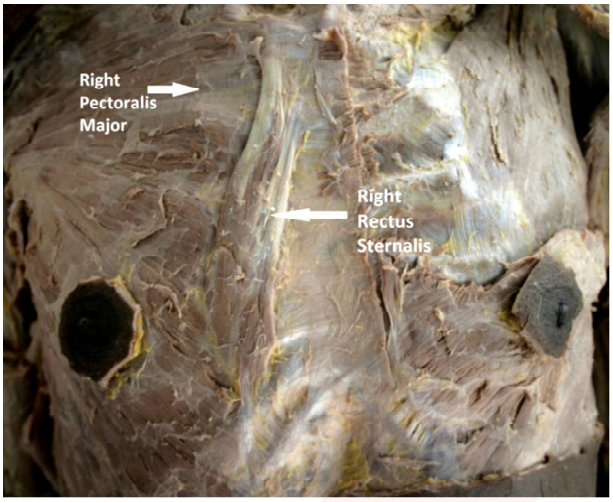
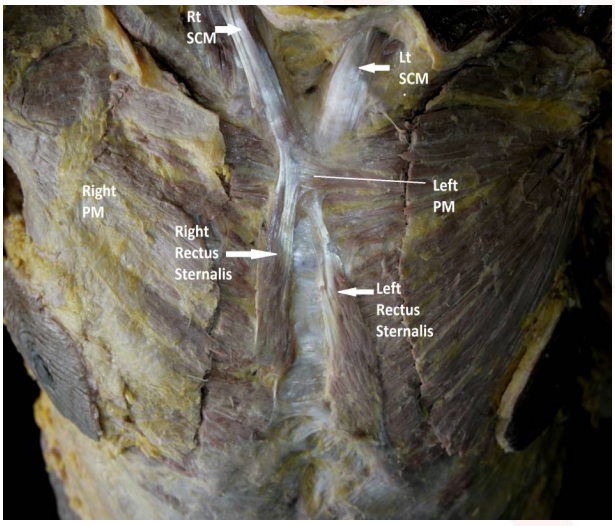


Fig. 2: Showing Slips of Rectus Sternalis muscles, Right PM- Right Pectoralis Major And Left PM- Left Pectoralis Major.



In second case, Rectus sternalis muscle was presented with a bilateral appearance over anterior pectoral region. On right side, a vertical fleshy strip of muscle arose from right fourth costal cartilage and passed vertically upward to reach upto right sternoclavicular joint as a tendon to be continuous with origin of right Sternocleidomastoid muscle. Left strip of muscle after origin, passed vertically upward to reach upto left 2nd costal cartilage and after forming tendon it had inserted to lower part of left sternoclavicular joint. At the level of second costal cartilage, both strips were 1.5 cm apart and at level of fourth costal cartilage they were 3 cm apart. On left side at the second costal cartilage level, left Pectoralis Major muscle fibres crossed over to merge with medial margin of right muscle strip. Both slips of muscle were connected transversely by about 1 cm fibrous band at level of fourth intercostal space and it was passing superficial to lower end of sternum.

DISCUSSION

The sternalis muscle is a fleshy band of longitudinal fibers of varying length and width, located close to and generally parallel to the sternum. When typical, it arises from the sheath of the rectus abdominis muscle, aponeurosis of the external oblique muscle, pectoralis major muscle, or costal cartilages and ends above onto the upper costal cartilages, manubrium, or may be joined to the sternal head of the sternocleidomastoid muscle [2].

Jelev in 2001 defined the characteristics of sternalis muscle as follows:

1. Situation between anterior thoracic superficial fascia & pectoral fascia.

2. Origin – Sternum or intraclavicular region.

3. Insertion – rectus sheath or costal cartilages or lower ribs or external oblique aponeurosis [11].

As per Jelev's criteria, Rectus sternalis muscle origin is from sternum or infraclavicular but in Gray's Textbook of Anatomy its origin has been said to be from lower costal cartilage or from rectus abdominis or from aponeurosis of External Oblique muscle. In present study muscles were fleshy in lower part which can be considered as its origin while in its upper part they were tendinous so can be considered as their insertion. As per Jelev's classification, insertion of Rectus Sternalis is either to the rectus sheath or costal cartilages or lower ribs or external oblique aponeurosis and as per Gray's textbook it should be upper costal cartilages, manubrium, or may be joined to the sternal head of the sternocleidomastoid muscle. We also agree with Gray's description as in our study we got similar finding for insertion of muscle and in one case where Sternalis muscle fibres were continuous with Right Sternocleidomastoid muscle.

Rectus Sternalis muscle's innervation and origin is under controversy. Various theories have been proposed for its origin. One of them based on nerve innervation,it states that 55% of Rectus sternalis are innervated by branches of internal or external thoracic nerves, 43% by branches of intercostal nerves and 2% by both intercostal and thoracic nerves.So as if it is supplied by Pectoral nerve it could have been arise from Pectoralis major muscle or if its nerve supply is from intercostal nerve then it could have arisen from rectus abdominis muscle [12]. Another theory based on arrangement of muscle fibre postulate that the sternalis muscle may be an aberrant extension of the adjacent muscles or their blastemas like sternocleidomastoid muscle or the rectus abdominis muscle; however, the sternalis muscle is always superficial to the rectus abdominis and not continuous with it [1,13].

Phylogenetically, it is present as a remnant of longitudinal ventral paramedian muscle sheet that disappears leaving the hyoid muscles in the neck and the rectus abdominis muscle in abdomen as representatives, although it has been described always superficial and not continuous with the rectus abdominis muscle [9]. Turner has described it as representing an atavistic form of Pectoralis cutaneous muscle of lower animal developmentally [14], while Barlow [7]considered it as remain of Panniculuscarnosus and according to Ruge [15] it is represented as vestige of cuticular muscle of mammal presented subcutaneously in trunk and in human in form of axillary arch. Clemente considered it as misplaced portion of pectoralis major and Sadler as part of ventral longitudinal muscle column arising from the ventral lips of hypomeres [16].

Rectus Sternalis is a rare anatomical variant found with racial and regional variations. Sarikcioglu L et al., reported its incidence to be 4-7% in white population, 8.4% in black population, 11% in Asian population, 1% in Taiwanese population and 9.3% in Turkish population [17]. In Indian population, its incidence is 5-8% and equal in both genders [18,19]. In Present study out of 40 cases, both Unilateral and Bilateral variety of Rectus sternalis muscles were found and incidence of muscle is derived as 5% which correspond to Study of Shah AC which denotes incidence of Rectus sternalis in Indian population of 4-8% [19]. In present study both unilateral and Bilateral Rectus sternalis were found with equal frequency but Mehta V et al.[20] discussed a more common unilateral occurrence of this muscle and also reported lack of acquaintance of the clinicians with this muscle variant. Its unilateral presence has been reported to be 4.5%, while its bilateral presence has been reported to be 1.7% [21]. Unilateral presence were reported by Mehta V et al., and Kulkarni DU et al., in their case reports [22]. Young LB et al. has found that the incidences of the bilateral sternalis muscles are very low around 1.7% and its concurrent existence with other rare anatomical abnormalities is even rarer [21]. Sarikcioglu L et al. reported presence of three Rectus Sternalis muscles in a single cadaver, one on right side and two on left side. According to them, it is a composite type of muscle [17].

In our case, the muscles were found in the pectoral region distinct from other muscles and in one case its left slip originated from aponeurosis of external oblique muscle. The fibres direction was same as that of the abdominal muscles and perpendicular to the pectoral muscle. Therefore we would exclude that it is part of pectoral muscles and rather agree with Sadler [9] that it as part of the ventral longitudinal column of muscles arising at the ventral tips of the hypomeres which has lost significance during evolution. In present study continuation of right slip of muscle with the sternocleidomastoid muscle of same side correspond with finding of study of Monika srivastava which also denoted same finding of continuation of left slip of muscle to sternocleidomastoid in case of bilateral sternalis [23]. Hence, it is also possible that the present Rectus sternalis is a derivative of the sternocleidomastoid muscle. According to these theoretical explanations, Rectus sternalis muscle may have evolved from two different origins: superiorly from the sternocleidomastoid muscle and inferiorly from the rectus abdominis muscle. Finally, regarding muscle location and fibre direction, this Rectus sternalis may assist in elevating the lower ribs. So we can conclude that Rectus Sternalis might have derived from primitive ventral longitudinal

muscle sheath which also gives rise to Rectus abdominis and Sternocleidomastoid muscle. This is supported by the findings that Sternalis muscle fibres are many times continuous with either sternocleidomastoid or rectus abdominis or both.

In present study from left side Pectoralis major muscle fibres in upper part were continuous with medial margin of right slip of Rectus sternalis muscle and both slips were attached to each other in front of lower part of sternum by 1 cm broad fibrous band. In one of case report by Levent at al. from Turkey had reported rectus sternalis with three slip and one of the slip is associated with Pectoralis major muscle and two slips of Rectus sternalis joined and became continuous with sternocleidomastoid muscle [17].

Knowledge of presence of this muscle is required amongst radiologist as during mammography it may mimic like a tumour growth leading to unnecessary surgical intervention. Rectus sternalis simulate to wide range of lesions, such as breast carcinoma, extra-abdominal desmoid tumours, granular cell tumours, diabetic mastopathy, abscesses, hematomas, sclerosing adenositis, lymphadenitis, fat necrosis, and surgical scars. There is a literature available which showed four patients who underwent open surgical biopsy for a presumed breast mass which was simulated by Rectus sternalis muscle. With presence of Rectus sternalis**,** lesion of Breast carcinoma infiltrating medial quadrant require modification of radiation dose during radiotherapy [24-27]. In addition, breast tissue extending deep to the Rectus sternalis muscle may be neglected during mastectomy [28]. Use of a conjoined sternalis-pectoralis muscle flap in immediate tissue expander reconstruction after breastectomy has been proposed by reconstructive surgeons [29].

CONCLUSION

The Rectus sternalis muscle is a variant muscle of the anterior chest wall, with varying origin, size and uncertain function. Its incidence in present study is found to be 5% and supports its origin from Sternocleidomastoid muscle from results obtained in this study. Findings of this study will add knowledge to south Gujarat radiologist about variable appearance of Rectus sternalis and help in better interpretation of great number of mammography done every year. In case of dilemma of diagnosis, CT scan or MRI study will be helpful. It will also be helpful to clinicians dealing pectoral region for interventional and diagnostic procedures. It is necessary to document this unusual anatomical variants with the use of various diagnostic and therapeutic tools like mammography, CT Scan or MRI as its presence affect area of surgical excision, radiation dose in breast cancer patient management and provide an option as a muscular flap for surgery of breast, head,neck and face.

Conflicts of Interests: None

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