The Conjoined Sternalis-Pectoralis Muscle Flap in Immediate Tissue Expander Reconstruction After Mastectomy

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Abstract: The sternalis muscle is an accessory muscle of the anterior chest wall. This is a rare anatomic variant reported in approximately 8% of the population, with variation among races. While several anatomic studies of the sternalis muscle exist, nothing in the literature addresses the implications of this muscle on reconstruction of the breast after mastectomy. Based on several encounters of this muscle variant by the senior author over a 15-year period, we offer a strategy and rationale for dealing with this rare, but known, anatomic variant during immediate tissue expander reconstruction of the breast after mastectomy. First is the importance of recognizing the presence of a sternalis muscle, which may present in a variety of configurations. We offer our technique of conjoined sternalis-pectoralis muscle flap during tissue expander reconstruction of the breast. This allows for the creation of a larger, more properly placed submuscular pocket with adequate muscle coverage of the tissue expander. Our experience illustrates that the reconstructive surgeon must be familiar with the sternalis muscle and be prepared to adapt his or her technique for tissue expander placement when faced with this accessory muscle.

Key Words: sternalis muscle, parasternal muscle, sternalis-pectoralis muscle flap, breast reconstruction, breast tissue expander, mastectomy, immediate breast reconstruction, breast implant

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Although the sternalis muscle has no known functional role in humans, its presence has surgical implications during breast reconstruction, specifically in regard to staged implant reconstruction. First and foremost, the reconstructive surgeon must be aware that this anatomic variant exists, and must recognize its presence when encountered in the operating room. Bailey and Tzarnas[1] demonstrated near-universal unfamiliarity of this anatomic variant among general surgeons, plastic surgeons, radiologists, and medical students.

Review of the literature regarding the sternalis muscle reveals several anatomic studies. The few reports about the clinical implications of the presence of a sternalis muscle are limited to the radiology literature. The muscle may cause diagnostic difficulty by appearing as a mass on mammography, necessitating further carcinoma workup and possible leading to unnecessary biopsy.[2] Additionally, the presence of a sternalis muscle may require adjustment during irradiation of the internal mammary nodes.[3] However, no reports exist describing the implications of this muscle on staged implant reconstruction of the breast.

Critical to an immediate implant reconstruction following mastectomy is the proper position and size of the submuscular pocket and the viability of the muscle draping the implant. This muscle serves as a critical interface between the breast prosthesis and the mastectomy skin flaps, which may at times be ischemic and require revision. The presence of a sternalis muscle necessitates our understanding of the chest wall anatomy and vascular supply of the chest wall muscles.

While this anatomic variant is rare, undoubtedly, the busy reconstructive surgeon will encounter this accessory muscle several times over the course of his or her career. During his 15-year career, the senior author has encountered this anatomic variant in roughly half a dozen cases of breast reconstructions. We offer important, and previously unreported, considerations during staged implant reconstruction of the breast in a patient with a sternalis muscle. To date, no reports exist in the literature describing the operative implications of this anatomic variant on immediate breast reconstruction. We offer our technique of elevating a conjoined sternalis-pectoralis muscle flap during immediate implant reconstruction of the breast.

CASE REPORTS

Patient 1

This is a 37-year-old female with recently diagnosed multifocal infiltrating ductal carcinoma of the right breast. She elected for a right modified radical mastectomy (MRM) and a prophylactic left mastectomy with immediate tissue expander insertion bilaterally. The patient had a left-sided sternalis muscle which was 12 cm long and 9 cm wide, oriented slightly oblique to the sternum and medial to the

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pectoralis major muscle (Fig. 1.). The sternalis and pectoralis major muscle were elevated as a conjoined muscle flap. During elevation, the perforators to the pectoralis major muscle and the sternalis muscle from the internal thoracic artery were ligated. A McGhan MV 133 600-mL tissue expander, filled with 50 mL saline, was placed below the sternalis-pectoralis muscle flap. No sternalis muscle was present on the right. She tolerated the procedure well.

Patient 2

This is a 57-year-old female with a history of right breast carcinoma in 1991, necessitating right MRM and TRAM flap reconstruction. She presented with invasive ductal carcinoma of the left breast and elected for a left MRM and sentinel lymph node biopsy with immediate tissue expander insertion. The patient had a left-sided sternalis muscle which was 15 cm long and 6 cm wide, oriented parallel to the sternum and medial to the pectoralis major muscle. The sternalis and pectoralis major muscle were elevated as a conjoined muscle flap. During elevation, the perforators to the pectoralis major muscle and the sternalis muscle from the internal thoracic artery were ligated. A McGhan MV 133 600-mL tissue expander was filled with 50 mL saline and placed beneath the sternalis-pectoralis muscle flap. She tolerated the procedure well. The operative report from the prior mastectomy made no mention of a right-sided sternalis muscle.

DISCUSSION

The sternalis muscle is a long, flat accessory muscle of the anterior chest wall that arises from the infraclavicular region of the chest and travels adjacent to the sternum. It is found superficial and medial to the pectoralis major muscle. It was first named by Carbriolus in 1604[4] and more accurately described by Du Puy in 1726. The first observation of this muscle in a living subject was made be Roubinowitch in 1888.[5] Because of its orientation and location, this muscle may appear to be a cranial extension of the rectus abdominis muscle; however, it is a distinct muscle. There have been numerous papers by anatomists describing this muscle and its variations. When present, the muscle can vary from a thin, narrow strip to a large broad band. It may be oriented parallel to the sternum or oblique. Additionally, a sternalis muscle with an inverted-Y shape has been described.[3] The literature contains approximately 17 synonyms for this muscle, which include anomalus sterni, parasternal, rectus sternalis, and praesternalis.

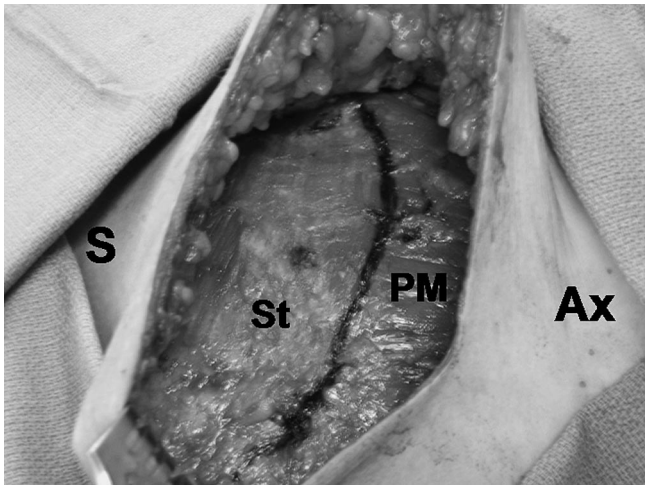

FIGURE 1. The left-sided sternalis muscle in patient 1, as viewed through the mastectomy defect, is a flat muscle arising from the infraclavicular region of the chest, oriented medial to the pectoralis major muscle and slightly oblique to the sternum. The ink marks the transition between the sternalis and the pectoralis muscle. S, sternum; Cl, clavicle; Ax, axilla; St, sternalis; PM, pectoralis major.

There is a lack of consensus regarding the development of this muscle. Some believe that this represents a vestigial muscle from early evolutionary development,[6,7] while others consider the sternalis to be a misplaced pectoralis major muscle.[8] Regardless of its etiology, this muscle has no known functional significance. Its presence most commonly represents an isolated anatomic variant without any implications. However, some systemic anomalies have been associated with the presence of a sternalis muscle; these include anomalies of the adrenal gland and skull, as well as abnormalities in the pectoralis major muscles. Additionally, the incidence of sternalis muscle in patients with anencephaly has been reported to be 48%.[9]

The sternalis muscle has equal incidence in males and females, with variation among different ethnic groups. A comprehensive cadaveric analysis by Barlow described an incidence of 11% in those of Asian descent, 6% in Americans of African descent, and 2% in European Caucasians, with nearly equal predilection for gender.[10] Studies in Indian populations describe a 4%–8% incidence.[11,12] Because the sternalis muscle is typically unilateral, its incidence during surgery of the breast, which is often itself a unilateral procedure, is much lower than that reported in cadaveric studies; Harish and Gopinath[13] report 8 sternalis muscles in 1152 patients (0.7%) who underwent modified radical mastectomies between 1990 and 2000.

While the sternalis muscle may present as an irregular medial density on mammography,[13] there remains no reliable clinical test for its presence. Prichler,[14] in 1911, described his method for detection: ". . . if you let the concerned individual perform stroking, scratching movements in a horizontal direction at the area of the opposite anterior superior iliac spine with the elbow fixed and flexed in a blunt angle, a sternalis muscle, if present, would become apparent." Accordingly, this muscle most likely presents as an unexpected finding present at the time of mastectomy or breast reconstruction. Thus, it is important to recognize that this anatomic variant exists.

The innervation of the sternalis muscle is varied. Extensive review of the literature comprising almost 200 sternalis muscles, reveals 55% innervated by branches of the internal or external thoracic nerves, 43% by branches of the intercostals nerves, and 2% from both the intercostals and thoracic nerves.[15] Less is known about the blood supply to this muscle. No large anatomic series exist which examine the vascular anatomy of this muscle. However, small series in

cadavers demonstrate that the sternalis is supplied by perforating branches of the internal thoracic artery.[16] Knowledge of chest wall vasculature also makes it likely that there are minor contributions to the sternalis muscle from intercostals perforators.

In the patient with normal chest wall musculature, we place our tissue expanders in the submuscular plane below the pectoralis major muscle. This is accomplished by disinserting the pectoralis from the chest wall along its medial and inferior insertions. This allows for a tension-free draping of muscle over the breast prosthesis. We then inset the muscle to the lower mastectomy flap.

Another critical factor in tissue expander insertion is the dissection of an adequately sized and properly centered submuscular pocket. The pocket should be large enough to comfortably accommodate the base diameter of the tissue expander being used. Additionally, the pocket should be located on the anterior chest wall, with careful attention to the vertical positioning, as well as the horizontal centering of the tissue expander. Careful preoperative marking of the midline, vertical axis of the breast, and inframammary fold is essential in determining the proper placement of the implant.

In the patient with a sternalis muscle, the tissue expander placement relies even more on the external markings of midline and axis of the breast, the latter of which is aligned with the vertically marked axis of the implant. Our experience has shown that the creation of an adequately sized and placed submuscular pocket may be confusing in the presence of the anomalous muscle. We have found that the sternalis muscle, when present, is found in a plane just superficial and medial to the pectoralis major muscle, with some overlap of that muscle. Accordingly, the pectoralis major muscle inserts several centimeters lateral to the lateral edge of the sternum. Therefore, simply creating a subpectoral pocket will result in a small pocket which may not adequately accommodate the base diameter of the tissue expander. Also, the pocket will have inadequate dissection medially and be laterally displaced. To overcome this, the medial dissection should include the sternalis muscle, thereby enlarging the pocket and placing it more correctly on the anterior chest wall.

Also, because of the more lateral insertion of the pectoralis major muscle, we have found that the overall size of the pectoralis muscle is smaller in the presence of a sternalis muscle. This certainly has no functional implications on the patient; however, this may result in inadequate coverage of the breast prosthesis. Elevation of the sternalis muscle provides additional muscle coverage of the tissue expander.

We have also found that in the presence of a sternalis muscle additional disinsertion along the length of the sternum is necessary to allow proper muscle draping of the implant. Normally, adequate mobilization of the pectoralis muscle is achieved by disinserting the inferior 4 to 5 cm of the medial attachment to the sternal edge. In the presence of a sternalis muscle with its many muscular insertions to the chest wall, we find that upwards of 8 to 10 cm of the sternalis muscle needs to be disinserted from the sternum to provide adequate mobilization and tension-free draping

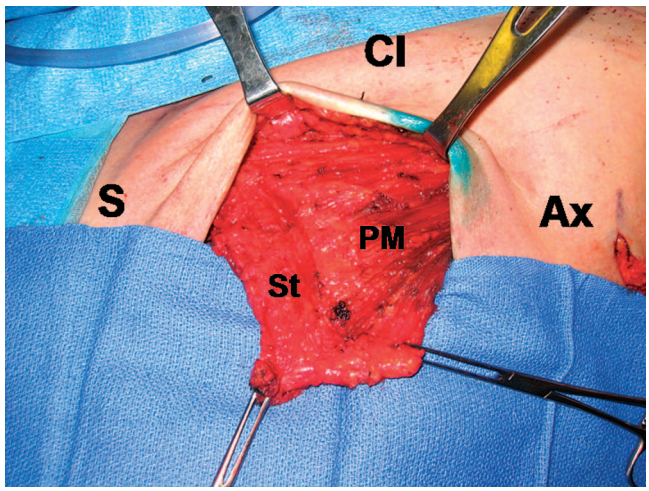

FIGURE 2. The conjoined sternalis-pectoralis muscle flap in patient 2 remains viable despite the disruption of the internal thoracic perforators because of blood supply derived from the thoracoacromial artery via intermuscular connections. This illustrates the importance of keeping the sternalis and the pectoralis major muscle in-continuity. S, sternum; Cl, clavicle; Ax, axilla; St, sternalis; PM, pectoralis major.

of the breast prosthesis (Fig. 2.). This is most likely the result of the longitudinal orientation of the sternalis muscle that does not allow much laxity when the muscle is pulled in the direction of its fibers.

The primary blood supply to the sternalis, arising from the internal thoracic perforators, needs to be killed to adequately mobilize the muscle. There is an additional blood supply to this muscle, which must be preserved from the thoracoacromial

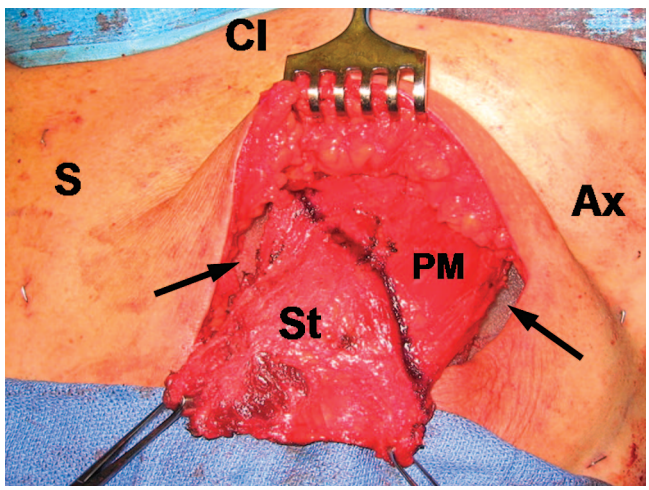

FIGURE 3. The sternalis-pectoralis muscle flap draping the tissue expander in patient 1. Note the amount of medial disinsertion needed to provide proper location of the submuscular pocket and tension-free muscle coverage of the tissue expander. The tissue expander (black arrows) is visible beneath this muscle flap and protected from the incisional repair with viable muscle. S, sternum; Cl, clavicle; Ax, axilla; St, sternalis; PM, pectoralis major.

artery via intermuscular connections with the pectoralis major muscle. To preserve this blood supply, the sternalis muscle and the pectoralis major muscle need to be raised in continuity with each other. This sternalis-pectoralis muscle flap muscle flap should be raised from a lateral to medial direction, thereby protecting the intermuscular connections. Additionally, elevating these muscles in continuity preserves the intercostals nerve branches, which pierce the pectoralis major muscle and enter the deep surface of the sternalis muscle. This conjoined muscle flap drapes over the tissue expander tension-free (Fig. 3). This technique of raising a conjoined sternalis-pectoralis muscle flap should be done, even if one prefers to use the serratus anterior muscle to provide additional lateral coverage of the implant.

CONCLUSION

While the overall presence of a sternalis muscle is rare, the busy reconstructive surgeon will undoubtedly encounter this muscle variant on several occasions. It is important for the reconstructive surgeon to recognize that in the setting of a sternalis muscle, the submuscular dissection is more difficult. The dissection technique should be adapted to respect blood supply to this anomalous muscle. We share our experience of encountered sternalis muscles during staged implant reconstruction of the breast and offer our technique of a sternalis-pectoral muscle flap. We believe that failing to modify one's standard technique in the setting of a sternalis muscle may result in an improperly placed tissue expander with inadequate muscle coverage. Clearly, further anatomic studies are needed which specifically examine the arterial supply to this rare anatomic variant. The rarity of this anomalous muscle, however, may make a proper anatomic study impractical.

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