

Islandized hemipectoralis muscle flap for sternoclavicular defect

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Sternoclavicular osteomyelitis is a late complication of septic arthritis of the sternoclavicular joint (SCJ). Treatment often requires wide débridement, which results in a significant bony defect and an unstable SCJ. Several techniques using the pectoralis major muscle for SCJ reconstruction have been described.

We present a versatile technique of an islandized hemipectoralis major muscle flap, which to our knowledge has not yet been reported, in which a portion of the pectoralis major muscle is completely islandized on its thoracoacromial blood supply. This muscle flap has the advantage of being based on a predictable dominant blood supply that is unlikely to be injured during bony resection. It results in eradication of the infection and stabilization of the SCJ and has an excellent cosmetic outcome, without significant functional loss. We describe our surgical technique for immediate reconstruction of the SCJ in an immunocompromised patient with sternoclavicular osteomyelitis.

CASE REPORT

A 60-year-old woman with short gut syndrome and liver failure as a result of long-term hyperalimentation was awaiting a combined small bowel and liver transplant. Right shoulder pain developed, and an orthopedic surgery evaluation revealed tenderness over the right SCJ, without erythema or swelling. A computed tomography (CT) scan showed fluid within the SCJ and bony destruction of the medial end of the right clavicular and manubrium suggestive of osteomyelitis (Figure 1). Aspiration and culture of this fluid was positive for oxacillin-resistant *Staphylococcus aureus* (ORSA). She was taken to the operating room for irrigation of the SCJ, excision of the infected bone, and reconstruction of the defect.

After marking the surface landmarks, a limited initial incision was made over the SCJ (Figure 2). Deep dissection was extended to the SCJ, which was grossly necrotic. After

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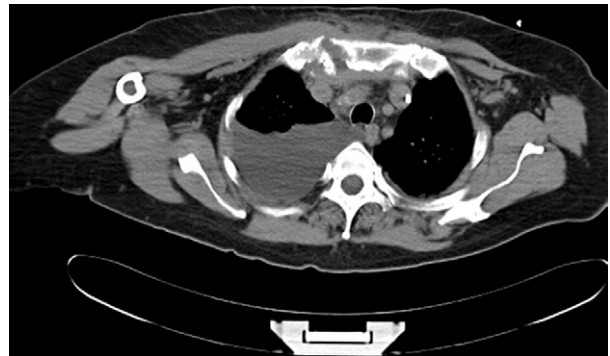


Figure 1 Computed tomography scan demonstrates fluid in the right sternoclavicular joint, with bony destruction of the clavicular head and manubrium suggestive of osteomyelitis.

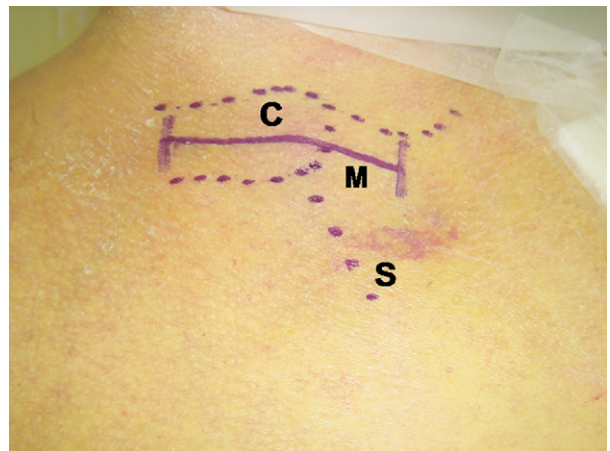


Figure 2 Anatomic landmarks of the right sternoclavicular joint. (C, Clavicle; M, manubrium; S, sternum.) The solid line indicates the initial skin incision for exploration of the sternoclavicular joint; this was subsequently extended both medially and laterally because of the extent of bony involvement.

assessing the extent of the underlying infection, this incision was extended medially over the manubrium and laterally to the midclavicle to provide adequate exposure for débridement. Necrosis and inflammatory changes extended from the medial third of the clavicle to the midline of the manubrium. Extensive osseous débridement and resection of the costoclavicular ligaments resulted in an 8-cm cavitory defect and destabilization of the medial edge of the residual clavicle. The skin and subcutaneous tissue were elevated

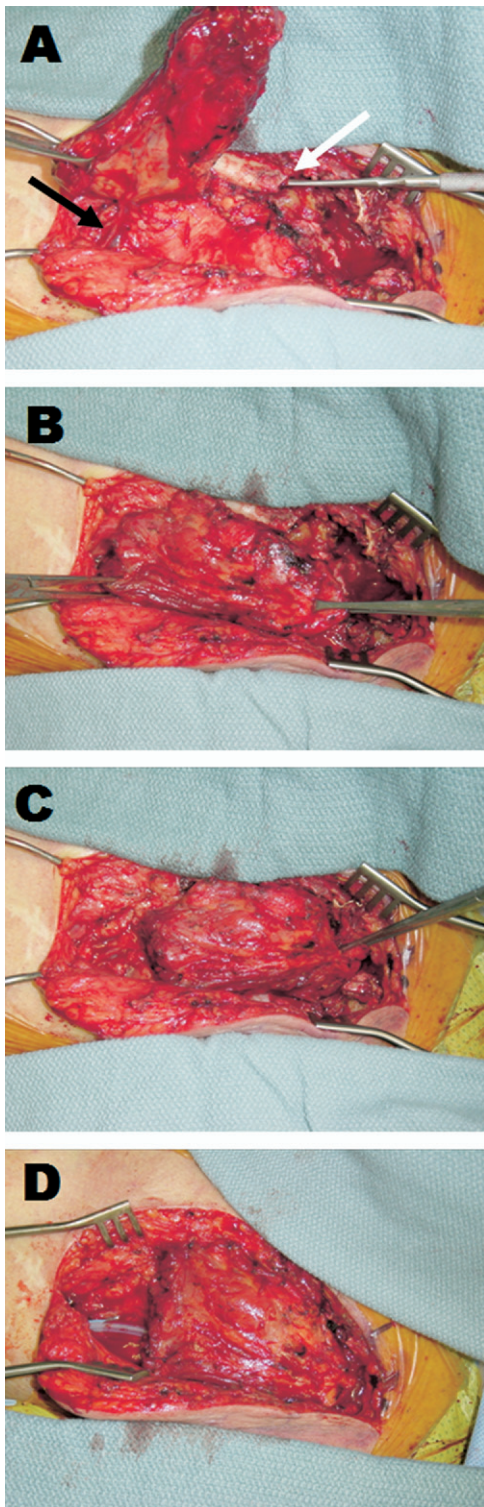


Figure 3 **A**, Islandized flap elevated on its vascular pedicle. The *black arrow* points to thoracoacromial vessels, and the *white arrow* points to the medial end of remaining right clavicle. **B**, Location of pectoralis muscle segment before mobilization. **C**, The muscle is retracted superiorly and medially to fill sternoclavicular defect. **D**, The flap is inset into defect without tension.

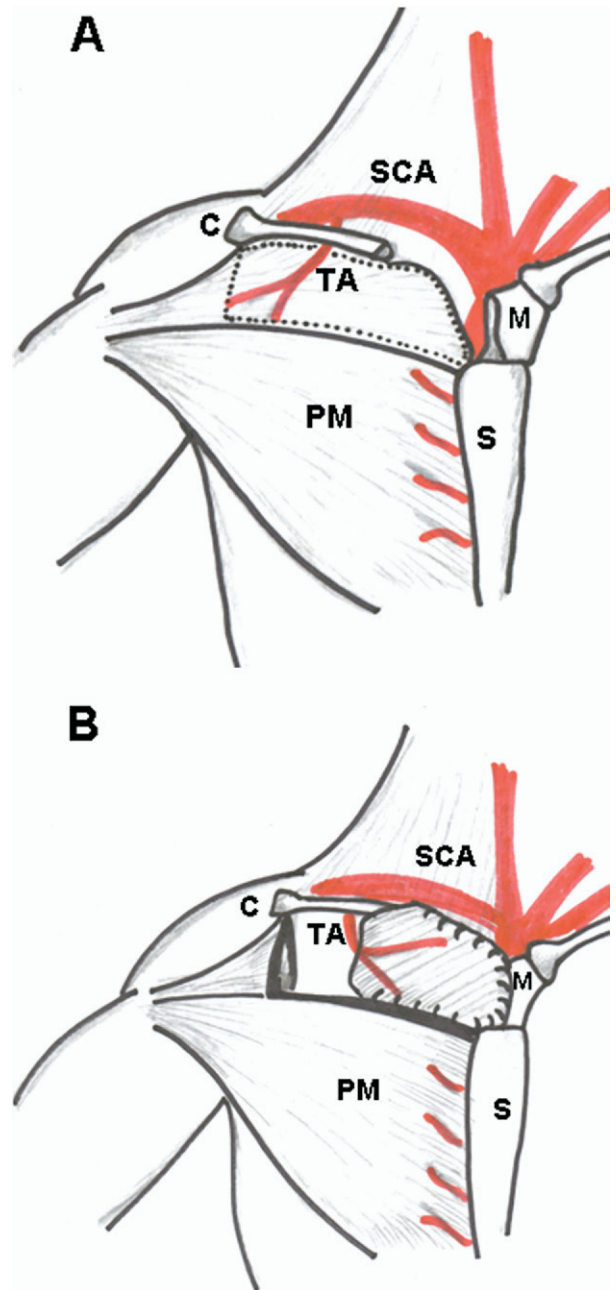


Figure 4 Schematic demonstrates the surgical technique. **A**, The *dashed line* represents the islandized portion of muscle. **B**, The islandized muscle is inset into the defect. Note the preservation of the vascular pedicle. (SCA, Subclavian artery; C, clavicle; S, sternum; M, manubrium; TA, thoracoacromial artery; PM, pectoralis major muscle.)

caudally, exposing the pectoralis major muscle. The interval between the clavicular and sternocostal portions of the pectoralis major muscle was identified and split in the direction of its fibers. Muscular attachments to the sternum medially and the clavicle superiorly were divided. The

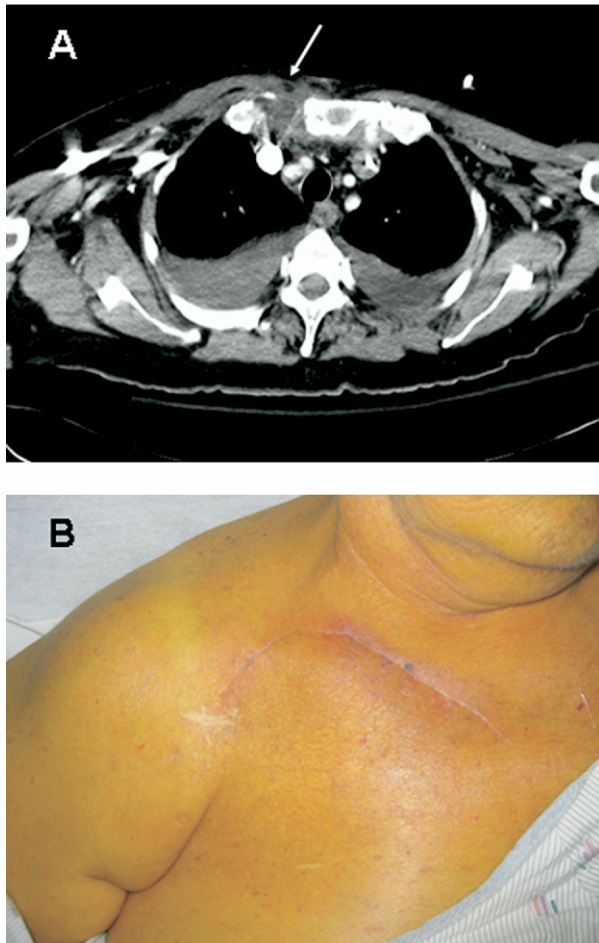


Figure 5 A, Computed tomography scan at 2 months. The *arrow* demonstrates interposition of muscle in the right sternoclavicular defect. **B,** Postoperative view at 5 months. Note the lack of contour irregularity of the anterior chest wall.

clavicular segment was then reflected superiorly, exposing the underlying thoracoacromial vessels.

A Doppler probe was used to verify the patency of this pedicle. The muscle was divided 3 cm lateral to the thoracoacromial vessels, completely islandizing it on the vascular pedicle. The pedicle was freed from surrounding tissue, which maximized the length and allowed adequate mobilization. The muscle was advanced medially and superiorly to fill the defect and was secured in place without tension with several interrupted 2.0 Vicryl (Ethicon, Somerville, NJ) sutures (Figures 3 and 4). A Doppler probe was again used to confirm patency of the pedicle. The skin was reapproximated in layers, and drains were placed beneath the muscle flap and within the donor site. The shoulder was immobilized in a sling.

The wound healed without complications. The drains were removed sequentially during a 2-week period. A CT scan at 2 months postoperatively revealed complete filling of the defect with viable muscle (Figure 5). At 5 months, the patient had full resolution of her SCJ pain. She regained

active range of motion to 130° of forward elevation and 40° of external rotation of the involved shoulder. Although no formal test of internal rotation strength was performed, she had a normal belly press test. She had no complaints relating to medial clavicular instability and reported no functional limitations. She is currently awaiting a combined liver and small bowel transplant.

DISCUSSION

Septic arthritis of the SCJ is uncommon, accounting for 1% of septic arthritis in the general population, and may be complicated by chest wall phlegmon, mediastinitis, and osteomyelitis.⁵ The latter complication mandates wide débridement and can result in a bony defect and instability of the chest wall and shoulder. Muscle flap reconstruction is critical for the treatment of the infection and stabilization of the remaining bone. It also provides coverage of underlying subclavian and innominate vessels and is important in cosmesis.³

Use of the total pectoralis major muscle has been described for clavicular resections.² Although the total muscle provides ample tissue for reconstruction, it results in significant functional loss and contour irregularities of the anterior chest. Accordingly, several techniques to minimize loss of function have been described that use only a portion of the muscle.^{7,8} These use rotation of a muscle segment based on medial sternal perforators from the internal mammary artery.

On the basis of its vascular anatomy, the pectoralis major muscle is classified as a type V muscle by Mathes and Nahai.⁴ The dominant blood supply is the thoracoacromial branch of the subclavian artery, and there are segmental contributions from internal mammary perforators. These medial perforators may be injured during resection of the clavicle and manubrium and may also not be patent in the face of surrounding inflammation. Accordingly, we believe the medial sternal perforators are an unreliable blood supply.

We prefer a pectoralis muscle flap based on the thoracoacromial vessels because they are dominant and highly reliable in diameter and location. Cadaveric studies demonstrate a mean external vessel diameter exceeding 1.8 mm and a vascular pedicle consistently entering the muscle lateral to the midpoint of the clavicle with a mean length of 8.8 cm.¹ This predictability explains why the pectoralis major muscle has remained a workhorse flap for reconstruction of the sternum, head, and neck. In addition, we maintain that these vessels are away from the area of inflammation and are unlikely to be injured during bony resection.

A partial pectoralis muscle advancement flap based on the thoracoacromial vessels has been described by Song et al.⁶ We believe this nonrotated flap is limited in its ability to fill significant defects without tension. Our flap is islandized on its vascular pedicle and rotated, thereby allowing maximum mobilization and the ability to fill deep defects. Because only the clavicular portion of the muscle is mobilized, there is no significant functional loss and minimal effect on the anterior chest wall contour. The anterior axillary fold is maintained, which is critical to chest wall cosmesis.

In our patient, the defect measured 8 cm and extended 1 cm lateral to the midline. Our technique easily filled this defect without tension. This flap is extremely versatile, how-

ever, and can be modified for larger defects and those that extend to the midline. Inclusion of a portion of the sternocostal head would be supported by the pedicle and can fill larger defects up to 15 cm. In addition, the pedicle length allows for tension-free mobilization of the muscle to the midline. It might be possible, through careful dissection of the pedicle and complete takedown of the humeral insertion of the pectoralis muscle, to extend this flap past the midline. However, this might result in excessive tension on the pedicle and compromise the blood supply, especially if a large portion of muscle is included.

CONCLUSION

We offer the islandized hemipectoralis muscle flap as a technique for immediate or delayed reconstruction of sternoclavicular defects. This versatile flap is based on a dominant, highly predictable blood supply that allows for tension-free filling of a SCJ defect. This approach helps to treat the infection by interposing well-vascularized muscle and aids in stabilization of the SCJ. Functional loss is minimal, and the cosmetic outcome is excellent in both the recipient and donor areas.

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