Muscle and Omental Flaps for Chest Wall Reconstruction

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KEYWORDS

• Chest wall • Reconstruction • Flaps

Reconstruction of the chest wall represents an important part of a patient's treatment after resection of a variety of thoracic tumors. Many different types of flaps, including both pedicled and free flaps, have been described for use in chest wall reconstruction. Pedicled muscle and myocutaneous options include the pectoralis major, latissimus dorsi, rectus abdominis, external oblique, and trapezius flaps. Omentum is another option that may be used either as a pedicled or free flap.

Reconstruction of chest wall defects can be, depending on the patient, a complicated undertaking and is best performed using a multidisciplinary approach. Preoperative planning is based on multiple factors that must be assessed and tailored to each patient to provide the best reconstruction possible. The assessment begins with the patient and includes prognosis, overall health, and both the desire and ability to undergo what can frequently be lengthy and difficult reconstructive procedures.

The type of reconstruction performed depends on several factors, including the size and exact location of the defect, the type of tissues resected, and the local conditions, such as previous radiotherapy or surgery, that may have compromised certain flap options. Superficial defects may be reconstructed with skin grafts. Resections involving deeper tissues may require flaps, as noted earlier. If appropriate local options have been compromised by prior surgery, if the defect is particularly large, or if there is extensive local injury from prior radiotherapy, free tissue transfer may be required. Also, the surgeon may use tissue expansion to obtain larger flaps or temporize the flap site with subatmospheric pressure wound therapy.

MUSCLE AND MYOCUTANEOUS FLAPS

Pectoralis Major Flap

One of the most common options for reconstruction of chest wall defects is the pectoralis major muscle. This flap may be used as muscle only or may include a skin paddle. Pectoralis major muscle originates from the lateral aspect of the sternum and inserts into the intertubercular groove of the humerus. The muscle has 2 blood supplies: the dominant supply is the pectoral branch of the thoracoacromial trunk arising from the subclavian artery and the secondary supply consists of the second through sixth intercostal perforating vessels originating from the internal mammary artery. Venous drainage parallels the arterial supply. The dominant nerve supply to the muscle is the lateral pectoral nerve, with frequent smaller contributions from the medial pectoral nerve.

The flap may be raised based on either of its blood supplies. Basing the flap on the thoracoacromial vessels allows it to be raised as an island flap, which significantly increases its reach, particularly with division of the humeral insertion and clavicular origin. The reach may be further increased by burring down or even resecting a portion of the clavicle, which also helps to prevent any bulging that occurs when the muscle is transposed over the clavicle. Basing the flap

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on the internal mammary perforating vessels allows for a turnover flap. The use of the turnover flap necessitates division of the humeral insertion, clavicular origin, and thoracoacromial vessels to allow for any mobility of the flap. The turnover flap represents a reasonable option that may be used for the reconstruction of midline defects, particularly in cases in which the thoracoacromial vessels are absent or damaged.

The pectoralis major flap has great utility for reconstruction of defects of the superior sternum and anterosuperior and anterolateral chest wall and neck. This flap may be used for external defects or passed between the superior ribs to occupy intrathoracic dead space that can result from partial or total lung resection (**Figs. 1–4**).

The flap may be raised as a muscle only or can include a skin island oriented vertically over the costochondral junction of the ribs or transversely at the inferior edge of the flap. Although the muscle flap is reliable, rates of skin paddle necrosis may be as high as 30%.[1–3] Additionally, loss of the anterior axillary fold can occur when the muscle is harvested in its entirety. Preservation of the lateral third of the muscle with the use of the medial two-thirds as a turnover flap can preserve the anterior axillary fold.[4]

Latissimus Dorsi Flap

Tansini[5] first described the use of the latissimus dorsi flap in 1906, and ever since it has become an important option for the reconstruction of chest wall defects. The latissimus dorsi muscle originates from the spinous processes of the 7th through 12th thoracic vertebrae and inserts into the intertubercular groove of the humerus. Its nerve supply is the thoracodorsal nerve and it has 2 blood supplies. The dominant blood supply is the thoracodorsal artery, which arises, in the large majority of patients, from the subscapular artery off the axillary artery. In a small percentage of individuals, the thoracodorsal artery arises from the axillary artery directly or from the lateral thoracic artery.[6] The secondary blood supply of the latissimus dorsi flap is the perforating vessels from the posterior intercostal vessels. Venous drainage parallels the arterial blood supply.

Fig. 1. Preoperative photo of a 68-year-old male with recurrent thymic carcinoma visible as a convexity to the left of the sternum.

The average surface area of the latissimus dorsi flap has been shown to be 105 cm^2 in women and 195 cm^2 in men, which covers a defect of significant size.[7] The flap may be raised either as a muscle only or as a myocutaneous flap. Given the large surface area of the muscle, a significant amount of skin may be taken; however, one of the goals for this particular flap is that the donor site be closed primarily. Primary closure of the donor site is usually possible if the skin paddle is 10 cm or less; otherwise, skin grafting may be necessary. Tissue expansion has been described to increase the amount of skin available.[8,9]

As with the pectoralis major flap, the latissimus dorsi flap may be raised on its dominant or secondary blood supply. Also, as with the pectoralis flap, the choice of blood supply dictates the arc of rotation. Raising the flap on the thoracodorsal artery provides a significant amount of mobility, and the flap may be successfully used to cover almost any defect of the ipsilateral thorax, including the upper abdomen, head and neck, and upper extremity (**Figs. 5–7**). Certain strategies may be used, including disinserting the muscle from the humerus and aggressive dissection of the pedicle from its investing fascia, to increase the functional length of the flap.[10] The flap may also be passed between the ribs to occupy intrathoracic dead space.

Raising the latissimus dorsi flap on the intercostal perforators produces a turnover flap that can be used for the coverage of midline spinal defects, or the muscle may be dissected off the posterior chest wall, maintaining the perforating vessels, and advanced to cover more lateral chest wall defects if the thoracodorsal artery has been ligated. In the author's experience, an advancement of 6 to 8 cm is possible.

If there has been damage to the thoracodorsal pedicle, retrograde flow through the arterial supply of the serratus muscle into the thoracodorsal vessels may provide adequate blood supply to the flap to allow for division of the intercostal