Algorithm for Autologous Breast Reconstruction for Partial Mastectomy Defects

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Background: The use of lateral thoracic skin and fat for breast reconstruction is advantageous because it does not require the use of muscle transfer, and the donor-site incision is well hidden under the arm. In patients with redundant skin at the thoracic flank, use of this tissue has the added benefit of removal of an unsightly roll. The lateral thoracic skin and fat flap can be harvested using microsurgical technique based on three different pedicles: the thoracodorsal artery perforators; a direct cutaneous branch of the thoracodorsal, axillary, or lateral thoracic arteries; and the lateral thoracic intercostal perforating vessel.

Methods: The authors describe the techniques for harvest of lateral thoracic tissue based on each of the pedicle options. A case is then presented to illustrate each option, and an algorithm is suggested for deciding which pedicle to use.

Results: The authors have used lateral thoracic tissue for partial breast reconstruction for a variety of defects. In this report, the authors review the results of three illustrative cases.

Conclusions: Partial breast reconstruction may be required for patients after breast-conserving therapy or after breast reconstruction by other methods. Lateral thoracic tissue can be safely transferred to correct defects in treated or reconstructed breast, or to obtain symmetry. Knowledge of the vascular anatomy to this region is helpful in understanding the pedicle options when harvesting this tissue. The authors present an algorithm for determining which pedicle is most appropriate for the transfer of lateral thoracic tissue for partial breast reconstruction. (*Plast. Reconstr. Surg.* 116: 762, 2005.)

Breast reconstruction with the use of adjacent tissues from the axillary and lateral thoracic region is advocated in this article as an option for the surgeon, especially in patients who have excess and redundant tissues at this site. The ease of harvest and versatility of the flaps described makes them attractive.

The use of lateral thoracic skin and subcutaneous tissue for breast reconstruction has advantages for several reasons. Proximity to the breast makes it an excellent choice for a local flap. It is similar in color and texture to the breast, and the donor-site scar is well hidden under the arm. A large volume of skin and subcutaneous fat can be harvested without violating any muscle. Also, in some patients, removing this axillary tissue, which may be an unsightly, redundant roll, has an added cosmetic benefit. Lateral thoracic soft tissue can be used for breast reconstruction with or without an implant, or for autologous breast augmentation by deepithelializing the flap and placing it behind the breast.

A lateral thoracodorsal fasciocutaneous flap has been described for immediate breast reconstruction.[1] This tissue can also be har-

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vested based on several different pedicles: musculocutaneous perforating vessels through the latissimus dorsi; direct cutaneous branches of the thoracodorsal, axillary, or lateral thoracic vessels; and intercostal musculocutaneous perforators. These options are outlined below, along with a case that illustrates each. We propose an algorithm for deciding which vascular pedicle should be used in a given situation.

Thoracodorsal Artery Perforator Flap

Since its description in 1906[2] and reintroduction in the 1970s, the latissimus dorsi myocutaneous flap has been a mainstay for breast reconstruction.[3] An adipocutaneous flap based on the thoracodorsal perforating vessels was described in 1995[4] and has been used for breast reconstruction.[5] The thoracodorsal artery perforator flap can be used in place of the latissimus dorsi myocutaneous flap and has the distinct advantage of complete muscle sparing.

The thoracodorsal branch of the subscapular artery, after giving off a branch to the serratus anterior, travels along the lateral undersurface of the latissimus dorsi muscle. It bifurcates into a horizontal (medial) and vertical (lateral) branch.[6] Both branches give off an approximately equal number of cutaneous perforators.[7] A large skin paddle can be designed over any of these perforators, provided that the selected vessels are of adequate diameter. There is a great deal of flexibility with respect to the orientation of the skin paddle.[4]

Case 1

A 42-year-old woman presented who had undergone a lumpectomy, axillary dissection, and radiation therapy of the right breast for breast cancer 7 years previously. Two years later, she had a recurrence in the right breast for which she underwent a right completion mastectomy and a left prophylactic mastectomy. She underwent reconstruction with bilateral expanders, which were ultimately replaced with implants. She had several complications on the right (irradiated) side resulting in explantation. She was referred for bilateral breast reconstruction with autologous tissue and underwent bilateral superficial inferior epigastric artery free flap reconstruction. She developed fat necrosis in the right breast flap, which a plastic surgeon in her hometown treated with excision of the firm area and placement of a saline implant. She subsequently developed complications with the implant and required three more operations and ultimate explantation. At this time, the patient returned to us for an autologous augmentation/reconstruction of her smaller reconstructed right breast (Fig. 1).

The lateral thoracic tissue was marked lateral to the breast with the 7-cm base of the flap at the anterior axillary line as described by Holmstrom and Lossing.[8] Thoracodorsal perforating vessels are identified with a handheld Doppler probe. The triangular design follows the curve of the ribs laterally. An intercostal perforating vessel was also identified at the base of the flap.

FIG. 1. Patient after bilateral superficial inferior epigastric artery reconstruction and subsequent problems leading to asymmetry.

The patient was placed in the supine position with a bolster under the right lateral back. The arm was abducted at 90 degrees. Flap dissection was begun lateral to the anterior axillary line in a subfascial plane. Thoracodorsal perforators were identified under loupe magnification and preserved (Fig. 2, *above*). The two thoracodorsal perforators were dissected down through the fibers of the latissimus dorsi muscle to the thoracodorsal artery. The thoracodorsal artery was then freed from surrounding tissue and from the thoracodorsal nerve (Fig. 2, *center*). Dissection was continued to the base of the flap, at which point the capsule from the prior implant was encountered at the lateral edge of the pectoralis muscle. Significantly, because of scar tissue from prior operations, the intercostal perforator was not present. The flap was completely isolated on its thoracodorsal artery perforator pedicle and passed between the fibers of the latissimus dorsi muscle. The flap was then deepithelialized. A space was created between the reconstructed breast and the pectoralis fascia, and the flap was turned over, passed into this space, and anchored with a 2-0 Vicryl stitch (Ethicon, Inc., Somerville, N.J.) (Fig. 2, *below*). A drain was placed and the defect was closed primarily (Fig. 3).

Lateral Thoracic Flap (Axillary Flap)

Axillary and lateral thoracic tissue can derive its blood supply in part from one or more direct cutaneous branches from the lateral thoracic artery, the axillary artery (accessory lateral thoracic artery), or the thoracodorsal artery[5] (or rarely from the subscapular artery).[9] Any of these vessels, when present, are excellent candidates for the basis of skin transfer for reconstruction, and their use as pedicles for free transfer of axillary tissue has been described.[10–12] There are varying reports as to the consistency of these vessels. In a study of 100 cadaveric dissections of the subscapular-thoracodorsal artery system, Roswell et al. found a direct cutaneous branch from the thoracodorsal artery in 47 percent of

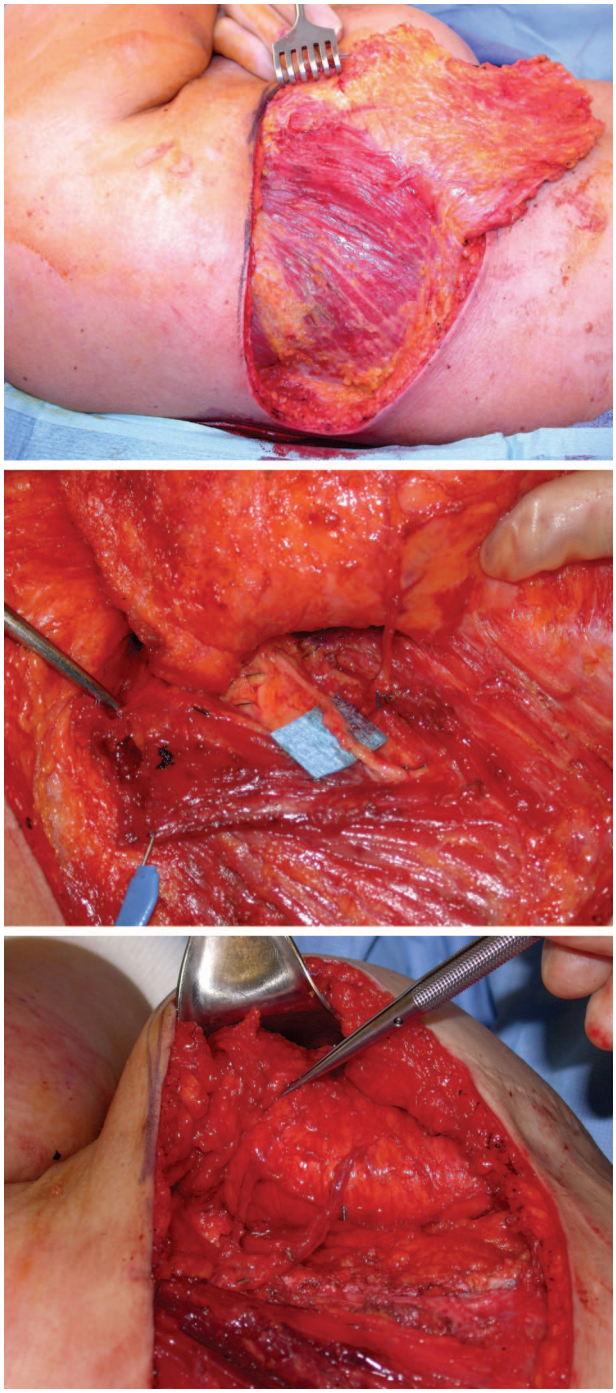

FIG. 2. (*Above*) Two thoracodorsal artery perforators were identified and preserved. (*Center*) The thoracodorsal artery perforator is dissected through the muscle, and the thoracodorsal nerve is preserved. (*Below*) The flap is turned over and secured behind the breast flap. The perforating vessels are seen passing into the flap.

subjects and from the subscapular artery in 7 percent.[9] Allen, et al. repeated this study on 20 cadavers in 2003 and found a direct cutaneous branch from the thoracodorsal artery in 55 percent of cadavers.[9]

FIG. 3. The defect is closed primarily and the drain is placed.

As with the thoracodorsal artery perforator, the skin and subcutaneous fat for transfer are isolated on the cutaneous vessels. The pedicle is then freed from surrounding tissue and transferred into position as described below.

Case 2

A 48-year-old woman who had undergone a lumpectomy, axillary dissection, radiation, and chemotherapy of the right breast for cancer presented with a deformity of the inferior pole of the right breast (Fig. 4). The skin paddle was designed similar to that in case 1. The width of the base was 7 cm and the length was 16 cm, extending over the latissimus dorsi muscle. Dissection was started laterally at the apex of the flap and continued in a subfascial plane toward the anterior axillary line. As the dissection proceeded anteriorly, no adequate thoracodorsal perforators were identified. Just anterior to the edge of the latissimus dorsi muscle, a direct cutaneous branch off of the thoracodorsal artery was identified and preserved. This pedicle was deemed adequate to perfuse the entire flap. The flap was completely elevated off of the underlying muscle (Fig. 5, *above*). An island flap was created by transecting the medial skin bridge. A subglandular dissection

FIG. 4. A 48-year-old patient after lumpectomy and radiation therapy.

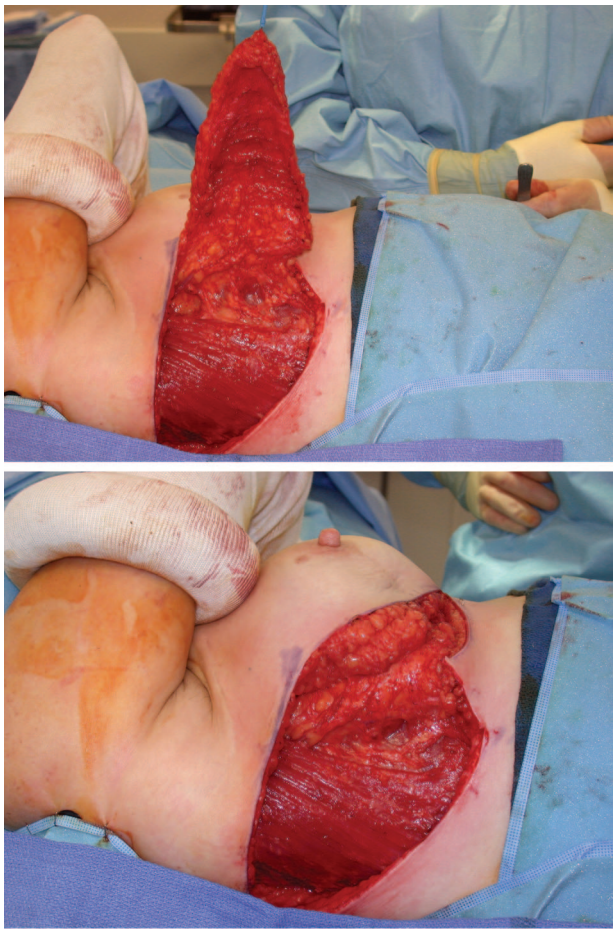

FIG. 5. (*Above*) The flap is elevated off the latissimus dorsi muscle. (*Below*) The flap is used to reconstruct the lower pole.

and scar contracture release was then performed to create a pocket for the flap. The flap was then deepithelialized and flipped over. The flap was then placed in the retromammary space to reconstruct the inferior pole and augment the breast (Fig. 5, *below*). A mastopexy was performed on the contralateral breast for symmetry. The patient did well postoperatively, with no complications.

INTERCOSTAL PERFORATOR FLAP

Lateral thoracic skin and subcutaneous tissue has been used as a fasciocutaneous flap for axillary and breast reconstruction.[1,8,13] Basing the flap on an intercostal perforator that enters the flap's base at the anterior axillary line allows the surgeon to create a reliable flap of large dimensions that can dramatically aid in breast reconstruction. This tissue can be used as a rotation flap with or without an implant, or it too can be used as a turnover flap to augment the lower pole as described below.

Case 3

A 61-year-old patient was treated for breast cancer with bilateral mastectomy and tissue expander reconstruction 4 years previous to presenting to us. She had several implant exchanges for recurrent, severe, grade IV capsular contractures; pain; extreme firmness; and poor shape and symmetry. We performed a bilateral superficial inferior epigastric artery flap reconstruction. Postoperatively, the patient's right reconstructed breast was smaller than the left, and the patient requested better symmetry. The flap was designed similar to those in cases 1 and 2. The intercostal perforators were identified in the fifth interspace at the anterior axillary line with a Doppler probe (Fig. 6). The flap was lifted from lateral to medial off of the underlying latissimus. Dissection proceeded posterior to anterior until the intercostal perforators were identified (Fig. 7). The skin at the base of the flap was then transected, and the flap was deepithelialized and the retromammary space developed. The flap was then turned over, placed into the pocket, and sutured in place.

DISCUSSION

Various breast abnormalities can result in partial breast defects. Women who are diagnosed with early-stage breast cancer are increasingly being treated with breast-conservation therapy. Breast-conservation therapy involves lumpectomy and sentinel node biopsy with or without axillary node dissection, and radiation therapy. This has resulted in a variety of breast deformities that ultimately require further treatment. In fact, 20 to 30 percent of patients who have breast-conservation therapy have a poor or mediocre cosmetic result, with deformity and asymmetry as a result of lumpectomy and radiation fibrosis.[14,15] The indications for breast-conservation therapy are expanding to include more advanced disease,[16,17] and as many as 71 percent of patients treated for cosmetic sequelae after breast-conservation therapy will ultimately seek partial breast reconstruction.[18] In addition, with the increasing popularity of breast augmentation and with the young age at which many breast augmentations are performed, plastic surgeons are see-

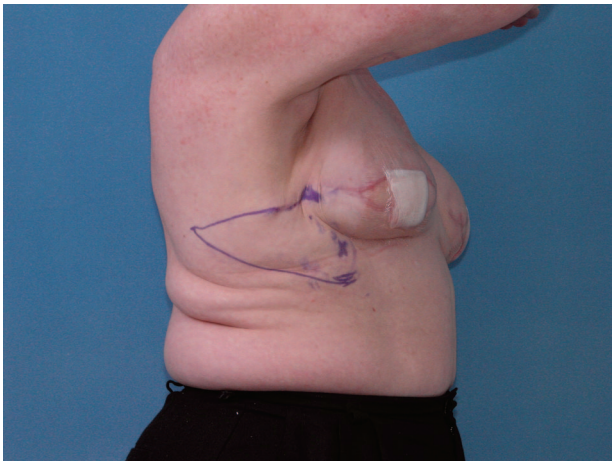

FIG. 6. Intercostal perforators were identified at the base of the flap at the anterior axillary line (*X*).

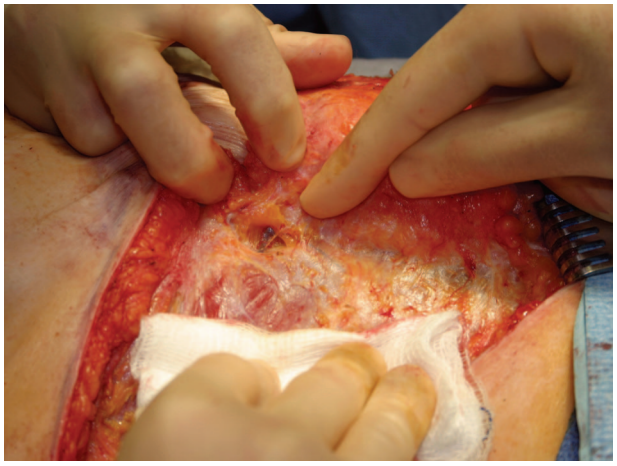

FIG. 7. Intercostal perforators at the base of the flap.

ing an increasing number of patients with what Van Landuyt et al. have called the "augmentation cripple," the patient who has failed cosmetic augmentation with repeated infections, hematomas, or sever capsular contractures.[19] Many of these patients are looking for an autologous solution to their breast deformity.

Most partial breast defects require a moderate amount of volume for reconstruction, and many do not require skin. These defects have traditionally been handled with a latissimus dorsi myocutaneous flap. We have found that the lateral thoracic skin and subcutaneous tissue is an ideal candidate for these defects. Taken from the natural redundancy of tissue at the lateral thorax, the scar is well hidden under the arm, and there is often an added cosmetic benefit to removing what sometimes is an unsightly roll. The scar is approximately 15 cm and concealed in the bra line. In addition, seromas seen with the latissimus myocutaneous flap is not noted to be a frequent problem. This flap can be used to recruit tissue with or without a skin island for augmentation or reconstruction.

ALGORITHM

The three cases presented in this report illustrate the variety of options that are available for reconstruction with tissue in the axillary and lateral thoracic region. The vascular anatomy of this area has been studied extensively. An algorithm for choosing a vascular pedicle can be described based on knowledge of this anatomy and preoperative Doppler planning. The triangular flap is designed with its base at the anterior axillary line. The base of the flap is marked with a 6- to 8-cm vertical height, centered directly over an interspace. If the tissue is needed for reconstructing the inferior pole, and if the use of a skin paddle is anticipated, the fifth interspace is chosen. If the tissue is needed for augmentation and thus flap deepithelialization is planned, the flap is centered over the fourth interspace. The superior and inferior incisions of the triangular flap are marked on the lateral thorax. The flap curves slightly upward overlying the contour of the ribs, coming to a point over the latissimus dorsi. The length of the flap is usually 15 cm. A hand-held Doppler probe is used to locate the thoracodorsal perforating vessels at the lateral edge of the latissimus dorsi and the intercostal perforator at the base of the flap.

Pedicle Option I

Starting the dissection lateral to the anterior axillary line, the skin and subcutaneous fat is incised down to the lateral latissimus dorsi. The dissection continues medially in a subfascial plane. Under loupe magnification, the thoracodorsal perforators are identified near the lateral edge of the latissimus dorsi. If they are adequate for flap perfusion, they are preserved and dissected down through the muscle fibers to the thoracodorsal artery. The thoracodorsal nerve is preserved and the flap is then passed through the opening on the muscle. The thoracodorsal vessels are freed proximally as needed to mobilize the flap into position.

Pedicle Option II

If the thoracodorsal perforating vessels are deemed to be inadequate for any reason, the dissection is continued anteriorly. The next option for flap perfusion would be direct cutaneous branches of the axillary, thoracodorsal, or lateral thoracic vessels. If direct cutaneous vessels are available, this option is advantageous in that dissection does not involve the latissimus dorsi. This pedicle can also be freed by dissecting the cutaneous branch to its parent vessel. This allows good mobilization of the flap.

Pedicle Option III

If neither of the first two options seems adequate, the intercostal perforating vessels provide an excellent option. They are very consistent and reliable, and very capable of carrying the flap. In patients who have had extensive surgery in this area, however, these vessels are sometime not available. Based on the intercostal perforators, this flap can be rotated 90 de-

grees as described by Holmstrom and Lossing[13] or deepithelialized and turned over.

CONCLUSIONS

All of these options make the lateral thoracic area a versatile donor site with a myriad of possibilities for flap perfusion. The use of this tissue has advantages, including complete muscle preservation, a well-hidden scar, and removal of redundant lateral thoracic tissue. Knowledge of the vascular anatomy and preoperative Doppler planning provide the surgeon with several perfusion options, making this a safe and reliable procedure. It can also be performed in approximately 1 hour. An algorithm for the use of lateral thoracic tissue is presented. Lateral thoracic tissue should be considered as a donor site for a variety of breast reconstruction defects.

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