Chest Wall Reconstruction and Advanced Disease

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ABSTRACT

Clinical experience supports a role for palliative procedures in patients with locally advanced or recurrent breast cancer, yet numerous challenges are entailed in both the extirpation and reconstruction of the chest wall in these cases. The defects may be profound and complicated by prior surgery, radiation therapy, or patient-related variables. The reconstructive techniques employed must neither encumber nor delay any necessary postoperative therapy and must not result in unacceptable morbidity or compromise quality of life. Our surgical approach to these cases incorporates a team of specialists from a broad spectrum of medical and surgical disciplines. Each operative plan is tailored to the specific needs and requirements of the individual patient.

KEYWORDS: Chest wall reconstruction, advanced breast cancer

The success of chemotherapy in the control of distant metastasis has resulted in an increasing number of patients with locally advanced breast cancer, previously deemed “inoperable,” to be referred for chest wall reconstruction after surgical extirpation for local tumor control.

PREOPERATIVE CONSIDERATIONS

Indications

In many cases of locally advanced breast cancer, radical ablation may be mandated because of extensive skin involvement, chest wall fixation, or both. In such instances, reconstructive surgical procedures are often necessary to cover exposed vital structures and to ensure timely wound closure to avoid a delay of adjuvant therapy. Reconstruction may also enhance the quality of life of patients with advanced breast cancer by providing palliation of hygiene problems posed by bulky, necrotic tumors.

Radiation Therapy

Radiation therapy, whether administered preoperatively or postoperatively, complicates reconstruction of the chest wall and may lead to some of the most staggering chest wall defects faced by the reconstructive surgeon. The mechanism of radiation injury was initially thought to be a vaso-occlusive process. More recently, it has been postulated that these effects result from a chromosomal alteration of fibroblasts, a position supported by studies demonstrating an irreversible inhibition of replication and dysfunction in collagen formation and breakdown in fibroblasts after radiation.¹⁻³ The overt radiation injury to the skin, as well as the increased incidence of delayed wound healing and breakdown after irradiation, is well documented.⁴ In our own institution, a recent investigation demonstrated that over 50% of patients who had mastectomy for inoperable breast cancer after radiation therapy had a wound complication (infection, dehiscence, or necrosis). In 30% of these cases, the complications were so severe that the patients required flap coverage for salvage.⁵

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Complications are markedly increased when reconstructions are performed in previously irradiated tissues.⁶⁻⁸ Prior irradiation results in a hostile recipient bed and increases wound healing complications.⁸ Furthermore, the viability of radiated tissue is often difficult to predict intraoperatively. Excision of as much of the radiated tissue as possible is necessary to minimize subsequent wound breakdown, and this greatly increases both the defect size and the reconstructive challenge.⁶ Donor tissues should also be well out of the irradiated field because total necrosis has been reported when irradiated muscle flaps are harvested.^{9,10} Microsurgical reconstruction is often necessary in cases in which radiation is involved. Unfortunately, radiation may compromise not only the wound bed but also the quality of the

recipient vessels available for microsurgical anastomosis, hence increasing the rate and incidence of complications in this setting.⁸

Although performing reconstruction prior to radiation therapy is technically easier, the subsequent impact of radiation on the transferred tissues must be factored in to the operative strategy. Radiation therapy after breast reconstruction has a complication rate of 30 to 87%.^{8,11} Irradiation of flaps may cause contracture and fibrosis, fat necrosis, loss of skin grafts, or even partial flap loss (Fig. 1). Although some of these effects may be anticipated based on the specific radiation dosage, ports, and boosts (e.g., supraclavicular, tumor bed) used, each patient appears to have an idiosyncratic response to radiation that is therefore often unpredictable,

Figure 1 Radiation damage to a free transverse rectus abdominis myocutaneous (TRAM) flap for breast reconstruction. A 54-year-old woman underwent bilateral mastectomies with immediate reconstruction utilizing free (TRAM) flaps. Unexpectedly, the patient's final pathology demonstrated significant axillary lymph node involvement, necessitating a course of postoperative radiation to the left breast reconstruction. The patient is seen (A) preoperatively and (B) 2 months postoperatively after her free TRAM. (C) The progressive effect of radiation on the reconstructed left breast TRAM flap can be noted a year following the completion of the radiation therapy. The patient subsequently required reduction of the right (nonirradiated) reconstruction to achieve symmetry.

and a revisionary or additional reconstructive procedure may be necessary in this setting.^{7,8,11} Substances called “radioprotectors,” which may reduce some radiation effects, are currently under investigation. One such substance, amifostine, is an oxygen free radical scavenger. Although amifostine has shown some promise in decreasing radiation effects, it has some significant side effects, such as hypotension.¹² The definitive treatment for severe radiation injury remains the excision and surgical replacement of affected tissues with well-vascularized tissue harvested from a remote site. In these cases, we favor regional or free flaps to ensure stable coverage and do not rely on local tissues.

Multidisciplinary Approach

At our institution, we employ a multidisciplinary approach to the management of advanced breast cancer requiring chest wall reconstruction. The complex nature of these cases requires open communication between the ablative and reconstructive teams to meet the oncologic goals and preserve reconstructive options critical to successful closure of the defect. The treatment plan must include a realistic appraisal of the anticipated size, location, and composition of the defect and the patient's prognosis. Additionally, the reconstructive surgeons must communicate the anticipated operative strategy to the resecting surgeons, including any limitations of flap availability (e.g., owing to prior surgery), preferred flaps, and recipient vessels, to preserve as many options as possible.

SOFT TISSUE RECONSTRUCTION

Several surgical options are available for chest wall reconstruction. The most appropriate operative strategy in any given case may be dictated by several factors. Conditions that most strongly impact the reconstructive approach include the size and composition of the defect and the adequacy of donor and recipient tissues, which may have been compromised by prior surgery or radiation therapy. The patient's prognosis, desires, and ability to withstand the rigors of a lengthy combined reconstructive procedure must also be considered in the decision-making process.

Skin Graft

If the chest wall defect is limited to the skin and subcutaneous tissues, a skin graft may be an appropriate reconstructive option. This maneuver is not as straightforward as one might assume. It must be remembered that a skin graft on the chest wall will result in a certain degree of contracture and provide a far less aesthetic and durable form of coverage than a vascularized flap. In

addition, graft take may be compromised in an irradiated bed (Fig. 2). The vacuum-assisted closure device (V.A.C.TM, Kenetic Concepts Inc., San Antonio, TX), which may enhance wound healing by several mechanisms such as decrease in edema and enhancement of angiogenesis (see later section in this article Negative-Pressure Therapy for further discussion), can also be used to improve the fixation and thus the adherence of skin grafts in compromised tissues, expediting wound closure.^{13,14} Skin grafts may also be used as an adjunct for coverage of very large defects. Grafts may be placed over muscle flaps (such as pectoralis or latissimus dorsi flaps) or used with an omental flap to resurface the chest wall.^{9,6,10,15}

FLAPS

Local Flaps for Chest Wall Reconstruction

Local flaps, whether random or axial, may be useful alone for coverage of smaller chest wall defects or in combination with regional or distant flaps for larger defects. The use of local flaps is predicated on the health of the available surrounding tissues and is precluded by any potential compromise from prior surgery, radiation, or tobacco use.

Skin flaps have demonstrated some utility in chest wall reconstruction. The thoracoepigastric (or transverse abdominal) flap is the most useful of these and is an axial pattern flap that may be based either anteriorly or posteriorly on perforating vessels from the intercostals. Although this flap was originally described for chest wall coverage, it was versatile enough to become a mainstay of breast reconstruction until eclipsed by the introduction of the far more reliable myocutaneous flaps in the 1970s. The utility of this flap in chest wall reconstruction is limited by its size, vascularity, and often unaesthetic donor site scar.^{16,17}

Variations of breast flaps have been described for anterior chest wall coverage. Although these may be reliable alternatives, they are not often employed due to oncological issues as well as the somewhat startling resultant postoperative appearance.^{18–20} The cyclops flap, for example, is fashioned from the remaining (usually large and pedulous) contralateral breast and is so named as the nipple comes to lie over the midline of the chest. The flap is advanced into the adjacent defect, based on the lateral thoracic artery and intercostal perforating vessels.¹⁹

Local fasciocutaneous flaps, such as the scapular and/or parascapular flaps, which are based on the circumflex scapular vessels, may also be used for chest wall reconstruction.²¹ In general, these relatively small fasciocutaneous flaps are rarely used in chest wall reconstruction after breast cancer, except perhaps in combination with other flaps for very large defects.

Figure 2 The V.A.C.™ for wound closure. (A) The V.A.C.™ utilizing negative pressure to remove tissue fluid and edema and enhance wound healing. (B) A compressible porous foam sponge placed on the wound is sealed with an occlusive dressing and subjected to a prescribed level of suction (continuous or intermittent). (C) A 61-year-old morbidly obese woman with diabetes mellitus, hidradenitis suppurativa, chronic obstructive pulmonary disease (COPD), and severe coronary artery disease (CAD) presented with an infected painful breast due to recurrent breast cancer. The patient had initially been treated with conservation therapy, which was then followed with an additional 75 Gy of radiation for tumor control after her recurrence. (D) Palliative resection was performed but the patient's CAD precluded use of general anesthesia. (E) She achieved definitive wound closure with serial debridement, V.A.C.™ dressing changes, allograft and split-thickness skin graft secured with the V.A.C.™ all done under local anesthesia. (F) Patient is seen 4 months postoperatively with a healed wound.

Regional Flaps for Chest Wall Reconstruction

LATISSIMUS DORSI FLAP

The latissimus dorsi flap has been a mainstay of chest wall reconstruction since it was utilized for this purpose in 1897 by the Italian surgeon Tansini.²² The dominant thoracodorsal vessel system most commonly provides the vascular basis of a pedicled latissimus dorsi flap used to reconstruct the chest wall or breast. Maneuvers to increase the arc of flap rotation such as release of the humeral insertion and/or transection of the vascular branches to the serratus muscle permit the flap to potentially reach across the midline of the chest. The flap can be harvested as a muscle flap, a myocutaneous flap, or even a split muscle or perforator flap.^{23–25} The muscular portion of the flap is usually quite wide; however, the size of the skin paddle of a latissimus dorsi

myocutaneous flap is dictated by the ability to achieve primary closure of the donor site defect after flap harvest.²⁶ Primary closure of the donor site is considered imperative because an open back wound is highly problematic, and skin grafts in this area generally do not fare well. Therefore, although almost 20 cm of length may be harvested with a latissimus dorsi flap, the width of the associated skin paddle is usually limited to 8 to 10 cm.

The latissimus dorsi flap has been one of the most commonly used flaps for chest wall reconstruction for advanced breast cancer (Fig. 3).^{6,9,10,15} The advantages of the latissimus dorsi flap for chest wall reconstruction include its straightforward harvest and reliability. The proximity of the flap to the chest is conducive to transfer as a pedicled flap, although the large-caliber, long vascular pedicle will permit microsurgical transfer if necessary. The disadvantages of the flap are relatively minor.

Figure 3 Latissimus dorsi pedicled flap for chest wall reconstruction. (A) A 52-year-old woman presented with inflammatory breast cancer and underwent neoadjuvant chemotherapy and radiation therapy. (B) A radical mastectomy for local control was followed by immediate chest wall coverage with a pedicled latissimus dorsi myocutaneous flap, placing the skin paddle transversely on the back, thus limiting the donor scar to within the patient's brassiere line. (C) The patient had an uneventful postoperative course and is seen 10 months postoperatively.

These include the need to move the patient into the lateral decubitus position for flap harvest, the proclivity for prolonged serous drainage from the back donor site, and the possibility of functional shoulder morbidity.

The reported incidence of seroma formation with the latissimus dorsi flap is estimated at 9 to 80% and appears to average 40 to 50%.^{27,28} Although usually self-limited, seroma formation can be problematic. Attempts to decrease seroma formation, such as plication of the donor site skin to the underlying thoracodorsal fascia or the instillation of adherent substances (such as fibrin glue), are still under investigation and have met with mixed success.^{29,30}

Traditionally, there was thought to be little functional morbidity after harvest of the latissimus dorsi muscle.^{31,32} However, recent analyses using dynamic testing suggest that there is a reduction in the strength of the affected extremity after latissimus dorsi flap transfer, and the deficit appears to be greater in women than in men, perhaps owing to differences in preoperative shoulder strength. This decrease has not been demonstrated to preclude normal activities but must be considered in patients who are heavily reliant on their shoulder girdle strength, such as individuals who are crutch- or walker-dependent.³³

The latissimus dorsi flap's vascularity is generally robust. The latissimus dorsi flap may survive on collateral flow between the thoracodorsal and serratus branches, even if the thoracodorsal vessels have been ligated.³⁴ Flap vascularity, however, may not be entirely reliable in such cases, especially in the face of radiation therapy. Although previous irradiation of the axilla is not a contraindication to latissimus dorsi flap transfer, when prior division of the thoracodorsal pedicle is associated with radiation, flap loss has been reported, presumably due to the unfavorable effect radiation is felt to have on the establishment of collateral circulation.³⁵

RECTUS ABDOMINIS FLAPS

Since the introduction of the rectus abdominis flaps in 1977, these flaps have been heavily used in reconstructive surgery owing to their ease of elevation, their reliability, and the large amount of tissue that may be harvested and still permit primary closure of the donor site.²⁶⁻³⁶ Rectus abdominis myocutaneous flaps are supplied primarily by the deep inferior and superior epigastric arteries, which communicate at the periumbilical watershed area, permitting a variety of potential flap configurations.³⁶

The vertically oriented rectus abdominis myocutaneous (VRAM) flap is simple, quick to harvest, and robust because the skin paddle is positioned directly over the muscle, where it is richly supplied by perforating vessels.³⁷ The drawbacks of the VRAM flap include a suboptimal donor site scar and a smaller available skin paddle than with the transverse rectus abdominis myocutaneous (TRAM) flap.

The superiorly based single-pedicled TRAM flap is most commonly used for autologous tissue postmastectomy breast reconstruction owing to the amount of tissue that may be harvested with a relatively aesthetic donor site scar. The TRAM flap, however, is generally a less well-vascularized flap than the VRAM flap because a large part of the skin paddle does not lie over the muscle and is dependent on the integrity of communicating perforating vessels (Fig. 4).³⁸ In patients who smoke, are diabetic, or have multiple abdominal scars, circulation is frequently inadequate and may severely limit the size and viability of the TRAM flap.

The ability to use a pedicled rectus abdominis flap may be compromised by resection of the internal mammary vessels (the dominant pedicle) during tumor extirpation. Although superiorly based rectus abdominis flaps have been successfully based solely on the costal marginal (eighth intercostal) vessels, this is a less well-vascularized configuration.³⁹ Alternatives to the single-pedicled TRAM flap, such as the double-pedicled, free, "supercharged," and "turbocharged" TRAM flaps, have been used as a means to enhance flap vascularity. The dual blood supply of the bipedicled TRAM flap permits reliable harvest of a large flap. However, the inclusion of both muscles in the flap results in a much bulkier pedicle, which may limit the arc of rotation. More importantly, the decreased abdominal strength and reported increased risk of hernia and bulge that result from the complete loss of both rectus abdominis muscles are significant disadvantages of a bipedicled TRAM flap.^{40,41}

The free TRAM flap provides a robust vascular supply and affords great versatility in flap positioning (Fig. 5).⁴² Usually, a variety of vessels are exposed during a chest wall extirpation, including the proximal internal mammary vessels, thoracoacromial trunk, and thoracodorsal vessels, which are easily accessible for microvascular anastomoses. In our experience, patients with a free TRAM flap tend to have less postoperative pain and a lower incidence of abdominal hernia or bulge and recover from their surgery more quickly than those receiving pedicled (especially bipedicled) TRAM flaps. Disadvantages of free flap transfer are the need for microsurgical expertise and also a potential for complete flap loss.

Microsurgically enhanced rectus abdominis flaps, also referred to as "supercharged" or "turbocharged" TRAM flaps, are less versatile with respect to the freedom of flap positioning but are viewed by many as providing the assurances of a pedicled flap and the enhanced vascularity of a free flap. The inferior epigastric vessels may be used to augment the vascular supply of a pedicled flap by microvascular anastomoses of either the venous ("supercharged") or arterial and venous ("turbocharged") systems of the flap. This tactic may be helpful to salvage a compromised or congested pedicled

Figure 4 Pedicled TRAM flap for chest wall coverage. (A) A 48-year-old woman with osteoradionecrosis of the sternum and recurrent breast cancer. A superiorly based pedicled TRAM flap based on the right superior epigastric vessels is planned, with the vascular zones of the TRAM illustrated. (B) The size of the defect necessitated skin grafting a portion of the rectus muscle at the inferior wound edge. Note the relatively smaller volume of abdominal TRAM flap tissue that may be transferred by pedicled in comparison to microvascular techniques (see Figs. 5 and 6). (Case courtesy of Dr. Robert Walton.) (From Bland KI, Copeland EM, eds. *The Breast: Comprehensive Management of Benign and Malignant Disorders*, 3rd ed. Harcourt Medical; 2003. Reprinted with permission of © Harcourt Medical.)

flap. Harvesting a portion of the deep inferior or superficial inferior epigastric vessels during pedicled TRAM flap harvest can allow for such a contingency.

Although several variations of the rectus abdominis myocutaneous flaps may be employed for chest wall reconstruction, we have found certain guidelines in their application to be helpful. We rarely rely on the distal portion of zone III or IV in a pedicled TRAM flap and use a free flap if a large volume of tissue is required. Limitations to the use of the rectus abdominis myocutaneous flaps are partly related to donor site concerns.^{40,41,43} Concerns for abdominal wall integrity have prompted the increased use of perforator flaps for breast reconstruction and other forms of reconstruction in many institutions, including our own.^{44,45} Unfortunately, perforator flaps tend to be less well vascularized and more prone to fat necrosis than comparable myocutaneous flaps. We do not often use perforator flaps in the reconstruction of full-thickness chest wall defects owing to the profound implications of flap loss in this setting.

PECTORALIS MAJOR FLAPS

The pectoralis major flap may be employed either as a rotational flap based on its dominant thoracoacromial

pedicle or as a “turnover” flap based on the medial vessels, which perforate the substance of the muscle along its sternal border. A generous muscle flap may be harvested, and a skin paddle may also be incorporated with the flap. This flap has been extensively used for sternal and chest wall reconstruction in a broad spectrum of pathologic conditions.^{14,46} The pectoralis major flap is particularly well suited to defects of the anterior and superior central chest. In the setting of reconstruction for advanced breast cancer, however, we have found this flap to be applicable primarily for smaller defects because the ipsilateral pectoralis muscle is usually involved by the tumor and is resected.

EXTERNAL OBLIQUE FLAPS

Although initially described as a myofascial flap for abdominal reconstruction, the external oblique flap subsequently has been more commonly used as a myocutaneous flap for repair of the chest wall.⁴⁷ The external oblique flap territory is large, extending from the midline of the abdomen to the anterior axillary line. The flap is elevated medially and rotated superiorly into the defect. The segmental blood supply to the muscle limits the useful arc of rotation of this flap, but several series have reported success using the external oblique flap for chest

Figure 5 Free TRAM flap for chest wall reconstruction. (A) A 50-year-old woman presented with locally advanced recurrent breast cancer. (B) An extensive chest wall defect resulted after wide resection of the tumor. (C) This defect was reconstructed with a large unilateral free TRAM flap. The postoperative result demonstrates the size of a TRAM that may be transferred on a single pedicle and the flexibility of flap positioning with microsurgical transfer. (D) In this case harvest of the large TRAM flap required a skin graft to close the donor site.

wall reconstruction, including an extended modification to increase the flap reach. Unfortunately, the extensive dissection necessary to facilitate rotation may compromise the segmental vascular pedicles and hence flap

reliability.^{48,49} Hernia formation after flap harvest is also a concern, and these considerations have limited the use of external oblique flaps for chest wall reconstruction at our institution.

OMENTAL FLAPS

The highly vascularized greater omentum has been a cornerstone of chest wall reconstruction for almost 30 years. Omental flaps have been used primarily as pedicled flaps covered with a skin graft to treat radiation injury to the chest wall.¹⁵ Although either the right (dominant) or left gastroepiploic artery may be used to supply the omental flap, use of the right gastroepiploic artery affords a 5- to 10-cm greater arc of rotation. The omentum is easy to harvest, well vascularized, and usually provides a large flap. There are limitations to the use of this flap. Flap harvest necessitates a laparotomy, which might lead to intra-abdominal morbidity. It is also difficult to accurately predict flap size preoperatively because the volume of greater omentum has no direct correlation with the patient's morphologic characteristics. Additionally, the delicate nature of the omentum may result in difficulties with flap fixation to the chest wall and retraction from defect edges, as well as instability of the overlying skin graft.

Role of Microsurgery in Chest Wall Reconstruction

The majority of chest wall reconstructions, even large full-thickness defects, may be successfully seen to completion solely with pedicled regional flaps.^{6,50,51} As described earlier there are some circumstances in which defect size and/or compromise of local or flap vasculature dictates the need for microsurgical augmentation ("super or turbocharged") or transfer of the flap. In rare instances selection of a remote tissue donor site, usually from the extremities such as the free anterolateral thigh or tensor fascia lata flap, may be warranted due to the large size and minimal donor morbidity of these sites. In extensive disease, the application of the "spare parts" approach may suggest the use of filet flaps for chest wall reconstruction in which forequarter amputation is indicated.^{51,52}

Negative Pressure Therapy: Flap Alternative Versus Adjunct

The application of negative pressure therapy, most often utilizing vacuum-assisted closure (V.A.C.TM) has been used successfully to treat a spectrum of wounds in through out the body.^{13,14} The V.A.C.TM utilizes sterile polyethylene foam with a pore size of 400 to 600 μ m placed adjacent the clean wound, covered with a bio-occlusive dressing; connected with sterile tubing the system delivers a controlled range of negative pressure via a closed system, collecting excess tissue fluid in a remote canister. This methodology is felt to enhance wound healing via removal of interstitial fluid, an increase in wound vascularity, a decrease in bacterial

colonization, and favorable responses of adjacent tissues to the biomechanical forces of negative pressure including an increase in neoangiogenesis and cellular proliferation.^{13,14,53}

Since its introduction into use in the 1990s the clinical indications and applications for the V.A.C.TM have been expanding prolifically due to its efficacy in problem areas. Not only can it provide a means to improve the adherence of skin grafts in compromised tissues, this technology has permitted closure of difficult wounds and complex wounds of the sternum, abdominal wall, and extremities that previously essentially defied treatment.^{13,14} The V.A.C.TM has progressed from a temporizing measure or salvage procedure between flaps to an effective bridge and even replacement for flap transfer in selective patients (Lee CK, personal communication, 2003).^{13,14,54} Although wound treatment utilizing this approach usually entails a longer time sequence to achieve closure than does a definitive flap coverage, we have found this technology may be a helpful alternative in patients, including those with advanced breast cancers, who are not considered candidates for a prolonged operative procedure (Fig. 2).

FULL-THICKNESS CHEST WALL DEFECTS AND PROSTHETIC MATERIALS

Reconstruction of the rib cage is not usually necessary after resection of one or two ribs if both flap coverage and ventilatory support are provided. If a greater amount of structural support is lost, it is usually advisable to stabilize the chest wall with prosthetic mesh (Marlex [C.R. Bard-Devol, Murray Hill, NJ] or Prolene [Ethicon, Inc., Cornelia, GA]). Mesh that is completely covered by viable tissue is usually well tolerated and will allow the patient to be weaned from the respirator and discharged from the hospital earlier than if prosthetic stabilization of the chest wall is not done.⁵⁵ Owing to the reliability of current prosthetic materials, cadaveric materials or ribs are rarely used in this setting.⁶ After resection of the sternum and/or loss of multiple ribs, rigid chest wall reconstruction with prosthetic materials such as methylmethacrylate (usually in addition to mesh) is controversial but is often favored by our thoracic surgery colleagues.⁵⁶⁻⁵⁸ Although devastating infectious consequences have been associated with the use of prosthetic materials, these complications do not often manifest, provided that the overlying flap is robust and that no preexisting infection is present.

Communication with the mediastinum or pleural cavity and exposure of any prosthetic materials used for chest wall stabilization can have profound and lethal consequences. Therefore, the reliability of autologous tissue coverage is even more critical for these larger full-thickness chest wall defects than for more superficial

defects. The latissimus dorsi myocutaneous flap is often a good choice in these cases. A rectus abdominis flap (either the vertical or transverse configuration) is another good option. These myocutaneous flaps are reliable, and their bulkiness may help to stabilize the chest wall and

compensate for the loss of ribs. To ensure stable flap coverage, free tissue transfers are often advisable when prosthetic materials are used. In many of these large defects, multiple flaps are required for closure (Fig. 6).

Figure 6 Combination of free TRAM and latissimus flaps for chest wall reconstruction. (A) A 47-year-old woman presented with neglected locally advanced breast cancer, which was responsive to neoadjuvant chemotherapy. Negative surgical margins were achieved with an en bloc tumor resection inclusive of the sternum and six ribs. The chest wall defect was reconstructed with Marlex mesh and methylmethacrylate (B) The sternal defect is seen at the right hand side of the photograph. (C) Bilateral free TRAM flaps and an ipsilateral latissimus dorsi myocutaneous flap were used to close the wound, with complete closure of all donor sites.

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Figure 6 (continued) (D, E) Patient had an uneventful recovery and is seen 9 months after completion of radiation therapy, with healed wounds. (From Bland KI, Copeland EM, eds. *The Breast: Comprehensive Management of Benign and Malignant Disorders*, 3rd ed. Harcourt Medical; 2003. Reprinted with permission of © Harcourt Medical.)

SUMMARY

If the chest wall defect is superficial and small, local flaps or a skin graft may be a reasonable choice for wound closure. However, chest wall defects resulting from extirpation of advanced breast cancer are generally sizable and best covered with well-vascularized axial flaps. Radiation therapy is frequently used in these patients, and it further complicates reconstruction by compromising both wound healing and reconstructive options. Well-vascularized tissue must be brought to these wounds to achieve coverage.

For chest wall reconstruction for advanced breast cancer, pedicled regional flaps are usually the most appropriate choice and will not hesitate to utilize microvascular techniques if there is any question of flap reach or vascularity. We most frequently use myocutaneous flaps (specifically the rectus abdominis and latissimus dorsi flaps). These flaps provide reliable, durable, high-quality skin coverage of defects that can reasonably tolerate postoperative radiation. The pedicled latissimus dorsi flap is often our choice for moderate ipsilateral defects; this flap may also be transferred microscopically. The rectus abdominis flaps provide an ample skin paddle and are of great utility for large defects. The decreased vascularity of zones III and IV in the pedicled TRAM skin paddle leads us to employ a free flap if a large flap is vital for wound coverage.

Full-thickness chest wall defects pose an additional challenge. If two or fewer ribs are resected, rigid chest wall reconstruction is usually not required. Prosthetic materials, primarily mesh, may be used in extensive defects with an acceptable complication rate, provided that they are covered with a well-vascularized flap. Although multiple flaps may be necessary in this setting, they are generally well tolerated by patients.

Although clinical experience supports a role for palliative procedures in patients with locally advanced or recurrent breast cancer, there are numerous challenges to extirpation and chest wall reconstruction in these cases.^{6,59} The defects may be profound and complicated

by prior surgery, radiation therapy, or patient-related variables. The reconstructive techniques employed must neither encumber nor delay any necessary postoperative therapy and must not result in unacceptable morbidity or compromise quality of life. Our surgical approach to these cases incorporates a team of specialists from a broad spectrum of medical and surgical disciplines. Each operative plan is tailored to the specific needs and requirements of the individual patient.

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