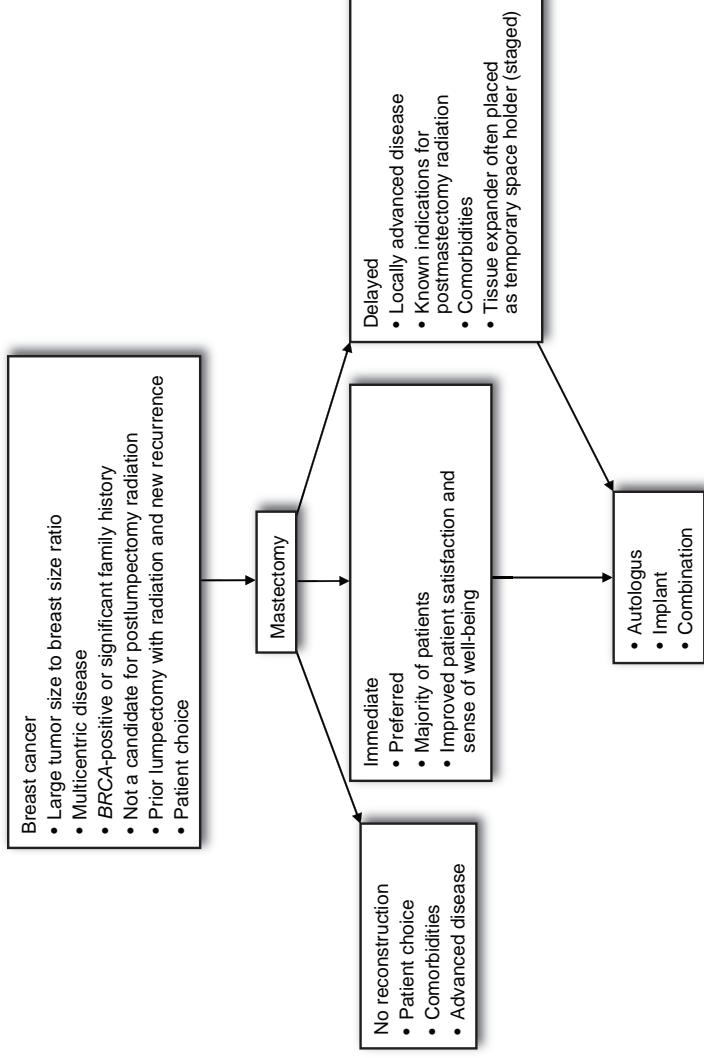


Algorithm for Breast Reconstruction



Breast Reconstruction

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What you need to know:

Breast reconstruction for women who have had a diagnosis of breast cancer is a covered expense by insurance companies thanks to the Women's Health and Cancer Rights Act (WHCRA) of 1998, which mandates coverage. This coverage includes alteration of the contralateral breast to ensure symmetry.

The majority of women needing or choosing mastectomy will be good candidates for some form of breast reconstruction. Women can choose to have reconstruction done immediately at the time of mastectomy or as a delayed procedure done some time after mastectomy.

Today there are a variety of methods for reconstructing the breast, including the use of implants (saline or silicone), or some form of tissue transfer—pedicled transverse rectus abdominus myocutaneous (TRAM) flap, free TRAM flap, deep inferior epigastric perforator (DIEP) flap, latissimus dorsi flap, or superior gluteal artery perforator (S-GAP) flap.

Reconstruction is usually a multistage process. The finale will be nipple reconstruction and areola tattooing.

Patients should be nicotine-free for at least 6 weeks prior to reconstructive surgery. This includes having completed transition from smoking to patch or gum to nothing at time of surgery. This is due to the risk of vasoconstriction that leads to tissue ischemia.

Diabetics are at higher risk for having small blood vessels and increased risk of poor wound healing. Coronary artery disease also affects blood flow and the success of reconstruction.

Women having DIEP flap reconstruction have less risk of hernia later in life than those having TRAM flap reconstruction. This is a key reason



that DIEP flap is preferred.^{1,2} In addition, there are no lifting restrictions for patients having DIEP flap once the postoperative healing is complete. Problems with bulge are also less frequent. However, the vessel used for the anastomosis is commonly the internal mammary (IM) artery, which is the same vessel that cardiac surgeons use for coronary revascularization in treating patients with coronary artery disease (CAD). Arterial conduits, such as IM artery–left internal mammary artery (LIMA) or radial artery grafts, have been shown to have a greater patency rate than saphenous vein grafts. Cardiac surgeons usually prefer these vessels, so in the event your patient needs coronary artery bypass grafting (CABG), the patient and her cardiac surgeon should review the operative report from her flap reconstruction to see which vessels were used. CAD may be more likely in women having radiation to the chest wall and, in particular, if their breast cancer was in the left breast.

A three-dimensional (3-D) computed tomography (CT) angiogram is sometimes done by the plastic surgeon in advance of the flap surgery to help identify the status of the vascular perforators in the abdominal muscle, and to preselect the area that appears to have the best vessels.

What your patient needs to know:

Women having mastectomy surgery have the right to receive reconstruction. Sometimes women do not discuss this issue with their surgeons because their attention is focused on survival and a faster recovery. Reconstruction should be discussed in depth with the patient, and all the various types of reconstruction reviewed to help her select the one that is best for her.

Women who opt to not have reconstruction done at time of mastectomy surgery, or for medical reasons cannot, have not burned their bridge by declining, however. Reconstruction can be done later—even years later.

Before 1998, breast reconstruction, even for someone with a diagnosis of breast cancer, was considered cosmetic surgery and was not covered by insurance. Since 1998, all forms of reconstruction have been covered, and are covered for the lifetime of the patient, including if she changes insurance companies, opts for a different type of reconstruction later (i.e., choosing to do implant first and then electing DIEP flap later), and/or has body size changes that result in asymmetry (i.e., weight gain that results in the natural breast being larger than the implant side).

Women should look at breast reconstruction as a short-term investment for a long-term gain.

Doing reconstruction at the time of mastectomy does not negatively affect proceeding with additional adjuvant therapy such as chemotherapy, and does not delay its start date.³



INTRODUCTION

The American College of Surgeons estimates that women's lifetime risk for breast cancer may be as high as 1 in 7. Approximately 75,000 women had breast reconstruction last year, which represents an approximately 150% increase from 1992. This increase in reconstruction is due partly to greater access to care, to more patient education, and to the passage of the WHCRA of 1998, which mandates insurance coverage for reconstruction and alteration of the contralateral breast for symmetry.

Most of our patients seek immediate breast reconstruction when they are contemplating a mastectomy. We feel privileged to provide this option to patients, and often it makes the decision to undergo a mastectomy more palatable when several good options for reconstruction are available. If their tumor biology and location are suitable, patients should also consider lumpectomy plus radiation as one of their choices, and pursue an informed discussion with their plastic surgeon and radiation oncologist (Figure 5.1). Women with a very strong family history of breast cancer (with or without *BRCA* mutation) may desire a bilateral mastectomy to reduce future risk and thus bilateral reconstruction.

Nonetheless, occasionally a woman will have too many medical comorbidities to undergo reconstruction, such that prolonged anesthesia or invasive surgery may prove a greater hazard than any potential benefit. A handful of women are advised to delay reconstruction until they have both physically and mentally recuperated from the mastectomy. Studies have shown that women who have "grieved the loss of a breast" are much more enthusiastic about their reconstruction when one is achieved, as compared to women who had immediate reconstruction. Several clinicians feel that a woman who goes to sleep with one breast and wakes up with a substitute breast after a

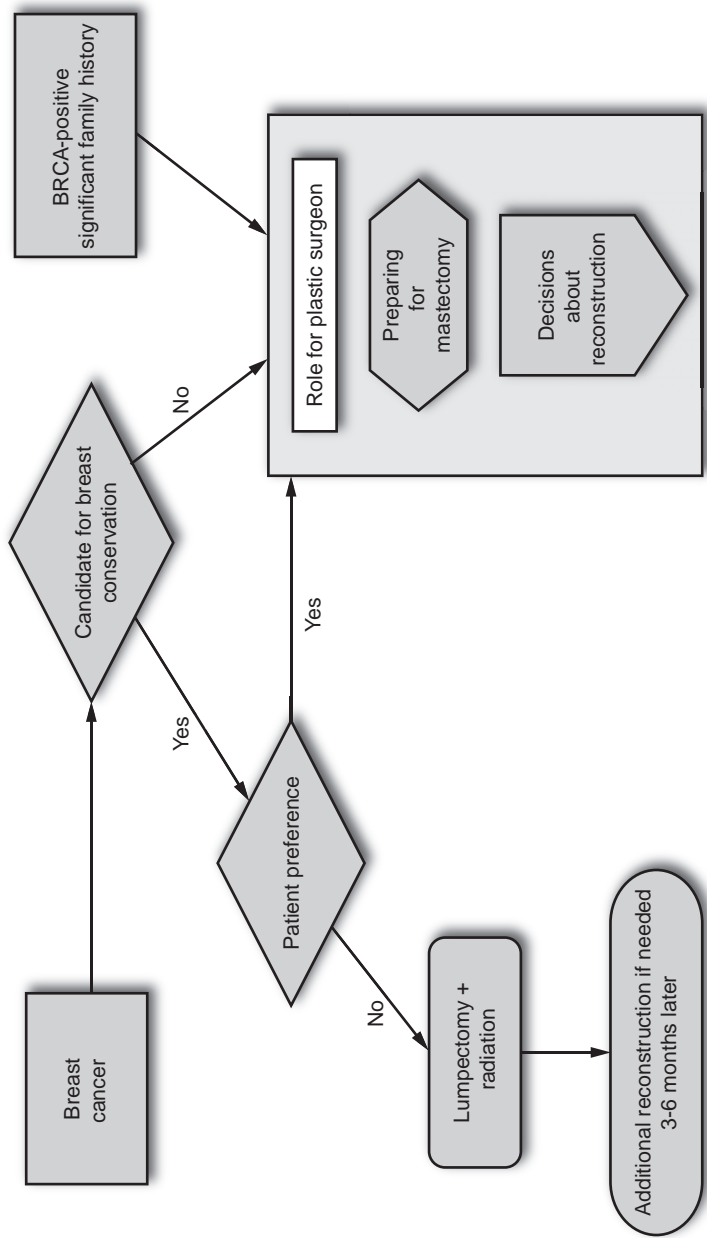


FIGURE 5.1 Deciding Between Lumpectomy Versus Mastectomy

combined oncologic–plastic procedure for immediate breast reconstruction will not be as accepting or as tolerant of the limitations.

Rarer still are the women who are good candidates, whose tumor is not advanced, but who nevertheless do not want to pursue breast reconstruction. Typically these are very active and athletic women who are trying to not let the cancer take away any more of their time than is absolutely necessary. In our 24/7 culture, physicians and nurses need to empower their patients to give themselves permission to heal and to take the time to pursue the best options available, not just the most expedient. I tell my patients, “Time is not of the essence. You are!”

Ultimately the role of the physician is that of a waiter: I tell patients what’s on the menu and advise them of the physical costs/risks associated with each item, and let them choose what they want to eat.⁴ An experienced surgeon, like a good waiter, can also tell the patient what the chef recommends—and allow his or her experience to benefit the novice.

Once she has decided on mastectomy, the patient can choose whether she wants immediate breast reconstruction or delayed breast reconstruction (Figure 5.2).

Reconstructive options are depicted in Figure 5.3.

The reconstructive options are as follows, in increasing order of complexity:

1. No reconstruction
2. Two-stage implant reconstruction
 - a. First stage—expander
 - b. Second stage—saline or silicone implant
3. Single-stage implant reconstruction
 - a. Using tissue replacement matrix
4. Pedicled transverse rectus abdominis musculocutaneous flap (TRAM)
5. Pedicled back tissue
 - a. Latissimus dorsi flap
 - b. Thoracodorsal artery perforator flap (TDAP)
6. Microsurgical free flaps
 - a. Free TRAM
 - b. Free TUTG (transverse upper thigh Gracilis)
 - c. Free DIEP (deep inferior epigastric artery perforator)
 - d. Free SGAP (superior gluteal artery perforator)
 - e. Free IGAP (inferior gluteal artery perforator)

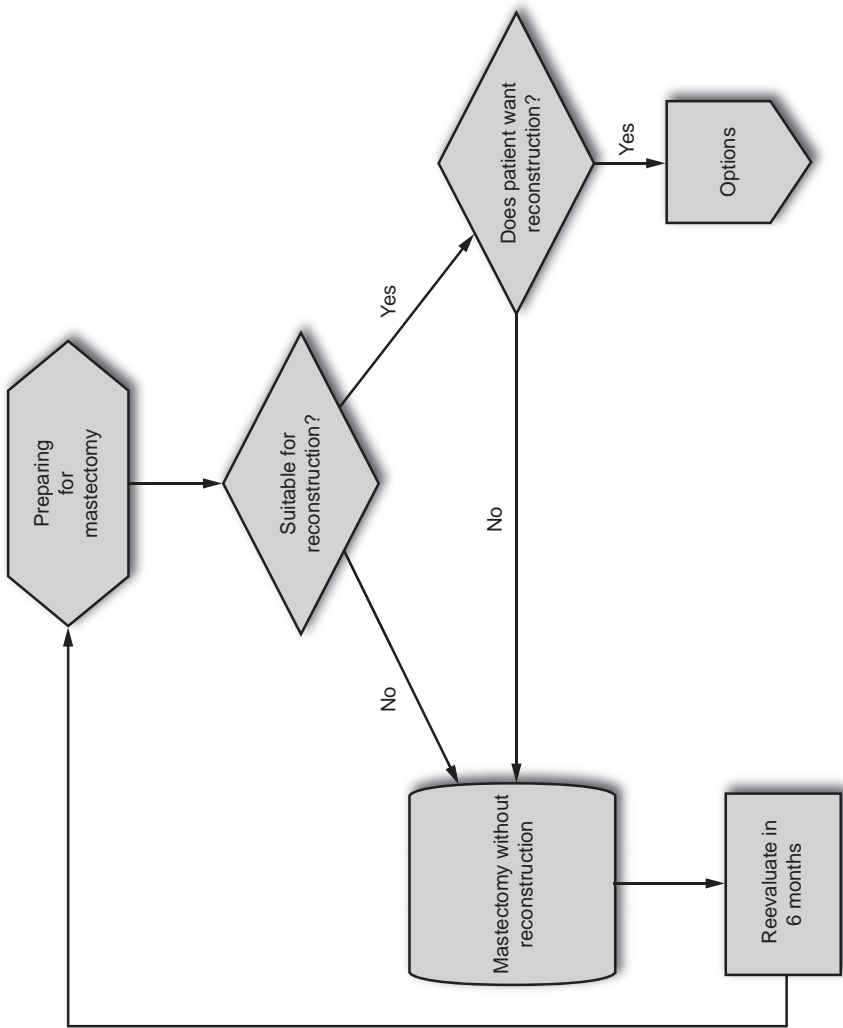


FIGURE 5.2 Evaluation for Immediate Reconstruction

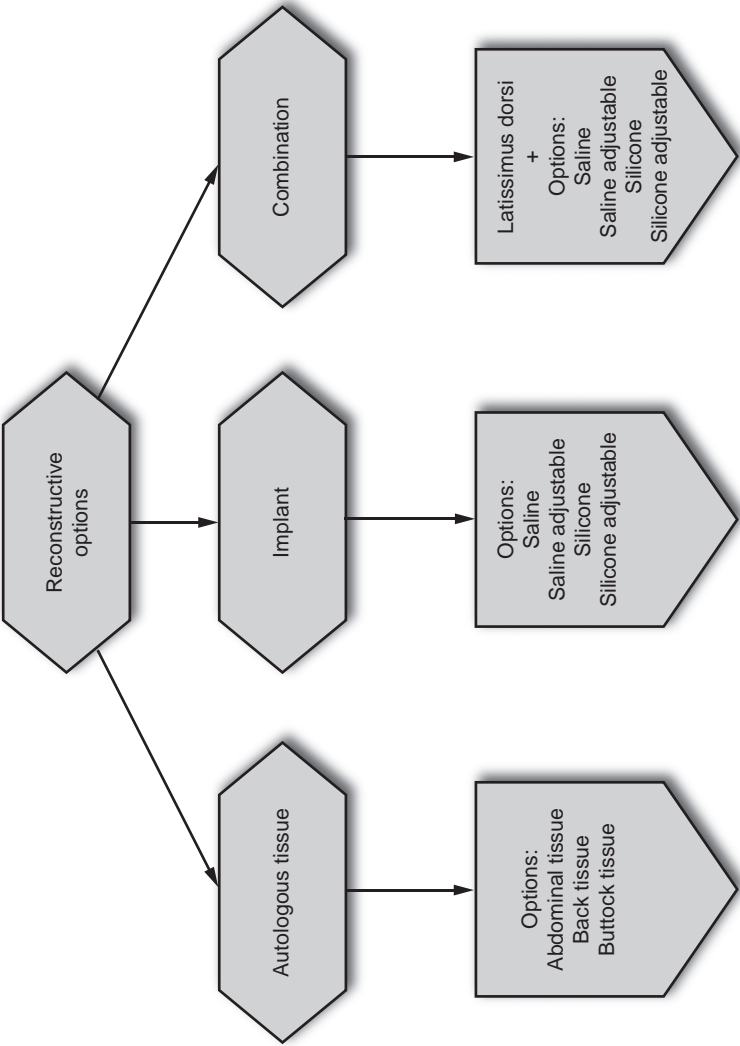


FIGURE 5.3 Multiple Reconstructive Options

PREOPERATIVE PLANNING

Our center is using 3-D perforator mapping of the abdomen to identify vessels (Figure 5.5). These data are currently preliminary but suggest a role for increased accuracy and decreased operating room time by preoperatively mapping the perforator and knowing its location.

Patients should undergo teaching via face-to-face time with the surgeon and/or designee such as a mid-level practitioner [e.g., nurse practitioner (NP), physician's assistant (PA)]. Brochures, videos, and other teaching tools can be used in addition to one-on-one time with the health care provider for educating the patient. We prefer to have the patient's husband or significant other participate in the process.

Patients should have preoperative teaching regarding the details of the procedures and options from both the surgical oncologist and plastic surgery perspectives. We also like our patients to meet with the physical therapist preoperatively as well as to learn gentle range-of-motion and core-strengthening exercises.

Some centers require preoperative autologous blood donation (PABD) to prepare for flap surgery. At our center, the need to transfuse for flap surgery arises so infrequently that it does not warrant PABD. Patients are educated nonetheless about the risks and benefits of potential blood transfusion, including the possibility of transfusion reaction and infection.

OPERATIVE PROCEDURES

Implant-based reconstruction at the time of mastectomy usually requires an overnight hospitalization, whereas autologous tissue reconstruction (Figure 5.4) requires approximately 3 to 4 days in the hospital. Similarly, the overall time to recuperate and return to work is longer for autologous tissue reconstruction.

Centers with higher volumes tend to have better outcomes because surgeons, nursing teams, and postoperative care become very standardized and consistent. When experience is concentrated in a few hands, outcomes improve. Further, a plastic surgeon who routinely devotes a significant portion of his or her practice to breast reconstruction is important for the center—as that individual will have

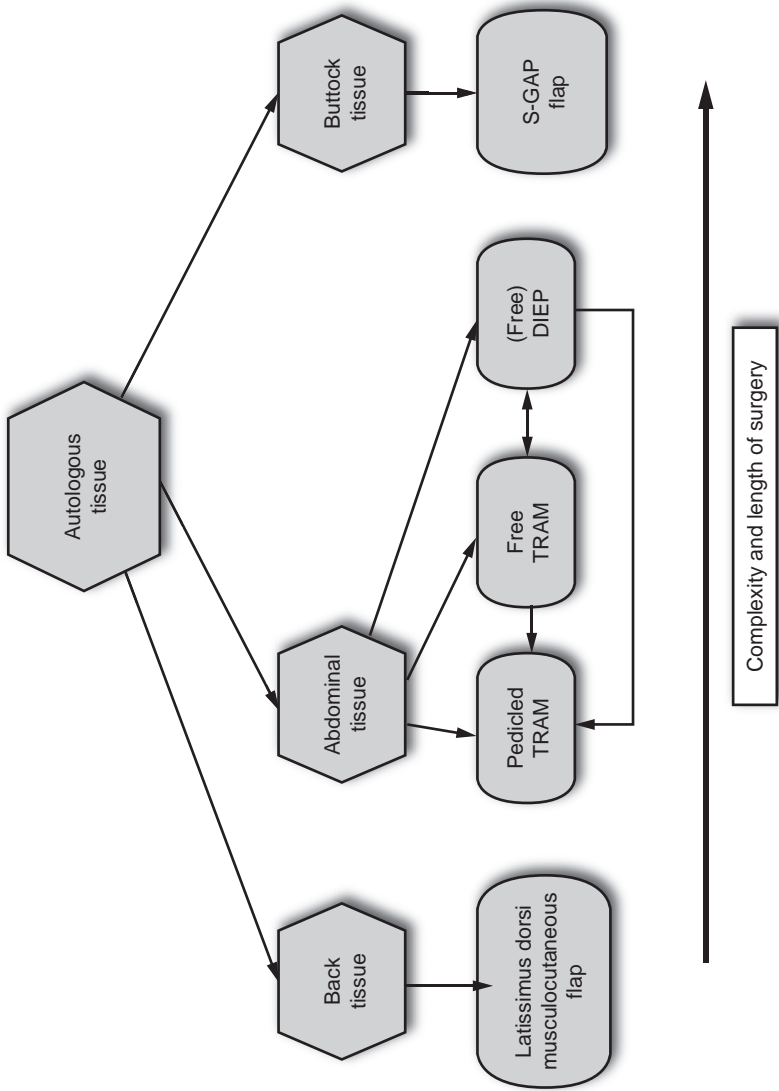


FIGURE 5.4 Autologous Tissue Options

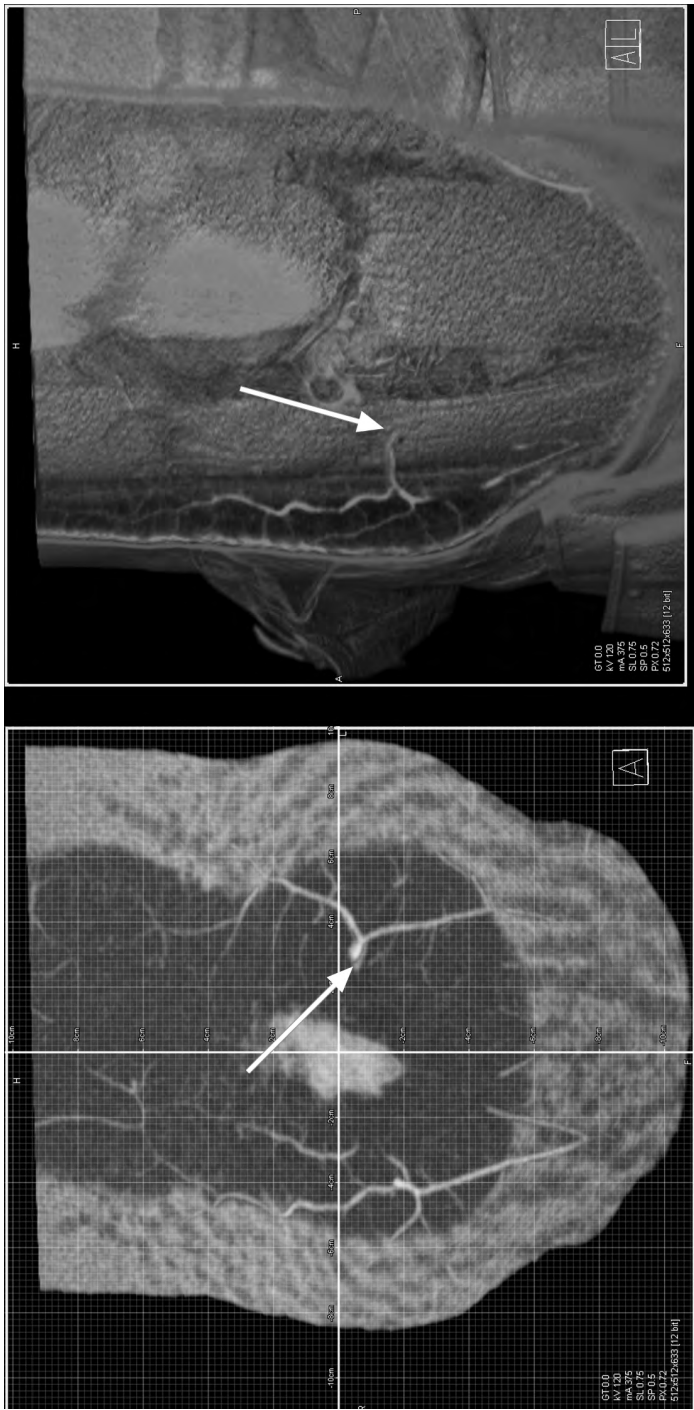


FIGURE 5.5 Mapping Abdominal Perforators in Preparation for DIEP Flap Surgery

great familiarity with the protocols and indications, a track record of teamwork with the oncologic surgeons, and the infrastructure to support a patient.

Postoperative care includes the following measures:

1. Showers allowed in 2 days.
2. No heavy lifting for 4 to 6 weeks. This allows the donor sites to heal without risk of hernia formation [in the case of TRAM flaps and DIEP flaps (Figure 5.6)] or disruption of the various layers and distortion of the ultimate aesthetic result of the reconstruction. The body continues to increase collagen content of a healing wound for up to 6 weeks. At that stage, collagen turnover and remodeling take over.
3. Antibiotics are used perioperatively, and rarely do they need to be continued after discharge from the hospital.
4. Gentle physical therapy exercises to encourage range of motion.

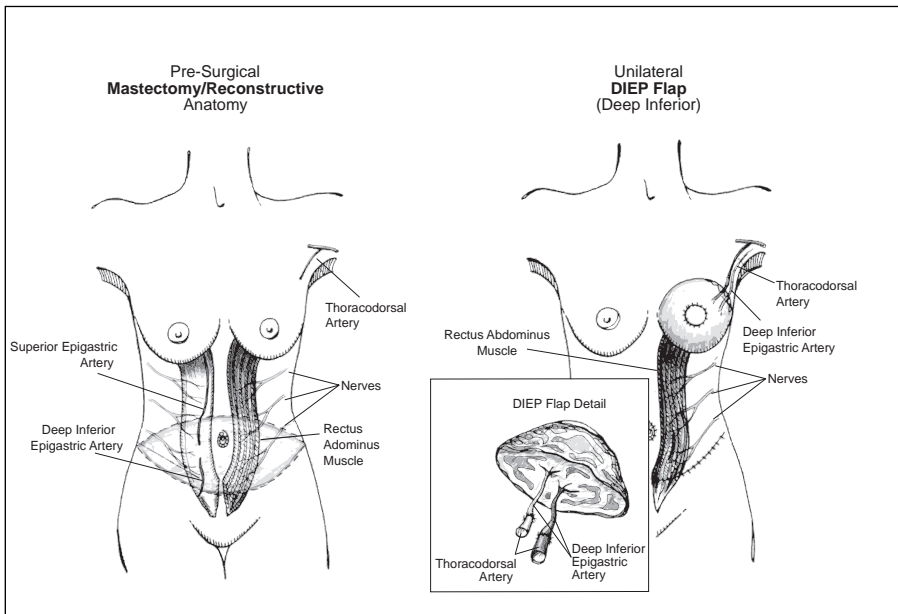


FIGURE 5.6 (left) Presurgical mastectomy/reconstructive anatomy. (right) Unilateral DIEP flap.

A PICTURE IS WORTH A THOUSAND WORDS

Implant-Based Reconstruction



FIGURE 5.7 (top) Preoperative; (bottom) Left implant reconstruction with right augmentation for symmetry.



FIGURE 5.7(continued) (top) Preoperative; (bottom) Right implant reconstruction with left augmentation for symmetry.



FIGURE 5.8 Nipple-sparing mastectomy with one-stage implant reconstruction with Alloderm used. (top) preoperative, (bottom) postoperative

Latissimus Dorsi Flap and TDAP Flap Reconstruction

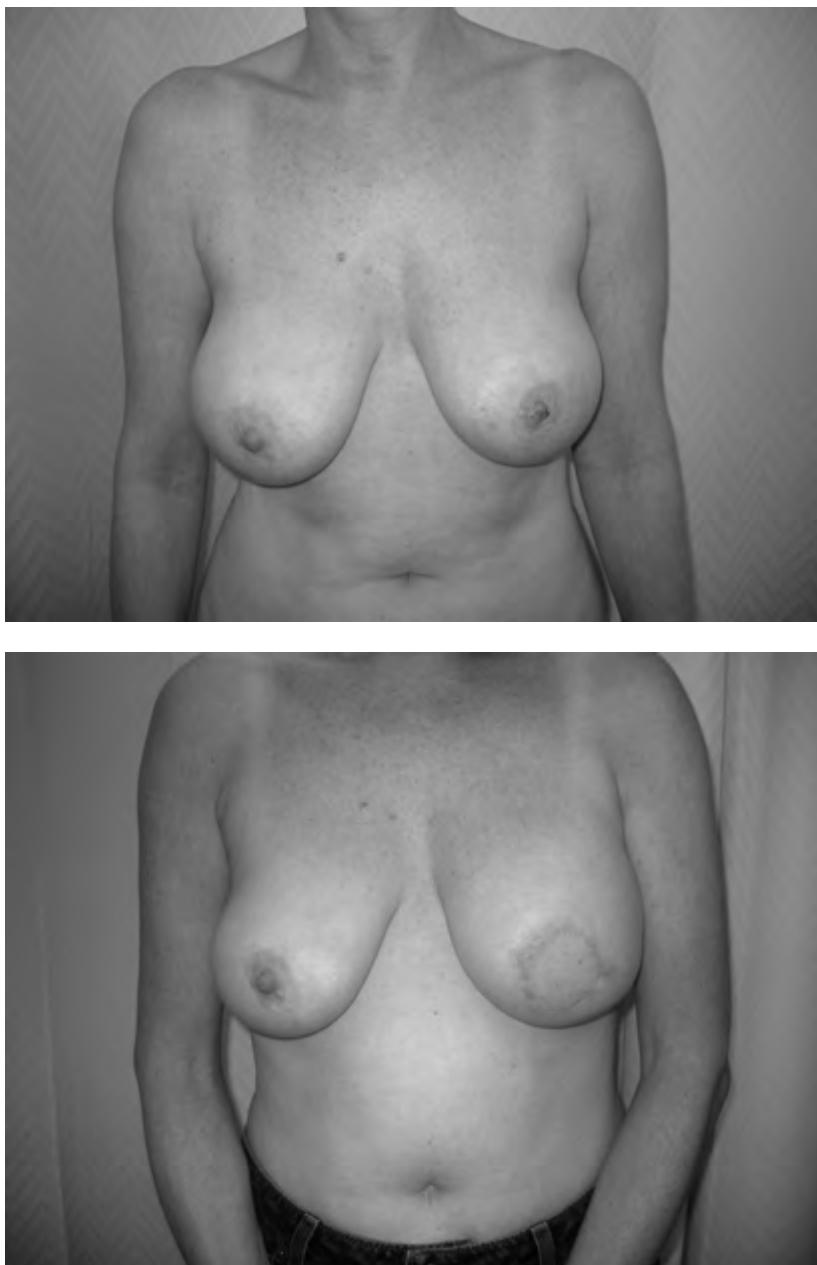


FIGURE 5.9 (top) Preoperative; (bottom) Postoperative left breast reconstruction with TDAP flap and implant, front view.



FIGURE 5.9(continued) Postoperative left breast reconstruction with TDAP flap and implant, back view.



FIGURE 5.9(continued) Preoperative left breast reconstruction with latissimus dorsi flap and implant (Patient had post-mastectomy infection and radiation therapy in the past).



FIGURE 5.9(continued) Postoperative left breast reconstruction with latissimus dorsi flap and implant; (top) front view, (bottom) back view

Free TRAM Reconstruction

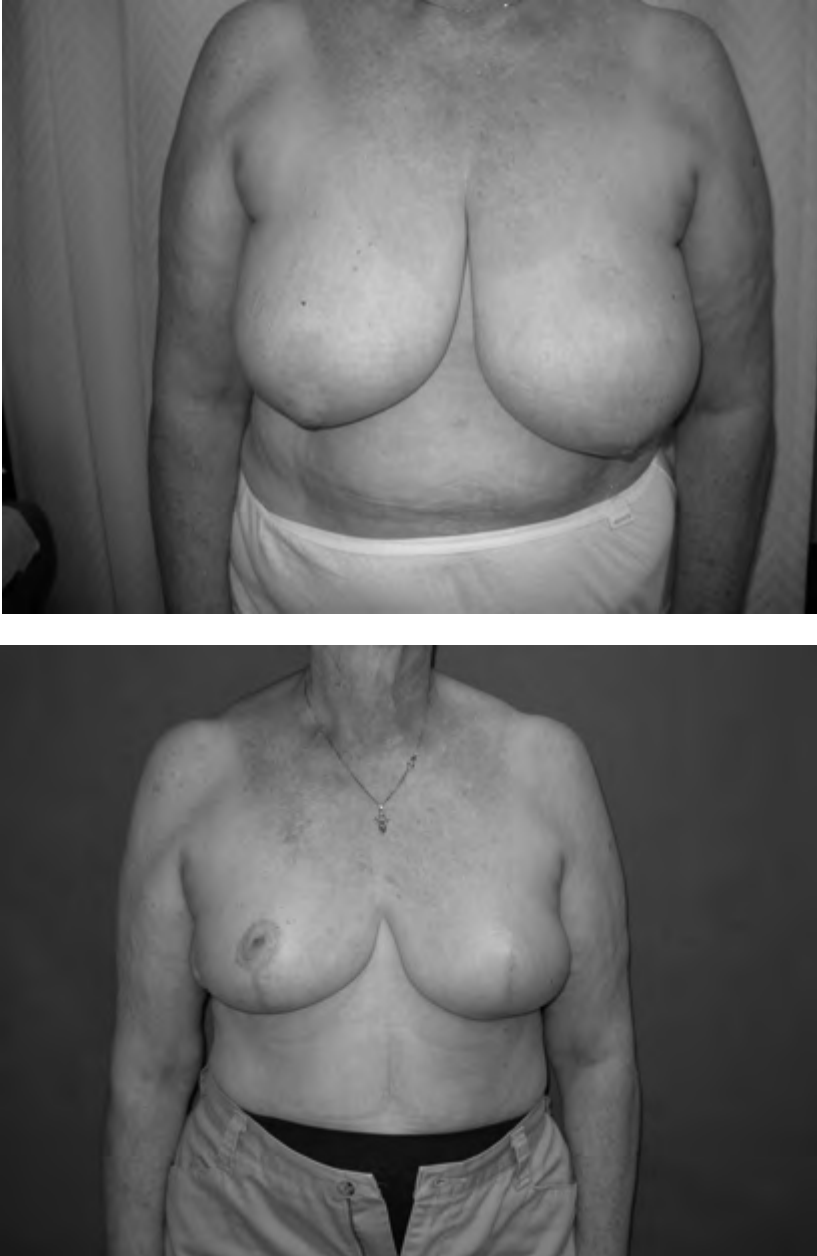


FIGURE 5.10 (top) Left free TRAM. (bottom) Right breast reduction for symmetry.

DIEP Reconstruction



FIGURE 5.11 (top) Right DIEP flap. (bottom) Left DIEP flap.

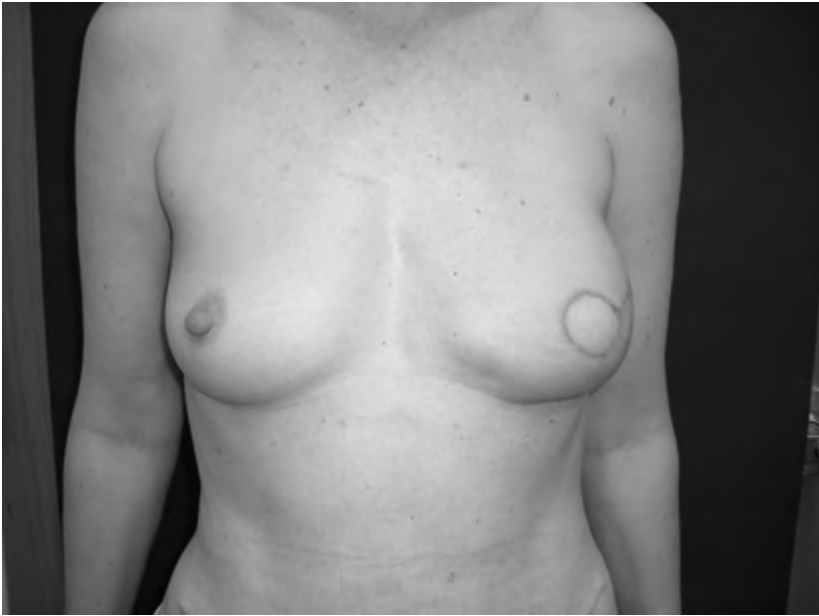
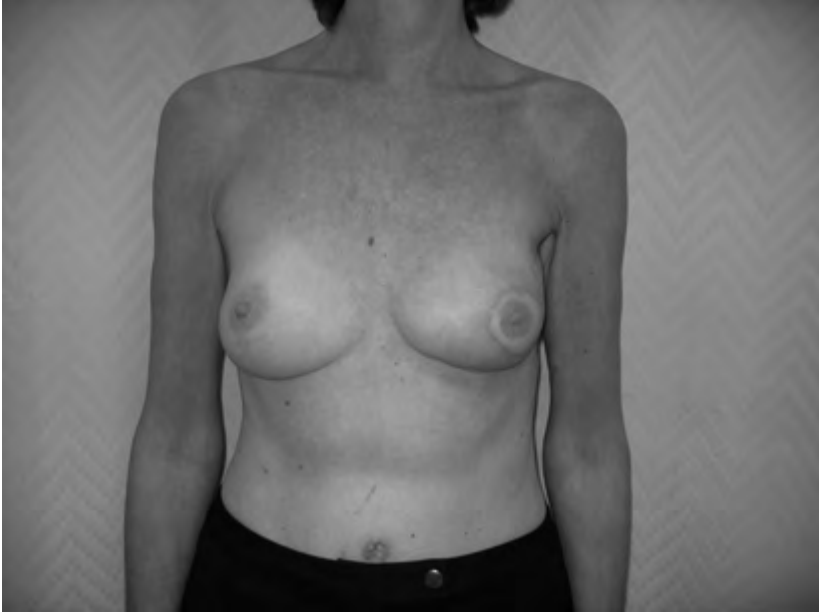


FIGURE 5.11(continued) (top) Left DIEP flap. (bottom) Left DIEP flap.



FIGURE 5.12 (top) Preoperative; (bottom) Right DIEP with left breast reduction.



FIGURE 5.13 Final Nipple Reconstruction and Tattoo



FIGURE 5.14 Close-up of umbilical reconstruction.

RISK FACTORS ASSOCIATED WITH POOR OUTCOMES

Smoking constitutes a constant threat to the patient's welfare—the risks for lung cancer, CAD, and peripheral vascular disease, among other conditions, are well known. A patient may be noncompliant with a physician's recommendation and/or smoking cessation program, and as a responsible adult she can make that informed refusal based on properly disseminated and properly received advice and data.⁵

However, when it comes to reconstruction of the breast—which is not an emergent or urgent condition—the patient has to understand that her chances of having a poor outcome are greater if she continues to smoke or to be exposed to nicotine in other forms. Whereas a patient may not stop smoking because of indifference to a silent, remote risk of hypertension and other pathological conditions, she is more likely to respond to an immediate cause-and-effect risk of a poor or failed outcome in breast reconstruction.

It is recommended that the patient be nicotine free for at least 6 weeks before reconstructive surgery—whether it is implant based or autologous tissue based. And by nicotine free, we mean the patient should have transitioned from smoking to patch or gum to nothing by the time of surgery. Whereas tobacco combustion products are noxious to the lungs, it is nicotine that is the critical agent in the vasoconstriction that leads to tissue ischemia.

Tissue ischemia, in turn, will cause fat necrosis with firm nodules in the reconstructed breast, abdominal wall delayed healing and necrosis, mastectomy flap necrosis, exposure and infection of the implants,⁶ and, especially in conjunction with radiation, total flap necrosis. In addition to direct plastic surgery considerations, the higher rate of coughing in smokers can increase their risk for postoperative hernias in TRAM operations, prolonged recovery from anesthesia, and postoperative pneumonia.

The patient needs to understand that the precious resources of her body (e.g., abdominal skin and fat and back fat) will need to be conserved for use when the timing for reconstruction is optimal. To this end, her reconstructive surgery may even be cancelled if her urine nicotine test is positive (showing cumulative nicotine exposure for up to 4 weeks prior to surgery) or if an arterial blood gases (ABG) test shows elevated carboxyhemoglobin levels on the morning of surgery.

Some patients are surprised when during preoperative teaching they are informed that second-hand smoke exposure is just as deleterious as smoking itself.

Frequently patients with diabetes present for breast reconstruction. Because diabetes is a small-blood-vessel disease, it increases the rate of wound healing complications. For reconstructions in patients with diabetes, we undermine the abdomen less, transfer smaller amounts of tissue per perforator, or have to modify the technique to a muscle-sparing free TRAM to capture more blood vessels for the amount of tissue to be transferred. Blood sugar levels must be optimized before the time of surgery to mitigate the risk of infections for patients with diabetes.

CAD may influence the choice of vessels used for breast reconstruction. The recipient vessels where free flaps are transferred were traditionally the thoracodorsal artery and vein in the axilla. These vessels were often dissected and preserved during axillary dissections and easily accessible from the mastectomy defect.

With the change in oncologic surgery techniques, including skin-sparing mastectomy and lymph node sampling (sentinel lymph node), the vessels are neither accessible nor already dissected. In addition, because the risk of lymphedema increases with greater dissection in the axilla, and there is a concern that the oncologic surgeon may return to the axilla if the sentinel lymph node is positive, we want to avoid placing our delicate microanastomoses in the axilla. Furthermore, by leaving intact the thoracodorsals, which are the primary nutrient supply for the latissimus dorsi musculocutaneous flap and the TDAP flap, we save these vessels as future options for reconstruction if there is failure of the free flap.

Increasingly the choice of recipient vessels is the internal mammary (IM) artery and vein. These vessels are a good size-match for the deep inferior epigastric artery and vein, of a suitable caliber for microanastomoses (2–3 mm in diameter), and readily accessible in the center of the chest defect by resecting a 3-cm piece of the medial cartilaginous portion of rib 3 or 4. This allows the flap to be placed centrally to create a better-positioned breast mound, in contrast to the axillary anastomoses, which force the flap to be somewhat laterally situated. Occasionally we find perforators of the IM vessels arising from within the rib interspaces that, although smaller than the IM vessels themselves, are

nonetheless usable for free-tissue transfer in our hands. The IM perforators are suitable for superficial inferior epigastric artery (SIEA) flap as well as DIEP flaps as much as 30% of the time. The preference for these vessels has to be communicated with the oncologic extirpative surgeon so that the vessels can be preserved during the mastectomy, as they arise at the lateral sternal border around ribs 2 to 4.⁷

The IM artery is the same vessel that cardiac surgeons use for coronary revascularization for patients with CAD. Arterial conduits, such as internal mammary artery–LIMA or radial artery grafts, have been shown to have a greater patency rate than saphenous vein grafts. Hence, cardiothoracic surgeons prefer a LIMA or occasionally a right internal mammary artery (RIMA) if it is available. Because our dissection utilizes the IM artery, the patient should be informed about the use of this vessel and its potential impact should she develop CAD. CAD may be more likely in the setting of radiation used to treat a left-sided breast cancer. Interestingly, breast cancer is slightly more common on the left than on the right. Our patients agree and request that their bodily resources be used to treat the disease that they currently have rather than a disease that they may or may not develop.⁸

Patients need to inform their cardiologist and cardiothoracic surgeons if in the future they need a coronary artery bypass graft (CABG) procedure. This information also needs to be disseminated to the cardiothoracic surgery literature. Occasionally, a left breast flap can be anastomosed to the right IM artery, and vice versa. Hence, simple visual inspection by the cardiothoracic surgeon will not suffice, and the surgeon should review the plastic surgery operative report.

THE SECOND STAGE AND CONTRALATERAL BREAST

Federal law requires that breast reconstruction be a covered benefit for women undergoing breast cancer management. This includes contralateral breast procedures to create symmetry and balance. Our goals in treating breast reconstruction are the “4 S’s” of breast:

1. **Size.** The breast size should be appropriate to the woman’s overall body habitus. This includes choosing an implant that will create an acceptable breast, but not so large that it threatens to attenuate the skin and cause local complications. For a flap, enough bulk has to be transported to create a mound of breast tissue.

2. Shape. To paraphrase Michaelangelo, “I saw an angel in the stone, and carved till I set it free.” The bulk of autologous fat or implant has to be a teardrop-like shape, with good central projection, and roundness to the breast at the lower pole and a “ski slope” transition at the upper pole. This is achievable with either autologous tissue or with implants—especially shaped “contour” implants.
3. Sensuality. Ultimately the reconstruction should look attractive—that is, it should be sensual. Furthermore, it should eventually be sensate—capable of delivering both protective sensation and erogenous sensibility. Women have reported erogenous sensation from the reconstructed breast (personal communication, LS); this is feasible especially with skin-sparing mastectomies. Once the nerves reconnect, the signals they send to the brain are not the same as they were preoperatively, but how the brain is trained to interpret these signals is paramount. The largest sexual organ is between our ears—the brain. Sensations from our earlobes, fingers, neck, genitalia, thighs, and toes can be interpreted by our brains as sensual. Studies have shown that the more attractive the breast and donor site are, the more likely the breast will be perceived as sensual.
4. Symmetry. The two breasts are never symmetric to start with and they will not be symmetric in the end. Although they cannot be the same, we can reconstruct them to be similar. The goal is not simply to create two attractive breasts, but to create two similarly attractive breasts. This is achievable by offering women whose reconstructed breast cannot be made to match their native breast a symmetry operation on the normal breast. This may include a reduction, an implant augmentation, or a lift (mastopexy) of the normal breast; this can be a “silver-lining” in the dark cloud of breast cancer. Both breasts can be rejuvenated. The WHCRA (1998) includes coverage for surgery of the opposite breast to achieve symmetry. Surgery on the opposite breast does place scars on the external breast skin as well as internally. It is important to have a baseline mammogram of the normal breast to confirm that it is, indeed, normal. Internal scars on the normal breast can be confusing because calcifications may mimic or obscure a malignancy. This remains largely a theoretical concern, and clinical trials confirm that surgery on the opposite breast remains safe.



IMPLANT-BASED RECONSTRUCTION

The most common breast reconstruction technique combines expansion of the breast skin with use of a temporary tissue expander, followed by insertion of a permanent silicone or saline breast implant. This type of reconstruction requires two separate operations.

At the time of the patient's mastectomy, the surgeon inserts a tissue expander beneath the patient's skin and chest muscle. Through a tiny valve mechanism located inside the expander, the nurse practitioner periodically injects a salt-water solution to gradually fill the expander over several weeks or months. The patient may feel a sensation of stretching and pressure in the breast area during this procedure, but most women do not find that it is too uncomfortable. This process will begin usually 2 weeks after the mastectomy, once the drains are removed. This procedure stretches the skin and muscle to make room for a temporary implant, just like a woman's belly stretches during pregnancy. The process continues until the size is slightly larger than the other breast. After the skin over the breast area has stretched enough, the expander is removed in a second operation and a more permanent implant is inserted. Some expanders are designed to be left in place as the final implant. The nipple and the dark skin surrounding it, called the areola, are reconstructed in a subsequent procedure.

With implant-based reconstruction, you will be in the hospital overnight and will be able to go home the next day. Many reconstruction options require a surgical drain to remove excess fluids from surgical sites immediately following the operation. In most circumstances, these drains will remain in place for 1 to 2 weeks. If they are highly productive, they will stay in longer.

You are likely to feel tired and sore for a week or two after reconstruction. Most of your discomfort can be controlled by medication prescribed by your doctor.

FLAP RECONSTRUCTION

An alternative approach to implant reconstruction involves creation of a skin flap using tissue taken from other parts of the body, such as the abdomen, the back, or the buttocks. This type of operation will require you to stay in the hospital for 3 to 4 days. You will also have 3 to

4 surgical drains depending on whether one or two breasts are reconstructed. In most circumstances, these drains will remain in for 1 to 2 weeks. If they are highly productive, they will stay in longer.

The recovery time for flap reconstruction is 4 to 6 weeks.

TRAM Flap

In this type of flap surgery, the tissue remains attached to its original site, retaining its blood supply. The flap consists of the skin, fat, and muscle with its blood supply, and is tunneled beneath the skin to the chest, creating a pocket for an implant or, in some cases, creating the breast mound itself, without need for an implant.

DIEP/SIEA Flap, Latissimus Dorsi Flap, and SGAP Flap

Another flap technique uses tissue that is surgically removed from the abdomen, back, or buttock and then transplanted to the chest by reconnecting the blood vessels to new ones in that region. This procedure requires the skills of a plastic surgeon who is also experienced in microvascular surgery.

Regardless of whether the tissue is tunneled beneath the skin on a pedicle or transplanted to the chest as a microvascular flap, this type of surgery is more complex than skin expansion. Scars will be left at both the tissue donor site and at the reconstructed breast, and recovery will take longer than with an implant. Conversely, when the breast is reconstructed entirely with the patient's own tissue, the results are generally more natural and there are no concerns about a silicone implant. In some cases, the patient may have the added benefit of an improved abdominal contour.

Chemotherapy or radiation may be recommended by the surgical oncologist following the mastectomy. If the patient chooses to have these treatments, it will delay her secondary procedures by a few months.

FOLLOW-UP PROCEDURES

Most breast reconstruction involves a series of procedures that occur over time. Usually the initial reconstructive operation is the most complex. Follow-up surgery may be required to replace a tissue expander with an implant; to reconstruct the nipple and the areola; or to enlarge,

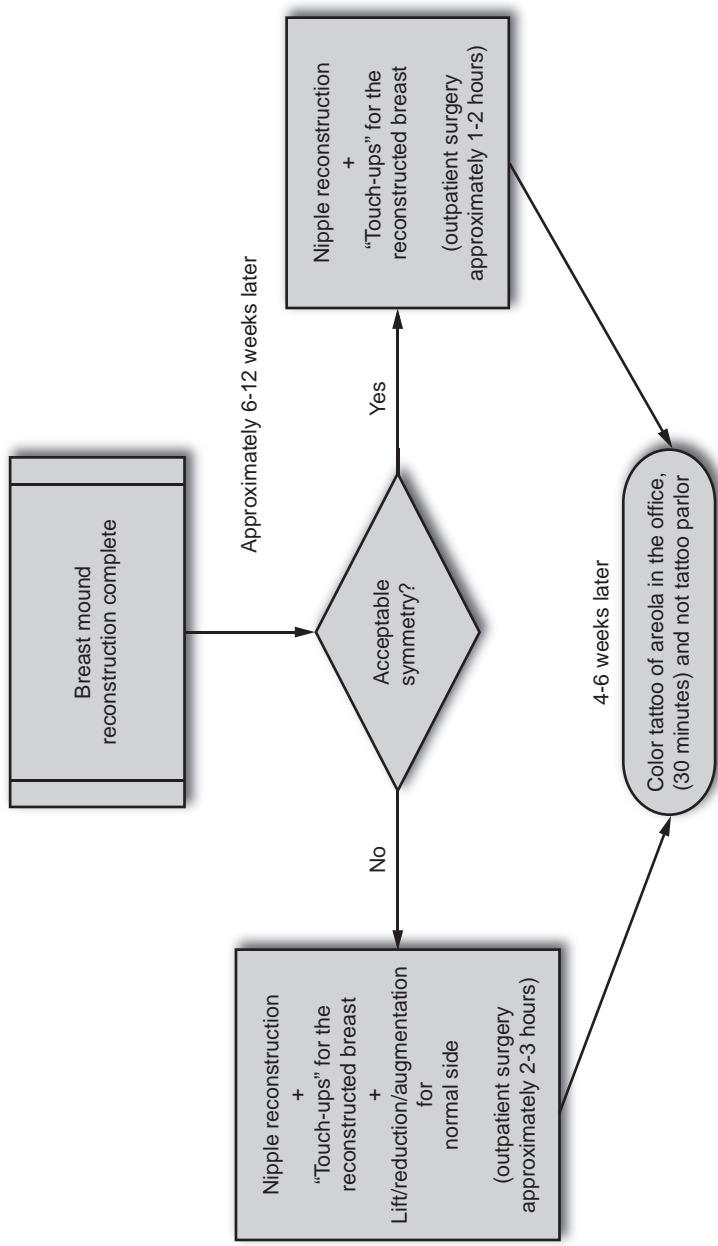


FIGURE 5.15 Outpatient "Touch-up" Surgeries

reduce, or lift the other natural breast to match the reconstructed breast. These secondary procedures are outpatient procedures and usually do not require the use of drains. The recovery time is based on the extent and complexity of the procedure, but usually ranges from a few days to a few weeks. (Figure 5.15)

Chances are that the reconstructed breast may feel firmer and look rounder or flatter than the natural breast. It may not have the same contour as the breast before mastectomy, and it will not exactly match the opposite breast. But these differences will be apparent only to the patient. For most mastectomy patients, breast reconstruction dramatically improves their appearance and quality of life following surgery.

ADVANTAGES AND DISADVANTAGES OF BREAST RECONSTRUCTION TECHNIQUES

DIEP/SIEA Flap Reconstruction

ADVANTAGES

- ▷ Because the reconstruction involves using the patient's own tissues, the risks of implant reconstruction are avoided.
- ▷ Most patients have less postoperative pain than after a TRAM flap and are, therefore, able to leave the hospital sooner and return to their normal activities more quickly than after a TRAM flap.
- ▷ Because abdominal muscle is not removed, patients have less risk of developing hernias at the site where the flap is removed than do patients who have had a TRAM flap.
- ▷ It is typically easier to match the contralateral natural breast with the patient's own tissue in flap reconstruction when compared with implant reconstruction.
- ▷ Patients essentially end up with a "tummy tuck" at the same time as the breast reconstruction.

DISADVANTAGES

- ▷ DIEP/SIEA flap reconstruction generally requires a longer and more difficult surgery at the first stage when compared with implants or TRAM flaps.
- ▷ Patients will have a scar across the lower abdomen where the flap is obtained.



Implant Reconstruction

ADVANTAGES

- ▷ The recovery from the initial expander placement surgery is usually quicker than for flap surgery.
- ▷ It may be easier to control the final size of the reconstructed breast with implant reconstruction.
- ▷ There are no scars on the patient's body other than those on the breasts.

DISADVANTAGES

- ▷ Because most patients require placement of an expander first followed by secondary replacement of the expander with an implant, at least two surgical stages are required as well as multiple visits to the plastic surgeon's office between these stages for tissue expansion.
- ▷ It is important to realize that for patients who are having a unilateral (one-sided) mastectomy, matching the other natural breast with an implant can be difficult. The shape and "feel" of an implant is not exactly like that of a natural breast.
- ▷ In the short term, implants can become infected or malpositioned and require surgery to correct these problems.
- ▷ In the longer term, implants can develop capsular contracture (tightening of the soft tissues around the implant), implant malposition, and implant rupture. All of these complications can require secondary procedures.

OTHER RECONSTRUCTION OPTIONS

The other breast reconstruction option is the latissimus flap, plus or minus an implant. This procedure leaves a scar across the patient's back, and would be used in conjunction with most likely a saline or silicone implant. The patient should understand that this procedure will lead to some loss of function with the latissimus dorsi, but this is not a dramatic functional loss for most people. With a pedicle flap, there is greater reliability in terms of flap healing but donor-site morbidity. In particular, seromas are fairly common in the latissimus dorsi donor site as well as a prominent scar.

With my patients, I also discuss the option of reconstruction using tissue from the patient's abdomen. She should understand that this could take the form of a pedicle TRAM flap, which harvests nearly the entire muscle and can leave her with weakness, bulging, or asymmetry. This option is less likely to have 100% failure, but there is a greater chance of fat necrosis associated with the pedicle flap especially in a patient with a heavyset body habitus.

Other flaps from the abdomen include a free TRAM flap, which involves microsurgery and transfer of a segment of the muscle as well as the overlying skin and fat. This is a good option and can decrease the risk of fat necrosis; however, there is a risk of weakness or bulge. The patient should understand that this flap can demonstrate an all-or-none phenomenon, with a complication resulting in loss of the entire flap as a possibility.

Another option for abdominal wall harvest is a free DIEP flap. This spares the muscle, but it is a lengthy and tedious dissection, which harvests skin and subcutaneous tissue but for the most part spares the muscle as well as the intercostal nerves. The patient should understand that this flap is associated with a higher risk of fat necrosis than is a free TRAM flap. However, the DIEP flap has a lower risk of abdominal wall weakness, bulge, or hernia. Moreover, this flap also demonstrates an all-or-none phenomenon. The flap complication rate is approximately 5% to 8%. If the patient were to have venous complications, she might require leech therapy and antibiotics as well as blood transfusions. If she were to have an arterial complication, she might require an urgent reoperation. Despite these measures, the flap might not be salvageable and total removal of the flap might be required. She might have to fall back on the other options, such as a latissimus flap plus or minus an implant, or tissue expander base reconstruction. It might not be possible to pursue these options at that same hospitalization.

In some anatomic scenarios, a DIEP flap may not be possible and the intraoperative alternatives would include conversion to a pedicled TRAM flap or implants.

Tissue expansion reconstruction is another possibility. This would involve placement of a saline or silicone tissue expander, which would require serial augmentation in the office over multiple visits spanning about 6 to 8 weeks. Once an adequate volume is reached, this implant would be removed and replaced with a permanent implant, either



silicone or saline depending on the patient's preference. Implants have the risk of capsular contracture and rupture. The patient should understand that with implant reconstruction there is a higher rate of complications in the face of radiation should she require radiation postoperatively or if she has had radiation preoperatively.

Frequently Asked Questions

1. *Will my breast and nipples have sensation?*

In implant-based reconstruction, the nerves will reorient from the periphery and innervate the skin flaps from the edges. The ultimate innervation density will never be equivalent to the original, but protective sensation is obtained. However, no deeper nerves can migrate to the surface because of the presence of the artificial prosthesis—the implant. In autologous techniques, nerves can connect from the deeper surface to the transferred fat and skin. This is facilitated when, specifically, we connect a sensory branch from the abdominal fat to an intercostal nerve in the chest.

2. *Are silicone implants safe?*

Yes. In 2006, the U.S. Food and Drug Administration (FDA) approved silicone implants for use in cosmetic patients, and it had always allowed them for breast cancer reconstruction. No evidence of systemic disease caused by silicone implants has been found.⁹ Because they are man-made objects and can rupture, the FDA recommends surveillance MRI scans every other year.

3. *I have had prior surgery on my abdomen. Am I still a candidate for a flap?*

Women who have had prior abdominal surgery, including cosmetic surgery, may not be candidates for reconstruction using abdominal tissue. For instance, an abdominoplasty (tummy tuck) precludes a TRAM, free TRAM, DIEP, or SIEA flap. Abdominal liposuction is not an absolute contraindication if the patient has regained the fatty deposits around the abdomen. If there is not sufficient fat in the sub-

cutaneous tissues of the infraumbilical abdomen, then the patient is not a good candidate based on being thin, not based on prior liposuction.

Occasionally an appendectomy, hysterectomy, or cesarean section incision may have damaged the underlying blood vessels; however, this is usually not an issue. Prior open cholecystectomy scars can interfere with abdominal incision healing after a TRAM, free TRAM, DIEP, or SIEA flap, especially in patients who are obese [body mass index (BMI) greater than 30]. However, we do recommend a 3D CT perforator scan of the abdomen in patients who have had abdominal liposuction.

4. *Is breast reconstruction dangerous?*

No. Studies have demonstrated no increased rate of tumor recurrence, no delay in diagnosis, and no difference in overall survival in women who choose breast reconstruction versus those who choose no reconstruction. If the patient has many medical or psychological comorbidities, it may be prudent to wait for delayed reconstruction.

Prior or future planned radiation is a relative contraindication to implant-based reconstruction. Advanced age alone is not a contraindication.

We educate patients about these risks, which include, but are not limited to, infection, bleeding, pain, scarring, asymmetry, numbness, deformity, hypertrophic/keloid scarring, loss of nipple, poor healing, delayed healing, contour irregularity, abdominal wall bulge/weakness/hernia, interference with mammography and cancer surveillance, inability to breastfeed, financial risks, chronic pain, weakness, wound dehiscence, donor-site morbidity, need for additional surgery (planned or unplanned and emergent), and stiffness. We discuss the best-, average-, and worst-case scenarios related to the proposed surgery. We also discuss alternative methods of management, expected time and course of recovery, expected course of management of complications, and warning signs and symptoms of postoperative complications. We also talk about how radiation affects surgery, especially increasing the risks of complications. We further discuss diabetes, either diagnosed or undiagnosed, and how it may influence the outcome.



MANAGING COMPLICATIONS

Complications associated with implant-based reconstruction include

- ▷ Infection. Any prosthetic-based reconstruction is inherently at higher risk for infection, because the body cannot effectively clear bacterial attachment from the biofilm formed on artificial surfaces.¹⁰ Infection is most likely in the perioperative period, but delayed infections can arise if the patient is bacteremic from another source such as an odontogenic infection or urinary tract infection. A trial of antibiotics (oral or intravenous, depending on the severity) is warranted, and if conservative management fails, explantation may be necessary. Typically a new implant cannot be placed at the same time and requires a “cooling off” period before another attempt at implant reconstruction can be considered, usually 2 to 3 months after explantation. There are some preliminary reports suggesting that antibiotic irrigation of the cavity with transfer of a muscle may allow immediate replacement with an implant.¹¹
- ▷ Exposure/extrusion. In attenuated skin, especially in the setting of prior radiation, the mechanical pressure from the expander or implant can result in extrusion through the skin. When this happens, an area of surrounding tissue must be excised.
- ▷ Capsular contracture. Although the etiology of this is unclear and attributed to either hematoma during surgery, low-grade bacterial colonization, or an idiopathic process, capsular contracture may develop in the months to years after surgery.¹² A normal capsule develops around all implants, but a capsular contracture is defined as a scarring process that distorts the reconstruction and/or makes it painful. The rate of capsular contracture is reported as 8% to 20%. Fibrosis from radiation therapy is similar to capsular contracture and can similarly distort the breast. The Baker–Gordon classification for capsular contracture is as follows:
 - Grade I: feels like normal breast tissue
 - Grade II: somewhat firm but normal in appearance
 - Grade III: firm and looks abnormal
 - Grade IV: firm, painful, and deformed in appearance

- ▷ Rupture/deflation. Saline implants may rupture, and if this happens the implant deflates and the saline is harmlessly absorbed by the body. The outer shell then needs to be removed and replaced with a new implant. If a silicone implant ruptures, the rupture may go undetected because the silicone gel remains in the normal capsule that develops around the implant. The most sensitive study to evaluate rupture is magnetic resonance imaging (MRI). Even if the implant ruptures, surgery to remove the gel material and replace with a new implant is predictable and scientific studies have not demonstrated any systemic risk of disease related to silicone. In fact, in late 2006 the FDA approved silicone gel implants for use in cosmetic cases in addition to the existing allowance of using gel implants in reconstruction cases. The newer generation of silicone gels are “cohesive” or “memory gels” that are less likely to extrude the contents of the implants, even when ruptured.

Complications associated with flap reconstruction include

- ▷ Fat necrosis. After a flap is transferred, either as a pedicled or a free flap, there may be areas of fat that are underperfused. They will typically necrose and form firm nodules. Observation for a period of one year is warranted because much of this tissue softens during the postoperative interval. Firm nodules of fat necrosis feel quite different from tumor, but definitive diagnosis may require further imaging such as MRI or position emission tomography (PET) scan, or biopsy. Fat necrosis may also need to be excised if it is painful.
- ▷ Donor-site seroma.
- ▷ Total or partial flap loss.

5. Does breast reconstruction affect breast cancer recurrence?

Reconstruction has no known effect on the recurrence of disease in the breast, and it does not generally interfere with chemotherapy or radiation treatment, should cancer recur. Your surgeon may recommend continuation of periodic mammograms on both the reconstructed breast and the remaining normal breast. If your reconstruction involves an implant, be sure to go to a radiology center where technicians are experienced in the special techniques required to get a reliable x-ray of a breast reconstructed with an implant.



6. *How will radiation affect my reconstruction?*

The effects of radiation therapy on a reconstructed breast are unpredictable. Radiation affects every patient differently, but can cause hyperpigmentation due to burns, and changes in the texture and quality of the skin.¹³ Some patients who desire to use their own tissue for reconstruction will have a tissue expander placed at the time of their mastectomy, undergo radiation treatment, and then at a later date have the expander removed and the breast recreated using their own tissues. This prevents the soft reconstructed breast from undergoing changes from radiation.¹⁴

Some studies have shown that patients who have radiation therapy are at an increased risk for problems with permanent implants.¹⁵ These problems include capsular contracture, infection, and wound healing difficulties, causing loss of the implant. Discuss these options with your surgical oncology and plastic surgery team.

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