

Reconstruction options following breast conservation therapy

■ ABSTRACT

Women who have had breast conservation therapy for malignancy are candidates for various surgical techniques for immediate or delayed breast reconstruction. These include local tissue rearrangement, therapeutic reduction mammoplasty, and various flap reconstruction procedures. Each technique has advantages and disadvantages, and individual patient factors, particularly breast size and resection defect size, should drive the choice among procedures. Immediate reconstruction (at the time of breast conservation surgery) is preferred over delayed reconstruction, for multiple reasons. Patients tend to be satisfied with the cosmetic outcome of these procedures, but thorough patient counseling and preoperative planning is critical to a good result.

Oncoplastic surgery refers to immediate or delayed breast reconstruction following partial mastectomy, also known as breast conservation therapy. The term was coined by Audretsch et al in 1998¹ and is now often referred to as *oncoplasty*. It involves four integral components:²

- Oncologically sound techniques of tumor removal
- Partial reconstruction of the breast to correct small defects
- Immediate reconstruction for larger defects using various principles of plastic surgery
- Creation of symmetry with the contralateral breast.

This article provides a brief overview of various procedures used for reconstruction following breast conservation therapy and the factors that guide selection among these procedures for individual patients. It concludes with a discussion of complications of oncoplastic procedures, patient counseling, and other general considerations in patient management.

■ THE RATIONALE FOR RECONSTRUCTION

Breast conservation therapy may result in suboptimal appearance of the breast, including contour deformities and asymmetry, especially following adjuvant radiation therapy (**Figure 1**).³ Many patients who have had breast conservation therapy come to plastic surgeons to improve the aesthetic appearance of their breast, sometimes years after their initial treatment. It is becoming increasingly accepted that immediate reconstruction not only is oncologically sound in most patients but also yields aesthetically superior results.^{4,5} Oncoplasty allows for the removal of large tumors with wider margins and better cosmetic results. Cosmetic failure with partial mastectomy is directly related to loss in breast volume.⁶ Collaboration between the oncologic surgeon and the plastic surgeon, especially in cases of larger tumors requiring more tissue removal, can improve cosmetic outcomes. Ideally, partial breast reconstruction should result in a normal-appearing breast in terms of shape and symmetry when compared with the contralateral breast.²

Effects of radiation argue for immediate reconstruction

Although radiation therapy is integral to the comprehensive treatment of breast cancer after breast conservation therapy, radiation-induced changes to the breast are one of the greatest obstacles faced when delayed reconstruction is performed. Radiation results in deformation of the parenchyma, leading to retraction, fibrosis, vasculitis, and skin breakdown. The effects of radiation on breast tissue may possibly be a larger problem when reconstruction is delayed, as wound healing is inhibited and vascular supply is impaired. Therefore, immediate reconstruction should be undertaken whenever possible.⁷ (The timing of reconstruction is discussed in greater detail in the final article in this supplement, although mainly in the context of mastectomy.)

■ OPTIONS FOR RECONSTRUCTION

Various techniques of partial breast reconstruction can be used to achieve an aesthetically acceptable result. They can be thought of as volume-displacement procedures, such as local tissue rearrangement and reduction

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Outcomes of breast conservation therapy plus radiation therapy *without* reconstruction



FIGURE 1. Patients who had breast conservation therapy (partial mastectomies) followed by radiation therapy without oncoplastic reconstruction. These women clearly had poor aesthetic outcomes and would have benefited from options such as reduction mammoplasty or local tissue rearrangement.

mammoplasty, or as volume-replacement procedures using flap reconstruction.⁸ Additionally, simple wound closure (primary closure) may be performed if small amounts of tissue can be removed without creating a noticeable defect, but simple closure is an option only for large breasts. The decision among techniques depends on a variety of factors, as delineated below.

Local tissue rearrangement

Local tissue rearrangement is defined as the use of local tissue (skin and subcutaneous and/or breast tissue) from either the breast or the axilla. This technique involves the transfer of adjacent breast parenchyma and skin to the area of the defect. It is dependent on a random blood supply and does not involve creating a parenchymal tissue pedicle.^{4,5} It does rely, however, on a balance between the amount of tissue resected and the available residual breast size and volume. This procedure is not suitable for patients who require large-volume resection with a small breast or limited breast tissue.

When local tissue rearrangement is to be performed, the surgical incision needs to be planned by both the oncologic surgeon and the plastic surgeon to ensure an appropriate cosmetic outcome and prevent displacement or distortion of the nipple-areola complex. If such planning is not done, the cosmetic outcome may be compromised, thereby undermining one of the reasons for breast conservation in the first place. When full-thickness excisions of tissue are removed from a certain area of the breast—termed “no man’s land” by Grisotti and Calabrese⁷—the nipple-areola complex shifts to an unnatural position. Therefore, resections in this area, located superior-medial to the nipple, should include little or no skin.

Other techniques of tissue transposition include circumareolar incisions for tumors located adjacent to the nipple-areola complex, radially designed resec-

tions for lateral tumors, and donut-shaped resections for superior or lateral tumors.⁸

Reconstruction using locally rotated tissue tends to have the lowest complication rate and best aesthetic outcome in terms of symmetry, texture, and color of the breast (**Figure 2**). However, up to 40% of patients will need a contralateral breast reduction to achieve symmetry. In one study, immediate reconstruction with local tissue rearrangement resulted in fewer complications compared with latissimus dorsi flap reconstruction.⁴

Reduction mammoplasty

The use of therapeutic mammoplasty to reconstruct the breast after breast conservation therapy involves total breast remodeling and a contralateral breast reduction, resulting in a size reduction of both breasts (**Figure 3**).⁹ Breast reduction techniques rely on the creation of a parenchymal tissue pedicle, which involves using de-epithelialized breast tissue. There may or may not be an intact nipple-areola complex, depending on the location of the tumor.^{2,4} It is important to note that standard breast reduction techniques cannot simply be applied to the affected breast and that the pattern of reduction depends on the location of the tumor. Centrally located tumors can be treated successfully with reduction techniques.⁹ Nipple centralization may need to be performed as well.⁵

Standard breast reduction techniques are used on the contralateral (uninvolved) breast. This matching procedure can be performed at the same time as the initial cancer operation or as a delayed procedure. The matching procedure is usually performed at a later date for those who need to undergo radiation therapy, allowing time for healing and for final breast volume and shape to be achieved. Reduction of the contralateral breast does not increase its risk for cancer; in fact, reduction may improve body image and make breast



FIGURE 2. Preoperative (left) and postoperative (right) photos of a 58-year-old woman who underwent bilateral breast conservation therapy and reconstruction with local tissue rearrangement (note faint lateral scar on the right breast, to the right of the areola). The postoperative photo was taken 5 weeks after surgery.

self-examinations and follow-up mammography easier.

Therapeutic reduction mammoplasty is highly versatile and gives a better aesthetic result in the immediate setting when compared with flap reconstruction. However, it is usually limited to patients with a brassiere cup size of D or larger.⁴

An advantage of reduction mammoplasty is that reducing the size of the affected breast facilitates postoperative radiation therapy. Some radiation oncologists are reluctant to administer radiation to a large breast because of increased toxicity to the skin and the likelihood of a poor aesthetic outcome. With reduction mammoplasty, lower radiation doses are required and the delivery of radiation is more uniform.⁴

Reduction mammoplasty is ideal for women with moderate-sized or large breasts with ptosis (sagging), for whom a reduction in size would be considered a positive outcome.¹⁰ Patients with symptomatic macromastia likewise benefit from reduction in breast volume. An additional advantage is that the reduction procedure on the contralateral breast affords the opportunity for tissue sampling from this presumed uninvolved breast; occult carcinomas in the contralateral breast have been identified in a small percentage of patients.¹¹

At the same time, the exposure of the contralateral breast to surgery also constitutes the main disadvantage of this procedure, as both breasts are placed at risk for wound or nipple complications and the discomfort of surgery.⁹ Moreover, surgery time is also increased. Lastly, reduction mammoplasty can be offered only to patients who possess enough breast tissue to undergo reduction.¹²

Flap reconstruction

Flap reconstruction is indicated in patients who have significant breast volume deficit after resection and have insufficient adjacent tissue for local tissue recruitment and rearrangement. This method of reconstruction is based on an axial blood supply, which means that a specific vascular pedicle is responsible for a given distribution of tissue. For this purpose, flaps can be either myocutaneous (muscle-skin flaps), fasciocutaneous (fascia, subcutaneous tis-

sue, and skin) or adipocutaneous (containing fat and skin). Examples include the latissimus dorsi myocutaneous flap, the transverse thoracoepigastric skin flap, and the lateral thoracic adipocutaneous flap.⁴⁻⁶

The **latissimus dorsi myocutaneous flap** is used most often, especially when more than 25% of the breast volume has been resected. Since a large volume of tissue is removed, either the tumor and a margin can be resected or a nipple-sparing subcutaneous mastectomy may be performed¹⁰ (nipple-sparing mastectomy would not be breast-conserving and has been discussed earlier in this supplement). This myocutaneous flap is based on the thoracodorsal vessels and was first described for volume replacement after breast-conserving surgery by Noguchi et al.¹³ A benefit of this flap is that most patients do not need reduction of the contralateral breast for symmetry, as the flap usually provides adequate tissue volume.⁴ This is beneficial for the patient, as she is not exposed to the potential complications of an operation on the contralateral breast.

The **lateral thoracic adipocutaneous flap** is another option. This flap has the benefit of sparing the muscle while using skin and fat from the axillary region. It can be based on one of three vascular pedicles that have been shown to be reliable as a sole blood supply. The most common pedicle for this technique is the thoracodorsal artery, as the main blood supply for the thoracodorsal artery perforator flap. This flap provides a potentially large amount of tissue for use and affords patients the chance to have a redundant roll of axillary tissue removed. This tissue can be used alone for reconstruction or in conjunction with a breast implant.⁶

One drawback of the latissimus dorsi flap is the potential for mismatch of skin color and texture when there is a need to address a significant skin deficit on the breast. Replacing a whole aesthetic unit, as opposed to only a small skin paddle, can minimize this potential; thus, using a larger amount of skin may provide a better aesthetic result. Rarely, if there is no skin defect, the muscle alone can be used, with no skin component.⁵ The lateral thoracic flap, on the other hand, may be more similar in skin color and texture to the native



FIGURE 3. Preoperative (left) and postoperative (right) photos of a 64-year-old woman who underwent right partial mastectomy and moderate reduction mammoplasty/mastopexy for symmetry. The postoperative photo was taken 1 month after surgery.

breast and may allow the scar to be better hidden in the axilla than is the case with the latissimus dorsi flap.⁶ Any type of flap presents potential donor site problems as well as breast complications (discussed below).

Flap reconstruction broadens the application of breast conservation therapy to women who would not otherwise be candidates because of the large volume of tissue they need to have removed.² Oncoplasty reconstruction also allows the oncologic surgeon to be more aggressive with tissue removal without concerns about compromising the aesthetic outcome. Patients with small to moderate breasts are therefore candidates for flap reconstruction, as even modest resections in such patients result in a large volume of tissue loss and the need for additional tissue to reconstruct the breast.¹⁴ Any of the aforementioned flaps are advantageous, as they are in close proximity to the breast and can readily be used for reconstruction.⁶

■ CHOICE OF TECHNIQUE

Many factors contribute to the choice among reconstructive methods for a particular patient after breast conservation therapy.

Tumor location plays a significant role. Kronowitz et al described using breast reduction as their primary reconstructive modality, particularly for tumors of the upper inner, upper outer, and lower inner quadrants of the breast.⁴ They used flap reconstruction only for outer-quadrant tumors, and they found that tumors of the lower outer quadrant were the largest and lent themselves to local tissue rearrangement, often with axillary tissue.⁴ Centrally located tumors usually require removal of the nipple-areola complex and can be challenging to reconstruct. The techniques include either (1) direct closure with some degree of local tissue remodeling, or (2) reduction mammoplasty. The majority of patients with centrally located tumors will need contralateral breast reduction for symmetry¹⁴ and nipple-areola reconstruction at a later date.

The size of the defect created by the tumor resec-

tion also significantly affects the choice of technique, as does the patient's preoperative brassiere size. In the analysis by Kronowitz et al, defects smaller than 20% of the overall breast size were found to be amenable to breast reduction, whereas larger defects were reconstructed with flaps or local tissue rearrangement.⁴ Also, women with a brassiere cup size of D or larger tended to undergo breast reduction, whereas those with a size smaller than D underwent local tissue rearrangement or flap reconstruction.⁴

One way to conceptualize the type of reconstruction needed is to consider the defect size in relation to the breast size, as delineated in **Table 1**. Small and medium-sized breasts with medium-sized defects not only need reshaping but also may need reallocation of tissue from the axilla to the breast. This will result in additional scars, but they should not be noticeable when the patient is clothed. Small or medium-sized breasts with large defects are generally not amenable to local tissue rearrangement, and latissimus dorsi flap reconstruction is preferred. The volume of tissue provided by the flap can correct the majority of these defects. Lastly, large breasts with large defects are most amenable to breast reshaping, with a contralateral operation to provide symmetry (ie, reduction mammoplasty).⁵

■ COMPLICATIONS

Complications of breast surgery include seromas (of the breast as well as the donor site when a flap is used), nipple necrosis, wound dehiscence, infection, hematoma, fat necrosis, and mastectomy flap necrosis. Postoperative hematomas and superficial wound infections tend to occur in the immediate postoperative period (usually within the first few days), whereas the other complications mentioned may take 1 to 2 weeks to develop. These complications are common to all breast operations and are not specific to reconstruction after breast conservation therapy.

Postoperative complications vary in frequency but are more common when reconstruction is delayed.^{4,7}

TABLE 1
Algorithm for selecting a reconstructive technique following breast conservation therapy

Breast size	Defect size	Technique
Small	Small-medium	Local tissue rearrangement/myocutaneous flap*
Medium	Small-medium	Local tissue rearrangement/myocutaneous flap*
Small-medium	Large	Myocutaneous flap*
Large	Small-medium	Primary closure
Large	Medium-large	Reduction mammoplasty

*"Myocutaneous flap" refers to any flap reconstruction technique.

They also vary depending on the reconstructive technique. Donor-site seromas and fat necrosis are most common with immediate reconstruction using a flap; wound dehiscence is most common with delayed local tissue rearrangement; and breast seroma is most common with delayed reduction mammoplasty.⁴

Other issues to consider include the possible delay in adjuvant therapy in patients who experience wound healing problems, especially in those who are obese, who smoke, or who undergo therapeutic mammoplasty.^{15,16} Moreover, operative time is increased with oncoplasty as compared with simple wide local excision, which increases patients' exposure to anesthesia and thereby raises the risk of complications, particularly in older patients with comorbidities.¹⁶

Risk factors for complications

Certain patient characteristics carry an increased risk for postoperative complications. These include tobacco smoking, previous breast surgeries, comorbidities that impair wound healing, and obesity.^{4,15-17}

The vasoconstrictive, thrombotic, and hypoxic effects of tobacco place patients who smoke at an increased risk for necrosis of the nipple-areola complex, as well as for pulmonary complications, when breast reduction is performed. The standard recommendation is cessation of smoking for 6 to 8 weeks preoperatively to reduce pulmonary risks, although rigorous scientific validation is lacking.¹⁷

Breasts that have been previously operated on have scarring of the skin and subcutaneous tissues, which may affect the surgical incision and technique. Additionally, vascular compromise of the underlying breast tissue and nipple-areola complex is a possibility in patients who have had previous breast operations.⁴ For these reasons, it is of utmost importance to obtain a full history of any

previous breast procedures a patient has had.

Obesity is a risk factor for impaired wound healing, as delayed wound healing has been correlated with increased body mass index in patients undergoing breast reduction.¹⁵

What about positive margins?

Addressing positive margins can be problematic after breast conservation therapy with immediate reconstruction, as it is difficult to locate the resection margin after the breast tissue has been rearranged.^{4,5,12,14} Patients who have positive margins will usually need to undergo completion mastectomy and opt for immediate reconstruction with a transverse rectus abdominis myocutaneous (TRAM) flap or a latissimus dorsi flap with an implant. Therefore, use of a TRAM flap for initial reconstruction after breast conservation therapy is discouraged.^{4,14} If a TRAM flap is needed to restore the shape and contour of the breast after breast conservation, it is usually better to perform a mastectomy, as it provides a superior aesthetic result and reduces the risk of a subsequent malignancy since the breast tissue is removed.⁵

PATIENT COUNSELING, PREOPERATIVE PLANNING

The diagnosis of breast cancer is devastating for most women and is compounded by mental anguish associated with the anticipated changes in their appearance.¹⁰ There is a psychological advantage to having reconstruction performed during the same operation as resection because the breast's preoperative form is immediately restored and little to no asymmetry is seen postoperatively.¹² One study showed that breast cancer patients who underwent reconstructive surgery had better body images and felt they had more control over their treatment compared with patients who simply had breast conservation therapy or mastectomy without reconstruction; these perceptions also conferred a psychological benefit among the patients who had reconstructive procedures.¹⁸

At the same time, all patients need to be counseled about the potential drawbacks of reconstruction, including the possibility of reoperation for positive margins, wound complications, or a disappointing or unacceptable aesthetic outcome.

Oncoplastic surgery is a multispecialty collaboration. Good communication and preoperative planning is imperative and must include the general surgeon, plastic surgeon, oncologist, and, most importantly, the patient. Considerations in how to approach diagnostic biopsies, lymph node sampling, timing of contralateral breast symmetrizing procedures, and the possibility of positive margins all need to be discussed preoperatively.^{8,10}

■ ADDITIONAL CONSIDERATIONS

Timing of reconstruction

Immediate reconstruction is preferred for many reasons, including a reduced incidence of wound healing problems, facility in administering postoperative radiation therapy, and better aesthetic results.^{3,4,11} A one-stage procedure also facilitates breast remodeling, as there is no scar tissue to deal with. Patients' psychological trauma of coping with a deformity is also reduced because better symmetry is achieved with immediate reconstruction.¹⁰

Additionally, some authors have reported lower rates of local recurrence in breast conservation therapy patients who received immediate reconstruction, likely owing to the larger amount of tissue resected and subsequent lower incidence of positive margins.^{4,11,14} Local recurrence in patients undergoing breast conservation therapy and oncoplasty is between 2% and 9%, depending on the study.^{11,12}

Postoperative surveillance

Postoperative surveillance can still be performed effectively despite the tissue transposition involved in any of the oncoplastic reconstruction techniques. A new baseline mammogram is obtained, to which future imaging studies are compared. Fat necrosis may appear to be new calcifications. Titanium clips may also be placed within the defect cavity so that it can be tracked to its new location. These clips also aid in localizing postoperative radiation therapy.¹¹

Patient satisfaction

Several studies have assessed patient satisfaction with breast conservation therapy without and with reconstruction. Following breast conservation therapy without reconstruction, cosmetic results are rated as poor by 15% to 20% of patients.¹⁰ Patients notice breast asymmetry and are generally dissatisfied to some degree after breast conservation with radiation therapy and no further reconstruction.³ In contrast, a survey in a series of patients who had oncoplasty found that 95% reported good aesthetic results at short-term follow-up.¹⁰ Another series found that 88% of patients undergoing oncoplastic techniques reported fair to excellent outcomes at 2 years, and 82% did so at 5 years.¹² When these patients were further analyzed, assessments of cosmetic outcomes were worse in those who received preoperative rather than postoperative radiation therapy.¹²

■ SUMMARY

Oncoplastic surgical approaches can be applied to the full spectrum of patients undergoing breast conservation therapy. They are particularly useful when a large defect is anticipated, when a symmetrizing procedure is desired

for the contralateral breast, and when the tumor-to-breast volume ratio is unfavorable for simple closure.¹⁴ Immediate reconstruction is clearly preferred over delayed reconstruction, as it is associated with fewer complications, easier administration of postoperative radiation therapy, better aesthetic results, and possibly lower rates of local recurrence. Patients are more satisfied with the cosmetic outcome of oncoplastic procedures compared with breast conservation therapy alone. Successful oncoplasty requires thorough patient counseling and comprehensive preoperative planning among patient, oncologist, and general and plastic surgeons.

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