

# Determining the Optimal Approach to Breast Reconstruction after Partial Mastectomy

Steven J. Kronowitz, M.D.  
 Jules A. Feledy, M.D.  
 Kelly K. Hunt, M.D.  
 Henry M. Kuerer, M.D.  
 Adel Youssef, M.D., Ph.D.  
 Cindy A. Koutz, M.S., P.A.-C.  
 Geoffrey L. Robb, M.D.

*Houston, Texas*

**Background:** Unfortunately, patients who desire repair of contour deformities after partial mastectomy usually present after radiation therapy, which may increase the risk of complications and result in a poor aesthetic outcome. The authors reviewed their experience with repair of partial mastectomy defects to determine the optimal approach to breast reconstruction after partial mastectomy.

**Methods:** Sixty-nine patients who underwent repair of a partial mastectomy defect and received radiation therapy were included in this analysis. The reconstructive techniques were categorized as local tissue rearrangement (LTR), breast reduction, or use of a latissimus dorsi myocutaneous flap or thoracoepigastric skin flap (hereafter referred to as “flap”).

**Results:** Fifty patients underwent immediate reconstruction before radiation therapy, and 19 underwent delayed reconstruction after radiation therapy. The reconstructive techniques in patients with immediate reconstruction were local tissue rearrangement in 28 percent, breast reduction in 66 percent, and flaps in 6 percent. In patients with delayed reconstruction, 32 percent had local tissue rearrangement, 42 percent had breast reduction, and 26 percent had flaps. The complication rates for immediate and delayed reconstruction were 26 percent and 42 percent, respectively. Overall, and in the setting of immediate reconstruction, the flap technique was associated with a higher complication rate than local tissue rearrangement and breast reduction. However, in the setting of delayed reconstruction, the flap technique was associated with a lower complication rate than the other two techniques. Fifty-seven percent of the immediate reconstructions performed with the local tissue rearrangement or breast reduction technique, but only 33 percent of the immediate reconstructions performed with the flap technique, were associated with an excellent or good aesthetic outcome.

**Conclusion:** Immediate repair of partial mastectomy defects with local tissues results in a lower risk of complications and better aesthetic outcomes than immediate repair of partial mastectomy defects with a latissimus dorsi flap. (*Plast. Reconstr. Surg.* 117: 1, 2006.)

**P**artial mastectomy followed by radiation therapy—referred to as breast conservation therapy—is recommended as the treatment of choice for women with early-stage breast cancer, provided that the margins of resection are free of tumor and an acceptable cosmetic result can be obtained.<sup>1</sup> Breast conservation therapy can be complicated by significant contour deformities,<sup>2</sup>

which can result in poor aesthetic outcomes and difficulties with activities of daily living. Unfortunately, patients who desire reconstruction of contour deformities after partial mastectomy usually present after radiation therapy, which may increase the risk of complications and often necessitates the use of autologous tissue for reconstruction.<sup>3</sup> These patients often have hopes of secondary correction; unfortunately, the results are often disappointing.<sup>4</sup> Although patients treated with mastectomy often request immediate breast reconstruction, patients treated with breast conservation therapy usually do not inquire about immediate reconstruction because breast preservation may provide sufficient psychological satisfaction, they may fear additional operations, or they may not be aware of the reconstructive option.<sup>5</sup>

We reviewed our experience with repair of partial mastectomy defects to determine the op-

*From the Departments of Plastic and Reconstructive Surgery and Surgical Oncology, The University of Texas M. D. Anderson Cancer Center.*

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timal approach to breast reconstruction after partial mastectomy with regard to whether immediate reconstruction (performed at the time of partial mastectomy, before radiation therapy) or delayed reconstruction (performed after radiation therapy) is superior in terms of complication rates and aesthetic outcomes. In addition, we wanted to determine whether it is reasonable from an oncology standpoint to perform immediate reconstruction after partial mastectomy, so we evaluated the risk of a positive postoperative tumor margin and the potential for local recurrence of breast cancer after immediate reconstruction. Whereas previous reports have offered recommendations largely based on clinical experience,<sup>5-7</sup> we sought to conduct a data-derived analysis to objectively determine the optimal approach to the repair of partial mastectomy defects.

## PATIENTS AND METHODS

Between 1990 and 2002, 84 patients underwent immediate or delayed repair of a partial mastectomy defect at The University of Texas M. D. Anderson Cancer Center. Of these 84 patients, 69 received radiation therapy either before or after reconstruction and were included in the analysis. Radiation therapy was delivered to the ipsilateral breast tissue and, when indicated, the draining lymphatics. A minimum dose of 50 Gy was administered using megavoltage irradiation. Each field was treated daily. Subsequently, the operative bed was boosted with an additional 10 to 15 Gy using either external-beam or interstitial techniques. Data were gathered by review of hospital records, query of a database containing records for all patients treated with breast conservation therapy, and assessment of patient photographs. Database queries regarding the reconstructions were verified by review of the medical records.

Body mass index was defined as the patient's weight in kilograms divided by the patient's height in meters squared. The mean extirpative defect size was calculated as follows:

$$\text{defect size} = \text{volume of resection specimen} / \text{preoperative volume of breast}$$

The relative proportions of glandular tissue and fat within breast tissue and their respective densities indicate that the density of breast tissue is 1.0 g/cm<sup>3</sup> (density of water).<sup>8</sup> Thus, the volume of breast tissue in cubic centimeters is equal to the weight of breast tissue in grams. For this study, the volume of each breast resection specimen was determined by weighing the specimen. Similarly, the preoperative volume of the entire breast was de-

termined by estimating the weight of the breast using the patient's brassiere cup size and chest wall circumference on the basis of previous work by Bostwick.<sup>9</sup>

For analysis, the reconstructions were grouped according to timing (immediate or delayed) and technique. The three techniques used were as follows: local tissue rearrangement, which involved the use of local breast tissue, subcutaneous tissue, or skin from the breast or axillary region with a random blood supply and without the creation of a parenchymal pedicle of breast tissue; breast reduction, which involved the creation of a parenchymal pedicle of de-epithelialized breast tissue with or without an intact nipple-areola complex; and the use of a latissimus dorsi myocutaneous flap or a transverse thoracoepigastric skin flap with an axial-based blood supply (hereafter referred to as "flap").

Complications of repair of partial mastectomy defects were defined as nipple necrosis, seroma formation at the recipient site after flap reconstruction, seroma formation at the donor site after flap reconstruction, wound dehiscence, infection, hematoma, fat necrosis, and mastectomy skin flap necrosis. Complications of contralateral breast reduction were defined as nipple necrosis, seroma, wound dehiscence, infection, hematoma, fat necrosis, and mastectomy skin flap necrosis.

Aesthetic outcomes were evaluated by review of postoperative photographs. Photographs were only available for 19 of the patients who were included in this analysis. Ten of them had undergone immediate reconstruction (four with local tissue rearrangement, three with breast reduction, and three with the flap technique) and nine had undergone delayed reconstruction (three with local tissue rearrangement, four with the breast reduction, and two with the flap technique). A panel of 23 physician assistants, nurses, and plastic surgery fellows who did not participate in these reconstructions blindly evaluated the patients' photographs. A four-point scale was used to evaluate the aesthetic outcomes, with 4 = excellent, 3 = good, 2 = fair, and 1 = poor. Results were considered excellent when the patient's reconstructed breast had an almost perfect shape and this breast was perfectly symmetrical with the contralateral breast. A good result indicated that the reconstructed breast was imperfect but breast symmetry was within normal limits. Results were rated as fair when there was some breast asymmetry but the shape of the reconstructed breast was reasonably normal, and poor when both shape and symmetry were unacceptable.

Statistical analysis was performed with Fisher’s exact test, the kappa test, and multiple logistic regression. Complication rates were analyzed per reconstruction, and observations from the same patient were assumed to be independent. No corrections were performed for multiple comparisons. For simplicity, means were presented. Probability (*p*) values less than or equal to 0.05 were considered significant.

### RESULTS

Fifty patients underwent immediate reconstruction (performed at the time of partial mastectomy, before radiation therapy), with a mean interval between reconstruction and radiation therapy of 3 months. Nineteen patients underwent delayed reconstruction (performed after radiation therapy), with a mean interval between radiation therapy and reconstruction of 4 months. The mean follow-up time overall was 35 months. Mean follow-up for patients in the immediate reconstruction group was 29 months, and mean follow-up for patients in the delayed reconstruction group was 54 months.

#### Factors Affecting Selection of Reconstructive Technique

Table 1 summarizes the effect of timing of the reconstruction and tumor location on the selection of reconstructive technique. Breast reduction was the most common reconstructive technique in both the immediate and delayed reconstruction groups. The majority of reconstructions (49 percent) were performed for tumors located in the upper outer quadrant of the breast. Tumor location had a significant effect on the type of reconstructive procedure performed (*p* = 0.03), with breast reduction used most often with tumors located in the upper outer, upper inner, and lower

inner quadrants of the breast. The flap technique was only utilized to reconstruct defects in the outer quadrants of the breast. The lower outer quadrant had the largest defects (mean defect size, 27 percent of breast volume), and defects in this quadrant were most often repaired with the local tissue rearrangement technique.

Table 2 summarizes the effects of clinicopathologic characteristics on the selection of reconstructive technique. The only significant predictors of reconstructive technique were mean defect size (smaller for breast reduction than for local tissue rearrangement or flap reconstructions) and brassiere cup size (patients with a cup size of D or larger were more likely to undergo breast reduction reconstruction, and patients with a cup size of D or smaller were more likely to undergo local tissue rearrangement or flap reconstruction). Smoking status (current or former smokers were more likely to undergo local tissue rearrangement or flap reconstruction than breast reduction reconstruction), previous surgery on the ipsilateral breast (patients with previous surgery were more likely to undergo local tissue rearrangement or flap reconstruction than breast reduction reconstruction), and mean weight of the partial mastectomy specimen (specimens were larger for breast reduction than for local tissue rearrangement or flap reconstructions) showed a trend toward statistical significance.

#### Factors Affecting Complication Rates

Table 3 lists the complication rates by timing of reconstruction and reconstructive technique. Overall and with the local tissue rearrangement and breast reduction techniques, delayed reconstruction was associated with a complication rate almost twice that of immediate reconstruction. With the flap technique, however, the complica-

**Table 1.** Effect of Timing of Reconstruction and Tumor Location on Selection of Reconstructive Technique

Variable	Reconstructive Technique, No. of Patients (%)		
	LTR ( <i>n</i> = 20)	BR ( <i>n</i> = 41)	FLAP ( <i>n</i> = 8)
Timing of reconstruction*			
Immediate	14 (28)	33 (66)	3 (6)
Delayed	6 (32)	8 (42)	5 (26)
Tumor location†			
Upper outer	7 (21)	23 (68)	4 (12)
Upper inner	4 (36)	7 (64)	–
Lower outer	6 (50)	2 (17)	4 (33)
Lower inner	1 (13)	7 (88)	–
Central	2 (50)	2 (50)	–

BR, breast reduction; FLAP, reconstruction with a latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement.

\**p* = 0.05.

†*p* = 0.03.

**Table 2.** Effect of Clinicopathologic Factors on Selection of Reconstruction Technique

Clinicopathologic Factor	Reconstructive Technique, No. of Patients (%)			<i>p</i>
	LTR ( <i>n</i> = 20)	BR ( <i>n</i> = 41)	FLAP ( <i>n</i> = 8)	
Patient age				0.69
≤50 years	8 (40)	12 (29)	2 (25)	
≥51 years	12 (60)	29 (71)	6 (75)	
Mean BMI*	29	33	29	0.14
Brassiere cup size†				<0.001
A	1 (5)	0 (0)	0 (0)	
B	7 (37)	0 (0)	1 (14)	
C	2 (11)	3 (7)	2 (29)	
D	6 (31)	12 (30)	3 (43)	
DD	2 (11)	19 (48)	1 (14)	
DDD‡	1 (5)	6 (15)	0 (0)	
Smoking status				0.08
Current or former smoker	9 (45)	9 (22)	4 (50)	
Nonsmoker	11 (55)	32 (78)	4 (50)	
Previous surgery on ipsilateral breast§				0.09
Yes	10 (50)	10 (24)	4 (50)	
No	10 (50)	31 (76)	4 (50)	
Mean weight of partial mastectomy specimen	194 g	253 g	236 g	0.081
Mean defect size	24%	18%	34%	0.053

BMI, body mass index; BR, breast reduction; FLAP, reconstruction with a latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement.

\*Body mass index = patient's weight (kg)/patient's height (m<sup>2</sup>).

†Initial brassiere cup size before partial mastectomy. Brassiere size was available for only 66 patients.

‡Any brassiere cup size greater than DD was included in this category.

§Surgery on involved breast before partial mastectomy with either immediate or delayed reconstruction. Included partial mastectomy, partial mastectomy with axillary lymph node dissection or sentinel lymph node biopsy, and bilateral breast reduction.

||Weight of breast cancer resection specimen (g)/projected breast weight based on initial brassiere cup size and chest wall circumference (g).

tion rate was higher in the setting of immediate reconstruction. Overall and in the setting of immediate reconstruction, the flap technique was associated with a higher complication rate than the local tissue rearrangement and breast reduction techniques. However, in the setting of delayed reconstruction, the flap technique was associated with a lower complication rate than the local tissue rearrangement and breast reduction techniques.

Table 4 lists the specific complications by timing of reconstruction and reconstructive technique. Immediate reconstruction with the flap technique was associated with a high rate of seroma formation at the donor site. Complications observed with immediate reconstruction with the local tissue rearrangement and breast reduction

techniques were similar to those commonly encountered with standard reduction mammoplasty. Among the 41 patients who underwent breast reduction, four (10 percent) required a free nipple graft or a nipple reconstruction. Free nipple grafts were required only with immediate reconstruction. In contrast, delayed reconstruction—especially with local tissue rearrangement and breast reduction—was associated with a high incidence of complications that are often associated with poor wound healing after radiation therapy.

Table 5 shows the relationship between the mean intervals between treatments and the occurrence of complications. For immediate reconstruction, the mean interval between reconstruction and radiation therapy did not differ between patients who had complications and those who did

**Table 3.** Complication Rates by Timing of Reconstruction and Reconstructive Technique\*

Timing of Reconstruction	No. (%) of Reconstructions Associated with Complications			
	All ( <i>n</i> = 69)	LTR ( <i>n</i> = 20)	BR ( <i>n</i> = 41)	FLAP ( <i>n</i> = 8)
All	21/69 (30)	6/20 (30)	12/41 (29)	3/8 (38)
Immediate ( <i>n</i> = 50)	13/50 (26)	3/14 (21)	8/33 (24)	2/3 (67)
Delayed ( <i>n</i> = 19)	8/19 (42)	3/6 (50)	4/8 (50)	1/5 (20)

BR, breast reduction; FLAP, reconstruction with a latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement.

\*Complications included nipple necrosis, donor- or recipient-site seroma, wound dehiscence, infection, hematoma, fat necrosis, and mastectomy skin flap necrosis.



not. For delayed reconstruction, the mean interval between partial mastectomy and radiation therapy was shorter for patients with complications, which may reflect less time for the remaining breast tissue to re-establish a local blood supply before the start of radiation therapy. Also for delayed reconstruction, the mean interval between the radiation therapy and reconstruction was longer for patients with complications. This finding contradicts the adage that waiting longer after radiation therapy to perform surgery will result in fewer complications.

**Factors Affecting Aesthetic Outcomes**

Table 6 shows the aesthetic outcome scores by timing of reconstruction and reconstructive technique. The proportion of patients with good to excellent aesthetic outcome was similar to that for patients who underwent reconstruction with local tissue rearrangement (Fig. 1) or breast reduction (Fig. 2) and patients who underwent reconstruction with the flap (Fig. 3) technique. In the setting of immediate reconstruction, the use of local tissues was associated with better aesthetic outcomes; however, in the setting of delayed reconstruction, the use of a flap was associated with better aesthetic outcomes.

Table 7 lists the factors that influenced the need for a contralateral breast reduction: reconstructive technique, tumor location, and brassiere cup size. Sixty-eight percent of all the reconstructions required a contralateral breast reduction for symmetry. The majority of breast reductions were performed after reconstruction with the breast reduction technique. No patients who had reconstruction performed with the flap technique required a contralateral breast reduction for symmetry. Patients with brassiere cup sizes of C or less and those with partial mastectomy defects located in the lower outer quadrant were less likely to require a contralateral breast reduction for symmetry. The need for a contralateral breast reduction for symmetry was associated with a complication rate of 17 percent.

Analysis with the kappa test revealed significant agreement between the design of the ipsilateral parenchymal pedicle for the breast reduction reconstructions and the design of the parenchymal pedicle for contralateral breast reductions performed to achieve breast symmetry (kappa, 56.4 percent; *p* = 0.001). Among patients who underwent contralateral breast reduction, there was a statistically significant relationship between the amount of tissue removed to achieve breast

**Table 4.** Specific Complications

Timing of Reconstruction and Reconstructive Technique	No. (%) of Reconstructions Associated with Complications							
	Nipple Necrosis	Hematoma†	Recipient-Site Seroma†	Donor-Site Seroma‡	Wound Dehiscence†	Infection†	Fat Necrosis†	Breast Skin Necrosis
Immediate								
LTR	—	—	2/14 (14)	—	—	1/14 (7)	—	—
BR	—	1/33 (3)	—	—	1/33 (3)	1/33 (3)	4/33 (12)	2/33 (6)
FLAP	—	—	—	1/3 (33)	—	—	1/3 (33)	—
Delayed								
LTR	—	—	1/6 (17)	—	2/6 (33)	—	1/6 (17)	1/6 (17)
BR	1/8 (13)	—	3/8 (38)	—	1/8 (13)	1/8 (13)	1/8 (13)	—
FLAP	—	—	—	—	—	1/6 (20)	1/5 (20)	—

BR, breast reduction; FLAP, latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement.

†Complication refers to a complication occurring within the remaining breast tissue or the transferred flap.

‡Seroma at site of harvest of latissimus dorsi myocutaneous flap.

**Table 5.** Mean Intervals between Treatments According to the Occurrence of Complications

Intervals	All	No Complications	Complications*
Immediate reconstruction PM + Recon → XRT	3 mo	3 mo	3 mo
Delayed reconstruction PM → XRT	4 mo	4 mo	3 mo
XRT → Recon	37 mo	28 mo	44 mo

PM, partial mastectomy; Recon, reconstruction; XRT, radiation therapy.

\*Complications included nipple necrosis, donor- or recipient-site seroma, wound dehiscence, infection, hematoma, fat necrosis, and mastectomy skin flap necrosis.

symmetry in the ipsilateral and contralateral breasts ( $r = 0.93$ ,  $p = 0.001$ ). The mean values of resected breast tissues for the breast reduction reconstructions and for the contralateral breast reductions for symmetry were 626 g and 882 g, respectively.

### Factors Affecting the Risk of Positive Margins and Local Recurrence

Table 8 shows the relationship between timing of partial mastectomy reconstruction and reconstructive technique and the rates of positive postoperative tumor margins and local recurrence of breast cancer. Only 5 percent of the patients had a positive tumor margin after review of permanent sections. No patient who underwent reconstruction with the flap technique had a positive postoperative tumor margin. Seventy-five percent of the patients who had a positive postoperative margin had a completion mastectomy, and two thirds of these patients also underwent immediate transverse rectus abdominis myocutaneous (TRAM) flap reconstruction.

Six percent of the patients developed a local recurrence of breast cancer. Delayed reconstruction after radiation therapy ( $p = 0.06$ ) and reconstruction using the flap technique were associated with higher rates of local recurrence. Seventy-five percent of the patients who developed a local recurrence of breast cancer had a completion mastectomy with immediate TRAM flap reconstruction.

## DISCUSSION

Despite a documented high level of patient satisfaction with breast conservation therapy, clinical practice indicates that patients are willing to accept significant deformity to preserve their breasts. Studies have shown that in many cases, outcomes after partial mastectomy and radiation therapy that are rated by patients as good to excellent are rated by plastic surgeons as poor.<sup>10,11</sup> Although the patient's opinion is certainly more

important than the plastic surgeon's, offering patients a better alternative—immediate repair of partial mastectomy defects—may ultimately improve patient satisfaction.

We found that immediate repair of partial mastectomy defects using local tissue rearrangement or breast reduction is preferable to delayed repair because of a decreased incidence of complications. Immediate reconstruction with local tissue rearrangement or breast reduction also results in a better aesthetic outcome than immediate repair with a flap because use of local tissues maintains the color and texture of the breast.<sup>6</sup> Delayed reconstruction after radiation therapy usually requires the use of autologous tissue to provide additional blood supply to assist with healing within the irradiated operative field.

The breast reduction technique was extremely versatile in the repair of partial mastectomy defects, as indicated by the fact that this was the most commonly used technique in our series. However, use of breast reduction was largely limited to patients with a brassiere cup size of D or larger, because this technique usually requires a significant amount of remaining breast tissue after tumor resection to reconstruct a breast with sufficient volume, shape, and contour. Breast reduction was the least commonly used technique in smokers and in patients who had previous surgery on the involved breast. The vasoconstrictive effects of nicotine and other byproducts of smoking<sup>12</sup> likely increased existing concerns about preserving the blood supply to the nipple-areola complex. Existing scars on the breast skin can make it difficult to design a suitable skin resection pattern for delayed reconstruction with the breast reduction technique. Internal parenchymal scarring can also disrupt the local blood supply and the ability to create a viable parenchymal pedicle.

In most quadrants of the breast, breast reduction was the most common method of reconstruction after partial mastectomy. However, for defects in the lower outer quadrant, reconstruction was most often accomplished with the local skin and

**Table 6.** Aesthetic Outcomes by Timing of Reconstruction and Reconstructive Technique\*

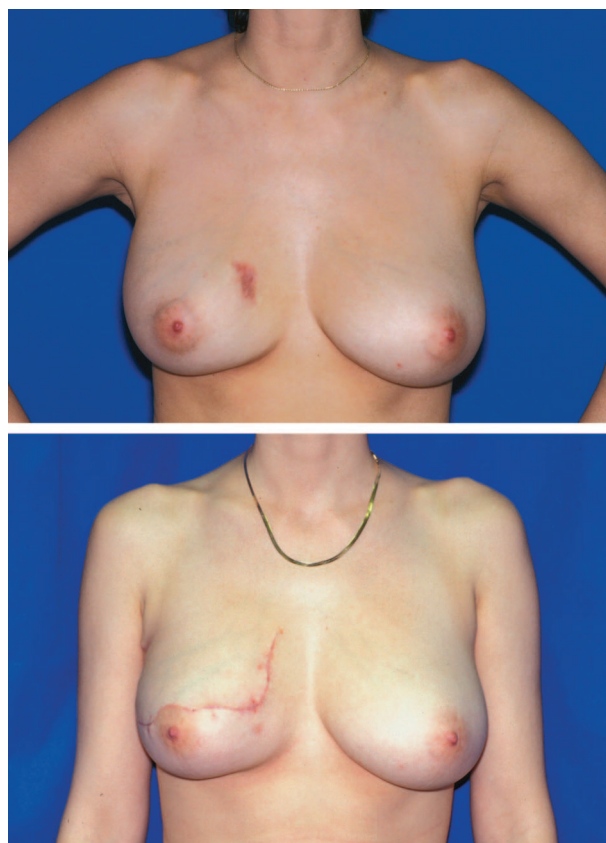
Reconstructive Technique	Aesthetic Outcome, No. of Patients (%)			
	All†		Delayed§	
	Excellent or Good	Fair or Poor	Excellent or Good	Fair or Poor
LTR or BR	9 (64)	5 (36)	4 (57)	5 (71)
FLAP	3 (60)	2 (40)	1 (33)	2 (100)

BR, breast reduction; FLAP, latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement.  
 \*As opposed to the calculation of complication rates, which were based on each reconstructed breast, an aesthetic outcome score was determined for each patient. Aesthetic outcomes were evaluated for 10 patients who underwent immediate reconstruction and nine patients who underwent delayed reconstruction.

†Mean intervals: reconstruction → photograph, 10 months; radiation therapy → photograph, 2 years 3 months. Mean defect size: 21 percent.

‡Mean intervals: reconstruction → photograph, 12 months; radiation therapy → photograph, 8 months. Mean defect size: 23 percent.

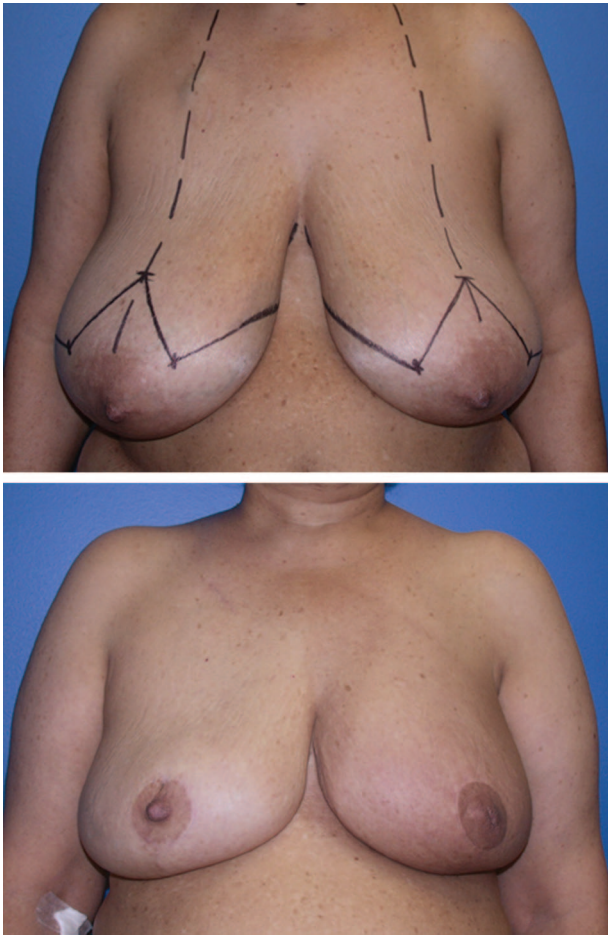
§Mean intervals: reconstruction → photograph, 8 months; radiation therapy → photograph, 4 years. Mean defect size: 19 percent.



**Fig. 1.** Immediate breast reconstruction after partial mastectomy in a 32-year-old woman who presented with a T1N0 (stage I) invasive ductal carcinoma. (Above) Preoperative view. The patient's brassiere size was 36D, and she had previously undergone open biopsy of the tumor. (Below) Postoperative view 2 years and 11 months after reconstruction and 2 years and 8 months after radiation therapy. The patient underwent immediate reconstruction with the local tissue rearrangement technique for a 7 percent defect in the upper inner quadrant of the right breast. The mean aesthetic outcome score was 2.96 (fair to good outcome).

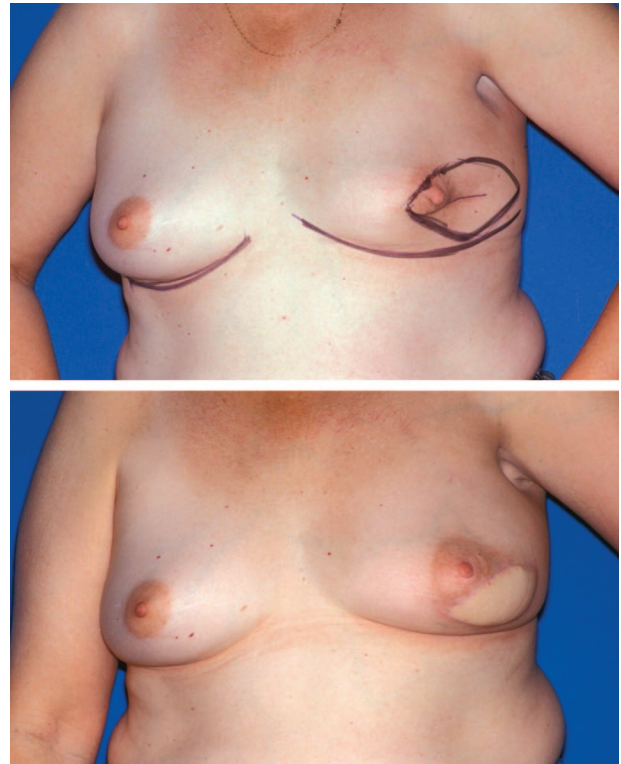
subcutaneous tissue from the axillary region (local tissue rearrangement technique). The axillary skin and subcutaneous tissue are directly adjacent to this region and can provide the ideal volume of tissue to reconstruct the lateral aspect of the breast.<sup>13</sup> Interestingly, the flap technique was used only to repair defects located in the outer quadrants of the breast. The largest defects, which were usually located in the lower outer quadrant, were usually repaired with the flap technique. The most likely explanation for these findings is that the bulk of a latissimus dorsi myocutaneous flap cannot be easily transposed to the inner quadrants of the breast but can easily be transposed to the lateral aspects of the breast.





**Fig. 2.** Immediate breast reconstruction after partial mastectomy in a 57-year-old woman with a 38DD brassiere size who presented with a T3N1 (stage III) invasive ductal carcinoma. (Above) Preoperative view. The patient had had an excellent response to neoadjuvant chemotherapy and desired breast conservation therapy. The patient was marked preoperatively with a Wise skin pattern. (Below) Postoperative view 9 months after reconstruction and 6 months after radiation therapy. The patient underwent immediate reconstruction with the breast reduction technique (inferomedially based parenchymal pedicle) for an 18 percent defect in the lower outer quadrant of the left breast. A right breast reduction was performed for symmetry. To optimize symmetry, the parenchymal pedicle designs and resection volumes for the contralateral breast were similar to those for the reconstructed breast. Also, to optimize symmetry, the involved breast was reconstructed before the contralateral breast was to permit optimal design of the parenchymal pedicle used for reconstruction (i.e., design that would allow the best volume match between the breasts). The mean aesthetic outcome score was 3.43 (good to excellent outcome).

A significant relationship existed between the reconstructive technique and the need for a contralateral breast reduction. As would be expected,



**Fig. 3.** Delayed breast reconstruction after partial mastectomy in a 60-year-old woman who presented with a T2N1 (stage II) invasive ductal carcinoma. (Above) Preoperative view after partial mastectomy and radiation therapy (50 Gy). The patient's brassiere size was 36B. (Below) Postoperative view 11 months after reconstruction and 15 months after radiation therapy. The patient underwent delayed reconstruction with the flap technique (pedicled latissimus dorsi myocutaneous flap) for a 23 percent defect in the lower outer quadrant of the left breast. The mean aesthetic outcome score was 2.57 (fair to good outcome).

most patients who underwent reconstruction with breast reduction also had a contralateral breast reduction. Most patients who underwent reconstruction with the flap technique did not require a contralateral breast reduction. A latissimus dorsi flap usually provides adequate skin and volume to restore the breast to its original size. The flap technique also tends to be used for outer quadrant defects, where there is some flexibility regarding the need to precisely replace the resected volume to obtain symmetry. Approximately half of the patients who underwent local tissue rearrangement required a contralateral breast reduction. Local tissue rearrangement was often used to repair defects in patients with small breasts, in whom even small defects can result in asymmetry with the contralateral breast.

The majority of patients with positive postoperative tumor margins after immediate repair of a



**Table 7.** Effect of Reconstructive Technique, Tumor Location, and Brassiere Cup Size on Requirement for a Contralateral Breast Reduction for Symmetry\*

Variable	No Contralateral Breast Reduction, No. (%)	Contralateral Breast Reduction, No. (%)	<i>p</i>
Reconstructive technique			<0.001
Overall	22 (32)	47 (68)	
LTR	12 (60)	8 (40)	
BR	2 (5)	39 (95)	
FLAP	8 (100)	–	
Tumor location			0.017
Upper outer	6 (18)	28 (82)	
Upper inner	2 (18)	9 (81)	
Lower outer	8 (67)	4 (33)	
Lower inner	2 (25)	6 (75)	
Central	2 (50)	2 (50)	
Brassiere cup size†			<0.001
A	1 (100)	–	
B	7 (88)	1 (12)	
C	6 (86)	1 (14)	
D	5 (24)	16 (76)	
DD	1 (5)	21 (95)	
DDD‡	–	7 (100)	

BR, breast reduction; FLAP, reconstruction with a latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement.

\*The need for a contralateral breast reduction for symmetry was associated with a complication rate of 17 percent.

†Initial brassiere cup size before partial mastectomy. Brassiere size was available for only 66 patients.

‡Any brassiere cup size greater than DD was included in this category.

partial mastectomy defect underwent a completion mastectomy with immediate TRAM flap breast reconstruction. This should alleviate concerns regarding the potentially awkward situation of trying to locate the position of positive margins discovered after an immediate repair using the breast reduction technique. This finding also demonstrates the importance of not using a TRAM flap for immediate reconstruction after partial mastectomy. A TRAM flap usually provides the ideal volume for total breast reconstruction, even in large-breasted patients or in patients who undergo bilateral mastectomy.

Although some patients may have other options besides a TRAM flap available for microvas-

cular tissue transfer to perform immediate reconstruction, the internal mammary blood vessels may still be required, which would preclude their use in any required future reconstruction. In addition, the thoracodorsal vessels are less often usable than the internal mammary vessels for delayed reconstruction after chest wall and axillary radiation therapy.<sup>14</sup> Furthermore, the use of the thoracodorsal dorsal vessels as recipient vessels for immediate reconstruction may prevent the use of an ipsilateral pedicled latissimus dorsi flap if a contour deformity were to occur as a consequence of radiation therapy.

Our finding of low rates of local recurrence (6 percent) after partial mastectomy reconstruction

**Table 8.** Effect of Timing of Reconstruction and Reconstructive Technique on Incidence of Positive Postoperative Tumor Margins and Local Recurrence of Breast Cancer

Factor	Positive Postoperative Tumor Margin* ( <i>n</i> = 4)	Local Recurrence of Breast Cancer† ( <i>n</i> = 4)
Timing of reconstruction		
All	5%	6%
LTR	5%	5%
BR	6%	5%
FLAP	0%	13%
Reconstructive technique		
Immediate	5%	2%
Delayed	–‡	16%§

BR, breast reduction; FLAP, reconstruction with a latissimus dorsi myocutaneous or thoracoepigastric flap; LTR, local tissue rearrangement. \*Based on the initial 84 patients before exclusion of patients who did not receive radiation therapy because radiation therapy did not affect the rate of positive postoperative tumor margins.

†Based on the 69 patients who received radiation therapy.

‡Positive postoperative tumor margins are only pertinent to immediate reconstruction after partial mastectomy.

§Borderline statistical significance (*p* = 0.06).

further substantiated the role of immediate reconstruction as a definitive method of breast reconstruction. The higher rate of local recurrence with delayed reconstruction (16 percent) was probably related to the larger tumor sizes, which probably affected the timing of reconstruction. The flap technique was associated with the highest risk of local recurrence (13 percent). The flap technique appeared to be used in situations where maybe consideration should have been given to performing a completion mastectomy with total breast reconstruction. The risk of local recurrence with the local tissue rearrangement and breast reduction techniques was only 6 percent, indicating that these reconstructive techniques were used optimally.

Our findings indicate that the majority of patients who develop a local recurrence and have a completion mastectomy will desire breast reconstruction. Seventy-five percent of the patients in our series who developed a local recurrence had a completion mastectomy with an immediate TRAM flap reconstruction. Again, this stresses the importance of preservation of reconstructive options, especially since the use of breast implants is not a preferred option after radiation therapy.<sup>15</sup>

Although using local tissue rearrangement and breast reduction for delayed reconstruction is technically feasible, the decreased healing properties of the irradiated local tissues are associated with a complication rate of 50 percent. Delayed reconstruction usually requires a latissimus dorsi flap because it assists with fluid reabsorption and wound healing within the irradiated field. However, it may be preferable to avoid delayed reconstruction with a latissimus dorsi flap (especially in patients who are not candidates for other autologous tissue options for delayed reconstruction after radiation therapy) or a TRAM flap, in case a completion mastectomy is later required because of a local recurrence or development of a contralateral breast cancer. To preserve reconstructive options, consideration should always be given to performing only a contralateral breast reduction for symmetry or a completion mastectomy with total breast reconstruction.

In addition to the advantages that have already been stated, immediate repair of partial mastectomy defects can facilitate the breast surgeon's ability to accomplish a widely negative resection margin around the tumor, which in turn has the potential to lower rates of local recurrence.<sup>6</sup> Immediate reconstruction with breast reduction may decrease the risk of local recurrence because of the additional breast tissue that is excised. In our

study, we found that the rate of local recurrence was 5 percent with breast reduction, compared with 13 percent for the flap technique, in which no additional breast tissue is usually removed.

Immediate reconstruction can also increase the eligibility of large-breasted patients for breast conservation therapy. Breast reconstruction (breast reduction technique) along with partial mastectomy represents an alternative for patients who would not otherwise be considered candidates for breast conservation therapy. Some radiation oncologists are reluctant to treat large-breasted women because of poor aesthetic outcomes and increased toxicity to the skin.<sup>16</sup> Radiation therapy delivered to a large breast can lead to increased fibrosis because of difficulties in daily set-up and because of the increased fat content of the breast.<sup>17</sup> The reduced size of the breast allows for more uniform delivery of radiation dose at lower levels, reducing unacceptable late radiation reactions.<sup>18,19</sup>

Although immediate reconstruction after partial mastectomy does not pose a problem with postoperative cancer surveillance,<sup>18</sup> with immediate reconstruction it may be difficult to locate the position of a positive tumor margin that is discovered postoperatively. A recent study from our institution<sup>20</sup> revealed that postoperative tumor margins were positive in 15.7 percent of patients who underwent partial mastectomy without reconstruction. However, it is important to note that these patients had defect sizes four times smaller than the defects in the patients in our series who had reconstruction. Larger defects in patients who undergo immediate reconstruction usually correlate with a lower incidence of positive postoperative tumor margins.<sup>4</sup>

A contralateral breast reduction is often required along with a partial mastectomy reconstruction (breast reduction and local tissue rearrangement techniques). This can be viewed as a disadvantage, but it also has the positive effect of allowing for sampling of breast tissue from the contralateral breast. Occult carcinomas have been found in 4.5 percent of contralateral breast reductions in patients undergoing a symmetry procedure for breast reconstruction.<sup>17</sup> Although the detection of occult carcinoma is not a reason to perform a contralateral breast reduction, it represents a potential benefit for high-risk patients.<sup>18</sup> Breast reduction surgery has been shown to significantly reduce the risk of breast cancer, especially among women over the age of 40 years.<sup>21</sup>

It is important to educate referring physicians regarding the value of immediate reconstruction

after partial mastectomy.<sup>6</sup> Preoperative discussions between the breast surgeon and plastic surgeon can allow for optimal planning of partial mastectomy reconstruction.<sup>19</sup> Breast surgeons should be encouraged to refer patients to plastic surgeons for preoperative evaluation whenever the anticipated defect is expected to lead to a suboptimal result in terms of cosmesis and breast symmetry. Plastic surgeons can provide valuable insight regarding the positioning and orientation of the breast scars<sup>13</sup> that may be important if a revision or reconstruction is required at a later date. Unfortunately, immediate reconstruction after partial mastectomy can be problematic because of scheduling conflicts between surgeons.<sup>2</sup> To ease the scheduling burden and to hasten the integration of immediate reconstruction as a routine aspect of breast conservation therapy, ambulatory care centers may be the ideal setting in which to perform immediate repair of partial mastectomy defects.

**Steven J. Kronowitz, M.D.**

Department of Plastic Surgery, Box 443  
The University of Texas M. D. Anderson Cancer Center  
1515 Holcombe Boulevard  
Houston, Texas 77030  
skronowi@mdanderson.org

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