

# True Incidence of All Complications following Immediate and Delayed Breast Reconstruction

Stephen R. Sullivan, M.D.  
Derek R. D. Fletcher, M.D.  
Casey D. Isom, M.D.  
F. Frank Isik, M.D.

Seattle, Wash.

**Background:** Improved self-image and psychological well-being after breast reconstruction are well documented. To determine methods that optimized results with minimal morbidity, the authors examined their results and complications based on reconstruction method and timing.

**Methods:** The authors reviewed all breast reconstructions after mastectomy for breast cancer performed under the supervision of a single surgeon over a 6-year period at a tertiary referral center. Reconstruction method and timing, patient characteristics, and complication rates were reviewed.

**Results:** Reconstruction was performed on 240 consecutive women (94 bilateral and 146 unilateral; 334 total reconstructions). Reconstruction timing was evenly split between immediate ( $n = 167$ ) and delayed ( $n = 167$ ). Autologous tissue ( $n = 192$ ) was more common than tissue expander/implant reconstruction ( $n = 142$ ), and the free deep inferior epigastric perforator was the most common free flap ( $n = 124$ ). The authors found no difference in the complication incidence with autologous reconstruction, whether performed immediately or delayed. However, there was a significantly higher complication rate following immediate placement of a tissue expander when compared with delayed reconstruction ( $p = 0.008$ ). Capsular contracture was a significantly more common late complication following immediate (40.4 percent) versus delayed (17.0 percent) reconstruction ( $p < 0.001$ ; odds ratio, 5.2; 95 percent confidence interval, 2.3 to 11.6).

**Conclusions:** Autologous reconstruction can be performed immediately or delayed, with optimal aesthetic outcome and low flap loss risk. However, the overall complication and capsular contracture incidence following immediate tissue expander/implant reconstruction was much higher than when performed delayed. Thus, tissue expander placement at the time of mastectomy may not necessarily save the patient an extra operation and may compromise the final aesthetic outcome. (*Plast. Reconstr. Surg.* 122: 19, 2008.)

**B**reast cancer is the most common cancer among women.<sup>1</sup> Although most patients will have breast conservation therapy, some patients will require mastectomy. Approximately 40 percent of the women who have mastectomy will choose to have breast reconstruction, but this is highly variable based on geographic location and access to medical care.<sup>2</sup>

Breast reconstruction after mastectomy results in improved self-image, psychological well-being,

and restoration of physical form after mastectomy. To achieve optimal long-term results, the breast cancer team, consisting of the medical, surgical, and radiation oncologists, must work closely together with the plastic surgeon in coordinating the surgical excision, radiation, chemotherapy, and reconstruction timing. It is our hypothesis that periodic critical examination of the team's results allows the presumed optimal approach to be verified and, if necessary, modified. This is the basis of our article.

Options for breast reconstruction method include tissue expander placement followed by in-

*From The Polyclinic and the Division of Plastic and Reconstructive Surgery, University of Washington.*

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sersion of a final implant versus an autologous tissue transfer, or a combination of both methods. Any method of reconstruction can be performed immediately at the time of mastectomy or delayed for weeks to years, but breast reconstruction is affected by the changing modalities of cancer therapy. The use of adjuvant and neoadjuvant irradiation and chemotherapy are becoming more commonplace in treating breast cancer. Although chemotherapy helps control locally advanced or systemic disease, impaired wound healing and immunosuppression can affect the reconstruction. Postmastectomy irradiation has also demonstrated superior locoregional control, disease-free survival, and overall survival in node-positive breast cancer patients<sup>3,4</sup> but results in increased complications for both implant<sup>5-7</sup> and autologous tissue reconstruction.<sup>8,9</sup> Therefore, predicting the need for adjuvant and neoadjuvant therapy is important in planning the reconstruction method and timing. Certain patient characteristics have been shown to adversely affect breast reconstruction results, such as diabetes mellitus,<sup>10</sup> smoking,<sup>11</sup> and body mass index.<sup>12</sup> Algorithms have been developed that incorporate these variables, including predicted probability of postoperative radiation requirement in determining the optimal method and timing used for breast reconstruction. These published recommendations provided the basis for recommending delaying breast reconstruction in our series.<sup>2,13,14</sup> The purposes of our study were to (1) determine the frequency and pattern of reconstruction timing and method at a regional referral hospital; (2) evaluate the clinical characteristics associated with and rates of complications based on reconstruction timing and type; (3) further refine our criteria for performing immediate or delayed breast reconstruction.

## PATIENTS AND METHODS

We performed a retrospective review of all patients who underwent breast reconstruction under the supervision of the senior author (F.F.I.) at the University of Washington Medical Center between 2000 and 2006 after receiving approval from the Human Subjects Internal Review Board. Data collected from the medical records included patient age, body mass index, smoking status (considered to be a smoker if they acknowledged any smoking within the 6 months before reconstruction), radiation therapy (before reconstruction, after reconstruction), prior lumpectomy, reconstruction timing (immediate versus delayed), reconstruction method (tissue expander/implant versus autologous tissue or both), and autologous

tissue type [free deep inferior epigastric perforator (DIEP) flap, free transverse rectus abdominis musculocutaneous (TRAM) flap, pedicled TRAM flap, pedicled latissimus dorsi myocutaneous flap]. Patients with both unilateral and bilateral reconstruction were included in this study, and a breast was the unit of analysis for all statistics.

Our selection method for timing and method of breast reconstruction is in keeping with previously published algorithms.<sup>2,13,14</sup> In brief, women who had prior chest wall irradiation, with stage III or IV disease, were actively smoking, or were morbidly obese (body mass index >35) were only offered delayed reconstruction. The remaining women were either self-selected or were referred by a surgical oncologist to undergo immediate reconstruction, including patients who had received prior lumpectomy and irradiation.

Autologous tissue reconstruction was offered to women that were not morbidly obese (body mass index <35), had prior chest wall irradiation, or had nonpliable chest wall soft tissues. Tissue expander/implant reconstruction was offered to women who had mobile, pliable chest wall soft tissue and had not received radiation after their mastectomy. Patients who did not meet these restraining criteria were offered a choice of tissue expander/implant or an autologous method. Mentor postoperatively adjustable Contour Profile or Low Height Style 6100 tissue expanders (Mentor Corp., Santa Barbara, Calif.) were used for all tissue expander reconstructions. All patients received Mentor smooth round moderate profile saline-filled implants filled to the recommended volume  $\pm 10$  percent. All expanders and implants were placed subpectorally, with anchoring of the serratus fascia (not muscle) to the lateral edge of the pectoralis major. We did not use AlloDerm (LifeCell Corp., Branchburg, N.J.) or similar non-autologous materials.

Our primary outcome of interest was the occurrence of a postoperative complication. A complication was very liberally defined to include *any* adverse postoperative event as a direct consequence of reconstruction that required additional treatment beyond the initial reconstruction.<sup>7</sup> Postoperative complications included infection requiring inpatient or outpatient antibiotics, hematoma, seroma, autologous tissue fat necrosis no matter how trivial, mastectomy skin flap necrosis, delayed wound healing, flap vessel thrombosis, flap loss (complete or partial), implant capsular contracture (Baker grade II, III, or IV),<sup>15</sup> implant malposition, expander/implant deflation, and expander/implant exposure.

## Statistical Analysis

Descriptive statistics were first calculated to compare patient and clinical characteristics between patient subgroups, and a breast was the unit of analysis. Continuous variables (age and body mass index) were compared using the two-sample *t* test assuming unequal variances. Binary variables (smoker, irradiation, prior lumpectomy, bilateral reconstruction, unilateral reconstruction, reconstruction time, reconstruction type) were compared using the chi-square or Fisher's exact test.

We next performed a series of univariate analyses using the chi-square or Fisher's exact test to compare our predictors of interest, reconstruction timing (immediate or delayed), and reconstruction type (tissue expander/implant or autologous tissue) to our outcome of interest: the occurrence of a complication. We calculated the incidence of each complication and the overall complication incidence. To evaluate for possible confounding or independent predictors of a complication, we next performed a series of univariate analyses using the chi-square or Fisher's exact test to determine whether there was an association between binary patient and clinical characteristics and the occurrence of a complication. We used logistic regression analysis to similarly test for an association between the occurrence of a complication and continuous patient variables (age and body mass index). All calculated probabilities were two-tailed and considered significant for values of  $p < 0.05$ . Results are presented as odds ratios and 95 percent confidence intervals as a measure of association. All statistical analyses were performed using Stata version 8 (Stata Corp., College Station, Texas).

## RESULTS

Table 1 summarizes the demographic, clinical characteristics, and descriptive statistics on 240 consecutive women who had mastectomy for breast cancer followed by reconstruction of 334 breasts (94 bilateral and 146 unilateral) supervised by the senior author over this 6-year time period. Follow-up ranged from at least 6 months to 4 years.

### Reconstruction Timing

Reconstruction timing after mastectomy was evenly distributed between immediate ( $n = 167$ ) and delayed ( $n = 167$ ). By univariate analyses, immediate and delayed reconstructions were similar with respect to age, body mass index, and unilateral and bilateral reconstruction. Delayed reconstructions were 2.71 times more likely to have had radiation therapy than immediate reconstructions ( $p < 0.001$ ; odds ratio, 2.71; 95 percent confidence interval, 1.62 to 4.53), reflecting our preselection of patients based on published algorithms. Immediate reconstructions were significantly more likely to have been performed on women who had had a prior lumpectomy ( $p = 0.03$ ; odds ratio, 1.66; 95 percent confidence interval, 1.05 to 2.62). Immediate reconstructions were also significantly more likely to be tissue expander/implant based, whereas delayed reconstructions were more likely to be with autologous tissue ( $p < 0.001$ ).

### Reconstruction Method

In our series, breast reconstruction was more commonly performed with autologous tissue ( $n = 192$ ) than with a tissue expander/implant ( $n = 142$ ). By univariate analyses, tissue expander/implant and autologous tissue reconstruction subgroups

**Table 1. Clinical Characteristics by Reconstruction Timing and Reconstruction Method**

Characteristic	Reconstruction Timing				Reconstruction Method		
	All Breast Reconstructions ( $n = 334$ ) (%)	Immediate ( $n = 167$ ) (%)	Delayed ( $n = 167$ ) (%)	$p^*$	Tissue Expander/Implant ( $n = 142$ ) (%)	Autologous Tissue ( $n = 192$ ) (%)	$p^*$
Age, years	47.2 ± 9.1	46.7 ± 8.8	47.7 ± 9.4	0.31	47.0 ± 10.2	47.4 ± 8.2	0.68
Body mass index, kg/m <sup>2</sup>	26.1 ± 6.7	25.5 ± 8.1	26.7 ± 4.8	0.12	25.5 ± 8.9	26.5 ± 4.2	0.21
Smoker	22 (6.6)	11 (6.6)	11 (6.6)	1.0	11 (7.7)	11 (5.7)	1.0
Radiation	87 (26.0)	28 (16.8)	59 (35.3)	<0.001	15 (10.6)	73 (38.0)	<0.001
Before reconstruction	80 (24.0)	23 (13.8)	57 (34.1)	<0.001	12 (8.5)	69 (35.9)	<0.001
After reconstruction	7 (2.1)	5 (3.0)	2 (1.2%)	0.44	3 (2.1)	4 (2.1)	0.99
Prior lumpectomy	115 (34.7)	67 (40.1)	48 (28.7)	0.03	45 (31.7)	70 (36.5)	0.36
Bilateral reconstruction	94	48	46	0.71†	43	51	0.26†
Unilateral reconstruction	146	71	75		56	90	

\*The  $p$  values were calculated with the use of the two-sample *t* test for continuous and chi-square or Fisher's exact test for binary variables.  
†The  $p$  value was based on a comparison between laterality (unilateral or bilateral) and reconstruction timing and type.

were similar with respect to patient age, body mass index, unilateral and bilateral reconstruction, and history of prior lumpectomy. Of autologous tissue reconstructions, free flaps ( $n = 157$ ) were performed more commonly than pedicled flaps ( $n = 41$ ) (Table 2). The DIEP flap was the most common method of breast reconstruction ( $n = 124$ ), followed by the free TRAM flap ( $n = 33$ ) and then the pedicled latissimus dorsi myocutaneous flap ( $n = 22$ ). When free flap reconstruction was performed, it was significantly more likely to be a DIEP than a TRAM flap ( $p = 0.02$ ). The bias toward autologous reconstruction with a DIEP over a TRAM flap was attributable to a combination of the senior physician's preference and the patient's interest.

### Complications

Good aesthetic results without morbidity can be achieved with any method of breast reconstruction, whether immediate or delayed. Representative results in our series are shown of immediate tissue expander/implant reconstruction (Fig. 1, *above*), delayed tissue expander/implant reconstruction (Fig. 1, *below*), immediate autologous tissue (DIEP) reconstruction (Fig. 2, *above*), and delayed autologous tissue (DIEP) reconstruction (Fig. 2, *below*). Overall, 179 breast reconstructions (53.6 percent) had no complication, whereas *any* complication, defined quite inclusively, was identified in 155 breast reconstructions (46.4 percent). Table 3 lists the specific complications for all reconstructions and further divides analysis by reconstruction timing and method. Table 4 compares the occurrence of a complication to specific clinical characteristics.

Although we found no difference in complication incidence when examining timing or re-

construction method, we found significant differences when subgroups of reconstruction methods were analyzed relative to reconstruction timing. When a tissue expander/implant complication occurred, it was 2.06 times more likely to have been placed immediately at the time of mastectomy rather than at a delayed time point ( $p = 0.008$ ; odds ratio, 2.06; 95 percent confidence interval, 1.21 to 3.52). Significantly, capsular contracture and/or malposition of the implant was 5.2 times more likely to develop following immediate reconstruction than with delayed reconstruction ( $p < 0.001$ ; odds ratio, 5.2; 95 percent confidence interval, 2.34 to 11.57) (Fig. 3). No difference in complication incidence for autologous tissue reconstruction was found relative to reconstruction timing ( $p = 0.70$ ). No differences were found between total flap loss, partial flap loss, fat necrosis, or vessel thrombosis of autologous tissue reconstructions relative to reconstruction timing.

### DISCUSSION

Mastectomy can have a significant impact on a woman's life. Women who choose breast reconstruction have a significant gain in their perceived quality of life and psychosocial well-being.<sup>16</sup> However, breast reconstruction results can be quite variable and the procedures are not without risk and complications. Although a multidisciplinary team determines the optimal oncologic treatment plan, the plastic surgeon is left solo to deal with the long-term aesthetic concerns. A high rate of complications, either surgical or aesthetic, can result in patient and physician dissatisfaction and higher medical delivery costs. Knowledge of the variables that adversely affect reconstruction aesthetics and complication incidence helps determine the most appropriate breast reconstruction timing and method for each patient.

**Table 2. Reconstruction Method by Reconstruction Timing**

Reconstruction Method	All Breast Reconstructions ( $n = 334$ ) (%)	Immediate ( $n = 167$ ) (%)	Delayed ( $n = 167$ ) (%)	$p^*$	OR (95% CI)
Tissue expander/implant	142 (42.5)	89 (53.3)	53 (31.7)	<0.001	2.45 (1.57–3.83)
Autologous tissue	192 (57.5)	78 (46.7)	114 (68.3)	<0.001	2.45 (1.57–3.83)
Pedicled flap	41 (12.3)	16 (9.6)	25 (15.0)	0.72†	0.88 (0.44–1.77)
TRAM flap	19 (5.7)	7 (4.2)	12 (7.2)	0.79‡	0.84 (0.24–2.91)
Latissimus	22 (6.6)	9 (5.4)	13 (7.7)		
Free flap	157 (47.0)	66 (38.9)	91 (54.5)		
DIEP flap	124 (37.1)	46 (28.1)	78 (46.7)	0.02§	2.61 (1.20–5.67)
TRAM flap	33 (9.9)	20 (12.0)	13 (7.7)		

OR, odds ratio; CI, confidence interval; TRAM, transverse rectus abdominis myocutaneous; DIEP, deep inferior epigastric perforator.

\*The  $p$  values were calculated with the use of the chi-square or Fisher's exact test.

†The  $p$  value was based on a comparison between autogenous tissue type (pedicled or free flap) and reconstruction timing.

‡The  $p$  value was based on a comparison between pedicle flap type (TRAM or latissimus) and reconstruction timing.

§The  $p$  value was based on a comparison between free flap type (DIEP or TRAM) and reconstruction timing.





**Fig. 1.** Preoperative photograph (*above, left*) of a woman who underwent left mastectomy and immediate tissue expander/implant reconstruction, shown 1 year postoperatively (*above, right*) at the time of tattooing. Preoperative view (*below, left*) of a woman who underwent right mastectomy 12 years before a delayed tissue expander/implant reconstruction and shown 1.5 years later (*below, right*), just before tattooing.

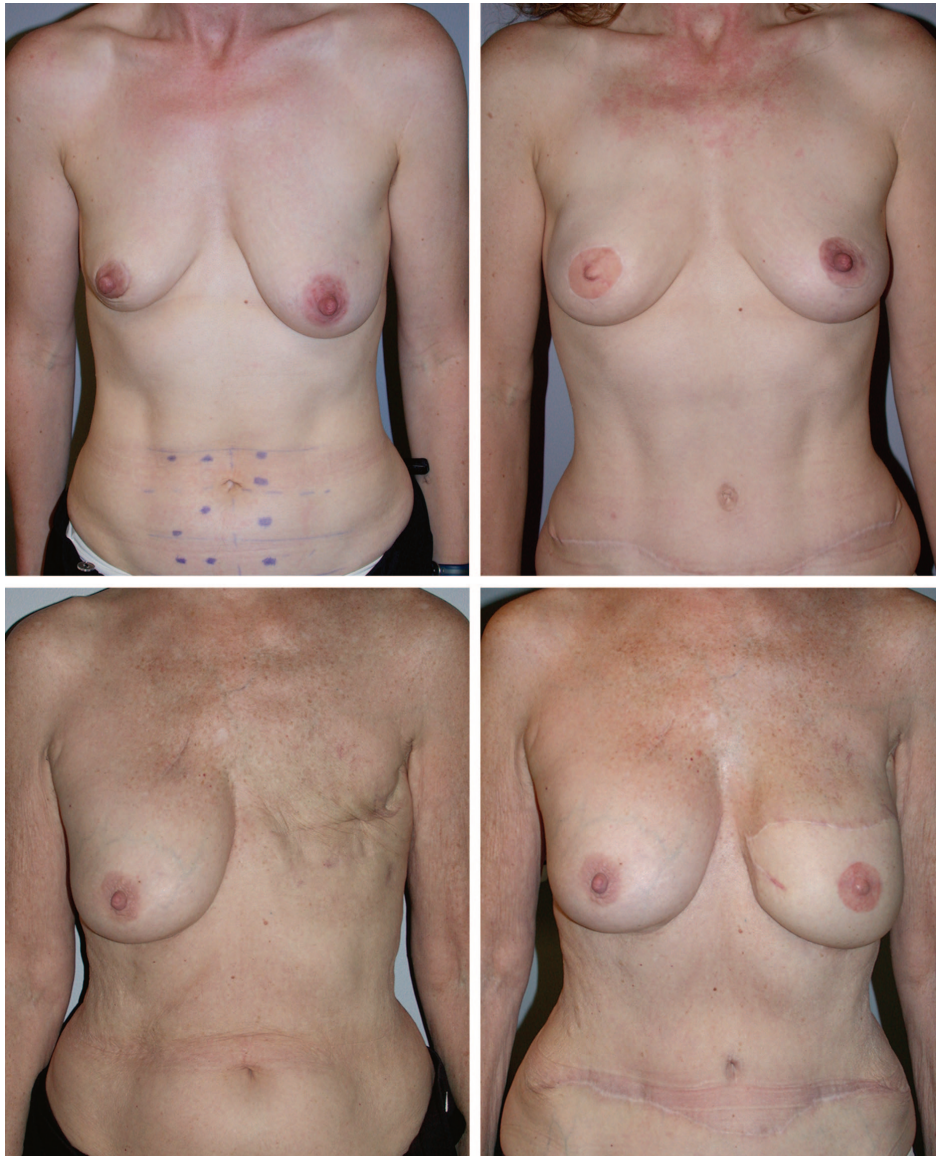
Prior publications on breast reconstruction have demonstrated variable but generally low major complication rates. In comparison with our study, many readers will initially think that our complication rates are excessively high. However, our inclusion criteria for complications were more liberal and realistic. This is important because what may seem to be a trivial complication to a health care provider may be significant to a patient. Because of this, we did not discriminate between minor and major complications. Our major complication rates and overall complication rates are similar to those of other major publications on breast reconstruction.<sup>7</sup>

### Reconstruction Timing

Immediate reconstruction has become more popular because of the potential benefits of fewer operations, decreased cost, and less psychological impairment by avoiding a period of disfigure-

ment. In addition, immediate reconstruction after mastectomy does not adversely affect survival, recurrence, or monitoring by mammography.<sup>17,18</sup> Allweis et al.<sup>19</sup> also noted that immediate breast reconstruction after mastectomy does not increase the time to chemotherapy compared with mastectomy alone. Although the safety of immediate breast reconstruction has been well addressed from an oncologic viewpoint, the reconstructive outcome deserves more evaluation. Although there may be some advantages to immediate reconstruction, there are also disadvantages.

Immediate reconstruction complication rates have been shown to be higher than delayed reconstruction (49 to 60 percent versus 31 to 37 percent).<sup>7</sup> We found a similar overall complication rate of 45.5 percent. After subgroup analysis by reconstruction method, we found that immediate tissue expander/implant breast reconstruction had a significantly higher overall complication inci-



**Fig. 2.** (Above) Preoperative and postoperative views of a woman who underwent right skin-sparing mastectomy with immediate DIEP flap, staged left mastopexy, followed by nipple reconstruction and tattooing. Final result shown is at 2 years. (Below) Preoperative and postoperative views of a woman who underwent left mastectomy 7 years before delayed autologous tissue reconstruction using a DIEP flap, shown on the right at 2-year follow-up.

dence and a higher capsular contracture incidence when compared with delayed tissue expander/implant reconstruction. The higher complication rates seen with immediate tissue expander/implant placement thus may not actually lead to fewer operations and lower cost than if the reconstruction had been delayed.

Based on our results, the senior author has changed his practice to delaying all tissue expander placements for at least 6 weeks after mastectomy. This time interval allows for the patho-

logic results to be reviewed, the pectoralis major muscle to adhere to the overlying (confirmed) viable mastectomy flap, and clearance of any possible bacterial contamination. Even with a skin-sparing mastectomy, the 6-week waiting period has no adverse effect on the aesthetic outcome.

There has been an increasing trend to use allograft or xenograft materials to secure the tissue expander laterally and better control pocket development. Although we did not use such adjuncts, the argument could be made that such materials



**Table 3. Complication by Reconstruction Timing and Method**

Complication	Overall (%)	Reconstruction Timing		p*	OR (95% CI)
		Immediate (%)	Delayed (%)		
Reconstruction with complication†	152 (45.5)	83 (49.7)	69 (41.3)	0.15	1.40 (0.91–2.16)
Reconstruction method					
Tissue expander/implant complication‡	72 (50.7)	46 (51.7)	26 (49.1)	0.008	2.06 (1.21–3.52)
Autologous tissue complication‡	83 (43.2)	43 (52.4)	40 (36.4)	0.70	1.10 (0.67–1.80)
Total flap loss§	9 (4.7)	4 (4.8)	5 (4.5)	1.0	0.87 (0.22–3.42)
Partial flap loss§	7 (3.6)	3 (3.6)	4 (3.6)	1.0	1.1 (0.27–4.53)
Fat necrosis§	43 (22.4)	20 (24.4)	23 (20.9)	0.37	1.36 (0.69–2.69)
Vessel thrombosis§	8 (4.2)	5 (6.0)	3 (2.7)	0.27	0.38 (0.10–1.48)
Infection†	22 (6.6)	9 (5.4)	4 (2.4)	0.26	2.32 (0.74–7.25)
Mastectomy skin flap necrosis†	5 (1.5)	5 (3.0)	0 (0)	NA	
Wound healing delayed†	9 (2.7)	3 (1.8)	6 (3.6)	0.50	0.49 (0.13–1.83)
Hematoma†	7 (2.1)	6 (3.6)	1 (0.6)	0.12	6.19 (0.96–)
Seroma†	5 (1.5)	2 (1.2)	3 (1.8)	1.0	0.66 (0–3.37)
Capsular contracture‡	45 (31.7)	36 (40.4)	9 (17.0)	<0.001	5.2 (2.34–11.57)
Implant malposition‡	4 (2.8)	3 (3.4)	1 (1.9)	1.0	1.81 (0.25–)
Implant exposure‡	2 (1.4)	2 (2.2)	0 (0)	NA	
Implant deflation‡	9 (6.3)	4 (4.5)	5 (9.4)	0.30	0.46 (0.13–1.67)

OR, odds ratio; CI, confidence interval; NA, not available.

The \*p values were based on a comparison between immediate and delayed reconstruction and were calculated with the use of the chi-square or Fisher’s exact test.

†Percentages are based on all reconstructions and reconstruction timing.

‡Percentages are based on number of implant reconstructions and reconstruction timing.

§Percentages are based on number of autologous tissue reconstructions and reconstruction timing.

**Table 4. Complications by Clinical Characteristics**

Variable	p*	Odds Ratio (95% CI)
Reconstruction timing	0.15	1.40 (0.91–2.16)
Reconstruction method	0.16	1.36 (0.88–2.10)
Tissue expander/implant immediate†	0.008	2.06 (1.21–3.52)
Autologous immediate‡	0.70	1.10 (0.67–1.80)
Age	0.13	1.02 (0.99–1.04)
Body mass index	0.26	0.98 (0.95–1.02)
Radiation	0.13	0.67 (0.41–1.10)
Radiation timing	0.38	0.5 (0.12–2.14)
Prior lumpectomy	0.44	1.19 (0.76–1.87)
Smoking	0.15	1.89 (0.81–4.39)

CI, confidence interval.

\*The p values were based on a comparison between the occurrence of a complication or no complication and were calculated using the chi-square or Fisher’s exact test for binary and logistic regression for continuous variables.

†Compared to tissue expander/implant delayed.

‡Compared to autologous delayed.

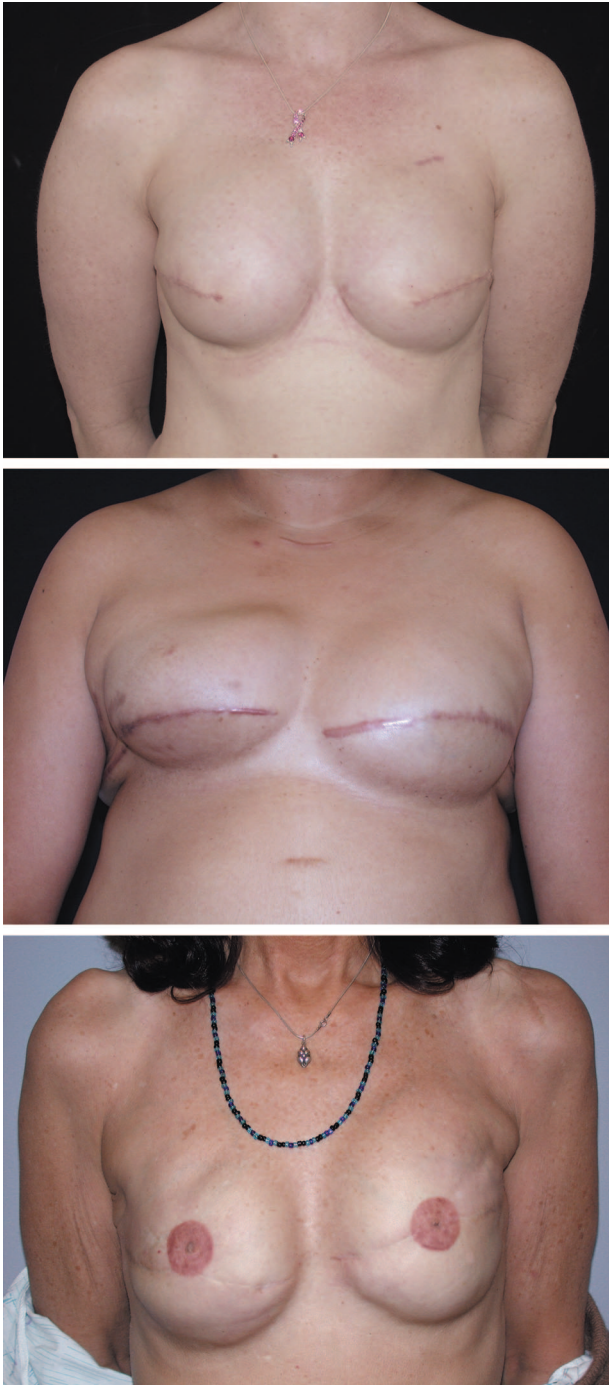
may help minimize malposition of the expander that is placed in too large a pocket created at the time of mastectomy. Whether or not this would decrease the incidence of long-term complications in the immediate subgroup is unknown.

**Reconstruction Method**

The majority of patients in this series had autologous tissue reconstruction. The distribution of reconstruction method in this series reflects a busy microsurgery breast reconstruction practice at a tertiary referral center where patients seek autol-

ogous reconstruction. The DIEP flap was the most common free flap used for breast reconstruction in this series. The DIEP flap has gained popularity in recent years because of the decreased abdominal wall morbidity and less postoperative pain when compared with the TRAM flap.<sup>20,21</sup> The DIEP flap is technically difficult and requires an experienced microsurgeon. Our overall total flap loss rate of 4.7 percent is comparable to other reviews of DIEP and TRAM free flap breast reconstruction (0.5 to 5 percent).<sup>21–23</sup> However, the majority of our flap losses occurred within the first 3 years of data collection and, with experience, the DIEP total flap loss rate fell to 2.6 percent over the subsequent 3 years. This trend reflects the learning curve inherent in new procedures, especially perforator free flaps.

Like Alderman et al.,<sup>7</sup> we found no difference in complication rates between tissue expander/implant and autologous tissue reconstruction or between specific types of autologous tissue reconstruction. Common complications of tissue expander/implant breast reconstruction included a capsular contracture (Baker grade II, III, or IV) incidence of 14 to 41 percent,<sup>24,25</sup> a deflation incidence of 9 percent,<sup>25</sup> an infection incidence of 1 to 24 percent,<sup>26,27</sup> and implant malposition. We found similar overall complication and incidence rates for tissue expander/implant reconstructions in our series. However, we found higher complication rates following immediate tissue expander/



**Fig. 3.** Photograph of a woman who had delayed tissue expander placement 6 weeks after bilateral mastectomy (*above*), shown at 6 months after final implant placement and before nipple reconstruction. (*Center*) Another patient had undergone left-sided mastectomy with delayed expander placement and 3 months later had a saline implant but then developed right-sided breast cancer and chose immediate tissue expander placement. Note the high position of the tissue expander following immediate reconstruction (3 months after expander placement). (*Below*) Another patient who had immediate expander placement shows capsular contracture on the left, with a poor aesthetic result.

implant reconstruction. We suspect the reasons for this were multifactorial. Possible factors that could have led to the higher complication rates include contamination of the surgical field during the mastectomy by *Staphylococcus epidermidis*, marginal mastectomy skin flap viability, increased inflammation attributable to the mastectomy, and misplacement of the expander because of the creation of a large pocket laterally and violation of the inframammary fold, or a combination of these multiple factors. In addition, all implants used in this series of patients were saline, as silicone gel was not available at our institution during this time. New silicone gel-filled implants may have different characteristics than saline breast implants in avoiding capsular contracture.<sup>28</sup> The cohesive gel-filled implants may retain anatomical shape better and ripple less even with some degree of capsular contracture<sup>29</sup> and, if used, may lead to lower capsulectomy and capsulotomy rates.

### Complications and Clinical Characteristics

Agarwal and Hultman<sup>10</sup> suggest that patient comorbidities are more important than reconstruction timing and method with respect to complications. Some patient characteristics have been found to be related to higher complication rates. In agreement with Alderman et al.,<sup>7</sup> we found that patient age does not seem to be significantly associated with increased complication rates. Elevated body mass index, however, has been found to be associated with increased wound healing and overall complication rates after breast reconstruction.<sup>5,7,9,10,12</sup> Smoking is also significantly associated with mastectomy skin and abdominal flap loss, umbilical necrosis, and delayed wound healing.<sup>30-32</sup> Unlike these authors, we did not find a significant association between complication rate and body mass index or smoking. However, our numbers of patients with a body mass index greater than 35 or who were smokers were low because of our preselection criteria.

### Limitations

This report focuses on the experience of a single tertiary referral center for breast reconstruction and has some limitations. The influence of individual practice style influences results and limits generalizing these data to other providers. Data were collected retrospectively and are affected by the reliability of accurate medical records. The unit of analysis in this study was a breast. However, some women had bilateral breast reconstruction. In these circumstances, we ac-



knowledge potential statistical limitations in that each breast may not be independent. Our sample is of moderate size, but smaller numbers of some variables such as postreconstruction irradiation, smoking, and body mass index may have limited finding potentially significant variables. Our screening of patients to delay reconstruction if irradiation will be needed, avoiding reconstruction in the setting of smoking, and encouraging weight loss for the morbidly obese limit the number of patients in these subgroups as well and create some selection bias. Some clinical variables that may be associated with complications, such as diabetes mellitus or peripheral vascular disease,<sup>10</sup> were not included in this analysis. Finally, some complications may not have been reported if the patients elected to receive follow-up care with another provider or institution.

## CONCLUSIONS

In our review of 334 consecutive cases of breast reconstruction, we found that reconstruction timing was evenly divided between immediate and delayed, whereas reconstruction method was more frequently autologous with the free DIEP flap. The most significant factor associated with a complication was immediate placement of a tissue expander/implant for breast reconstruction, which was associated with both a significantly greater overall complication incidence and capsular contracture incidence. Autologous reconstruction can be performed either immediately or delayed, although tissue expander/implant reconstruction requires careful consideration by the plastic surgeon and patient. Health care provider team members and the patient must work closely together in identifying individual risk factors for reconstruction complications and select the most appropriately coordinated time and method of therapy for cancer treatment and breast reconstruction so that optimal breast reconstruction can be achieved.

**F. Frank Isik, M.D.**

The Polyclinic  
1145 Broadway  
Seattle, Wash. 98122  
frank.isik@polyclinic.com

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