A Comparison of Elliptical Mastectomy to Inverted-T Pattern Mastectomy in Two-Stage Prosthetic Breast Reconstruction

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Background: Patients with large or ptotic breasts undergoing mastectomy followed by tissue expander/implant-based reconstruction may benefit from a Wise (inverted-T) pattern reduction mammaplasty incision compared with the traditional horizontal elliptical incision. The authors compared these two groups of patients with regard to complication rates and outcomes.
Methods: Sixty-nine patients (117 breasts) were identified who underwent Wise pattern mastectomy and two-stage reconstruction. A control group of 89 patients (136 breasts) who underwent reconstruction after horizontal elliptical mastectomy were selected over the same period. Patient demographics, clinical characteristics, and complication rates were recorded and analyzed statistically.
Results: Patient demographics (age, body mass index, diabetes, smoking, and irradiation history) and clinical characteristics (laterality, expander size and fill volume, and time to expansion) were similar, with the exception of body mass index (control, 26.7 kg/m^2; inverted-T, 28.7 kg/m^2; $p = 0.04$) and mean intraoperative fill volume (control, 158.7 cc; inverted-T, 196.9 cc; $p = 0.02$). Of all complications (infection, seroma, flap necrosis, expander loss, and salvage), only the rate of mastectomy flap necrosis was significantly greater ($p = 0.002$) in patients undergoing inverted-T mastectomy (25.6 percent versus 11.0 percent). This difference did not result in a significantly higher rate of expander loss or need for salvage surgery.
Conclusions: The inverted-T mastectomy approach can be performed safely with acceptable complication rates. When compared with an internal control group, complication rates were similar, with the exception of mastectomy flap necrosis. Despite a higher rate of flap necrosis, 91 percent of inverted-T patients successfully completed the expansion process. (*Plast. Reconstr. Surg.* 136: 426e, 2015.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, III.

The use of the Wise (inverted-T) reduction mammaplasty pattern for mastectomy skin excision was first described by Toth and Lappert as an alternative to the traditional elliptical pattern.[1] Patients with large or ptotic breasts were traditionally seen as poor candidates for expander/implant reconstruction because of a perceived inability to create a natural breast shape on the affected side and achieve reasonable symmetry with the contralateral breast. The Wise reduction mammaplasty skin excision pattern for mastectomy was introduced with the hope of improving the reconstructive outcomes in this challenging group of patients through better shape, projection, scar location, and symmetry (Fig. 1).

Initial skepticism about implant-based reconstruction using a Wise pattern mastectomy was directed toward the risk of flap necrosis at the T-junction. Coverage of the tissue expander with an inferiorly based dermal pedicle underneath the area of likely skin necrosis was popularized by Bostwick to effectively mitigate the risk of device

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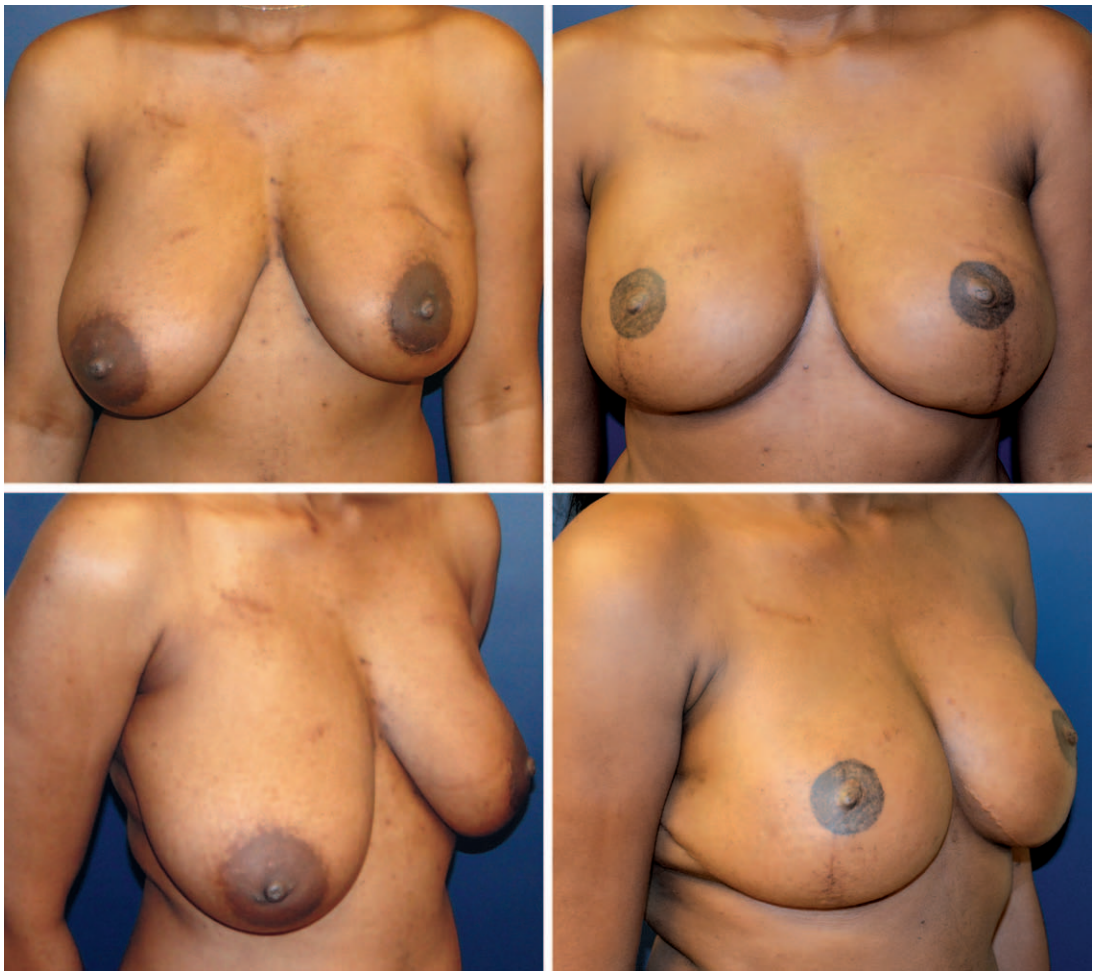

Fig. 1. (*Left*) Anterior and oblique preoperative views of a 30-year-old woman who underwent bilateral mastectomy for left breast cancer and right prophylaxis using Wise pattern incisions. She underwent reconstruction with 500-cc Natrelle 133 MX (Allergan, Inc., Santa Barbara, Calif.) expanders, filled intraoperatively to 200 cc. (*Right*) Anterior and oblique 1-year postoperative views after placing 550-cc MemoryGel Moderate Plus Profile (Mentor Corp., Irving, Texas) silicone implants. She subsequently underwent nipple-areola complex reconstruction and fat grafting.

exposure and reconstructive failure.[2] Subsequent smaller case series have been able to demonstrate the effectiveness and reproducibility of the Bostwick dermal pedicle in two-stage expander/implant reconstruction.[3–6]

The goal of our study was to determine whether this technique represents a safe alternative to the more traditional elliptical skin excision pattern for patients undergoing a two-stage prosthetic reconstruction. Our study compares the outcomes of patients undergoing expander/implant reconstruction after mastectomy using an inverted-T mastectomy with a control group undergoing traditional horizontal elliptical mastectomy. All reconstructions were performed by the same group of surgeons over the same 3-year period. To our knowledge, this is the first and only retrospective cohort study to date evaluating the performance of the inverted-T mastectomy.

PATIENTS AND METHODS

Institutional review board approval was obtained through Winthrop University Hospital Institutional Review Board Services. A database was created identifying 69 patients undergoing Wise pattern mastectomy and two-stage reconstruction from 2008 to 2011 (117 reconstructions). Of these 69 patients, 21 underwent unilateral mastectomy and 46 underwent bilateral mastectomy. A control group of 89 patients undergoing horizontal elliptical mastectomy and two-stage reconstruction was selected over the same period (136 reconstructions). Of these 89 patients, 42 underwent

unilateral mastectomy and 47 underwent bilateral mastectomy. These groups represented consecutive patients and encompassed all reconstructions using the respective techniques over the 3-year period. All reconstructions were performed by one of three reconstructive surgeons. Patient demographics are listed in Table 1. The *p* values for patient demographics correspond to a chi-square test for association (categorical variables), a two-tailed Fisher's exact test (categorical variables with expected counts less than five), or *t* test (continuous variables).

Patient characteristics associated with increased risk of complications such as active smoking, diabetes, and irradiation history were compared in addition to body mass index. Intraoperative characteristics for the two groups were also collected, including average expander size, intraoperative fill volumes, use of acellular dermal matrix, and mean time to complete expansion. A comparison of the intraoperative fill volume expressed as a percentage of the total expander volume for the two groups was based on a *t* test. The *p* values for patient clinical and operative characteristics correspond to a chi-square test for association (categorical variables), a two-tailed Fisher's exact test (categorical variables with expected counts less than five), or a *t* test (continuous variables).

The groups were compared with regard to tissue expander complication rates, including infection, seroma formation, mastectomy skin flap necrosis, expander loss, and need for salvage surgery. Rates of mastectomy flap necrosis were further defined as either minor or major events. Flap necrosis was considered minor if it could be managed on an outpatient basis with local wound care and/or limited débridement with or without primary closure. This group included patients with small areas of partial- or full-thickness skin loss. Major necrosis involved more extensive skin loss that required operative débridement with primary closure, graft, or flap placement.

Salvage surgery was performed to prevent expander loss through infection or exposure. All procedures involved exploration and washout of the pocket with temporary removal or replacement of the expander. In the inverted-T group, excessive skin loss could frequently be managed with the application of a skin graft to the underlying dermal pedicle. Two-tailed Fisher's exact tests were used to calculate *p* values for complications.

Table 1. Patient Demographics

	Control (%)	Inverted-T (%)	*p**
Total no. of patients	89	69	
Total no. of breasts	136	117	
Age, yr			
Mean	54.1	53.0	0.52
SD	10.4	12.1	
Range	31–77	30–83	
BMI, kg/m^2			
Mean	26.7	28.7	0.04
SD	5.3	6.6	
Range	18.8–44	19.11–47.1	
Smoking	7/89 (7.9)	4/69 (5.8)	0.76
Diabetes	8/89 (9.0)	7/69 (10.1)	0.80
Previous irradiation	12/136 (8.8)	14/117 (12.0)	0.41

BMI, body mass index.
*Corresponds to a *t* test, χ^2 test for association, or a two-tailed Fisher's exact test. The *p* values for age and body mass index were calculated using a *t* test. The *p* value for smoking was calculated using a two-tailed Fisher's exact test. The *p* values for diabetes and previous irradiation were calculated using a χ^2 test for association.

Wise Pattern Technique

Selection of technique was primarily based on breast anatomy. Patients who might otherwise have benefitted from a reduction or mastopexy (i.e., patients with large or ptotic breasts) were deemed suitable candidates for the Wise pattern approach. Other considerations that influenced mastectomy type included preexisting scar location or the need to remove excisional biopsy sites. In addition, some patients initially considered for the Wise pattern technique were converted intraoperatively to the elliptical approach based on intraoperative assessment of flap viability.

All patients undergoing mastectomy are evaluated for marking while standing to determine the position of the midline, the inframammary fold, and the overall breast footprint. Those patients selected for a Wise pattern mastectomy had completion of the resection pattern, which included the nipple-areola complex, to accommodate the boundary of the inferior dermal pedicle. In general, the vertical limb lengths average between 8 and 10 cm to allow for coverage of the skin envelope without tension over the expander device (Fig. 2).

The breast surgeon then follows the incision outline in the shape of a triangle for generous access to the breast tissue with the two sides defined by the two vertical limbs and the base as the superior limit of the dermal pedicle. This triangular zone of access for the breast surgeon is easily expanded when needed through an extension along the horizontal limbs of the Wise pattern for an additional 5 to 10 cm along the superior edge of the inferiorly based dermal pedicle.

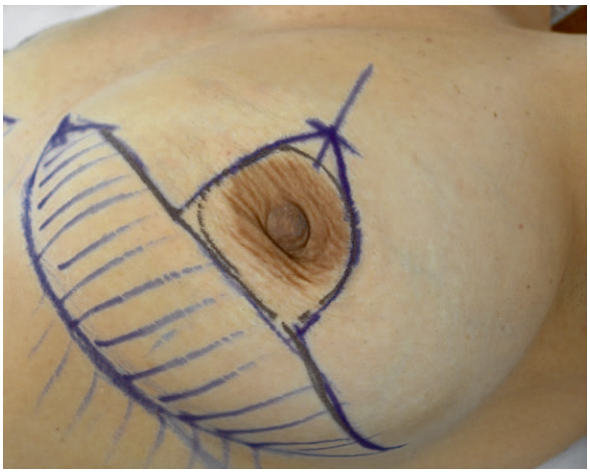

Fig. 2. Preoperative markings demonstrating location of dermal flap.

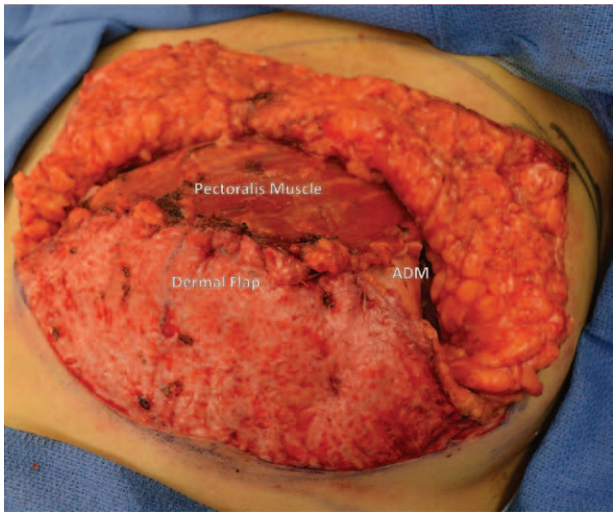

Fig. 3. Intraoperative photograph with expander in place showing pectoralis muscle and dermal pedicle. *ADM*, acellular dermal matrix.

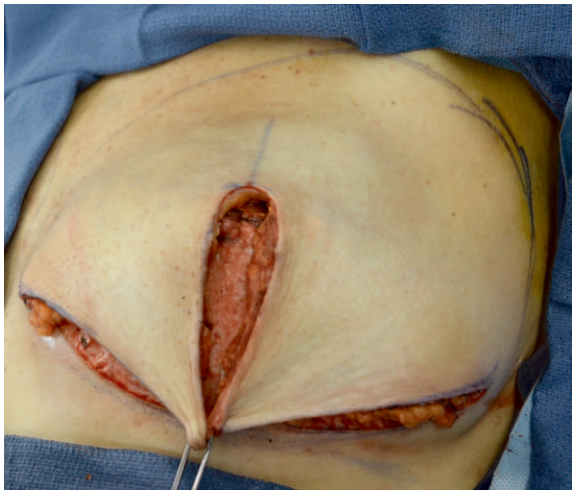

Fig. 4. Intraoperative photograph with skin flaps in place.

After completion of the mastectomy, the central inferior breast skin is deepithelialized in the standard fashion to create the inferiorly based dermal pedicle. Delaying the deepithelialization process until after the mastectomy allows for conversion to the more traditional elliptical excision pattern if the flaps demonstrate vascular compromise intraoperatively. Once completed, the pectoralis major is then elevated and divided along its inferior border and secured to the superior edge of the dermal pedicle.

The expander is then inserted into the subpectoral/dermal pocket and the remaining lower pole coverage both medially and laterally can be completed with AlloDerm (LifeCell Corp., Branchburg, N.J.) or Strattice (LifeCell) extensions, if required (Figs. 3 and 4). The mastectomy skin flaps are again evaluated for signs of compromise and additional resection is performed based purely on clinical judgment by the reconstructive surgeon. Jackson-Pratt drains are placed between the mastectomy flaps and the vascularized expander pocket.

RESULTS

Overall, the patient demographics were comparable between the controls and the inverted-T group, respectively, for age (54.1 years versus 53.0 years) and diabetes (9.0 percent versus 10.1 percent). Both the controls and inverted-T groups had a mean body mass index that fell into the overweight range (26.7 kg/m^2 versus 28.7 kg/m^2). The difference in body mass index was statistically significant (p = 0.04). The prevalences of smoking, diabetes, and previous irradiation were similar in both groups; chi-square tests for association between these variables and the type of mastectomy received did not produce statistically significant results (Table 1).

In our series, the majority of the 69 patients selected for inverted-T mastectomy elected to also have a contralateral prophylactic mastectomy, resulting in a total of 117 breast reconstructions. The control group, with the traditional horizontal elliptical resection pattern, consisted of 89 patients and a total of 136 breast reconstructions. The higher rate of bilateral procedures in the inverted-T group reached statistical significance (p = 0.03) (Table 2). Acellular dermal matrix was used in the reconstructions of 126 of the 136 breasts in the control group (92.6 percent) and 113 of the 117 breasts in the inverted-T group (96.6 percent). The mean intraoperative expander fill volume was significantly higher in

Table 2. Clinical Characteristics

	Control	Inverted-T	*p**
Total no. of patients	89	69	
Total no. of breasts	136	117	
Operation			0.033
Unilateral	42/89 (47.2%)	21/69 (30.4%)	
Bilateral	47/89 (52.8%)	48/69 (69.6%)	
ADM	126/136 (92.6%)	113/117 (96.6%)	0.17
Mean expander size, cc	539.2	540.6	0.94
Mean intraoperative fill volume, cc	158.7	196.9	0.02
Mean intraoperative expander fill volume	30.1%	35.4%	0.08
Mean time to complete expansion, days	106.5	97.1	0.26

ADM, acellular dermal matrix.
*Corresponds to a χ^2 test for association or a *t* test. The *p* values for operation type and ADM were calculated using a χ^2 test for association. The *p* values for mean expander size, mean intraoperative fill volume, mean intraoperative expander fill volume percentage, and mean time to complete expansion were calculated using a *t* test.

the inverted-T group (196.9 cc) compared with the control group (158.7 cc) ($p = 0.02$). The average time to reach total expansion was 106.5 days for controls and 97.1 days for inverted-T patients (Table 2).

With regard to outcomes and complications, infection rates were not significantly higher in the inverted-T group compared with the control group (9.4 percent versus 5.9 percent). The majority of patients with infections in either group were managed successfully with oral antibiotics on an outpatient basis. There was no statistically significant difference between the groups with regard to seroma formation (6.0 percent versus 4.4 percent). Seromas were most commonly drained in the outpatient setting, typically resolving after one or more needle aspirations.

As discussed previously, rates of mastectomy flap necrosis were recorded as either minor or major events. We experienced a statistically significant difference in major flap necrosis rates (9.4 percent versus 1.5 percent) between the inverted-T and control groups ($p = 0.004$). Minor skin flap necrosis was also higher (16.2 percent versus 9.6 percent) in the Wise pattern group compared with the control group, although the difference was not significant ($p = 0.11$). The total flap necrosis rates were 25.6 percent and 11.0 percent for the inverted-T and control groups, respectively ($p = 0.002$) (Table 3). Tissue necrosis was most prominent at the T junction in the Wise pattern cohort.

Table 3. Complications

	Control (%)	Inverted-T (%)	*p**
No. of breasts	136	117	
Infection	8/136 (5.9)	11/117 (9.4)	0.29
Seroma	6/136 (4.4)	7/117 (6.0)	0.57
Flap necrosis	15/136 (11.0)	30/117 (25.6)	0.002
Minor	13/136 (9.6)	19/117 (16.2)	0.11
Major	2/136 (1.5)	11/117 (9.4)	0.004
Expander loss	3/136 (2.2)	7/117 (6.0)	0.19
Salvage surgery	3/136 (2.2)	3/117 (2.7)	1

*Corresponds to a χ^2 test for association or a two-tailed Fisher's exact test. The *p* values for infection, seroma, and overall flap necrosis were calculated using a χ^2 test for association. The *p* values for flap necrosis by group (major/minor), expander loss, and salvage surgery were calculated using a two-tailed Fisher's exact test.

Of the 117 inverted-T breast reconstructions, tissue expander loss occurred in seven breasts (six patients). All of the remaining 63 patients (110 breasts) completed the expansion process. Three patients (five breasts) were lost to follow-up before their second-stage procedure. Four patients (five breasts) underwent elective removal of their expander(s) and reconstruction with deep inferior epigastric artery perforator flaps after completion of adjuvant radiation therapy. Implant loss was recorded for only one breast (one patient) among the remaining 100 reconstructions in which expander/implant exchange was attempted (Figs. 5 and 6).

Of the 136 elliptical mastectomy pattern breast reconstructions, tissue expander loss occurred in three breasts (three patients). A total of four breasts (three patients) underwent deep inferior epigastric artery perforator flap reconstruction after tissue expansion, whereas one breast (one patient) underwent transverse rectus abdominis myocutaneous flap reconstruction. A further 10 breasts (seven patients) were lost to follow-up after completion of tissue expansion. Implant loss was recorded for only one breast (one patient) in 118 expander/implant exchanges. It is important to note that higher rates of overall mastectomy flap necrosis in the Wise pattern group did not translate into a significant increase in expander loss (6.0 percent versus 2.2 percent), need for salvage surgery (2.7 percent versus 2.2 percent), or prolonged expansion time (97.1 versus 106.5 days).

Fig. 5. (*Left*) Preoperative view of a 47-year-old woman who underwent bilateral mastectomy for multifocal lobular carcinoma in situ using Wise pattern incisions. She underwent reconstruction with 600-cc Natrelle 133 MX expanders, filled intraoperatively to 300 cc. (*Right*) One-year postoperative view after placing 500-cc MemoryGel Moderate Plus Profile silicone implants. She subsequently underwent nipple-areola complex reconstruction and fat grafting.

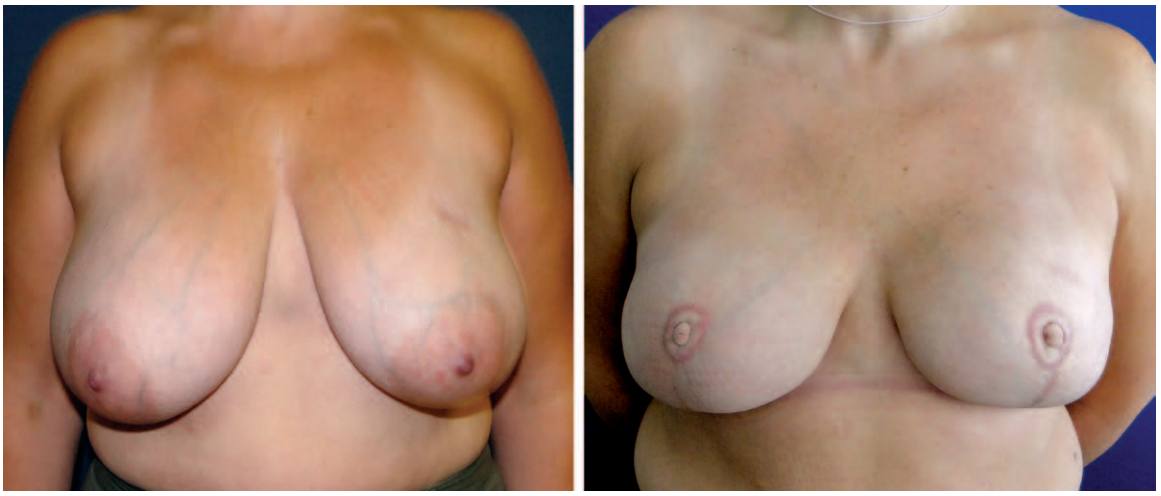

Fig. 6. (*Left*) Preoperative view of a 47-year-old woman with invasive ductal carcinoma of the left breast who underwent bilateral mastectomy using Wise pattern incisions. She underwent reconstruction with 850-cc Natrelle 133 MX expanders, filled intraoperatively to 400 cc. (*Right*) One-year postoperative view after placement of 800-cc MemoryGel Moderate Plus Profile silicone implants. She subsequently underwent nipple-areola complex reconstruction and fat grafting.

DISCUSSION

The inverted-T mastectomy for staged prosthetic breast reconstruction benefits patients with large or ptotic breasts by creating a more natural breast shape and improved symmetry. However, previously published literature demonstrates an increased risk of complications (8 to 25 percent) related primarily to breakdown and necrosis of the mastectomy skin flaps at the T-junction and along the vertical limb.[3,5,7,8] Variability in reported necrosis rates may depend not only on differences in surgical technique but also on the authors' definition of what constitutes tissue necrosis.[9] Our definition of flap necrosis was all-inclusive, ranging from simple epidermolysis to extensive full-thickness skin loss.

Attempts to minimize necrosis at the T site by alterations in technique have been described previously. A recent study published by Liu et al. recommends a staged approach to the Wise pattern mastectomy to minimize the risk of mastectomy flap necrosis by performing the vertical and horizontal excisions in two separate procedures.[10] This technique completely eliminates the use of

a dermal pedicle and its associated protective benefits.[3–5,8,11] Additional technical modifications include shortening the vertical limbs by raising the inframammary fold incision or maintenance of an inferiorly based triangle of skin at the inverted-T junction.[5] However, these techniques alter scar location and may adversely affect aesthetic outcomes.

We hypothesized that the higher rates of mastectomy flap necrosis associated with the Wise pattern mastectomy would not necessarily lead to an increased incidence of reconstructive failure. By comparing patients undergoing expander placement after a Wise pattern mastectomy with an internal control group, we found overall rates of skin flap necrosis to be significantly higher in the inverted-T group (25.6 percent versus 11.0 percent), yet the differences in rates of expander loss (6.0 percent versus 2.2 percent), need for salvage surgery (2.7 percent versus 2.2 percent), or time to complete expansion (97.1 days versus 106.5 days) were not statistically significant.

The high rate of success is consistent with prior studies and is attributed to early and aggressive management of tissue necrosis along with the use of the inferiorly based dermal flap.[3–5,8,11] The dermal flap provides a well-vascularized barrier, preventing expander exposure and loss after both minor and major skin necrosis. With more extensive skin loss, the dermal pedicle provides an excellent bed for application of a skin graft and may obviate the need for a more complex flap procedure. Moreover, the lower pole vascularized coverage minimized the requirements for acellular dermal matrix use and when required was used only as small medial and lateral patches. Increased complication rates have been documented previously with the use of acellular dermal matrix in prosthetic breast reconstruction.[12,13]

In addition, not only is the inferior dermal flap protective with regard to lower pole coverage, it also allows for an increase in the lower pole pocket size and the possibility for higher initial fill volumes. In our study, we had significantly higher mean intraoperative fill volumes for our inverted-T cohort. The greater lower pole expansion early in the postoperative period may allow for a larger recruitment of skin for lower pole expansion, contributing to a more natural breast shape and better aesthetic outcome.

Although we were able to compare our results to a control group during the same period with the same reconstructive surgeons, our conclusions are limited by the nonrandomized, retrospective nature of the study. These limitations include the inability to control for known risk factors in prosthetic reconstructive failure. For example, mean intraoperative fill volumes were significantly higher in the inverted-T group ($p = 0.02$). Although this may allow for better skin recruitment, some studies suggest that high intraoperative fill volumes are associated with an increase in perioperative complications, specifically, mastectomy flap necrosis.[9,14] In addition, patients in the inverted-T group demonstrated a higher mean body mass index than the control group (28.7 kg/m^2 versus 26.7 kg/m^2; $p = 0.04$). This would indicate a larger percentage of obese patients in the inverted-T cohort, a factor shown previously to increase complication rates in expander/implant reconstruction.[15]

The high rate of bilateral mastectomy in the inverted-T group also demonstrated a statistically significant difference compared with the control group. Recent studies have concluded that patients undergoing bilateral mastectomy are at greater risk of overall complications, although the complication rate for the index breast was equivalent to that of the contralateral, prophylactic side.[16,17] Because our complication rate was calculated per breast and not per patient, this finding would not be expected to confound our results.

Selection bias may also be a confounding factor influencing our results. Although only three surgeons performed the reconstructive procedures, a much larger number of breast surgeons (29) were included in the study (although 84 percent of the procedures were performed by only nine breast surgeons). Unequal distribution of procedures performed by an individual breast surgeon occurred in some cases, as several of the breast surgeons included in the study preferred one technique to the other. The quality of the mastectomy flap, which is an important determinant of necrosis, is highly dependent on the skill set of the breast surgeon, and this variable may have affected necrosis rates.

Obviously, clinical judgment alone has its limitations with regard to predicting postoperative mastectomy flap necrosis. Although our necrosis rates are comparable with those reported previously in the literature,[3,5,7,8] we are currently incorporating a greater use of laser-assisted indocyanine green imaging as an adjunct to intraoperative assessment of mastectomy flap viability. Recent studies have demonstrated the efficacy of this approach.[18,19]

CONCLUSIONS

The inverted-T mastectomy approach can be performed safely in patients undergoing staged

tissue expander breast reconstruction, with acceptable complication rates. Although mastectomy flap necrosis is more commonly associated with this procedure, judicious débridement combined with the inferiorly based dermal flap prevents progression to infection, exposure, and expander loss. The Wise pattern mastectomy is a viable option for breast reconstruction in patients with large or ptotic breasts, with clear aesthetic benefits and high rates of reconstructive success.

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REFERENCES

1. Toth BA, Lappert P. Modified skin incisions for mastectomy: The need for plastic surgical input in preoperative planning. *Plast Reconstr Surg.* 1991;87:1048–1053.
2. Bostwick J. Prophylactic (risk-reducing) mastectomy and reconstruction. In: *Plastic and Reconstructive Breast Surgery.* Vol. 2. St. Louis: Quality Medical; 1990:1369–1373.
3. Hammond DC, Capraro PA, Ozolins EB, Arnold JF. Use of a skin-sparing reduction pattern to create a combination skin-muscle flap pocket in immediate breast reconstruction. *Plast Reconstr Surg.* 2002;110:206–211.
4. Nava MB, Cortinovis U, Ottolenghi J, et al. Skin-reducing mastectomy. *Plast Reconstr Surg.* 2006;118:603–610; discussion 611–613.
5. Losken A, Collins BA, Carlson GW. Dual-plane prosthetic reconstruction using the modified wise pattern mastectomy and fasciocutaneous flap in women with macromastia. *Plast Reconstr Surg.* 2010;126:731–738.
6. Ladizinsky DA, Sandholm PH, Jewett ST, Shahzad F, Andrews K. Breast reconstruction with the Bostwick autoderm technique. *Plast Reconstr Surg.* 2013;132:261–270.
7. Derderian CA, Karp NS, Choi M. Wise-pattern breast reconstruction: Modification using AlloDerm and a vascularized dermal-subcutaneous pedicle. *Ann Plast Surg.* 2009;62:528–532.
8. Hudson DA, Skoll PJ. Complete one-stage, immediate breast reconstruction with prosthetic material in patients with large or ptotic breasts. *Plast Reconstr Surg.* 2002;110:487–493; discussion 494–496.
9. Khavanin N, Jordan S, Lovecchio F, Fine NA, Kim J. Synergistic interactions with a high intraoperative expander fill volume increase the risk for mastectomy flap necrosis. *J Breast Cancer* 2013;16:426–431.
10. Liu TS, Crisera CA, Festekjian JH, Da Lio AL. Staged wise-pattern skin excision for reconstruction of the large and ptotic breast. *Plast Reconstr Surg.* 2010;126:1831–1839.
11. Carlson GW, Bostwick J III, Styblo TM, et al. Skin-sparing mastectomy: Oncologic and reconstructive considerations. *Ann Surg.* 1997;225:570–575; discussion 575–578.
12. Newman MI, Swartz KA, Samson MC, Mahoney CB, Diab K. The true incidence of near-term postoperative complications in prosthetic breast reconstruction utilizing human acellular dermal matrices: A meta-analysis. *Aesthetic Plast Surg.* 2011;35:100–106.
13. McCarthy CM, Lee CN, Halvorson EG, et al. The use of acellular dermal matrices in two-stage expander/implant reconstruction: A multicenter, blinded, randomized controlled trial. *Plast Reconstr Surg.* 2012;130(Suppl 2):57S–66S.
14. Mlodinow AS, Fine NA, Khavanin N, Kim JY. Risk factors for mastectomy flap necrosis following immediate tissue expander breast reconstruction. *J Plast Surg Hand Surg.* 2014;48:322–326.
15. McCarthy CM, Mehrara BJ, Riedel E, et al. Predicting complications following expander/implant breast reconstruction: An outcomes analysis based on preoperative clinical risk. *Plast Reconstr Surg.* 2008;121:1886–1892.
16. Crosby MA, Garvey PB, Selber JC, et al. Reconstructive outcomes in patients undergoing contralateral prophylactic mastectomy. *Plast Reconstr Surg.* 2011;128:1025–1033.
17. Osman F, Saleh F, Jackson TD, Corrigan MA, Cil T. Increased postoperative complications in bilateral mastectomy patients compared to unilateral mastectomy: An analysis of the NSQIP database. *Ann Surg Oncol.* 2013;20:3212–3217.
18. Phillips BT, Lanier ST, Conkling N, et al. Intraoperative perfusion techniques can accurately predict mastectomy skin flap necrosis in breast reconstruction: Results of a prospective trial. *Plast Reconstr Surg.* 2012;129:778e–788e.
19. Komorowska-Timek E, Gurtner GC. Intraoperative perfusion mapping with laser-assisted indocyanine green imaging can predict and prevent complications in immediate breast reconstruction. *Plast Reconstr Surg.* 2010;125:1065–1073.