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Nipple-Sparing Mastectomy via an Inframammary Fold Incision with Implant-Based Reconstruction in Patients with Prior Cosmetic Breast Surgery

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Abstract

Background: Nipple-sparing mastectomy through an inframammary fold incision (NSM-IMF) with implant-based reconstruction (IBR) is a cosmetically preferable approach to breast cancer treatment in appropriate candidates. However, patients who have undergone prior cosmetic breast surgery (CBS) may be at increased risk for postoperative complications secondary to existing surgical scars.

Objective: To assess whether prior CBS increases the risk of complications following NSM-IMF with IBR.

Methods: A retrospective chart review was conducted for 398 NSM-IMFs with IBR performed between July 2006 and December 2013. CBS cases were identified. Outcomes were reviewed.

Results: Of 398 NSM-IMF cases, 41 had prior CBS: 24 augmentations, 12 reductions, three mastopexies, and two augmentation mastopexies. NSM-IMF was performed an average of 8 years following CBS. CBS cases had lower BMIs ($P = .040$), more breast tissue resected ($P = .021$), wider breast bases ($P = .0002$), more single-stage reconstructions ($P < .0001$), more ADM use ($P < .0001$), and larger permanent implants ($P = .0051$) than those without CBS. Postoperatively, CBS cases had higher rates of mastectomy flap ischemia ($P = .0392$) and hematoma ($P = .0335$). Among CBS cases, single-stage reconstruction was associated with increased full-thickness flap ischemia ($P = .0066$). Compared to prior augmentation cases, prior reduction/mastopexy cases had higher rates of capsular contracture ($P = .0409$) and seroma ($P = .0226$).

Conclusions: This series is the largest to date to evaluate the success of NSM-IMF with IBR in CBS patients. These women should be cautiously considered for IBR, particularly in the setting of single-stage reconstruction.

Level of Evidence: 4

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From 1998 to 2008, the rate of immediate breast reconstruction following mastectomy increased an average of 5% per year, from 20.8% to 37.8%.[1] The rate of implant-based breast reconstruction (IBR) increased by an average of 11% per year and surpassed autologous reconstruction as the predominant form of breast reconstruction after 2002.[1] Rates of cosmetic breast surgery (CBS) have also been rising, with rates of augmentation mammoplasty increasing by 5%-13% per year and reduction mammoplasty by 23% per year from 2000 to 2008.[2] Consequently, it follows that an increasing number of women with a history of CBS are undergoing mastectomy and considering IBR.

For women faced with the psychological obstacle of losing their breasts, the option to preserve the nipple-areolar complex (NAC) during mastectomy can offer significant relief and an improvement in aesthetic outcomes.[3-6] Recently, nipple-sparing mastectomy (NSM) has been shown to be a safe and aesthetically superior approach to mastectomy in appropriate candidates.[7] Criteria for candidacy for NSM generally include an early-stage tumor smaller than 3 cm in size and further than 2 cm from the NAC with clinically negative axillary nodes and no skin involvement, small and minimally ptotic breasts, and a negative retro-areolar intraoperative biopsy.[8] NSM can be performed through a number of surgical incisions, including radial, periareolar, and inframammary fold (IMF) incisions.[9,10] While there exists no consensus regarding an optimal approach to NSM, our senior author has previously documented that the IMF incision provides superior cosmesis and a high level of patient satisfaction.[4,6] The IMF incision has the advantage of hiding the scar in a natural crease while providing sufficient exposure for resection. Since this approach does, however, require extensive undermining of the NAC, particular attention must always be paid to preserving its blood supply.

Patients who have undergone a prior breast reduction or mastopexy have been shown to be at higher risk for mastectomy flap necrosis, even in the absence of NAC preservation, due to compromised tissue perfusion.[11] Prior breast reduction has also been reported as a risk factor for nipple necrosis following repeat reduction.[12] Following a breast reduction or mastopexy, the NAC receives its blood supply from both the subdermal plexus and a glandular pedicle. Following NSM, the NAC becomes dependent on the subdermal plexus exclusively, which may be compromised in part by the presence of surgical scars. Consequently, the potential for NAC ischemic complications following NSM is of concern and careful attention must be paid at the time of mastectomy and retro-areolar biopsy to preserve the integrity of the subdermal plexus.

Fewer studies have assessed the correlation between prior breast augmentation and mastectomy flap necrosis. Investigators have reported that patients with prior augmentation tend to be poorer candidates for breast conservation therapy secondary to smaller native breast size and the risk of implant-related complications with radiation, such as infection, extrusion, capsular contracture, or poor cosmesis.[13-16] Consequently, previously augmented patients are often advised to undergo a mastectomy rather than breast conservation therapy. Moreover, these patients are more likely to pursue IBR following a mastectomy, in part due to pre-existing comfort with implants.[15] However, the complication profile following NSM with IBR remains unknown. The presence of scar tissue and the disrupted blood supply in a previously augmented breast may increase the risk of NAC ischemia.

Despite increasing rates of CBS, a paucity of data exists to establish whether NSM with IBR is appropriate in these patients.[13] Furthermore, no significant study has documented the complication profile of NSM through an IMF incision (NSM-IMF) with IBR in prior CBS patients. These patients present a unique combination of reconstructive challenges, including the presence of surgical scars that risk compromising mastectomy flap perfusion, inconsistent access to prior operative records, as well as potentially greater aesthetic expectations and breast awareness.

This study is the largest series to date to investigate the success of NSM-IMF with IBR in prior CBS patients.[13-15,17-21] It is our hope that the outcomes from this study will aid in the selection of appropriate surgical candidates and in preoperative patient counseling.

METHODS

A retrospective chart review was conducted on a prospectively collected database of women who had undergone NSM via an IMF incision with either single-stage or two-stage IBR between July 2006 and December 2013. Institutional Review Board approval was obtained from Weill Cornell Medical College (New York, NY). All of the reconstructions were performed by a single plastic surgeon (the senior author, M.T.) at a single, tertiary-care academic medical center. The mastectomies were performed by a number of breast surgeons. All patients who met the inclusion criteria were included in the study, regardless of demographic factors, risk factors, indication for mastectomy, oncologic burden, or postoperative results. Of note, NSM was not offered to patients with a cup size larger than C or grade III ptosis because of concern that the increased length of the mastectomy skin flap would increase the risk of ischemic NAC complications. These larger-breasted women are also at increased risk for NAC malposition, which we have previously reported.[5] However, since we have developed a protocol to treat this NAC malposition, we do not consider the risk of NAC malposition a contraindication to NSM-IMF in larger-breasted women. Otherwise, candidacy for NSM was determined by the

breast surgeon in accordance with the criteria outlined above in the introduction.

All NSMs were performed using the same technique, as previously described by the senior author.[4-6] Reconstructions were performed with either tissue expanders or permanent silicone or saline implants using a standard subpectoral approach, as previously described by the senior author.[4-6] Single-stage reconstruction was generally reserved for patients with small volume implants, optimal tissue quality, and minimal clinical or demographic comorbidity. When the available muscle was insufficient for complete coverage of the tissue expander or implant, a strip of acellular dermal matrix (ADM) was placed inferiorly as a sling at the discretion of the senior author.[4-6] In cases of prior subpectoral augmentation, an attempt was made to preserve the existing implant capsule in order to improve implant coverage. Both smooth, round, and textured, shaped, permanent implants were used at the discretion of the senior author; no particular difficulty was encountered in placing textured, shaped, implants in patients with round implant pockets.

Of note, since the breast surgeons at our institution use tumescent solution with epinephrine during the mastectomy, any objective intra-operative assessment of mastectomy flap ischemia was precluded. Consequently, mastectomy flaps were only debrided intra-operatively in the event of visible ischemia. This was performed at the discretion of the senior author when a flap appeared dusky in color, cool to the touch, and had limited bleeding at the cut skin edge.

All patients received intravenous antibiotics within 30 minutes of surgical incision and were maintained on a one-week course of postoperative antibiotics. All patients received the same postoperative dressing, as previously described by the senior author.[4-6]

During subsequent postoperative visits, all patients were assessed subjectively by the senior author alone. Whenever possible, patients were followed at regular intervals for the first year postoperatively, and then yearly.

Patients with a history of CBS were identified. Demographic factors, operative details, and postoperative results were compared between cases with and without prior CBS. Additional subgroup analysis was performed by the specific type of prior CBS (augmentation versus reduction or mastopexy). Demographic factors evaluated included age, body mass index (BMI), volume of breast tissue resected, sternal notch-to-nipple distance, breast base width, smoking status (active or former), presence of diabetes (controlled with diet, oral hypoglycemic agents, or insulin), history of chest wall or breast radiation, postoperative radiation, and history of lumpectomy. Operative factors evaluated included final implant volume, use of single-stage reconstruction, and ADM use. Postoperative complications considered included NAC or mastectomy flap ischemia, capsular contracture (grades II to IV), hematoma, seroma, and need for explantation of the prosthesis. For all continuous variables, an unpaired Student *t*-test was utilized and both p-values and 95% confidence intervals were reported. For all binary outcomes, a Chi-squared test was utilized and *P*-values were reported.

RESULTS

Patient Characteristics

Three hundred ninety-eight NSMs through IMF incisions with immediate IBR were included. Forty-one cases (10.3%) in 25 patients had undergone prior CBS, including 24 augmentations, 12 reductions, 3 mastopexies, and 2 augmentation-mastopexies (Figures 1-3 and Supplementary Figure 1). Three hundred fifty-seven cases (89.7%) in 208 patients had not undergone prior CBS. NSM was performed an average of 8 years after CBS (range, 1 month to 25 years).

Prior CBS cases had an average age of 46.6 years (range, 30 to 68 years), which was statistically similar to non-CBS cases (47.4 years; range, 25 to 77 years; $P = .63$). CBS cases had a significantly lower average BMI (20.6) than non-CBS cases (21.6, $P = .040$) (see Table 1). The prior augmentation cases also had a significantly lower average BMI (20.0) than the non-CBS cases (21.6, $P = .010$). The combined prior reduction and mastopexy cases, however, did not have a significantly different average BMI (21.8) than either the non-CBS cases (21.6, $P = .81$) or the prior augmentation cases (20.0, $P = .056$). The volume of breast tissue resected was significantly greater for CBS cases (708 cc) than for non-CBS cases (549 cc, $P = .021$). The volume of breast tissue resected for the prior reduction/mastopexy cases (1259 cc) was also significantly greater than the volume resected for both the non-CBS cases (549 cc, $P < .0001$) and the prior augmentation cases (366 cc, $P = .0003$). Conversely, a significantly smaller volume of breast tissue was resected for the prior augmentation cases than for the non-CBS cases ($P = .013$). The average breast base width was significantly greater for CBS cases (15.0 cm) than for non-CBS cases (13.7 cm, $P = .0002$). The average sternal notch-to-nipple distances (22.3 cm versus 21.8 cm, $P = .19$), rates of active smoking (0% versus 2.0%, $P = .3657$), diabetes (0% versus 1.7%, $P = .4029$), prior chest wall or breast radiation (7.3% versus 8.1%, $P = .8584$), postoperative radiation (4.9% versus 10.1%, $P = .2827$), and prior lumpectomy (36.6% versus 35.6%, $P = .9025$) were statistically similar between CBS and non-CBS cases, respectively (see Table 2).

Surgical Indications and Technique

Indications for NSM included invasive ductal carcinoma (n = 114, 28.6%), invasive lobular carcinoma (n = 28, 7.0%), a combination of invasive ductal and invasive

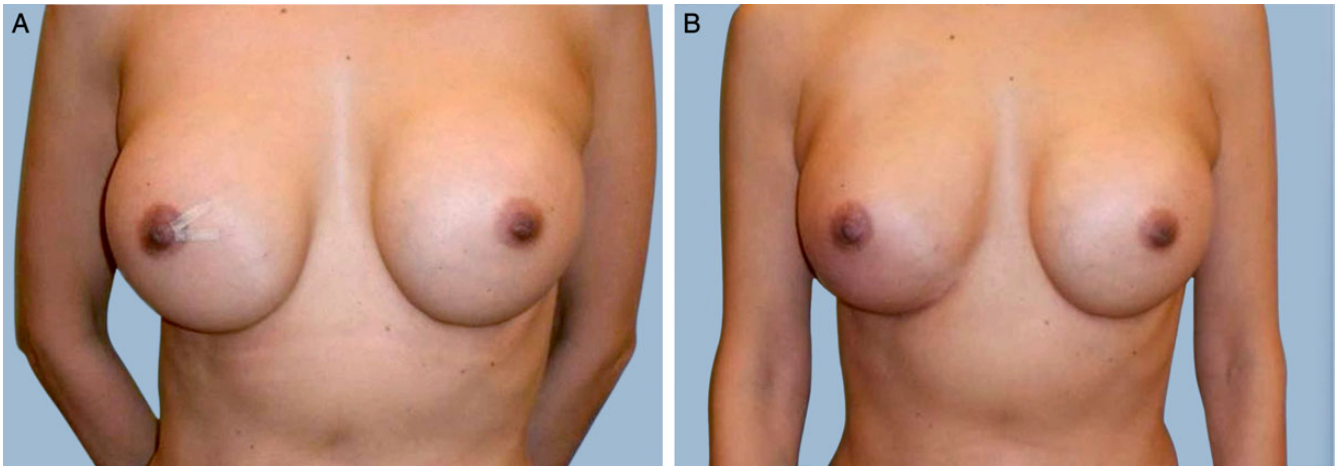

Figure 1. A 56 year-old female with history of prior subpectoral saline augmentation (8 years prior) status post right nipple-sparing mastectomy (NSM) for ductal carcinoma in situ (DCIS). Single-stage reconstruction was performed with a 425 cc shaped silicone implant. Patient shown preoperatively (A) and one year postoperatively (B).

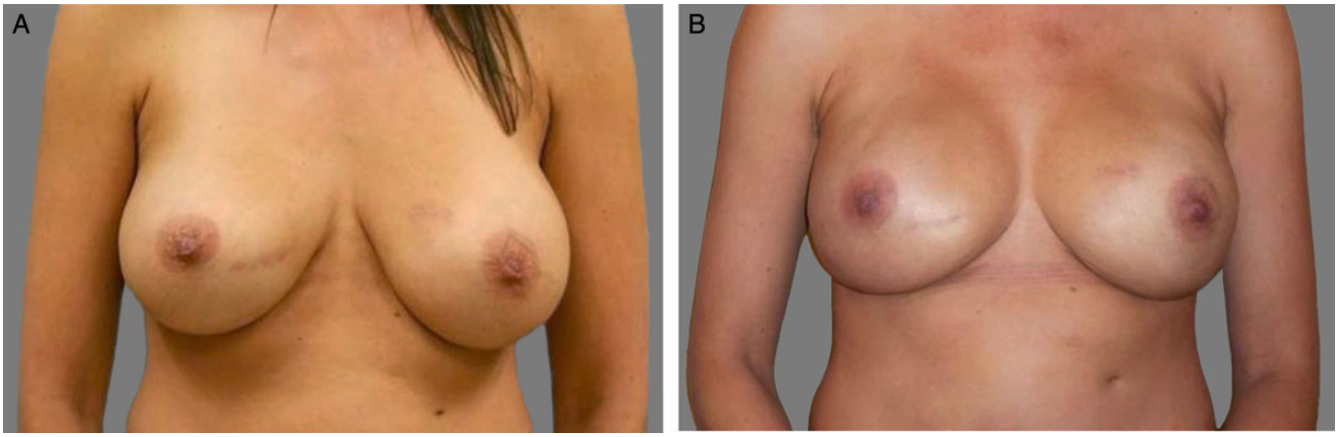

Figure 2. A 46 year-old female with history of prior subpectoral saline augmentation (10-12 years prior) status post bilateral NSM for left-sided DCIS. Single-stage reconstruction was performed with 750 cc silicone implants. Patient shown preoperatively (A) and one year postoperatively (B).

lobular carcinoma (n = 6, 1.5%), ductal carcinoma in situ (DCIS) (n = 70, 17.6%), lobular carcinoma in situ (LCIS) (n = 14, 3.5%), and prophylaxis (n = 166, 41.7%).

The rate of single-stage reconstruction, as compared to tissue expander-based reconstruction, was significantly higher for CBS cases (48.8%) than for non-CBS cases (16.0%, $P < .0001$) (see Tables 1 and 2). None of the cases that were initially scheduled as single-stage reconstructions required conversion to tissue expander-based reconstruction intra-operatively. ADM was utilized significantly more frequently in CBS cases (65.8%) than in non-CBS cases (31.6%, $P < .0001$). ADM was also utilized significantly more frequently in prior augmentation cases (83.3%) than in prior reduction/mastopexy cases (33.3%, $P = .0015$). Among prior CBS cases, ADM was utilized more frequently in single-stage reconstruction cases (80.0%) than in tissue expander-based reconstruction cases (52.4%), but the difference was not statistically significant ($P = .0623$). The average final implant volume was significantly higher for CBS cases (509 cc) than for non-CBS cases (434 cc, $P = .0051$).

Cases were followed for an average of approximately 18 months, with a range of 7 days to approximately 80 months. The individual patient who was only followed for 7 days was an international patient who returned to her home country.

Postoperative Complications

Postoperative partial- or full-thickness mastectomy flap ischemia was significantly more common in CBS cases (31.7%) than in non-CBS cases (18.2%, $P = .0392$) (see Table 3). Hematoma rates were also significantly higher in CBS cases (9.8%) than in non-CBS cases (3.1%, $P = .0335$). Rates of prosthesis explantation (7.3% versus 2.5%, $P = .0890$), capsular contracture (12.2% versus 25.2%, $P = .0641$), and seroma (12.2% versus 7.8%,

Figure 3. A 47 year-old female with history of prior subpectoral silicone augmentation (5 years prior) status post bilateral NSM for left-sided DCIS. Two-stage reconstruction was performed with 480 cc silicone implants. Patient shown preoperatively (A), intraoperatively at the time of tissue expander placement (B), and one year postoperatively (C).

Table 1. Characteristics of Patients With and Without Prior CBS, Significant Differences

	BMI			Breast Volume Resected (cc)			Single-stage Reconstruction	
	μ	95% CI	*P* value	μ	95% CI	*P* value	Rate (%)	*P* value
Prior CBS	20.6	19.7-21.5	.040	708	580-836	.021	48.8	<.0001
No	21.6	21.3-21.9		549	505-592		16.0	
	Breast Base Width (cm)			Final Implant Volume (cc)			ADM Use	
	μ	95% CI	*P* value	μ	95% CI	*P* value	Rate (%)	*P* value
Prior CBS	15.0	14.3-15.6	.0002	509	459-558	.0051	65.8	<.0001
No	13.7	13.5-13.9		434	418-450		31.6	

CBS, cosmetic breast surgery; BMI, body mass index; μ, mean; CI, confidence interval; ADM, acellular dermal matrix.

P = .3385) were statistically similar between CBS and non-CBS cases, respectively (see Table 4).

Among CBS cases, no significant difference in outcomes was noted when relatively recent CBS cases (up to one year prior to NSM, n = 7, 17.1%) were compared to more remote CBS cases (greater than one year prior to NSM, n = 34, 82.9%), possibly secondary to the small sample size.

Among CBS cases, a significantly higher rate of full-thickness mastectomy flap ischemia was seen after single-stage reconstruction (30.0%) than after tissue expander-based reconstruction (0.0%, *P* = .0066) (see Table 5). Conversely, a significantly lower rate of capsular contracture was noted after single-stage reconstruction (0.0%) than after tissue expander-based reconstruction

Table 2. Characteristics of Patients With and Without Prior CBS, no Difference

	Age (Years)			Current Smoking		Diabetes Mellitus		Prior Lumpectomy	
	μ	95% CI	*P* value	Rate (%)	*P* value	Rate (%)	*P* value	Rate (%)	*P* value
Prior CBS	46.6	43.4-49.8	.63	0.0	.3657	0.0	.4029	36.6	.9025
No	47.4	46.3-48.5		2.0		1.7		35.6	
	Sternal Notch-to-nipple Distance (cm)			Prior Radiation		Post-operative Radiation			
	μ	95% CI	*P* value	Rate (%)	*P* value	Rate (%)	*P* value		
Prior CBS	22.3	21.5-23.2	.19	7.3	.8584	4.9	.2827		
No	21.8	21.5-22.0		8.1		10.1			

CBS, cosmetic breast surgery; μ, mean; CI, confidence interval.

Table 3. Complications in Patients With and Without Prior CBS, Significant Differences

	Flap Ischemia, all		Hematoma	
	Rate (%)	*P* value	Rate (%)	*P* value
Prior CBS	31.7	.0392	9.8	.0335
No	18.2		3.1	

CBS, cosmetic breast surgery.

Table 4. Complications in Patients With and Without Prior CBS, no Difference

	Required Explantation		Capsular contracture		Seroma	
	Rate (%)	*P* value	Rate (%)	*P* value	Rate (%)	*P* value
Prior CBS	7.3	.0890	12.2	.0641	12.2	.3385
No	2.5		25.2		7.8	

CBS, cosmetic breast surgery.

Table 5. Complications in Patients With Single-stage and Tissue Expander-based Reconstruction, Significant Differences

	Flap Ischemia, Full-thickness		Capsular Contracture	
	Rate (%)	*P* value	Rate (%)	*P* value
Single-stage	30.0	.0066	0.0	.0199
Tissue expander	0.0		23.8	

(23.8%, $P = .0199$). Higher rates of prosthesis explantation were seen after single-stage reconstruction (15.0%) than after tissue expander-based reconstruction (0.0%), but the difference was not significant ($P = .0652$) (see Table 6). No significant differences were noted in the rates of hematoma (15.0% versus 4.8%, $P = .2694$) or seroma (10.0% versus 14.3%, $P = .6751$) following single-stage and tissue expander-based reconstruction in CBS cases, respectively.

Prior augmentation cases experienced significantly lower rates of capsular contracture (4.2% versus 26.7%, $P = .0409$) and seroma (0.0% versus 20.0%, $P = .0226$) than prior reduction/mastopexy cases (see Tables 7 and 8). Statistically similar rates of partial- or full-thickness mastectomy flap ischemia (29.2% versus 40.0%, $P = .4850$), prosthesis explantation (8.3% versus 6.7%, $P = .8502$), and hematoma (12.5% versus 6.7%, $P = .5591$) were seen between prior augmentation and prior reduction/mastopexy cases, respectively.

Prior augmentation cases experienced a significantly lower rate of capsular contracture (4.2% versus 25.2%, $P = .0193$) and a higher rate of hematoma (12.5% versus 3.1%, $P = .0176$) than non-CBS cases (see Tables 7 and 8). Statistically similar rates of partial- or full-thickness mastectomy flap ischemia (29.2% versus 18.2%, $P = .1843$), prosthesis explantation (8.3% versus 2.5%, $P = .0997$), and seroma (0.0% versus 7.8%, $P = .1541$) were seen between prior augmentation and non-CBS cases, respectively.

There were no statistically significant differences in the complication rates between prior subpectoral and prior subglandular augmentation cases. There were only 4 cases of prior subglandular augmentation; consequently, the sample size may have been too small for useful comparison.

Prior reduction/mastopexy cases experienced a significantly higher rate of partial- or full-thickness mastectomy flap ischemia than non-CBS cases (40.0% versus 18.2%, $P = .0354$) (see Tables 7 and 8). Statistically similar rates of capsular contracture (26.7% versus 25.2%, $P = .9033$), hematoma (6.7% versus 3.1%, $P = .4413$), seroma (20.0% versus 7.8%, $P = .0951$), and prosthesis explantation (6.7% versus 2.5%, $P = .3308$) were seen between prior reduction/mastopexy and non-CBS cases, respectively.

Table 6. Complications in Patients With Single-stage and Tissue Expander-based Reconstruction, no Difference

	Required Explantation		Hematoma		Seroma	
	Rate (%)	*P* value	Rate (%)	*P* value	Rate (%)	*P* value
Single-stage	15.0	.0652	15.0	.2694	10.0	.6751
Tissue expander	0.0		4.8		14.3	

Table 7. Complications in Patients With Prior Augmentation and Prior Reduction/Mastopexy, Significant Differences

	Flap Ischemia, all		Capsular Contracture		Hematoma		Seroma	
	Rate (%)	*P* value	Rate (%)	*P* value	Rate (%)	*P* value	Rate (%)	*P* value
Prior augmentation	29.2	.4850	4.2	**.0409**	12.5	.5591	0.0	**.0226**
Prior reduction/ mastopexy	40.0		26.7		6.7		20.0	
Prior augmentation	29.2	.1843	4.2	**.0193**	12.5	**.0176**	0.0	.1541
No prior CBS	18.2		25.2		3.1		7.8	
Prior reduction/ mastopexy	40.0	**.0354**	26.7	.9033	6.7	.4413	20.0	.0951
No prior CBS	18.2		25.2		3.1		7.8	

CBS, cosmetic breast surgery.

Table 8. Complications in Patients With Prior Augmentation and Prior Reduction/Mastopexy, no Difference

	Flap Ischemia, Full-thickness		Required Explantation	
	Rate (%)	*P* value	Rate (%)	*P* value
Prior augmentation	16.7	.7791	8.3	.8502
Prior reduction/mastopexy	13.3		6.7	
Prior augmentation	16.7	.0840	8.3	.0997
No prior CBS	7.0		2.5	
Prior reduction/mastopexy	13.3	.3546	6.7	.3308
No prior CBS	7.0		2.5	

CBS, cosmetic breast surgery.

Among prior CBS cases, statistically similar average final implant volumes were used both in patients who experienced mastectomy flap ischemia (499.6 cc) and in those who did not (514.0 cc, $P = .235$). The sample size was too small to assess the relationship between average final implant volume and subsequent prosthesis explantation.

DISCUSSION

A paucity of data exists to establish whether NSM is appropriate in patients who have undergone prior CBS.[13] However, as the rate of CBS increases, especially in conjunction with increasing rates of immediate breast reconstruction and IBR, specifically, plastic surgeons must address the complication profile of post-mastectomy reconstruction in the setting of prior CBS. Of concern in performing NSM after prior CBS is the presence of surgical scars that compromise perfusion to the NAC. Previous investigations in the literature have provided equivocal evidence on the safety profile of these procedures and have not correlated any patient demographic or intra-operative factors with post-operative outcomes.

Alperovich et al presented a series of 13 breasts in 8 patients with a history of reduction or mastopexy who underwent NSM.[13] Ten of the breasts were reconstructed with implants. The group reported 100% NAC viability postoperatively with 1 hematoma requiring evacuation and 1 displaced implant. Of note, they endorsed the use of laser-assisted indocyanine green perfusion mapping (SPY Elite System®; LifeCell, Bridgewater and Branchburg, NJ, USA) and prophylactic excision of ischemic tissue intraoperatively, which we were unable to use in our cases for the reasons outlined above.

Vaughn et al presented 21 NSM cases in 11 patients with a history of prior CBS (7 reductions, 3 augmentations, 4 mastopexies, and 7 augmentation-mastopexies).[17] All NSMs were performed via IMF incisions and reconstructed with tissue expanders. One case required expander removal in the setting of cellulitis and 2 cases required operative closure for wound breakdown.

Both Salgarello et al and Elliot et al have reported success with single-stage IBR after skin-sparing mastectomy or NSM in patients with a history of augmentation.[14,18] Both groups advocate for preservation of the periprosthetic capsule during mastectomy, which then forms or is used to reinforce the new implant pocket. Salgarello et al compared matched controls to 12 patients with a history of augmentation. The prior CBS cases reported significantly higher postoperative satisfaction via the Breast Q questionnaire ($P = .009$). No significant difference was found in the postoperative complication profiles. Elliot et al presented 35 breasts in 20 patients with a history of augmentation. They concluded that the capsule-sparing approach they employed is safe, fast, and provides aesthetically-pleasing results.

Spear et al report their success with the use of oncoplastic reduction or oncoplastic mastopexy prior to a planned mastectomy as a means of helping women with very large or ptotic breasts to become better candidates for NSM.[19] The NSM and subsequent reconstruction were delayed for a minimum of 4 weeks and until after completion of any adjuvant therapy. The authors presented 24 cases in 15 patients. Complications included 2 cases of erythema that resolved with oral antibiotics, 3 cases of partial NAC necrosis, 4 cases of flap necrosis requiring operative debridement, and 1 case that required prosthesis explantation in the setting of infection. The authors concluded that they felt comfortable offering this staged approach to patients with moderately large or ptotic breasts, although not to patients with very large or ptotic breasts.

With 41 cases in 25 patients, our study represents the largest series to date of NSM-IMF cases with subsequent IBR in the setting of prior CBS.[13-15,17-21] While we acknowledge that our principal subgroups (augmentation and reduction/mastopexy) are similar in size to some of the larger studies in the literature, both our subgroups and our overall sample represent the largest series of specifically NSM cases through IMF incisions with IBR. The size of our sample has also allowed for a statistically and clinically meaningful comparison of outcomes between cases with and without prior CBS and by subtype of CBS, which is currently lacking in the literature. In summary, we found that prior CBS cases had significantly higher rates of hematoma ($P = .0335$) and partial- or full-thickness mastectomy flap ischemia ($P = .0392$) than non-CBS cases. When analyzed by subgroup, we found that prior augmentation cases had a significantly higher rate of hematoma than non-CBS cases ($P = .0176$) and that prior reduction/mastopexy cases had a significantly higher rate of partial- or full-thickness mastectomy flap ischemia than non-CBS cases ($P = .0354$). The increased rate of hematoma in prior augmentation cases may potentially be explained by a more difficult dissection in the setting of scar tissue. The increased rate of flap ischemia in prior reduction/mastopexy cases may also be secondary to the presence of prior surgical scars, which can compromise perfusion to the skin envelope and NAC. Of note, prior reduction/mastopexy cases had significantly more breast tissue resected ($P < .0001$) than non-CBS cases. Furthermore, prior CBS cases were reconstructed with significantly larger final implants ($P = .0051$) than non-CBS cases. Both of these factors present potential confounding variables that may have contributed to the increased rates of hematoma and flap ischemia observed.

We found that the risk of full-thickness flap ischemia in prior CBS patients is further increased in the setting of single-stage reconstruction ($P = .0066$). These findings contradict the earlier claims of Salgarello and Elliot. This increased risk may be a consequence of the greater tension exerted on the mastectomy flap by the relatively larger implant, in contrast to the tension exerted by a partially-inflated tissue expander. Furthermore, when flap ischemia is suspected, the surgeon is unable to deflate a permanent implant in the office to allow for healing under reduced tension. While the difference did not reach statistical significance, a notably higher rate of prosthesis explantation was observed following single-stage reconstruction (15.0%) than following tissue expander-based reconstruction (0.0%, $P = .0652$). This trend may be a consequence of the increased rate of flap ischemia, although the majority of the ischemia cases healed without requiring any operative intervention. With nearly one-third (30.0%) of our cases suffering some degree of full-thickness flap ischemia and with concern that this may result in an increased risk of prosthesis explantation, we recommend careful patient selection and thorough preoperative counseling for all CBS cases considering single-stage reconstruction. None of the cases in the study that were initially scheduled as single-stage reconstructions were converted to tissue expander-based reconstructions intra-operatively. However, based on the results of our study, we now approve all potential

single-stage reconstruction cases for both implant and tissue expander placement and convert to tissue expander-based reconstruction if the mastectomy flaps do not appear well perfused following the mastectomy.

Single-stage reconstruction cases also experienced a significantly lower rate of capsular contracture compared to tissue expander-based reconstruction cases ($P = .0199$). The increased rate of capsular contracture after tissue expander-based reconstruction may be due to frequent disruption of the maturing capsule by serial expansions in the office. Furthermore, the majority of the single-stage reconstructions (18 of 20 cases) were performed in previously augmented patients, in whom the surgeon was able to perform a capsulotomy at the time of reconstruction if needed to improve capsular contracture. These factors may both contribute to the decreased rate of capsular contracture observed after single-stage reconstruction. They may also explain the observations that capsular contracture was less common in prior augmentation cases than in either prior reduction/mastopexy cases ($P = .0409$) or non-CBS cases (0.0193) and that seroma was also less common in prior augmentation cases than in prior reduction/mastopexy cases ($P = .0226$).

Limitations of this study include its retrospective nature and the fact that it presents only the patients of a single plastic surgeon operating at a single, tertiary-care academic medical center. Our experience and conclusions may not be generalizable to all surgeons and all institutions. Our patient population was thinner than the average population, with average BMIs of 20.6 and 21.6 among cases with and without prior CBS, respectively. The mastectomies were performed by a number of breast surgeons, each with a different surgical technique and level of experience. Subgroup analysis by a breast surgeon was not possible because many of the sample sizes became too small for meaningful comparison once cases were stratified by a breast surgeon. All mastectomies were performed through an IMF incision with immediate IBR, per our inclusion criteria; this study was not designed to compare different surgical approaches to NSM and reconstruction. All assessment of postoperative results was subjective and determined by the senior author. Our two groups—cases with and without prior CBS—were not identical and there are numerous unmatched demographic and operative variables that could potentially confound conclusions. Finally, since we were especially interested in the effect of surgical scars from prior CBS on the perfusion of the mastectomy flaps, our analysis focuses particularly on complications related to ischemia.

CONCLUSIONS

This series is the largest to date to evaluate the success of NSM-IMF with IBR in women who have undergone prior CBS.[13-15,17-21] Our findings suggest that these patients should be cautiously considered as candidates for this procedure. Moreover, due to the increased risk of full-thickness flap ischemia, we recommend careful patient selection and thorough preoperative counseling for all CBS cases considering single-stage reconstruction. Surgeons should consider the increased risk of complications, including hematoma and mastectomy flap ischemia, in both the selection of appropriate surgical candidates and in preoperative patient counseling.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

Disclosures

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