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ORIGINAL ARTICLE
Breast

Correction of Breast Ptosis in Immediate Breast Reconstruction

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Background: Nipple-sparing mastectomy is psychologically advantageous and can result in superior cosmetic outcomes. However, nipple position adjustment is challenging, and ischemic complications may arise. For patients who require timely mastectomies and reconstructions, concurrent mastopexy may prevent nipple malposition and reduce the risk for future corrections.

Methods: A retrospective chart review of all patients undergoing immediate prosthetic reconstruction after nipple-sparing mastectomy were analyzed. Data regarding patient characteristics; surgical indications; reconstructive modality, including presence or absence of simultaneous nipple lift; and early and late complications were examined.

Results: In total, 142 patients underwent 228 nipple-sparing mastectomies and prosthetic reconstructions. Correction of ptosis (lift) was performed in 22 patients and 34 breasts. The remaining 122 patients and 194 breasts did not receive mastopexy (no-lift). Two patients received bilateral reconstructions involving both lift and no-lift. Comparing the lift and no-lift cohorts demonstrated no differences in major complications (47.1% versus 57.7%; $P = 0.25$) and minor complications (76.5% versus 74.7%; $P = 0.83$). Control for plane of implant placement also did not show differences in major ($P = 0.31$) or minor ($P = 0.97$) complications. Similarly, control of application of acellular dermal matrix found major ($P = 0.25$) and minor ($P = 0.83$) complications uniform and not affected by lift status. Nipple lift distance was not associated with increased major ($P = 0.10$) complications.

Conclusion: Simultaneous correction of nipple position in immediate prosthetic breast reconstruction seem safe with uniform complications rates that are unaffected by acellular dermal matrix use or plane of implant placement. *(Plast Reconstr Surg Glob Open 2023; 11:e5000; doi: 10.1097/GOX.0000000000005000; Published online 24 May 2023.)*

INTRODUCTION

The nipple is a unique anatomical detail that defines the breast. Loss of the nipple due to breast cancer treatment is emotionally distressing.[1] Although surgical nipple creation has an important positive psychological impact on patients, reconstructed nipples have their disadvantages, such as lack of sensation and inadequate color match, shape, and texture.[2] Surgically created nipples have been associated with patient dissatisfaction rates up to 36%.[3,4] On the contrary, nipple preservation can offer a superior reconstructive outcome, improve body image and sexuality, and aid with psychological adjustment.[4] However, irrespective of oncological safety, not all patients are candidates for a nipple-sparing procedure, which presents a surgical challenge.

Preexisting excessive breast skin and ptosis may lead to poor aesthetic results and increased ischemic complications.[3,5–7] Mastopexy can result in devastating outcomes due to fragile, thin mastectomy flaps with poor blood supply. Venous congestion and/or arterial insufficiency leads to nipple ischemia and can result in partial or total nipple necrosis. Necrosis of the nipple–areola complex (NAC) after nipple-sparing mastectomy (NSM) ranges broadly from 2.8% to 76%, with a high incidence of nipple loss associated with a periareolar incision.[1,2,8,9] Additionally, obesity, diabetes, radiation, and smoking all contribute to impaired mastectomy flap perfusion.[2]

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Traditionally, NSM followed by immediate reconstruction has been offered to patients with relatively modest breast size and mild or absent ptosis.[3–5,10,11] In larger and/or saggy breasts, immediate correction of mastectomy skin excess and optimization of nipple location are paramount to achieve satisfactory breast shape and prevent nipple malposition.[7,12] Mastopexy has previously been deemed safe in subpectoral breast reconstruction.[13] However, subpectoral breast reconstruction can result in animation deformity, additional postoperative pain, and muscle spasms.[13] There is sparse literature reporting the safety of mastopexy in prepectoral reconstruction.[14–17] The few current reports that support its efficacy are small in patient size, lack control groups, and do not account for confounding variables.

In our study, the outcomes of immediate breast reconstruction coupled with a circumvertical mastopexy were analyzed. Patient demographics, anatomic characteristics, comorbidities, plane of implant placement, use of acellular dermal matrix (ADM), and complications were observed in the study group and compared with the cohort that did not require nipple position adjustment.

Takeaways

Question: Does mastopexy (lift) in prepectoral prosthetic breast reconstruction result in similar or improved outcomes compared with reconstruction without mastopexy (no-lift) and/or subpectoral implants.

Findings: This study controlled for plane of implant placement (prepectoral versus subpectoral) and adjunctive ADM use or not. With control of these variables, there were no differences in major and minor complications between the lift and no-lift groups.

Meaning: Breast reconstruction with concurrent mastopexy does not increase the risk of deleterious outcomes, irrespective of lift height. Prepectoral reconstruction with mastopexy is as safe as subpectoral implants.

METHODS

The records of all patients who underwent immediate reconstruction after NSM by the senior author between April 2010 and January 2021 were included in the study. This study was approved by the Spectrum Health institutional review board.

Data Collection

Data collected for the study included patient demographics and comorbidities (eg, diabetes, hypertension, smoking history, prior chemotherapy, and prior radiation treatment). Smoking history was noted as either 0, never; 1, previous smoker that quit more than 2 months prior to surgery; and 2, current smoker or quit less than 2 months prior to surgery. The type of surgical procedure was recorded and defined as either reconstruction with NAC correction (lift) or without NAC correction (no-lift). Additional details describing the reason for mastectomy, cancer grade, mastectomy specimen weight, ptosis grade, skin envelope laxity grade, implant type, plane of implant placement, and type of reconstruction were analyzed.

Determination of Preoperative Breast Anatomy

Preoperative physical examination and photographs were analyzed to determine the patients' breast anatomy with regard to skin laxity and degree of NAC ptosis. Skin laxity was expressed on a four-point scale as 1, tight; 2, mild; 3, moderate; and 4, loose. NAC ptosis was established based on Regnault classification.[18]

Surgical Approach

Nipple-sparing Mastectomy

NSM was offered to patients with genetic predisposition to breast cancer as a prophylactic procedure and women with early-stage breast cancer without regional or distant metastases. In every case, nipples were cored out and tissue containing the milk ducts was pathologically analyzed under frozen section control and further processed as routine permanent specimens. Regardless of lift status, all breasts received a J-incision starting below the NAC and carried down and out toward the infra-mammary fold. All preserved nipples were found to be negative for atypia or cancer by intraoperative biopsy. Intraoperative breast weight was recorded.

Circumvertical Mastopexy

The need for correction of NAC ptosis was determined by the operative surgeon during preoperative evaluation. Patients who underwent preoperative radiation therapy were not considered for mastopexy. The distance of nipple lift in centimeters was marked and recorded before the surgery with the patient in a standing position. Preoperative planning, intraoperative procedure, and postoperative outcomes in an exemplary patient are presented in Figure 1. Initially, the degree of ptosis was assessed, and correction of NAC position was designed (Fig. 1A). In addition to the J-incision, lift patients also received periareolar deepithelialization that accounted for the nipple lift (Fig. 1B). The area of designed periareolar lift was deepithelialized by the reconstructive surgeon, ideally before the commencement of mastectomy. Mastectomy was performed by a surgical oncologist. The inset of the adjusted areola was carried out using an interlocking 1.0 PTFE suture (Surgiform, Surgiform Technology, Ltd., Lugoff, S.C.) and 4.0 Monocryl (Ethicon, Inc., Somerville, N.J.) or 3.0 Stratafix (Ethicon, Inc., Somerville, N.J.) subcuticular suture (Fig. 1C).[19] Initial postoperative follow-up was carried out after 1 and 2 weeks to assure viability of NAC complex and at further time intervals, as dictated by the reconstructive modality (Fig. 1D).

Acellular Dermal Matrix

In breasts that received subpectoral implants, ADM was sutured to the inferior portion of the muscle superiorly and to the infra-mammary fold inferiorly. ADM anchored to the undersurface of the mastectomy flap covering the

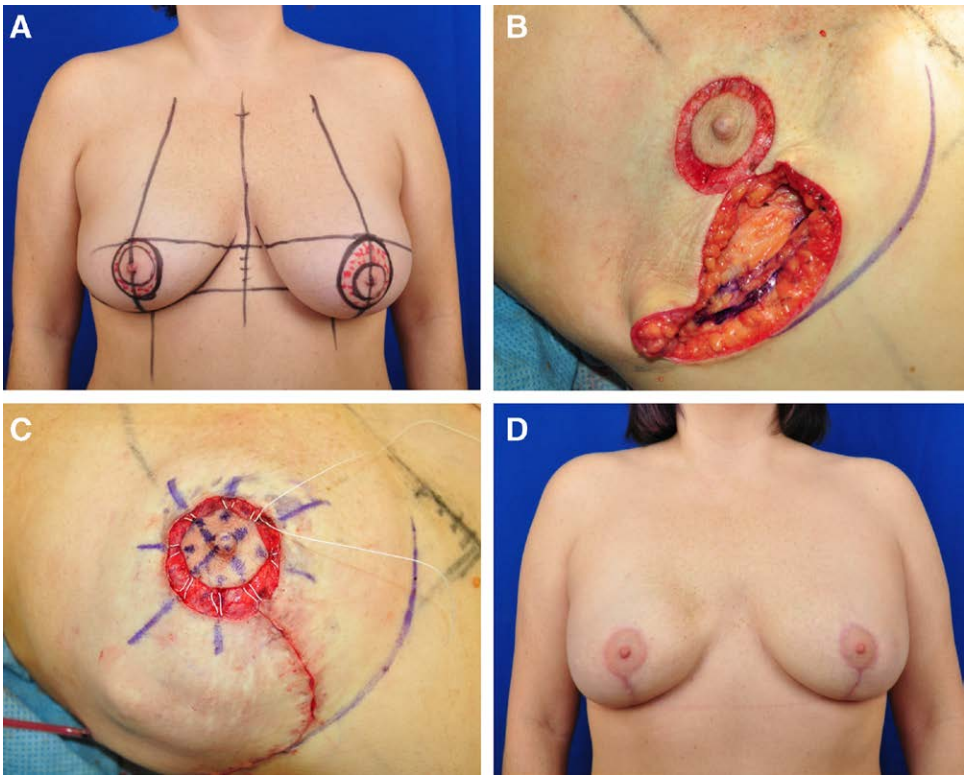

Fig. 1. The circumvertical nipple lift in an immediate prepectoral reconstruction. A, Preoperative view. B, Deepithelialized periareolar area and prepectoral NSM. C, Adjusted areola with an interlocking suture. D, Postoperative result 9 months after completion of reconstruction.

undersurface of the nipple and the incision line when implants were placed in the prepectoral plane.

Assessment of Surgical Outcomes

Postoperative complications observed within 30 days were individually analyzed and within minor or major complication groups. Minor complications included erythema, administration of extra-antibiotics for postoperative infection, flap necrosis, nipple necrosis, and seroma. Major complications included capsular contracture, dehiscence, hematoma, hospitalization, infection, loss of implant, necrosis requiring surgical debridement, and surgery for any complication. Capsular contracture were measured by last follow-up date. Ecchymoses were measured individually. Excision of necrosis was carried out for all established necrosis except for obviously superficial tissue loss.

Statistical Analysis

The patients were divided into two groups (lift and no-lift), depending on the respective surgical technique. For purposes of comparison, the units of analysis were individual breasts. The only exceptions were for the duplicative outcomes that necessitated analysis per the individual patient, such as patient demographics, hospitalization, and administration of extra-antibiotics. Quantitative data are expressed as the mean ± SD, whereas nominal data are expressed as a percentage. Comparisons between the two groups for quantitative variables were performed using the *t* test. Nominal variables were evaluated using the chi-square test or Fisher exact test. A Cochran-Mantel Haenszel test was used to measure mastopexy complication rates (lift versus no-lift) while controlling for plane of implant placement (subpectoral versus prepectoral) and ADM use or not (ADM versus no-ADM). A generalized estimating equation (GEE) ran a logistic regression model while accounting for the repeating breast reconstructions per patient, with complications as the dependent variables. For the GEE model, the independent variables used were type of operation (lift versus no-lift), ADM use or not, plane of implant placement, BMI, and smoking status (0, never smoker/quit more than 2 months prior to surgery and 1, current smoker/quit less than 2 months prior to surgery). For lift patients with a nipple lift height documented, a Wilcoxon rank sum distributed nipple lift height between major and no-major complications to determine whether there was an association with adverse outcomes. This method also distributed nipple lift height between minor and no-minor complications. Significance was assessed at a *P* value less than 0.05.

RESULTS

In the study period, we identified 142 patients who underwent 228 immediate breast reconstructions after

NSM. Preoperative breast anatomy and surgical details are depicted in Table 1. Thirty-four breasts in 22 patients underwent nipple–areola correction (lift) compared with 122 patients and 194 breasts that did not (no-lift). Eighty-six patients received bilateral reconstructions, whereas 56 patients had unilateral reconstructions. Two patients received bilateral reconstructions involving both a lift and no-lift procedure. Patient demographics in the lift and no-lift groups are summarized in Table 2. Lift patients had significantly greater BMIs with 27.3±4.0 compared with BMIs of no-lift patients with 25.7±4.9 ($P < 0.001$).

The reconstructive modalities included prepectoral or subpectoral implants. Significantly more subpectoral implants were placed in lift breasts than no-lift breasts, with 91.2% and 40.2% respectively ($P < 0.001$) (Table 1). Implants included tissue expanders or direct-to-implants (DTI), and with or without ADM (Table 2). For both lift and no-lift cohorts, tissue expanders were the primary choice of implant over DTI (94.1% versus 79.9%; $P < 0.01$). There was no difference in ADM use between the lift and no-lift cohorts (67.6% versus 65.9%; $P = 0.47$).

Breast Anatomy

Data on NAC ptosis, breast skin laxity (skin envelope grading), and breast weight are shown in Table 1. Most no-lift patients (84.9%) had either no (56.3%) or mild (28.6%) NAC ptosis. The lift group had a significantly greater degree of preexisting ptosis (2.0±0.61) compared with no-lift patients (0.64±0.75; $P < 0.001$). The lift group also exhibited a greater skin envelope grading of 2.73±0.87 compared with 2.22±0.92 in no-lift patients ($P < 0.001$). The breast specimen weights reflected the differences in the preoperative anatomy between the groups and were significantly greater in lifted breasts (610±210 g; N = 26) than not lifted (394±196 g; N = 171, $P < 0.001$). The extent of NAC elevation in the lift group was 3.73±2.12 cm (N = 30).

Patient Characteristics

The no-lift group received more radiation prior to surgery than the lift group, with 6.7% and 0%, respectively ($P < 0.001$). In terms of indications for mastectomy, 119 of 142 patients (83.2%) did not have active breasts with malignancy at the time of surgical treatment and underwent prophylactic mastectomies for personal and/or family breast cancer history or benign pathology of the breast (Table 2). Overall, prophylactic procedures were performed in 145 of 228 (63.6%) of operated breasts. Carrier status for the breast cancer gene was the reason for 40 prophylactic mastectomies, whereas 105 mastectomies were breasts complimentary to those with malignancy. Of the 83 breasts with malignancy, invasive ductal carcinoma was the most common diagnosis with 49.4%, followed by ductal carcinoma in situ with 32.5%. There was no significant difference between the lift and no-lift groups with respect to indication for mastectomy and reconstruction. All the intraoperative nipple biopsies were found to be negative for breast carcinoma by permanent pathology.

Postoperative Complications

Overall Results

We first analyzed postoperative outcomes between lift and no-lift groups and found no difference between major and minor complications (Table 3). Although not significantly different between the lift and no-lift groups, the most frequent major complications were surgery for any complication (38.2% versus 28.9%; P = NS) and

Table 1. Preoperative Breast Anatomy and Surgical Details

	Overall (N = 228 Sides, 142 Pts.)			Lift (N = 34 Sides, 22 Pts.)			No-lift (N = 194 Sides, 122 Pts.)			*P*
Variable	**N**	**Mean ± SD**	**%**	**N**	**Mean ± SD**	**%**	**N**	**Mean ± SD**	**%**	
Breast Surgery										<0.01
Bilateral per side	**172**		**75.4**	26		76.5	148		76.3	
Per pt.	**86**		**60.6**	14		63.6	74		60.7	
Unilateral per side	**56**		**24.6**	8		23.5	48		24.7	
Left	**26**		**46.4**	2		20	24		50	0.11
Right	**30**		**53.6**	6		80	24		50	
Ptosis grade	**N = 226**	**0.85±0.96**		N = 34	2.0±0.61		N = 192	0.64±0.75		**<0.001**
Grade 0	**108**		**47.8**	0		0	108		56.3	
Grade 1	**61**		**27**	6		17.6	55		28.6	
Grade 2	**40**		**17.7**	21		61.8	19		9.9	
Grade 3	**17**		**7.5**	7		20.6	10		5.2	
Nipple lift (cm)	**N = 30**			N = 30	3.73±2.12					
Skin envelope grade		**2.3±0.93**			2.73±0.87			2.22±0.92		**<0.001**
Specimen weight (g)	**N = 188**	**423±211**		N = 26	610±210		N = 171	394±196		**<0.001**
Implant placement										**<0.001**
Prepectoral	**119**		**52.2**	3		8.8	116		59.8	
Subpectoral	**109**		**47.8**	31		91.2	78		40.2	
Implant type										**<0.01**
Tissue expander	**187**		**82.0**	32		94.1	155		79.9	
Direct to implant	**41**		**18.0**	2		5.9	39		21.1	
ADM use	**151**		**66.2**	23		67.6	128		65.9	0.47

Pts., patients.
Results in bold are the first column to denote "overall" results and statistically significant *P* values.

Table 2. Patient Demographics and Surgical Indications

Variable	Overall (N = 228 Sides, 142 Pts.)			Lift (N = 34 Sides, 22 Pts.)			No-lift (N = 194 Sides, 122 Pts.)			*P*
	N	Mean ± SD	%	N	Mean ± SD	%	N	Mean ± SD	%	
Age (per pt.)		**49±10**			46±8.2			49±10.7		0.18
BMI (per pt.)		**25.9±4.8**			27.3±4.0			25.7±4.9		**<0.001**
Diabetes (per pt.)	**2**		**1.4**	0			2		1.7	0.28
Hypertension (per pt.)	**31**		**22**	4		18	27		22	0.35
Smoking										0.17
Never										
Per side	**159**		**69.7**	24		70.6	135		69.6	
Per pt.	**100**		**70.4**	16		72.7	86		70.5	
Quit >2 mo										
Per side	**45**		**19.7**	10		29.4	35		18	
Per pt.	**26**		**18.3**	6		27.3	20		16.4	
Current/quit <2 mo										
Per side	**24**		**10.6**	0		0	24		12.4	
Per pt.	**16**		**11.3**	0		0	16		13.1	
Prior chemo (per pt.)	**30**		**20.9**	6		27.3	24		19.8	0.34
Prior radiation (per side)	**13**		**5.7**	0		0	13		6.7	**<0.001**
Cancer grade (per side)		**0.74±1.1**			0.4±0.96			0.8±1.15		0.10
Surgical indication										0.34
Prophylactic per side	**145**		**63.6**	23		67.6	122		62.9	
Breast cancer gene	**40**		**27.6**	4		10	36		90	
Malignancy per side	**83**		**36.4**	11		32.4	72		37.1	
Invasive ductal carcinoma	**41**		**49.4**	5		45.5	36		50	
Ductal carcinoma in situ	**27**		**32.5**	5		45.5	22		30.1	
Invasive lobular carcinoma	**5**		**6.0**	1		9	4		5.6	
Other	**10**		**12.1**	0		0	10		14.3	

Pts., patients.
Results in bold are the first column to denote "overall" results and statistically significant *P* values.

Table 3. Surgical Outcomes: Lift versus No-lift

	Lift		No-lift		
Complications	**N = 34**	**%**	**N = 194**	**%**	***P***
All major complications	16	47.1	112	57.7	0.25
Infection	3	8.8	20	10.3	1.00*
Hospitalization	4	11.8	20	10.3	0.76*
Necrosis requiring surgery	**N = 14**		**N = 64**		
	7	50.0	44	68.8	0.22*
Surgery for any complication	13	38.2	56	28.9	0.27
Capsular contracture	**N = 25**		**N = 187**		
	2	8.0	47	25.1	0.056
Loss of implant	4	11.8	47	24.2	0.11
Dehiscence	2	5.9	13	6.7	1.00*
All minor complications	26	76.5	145	74.7	0.83
Necrosis	10	29.4	62	32.0	0.77
Nipple necrosis	11	33.3	39	20.2	0.09
Erythema	13	38.2	78	40.2	0.83
Seroma	3	8.8	42	21.7	0.08
Hematoma	0	0.0	8	4.1	0.61*
Extra-antibiotics	18	52.9	113	58.2	0.56
Ecchymosis	4	11.8	84	43.3	**<0.01**

All data were expressed as count and percent, and analyzed using chi-square test unless indicated otherwise.
P values in bold are statistically significant.
*Fisher exact test.

necrosis requiring surgical debridement (50% versus 68.8%; *P* = NS).

As we found no difference between lift and no-lift outcomes, we then questioned whether differences would vary based on plane of implant placement. Irrespective of lift status, prepectoral implants compared with subpectoral implants were associated with more implant loss (27.7% versus 16.5%; *P* = 0.04) and seroma (28.6% versus 10.1%; *P* < 0.001) (Table 4). ADM versus no-ADM groups were also analyzed irrespective of lift status (Table 5). With ADM use, there was more nipple necrosis (26% versus 14.5%; *P* = 0.049). However, there was no difference

Table 4. Surgical Outcomes: Prepectoral versus Subpectoral Implants

	Prepectoral		Subpectoral		
Complication	**N = 119**	**%**	**N = 109**	**%**	***P***
All major complications	69	58.0	59	54.1	0.56
Infection	14	11.8	9	8.3	0.38
Hospitalization	15	12.6	9	8.3	0.29
Necrosis requiring surgery	**N = 37**		**N = 41**		
	25	67.6	26	63.4	0.70
Surgery for any complication	34	28.6	35	32.1	0.56
Capsular contracture	**N =117**		**N = 95**		
	27	23.1	22	23.2	0.99
Loss of implant	33	27.7	18	16.5	**0.04**
Dehiscence	7	5.9	8	7.3	0.66
All minor complications	87	73.1	84	77.1	0.49
Necrosis	33	27.7	39	35.8	0.19
Nipple necrosis	**N=119**		**N=107**		
	28	23.5	22	20.6	0.59
Erythema	49	41.2	43	38.5	0.68
Seroma	34	28.6	11	10.1	**<0.001**
Hematoma	4	3.4	4	3.7	1.00
Extra-antibiotics	66	55.5	65	59.6	0.52
Ecchymosis	67	56.3	21	19.3	**<0.001**

P values in bold are statistically significant.

Table 5. Surgical Outcomes: ADM versus No-ADM

	ADM		No-ADM		*P*
Complication	**N = 151**	**%**	**N = 77**	**%**	
All major complications	80	53.0	48	62.3	0.18
Infection	16	10.6	7	9.1	0.72
Hospitalization	15	9.9	9	11.7	0.68
Necrosis requiring surgery	**N = 56**		**N = 22**		
	37	66.1	14	63.6	0.84
Surgery for any complication	46	30.5	23	29.9	0.93
Capsular contracture	**N = 135**		**N = 77**		
	28	20.7	21	27.3	0.28
Loss of implant	29	19.2	22	28.6	0.11
Dehiscence	11	7.3	4	5.2	0.55
All minor complication	118	78.1	53	68.8	0.12
Necrosis	52	34.4	20	26.0	0.19
Nipple necrosis	**N = 150**		**N = 76**		
	39	26.0	11	14.5	**0.049***
Erythema	65	43.0	26	33.8	0.18
Seroma	31	20.5	14	18.2	0.67
Hematoma	5	2.7	4	5.2	0.45
Extra-antibiotics	87	57.6	44	57.1	0.95
Ecchymosis	66	43.7	22	28.6	**0.026***

All data were expressed as count and percent, and analyzed using chi-square unless indicated.
P values in bold are statistically significant.
*Fisher exact test.

between the ADM and no-ADM groups regarding surgical debridement for necrosis.

Analyses Controlling for Confounders

Because of the differences between the lift and no-lift group outcomes due to surgical modalities, two controlling tests were executed. A Cochran-Mantel-Haenszel test first analyzed and controlled for implant placement (prepectoral versus subpectoral) and adjunctive ADM use or not (ADM versus no-ADM) (Table 6). With control of these variables, there were no differences in major and minor complications between the lift and no-lift groups (Table 6). Additionally, controlling for plane of implant placement demonstrated no difference in seroma and implant loss despite the previous analysis solely comparing prepectoral and subpectoral groups.

The GEE analysis supported the above results and demonstrated no difference in complications between the lift and no-lift groups when controlling for plane of implant placement and ADM or no-ADM use (Table 7).

Table 6. Outcomes of Lift versus No-lift with Control of Surgical Variables

Controlled Variables	Lift	No-lift	*P*
	All minor complications		
ADM	78.3%	78.1%	0.84
No-ADM	72.7%	68.2%	
	All major complications		
ADM	47.8%	53.9%	0.25
No-ADM	45.4%	65.1%	
Implant plane	All minor complications		
Prepectoral	100%	72.4%	0.97
Subpectoral	74.2%	78.2%	
Implant plane	All major complications		
Prepectoral	66.7%	57.8%	0.31
Subpectoral	45.2%	57.7%	
Implant plane	Seroma		
Prepectoral	0%	29.3%	0.54
Subpectoral	9.7%	10.3%	
Implant plane	Loss of implant		
Prepectoral	0%	28.4%	0.31
Subpectoral	12.9%	18.0%	

Table 7. GEE: Analysis of Parameter Estimates

Lift versus No-lift													
Parameter		Major Complications						Minor Complications					
		Estimate	SE	95% CI		Z	Pr > |Z|	Estimate	SE	95% CI		Z	Pr > |Z|
Intercept		−0.58	0.86	−2.26	1.10	−0.67	0.50	1.37	1.14	−0.85	3.6	1.21	0.23
BMI		0.03	0.03	−0.03	0.09	0.91	0.36	−0.01	0.04	−0.10	0.07	−0.25	0.80
Smoking status	Y	0.55	0.37	−0.17	1.27	1.50	0.13	0.20	0.43	−0.65	1.05	0.46	0.65
	N	0.00	0.00	0.00	0.00	.	.	0.00	0.00	0.00	0.00	.	.
Lift	Y	−0.19	0.55	−1.27	0.89	−0.34	0.73	0.13	0.35	−0.56	0.82	0.37	0.71
	N	0.00	0.00	0.00	0.00	.	.	0.00	0.00	0.00	0.00	.	.
Subpectoral Implants versus Prepectoral Implants													
Parameter		Major Complications						Minor Complications					
		Estimate	SE	95% CI		Z	Pr > |Z|	Estimate	SE	95% CI		Z	Pr > |Z|
Intercept		−0.51	0.91	−2.29	1.28	−0.55	0.5793	1.21	1.19	−1.12	3.54	1.02	0.31
BMI		0.03	0.03	−0.04	0.09	0.82	0.4107	−0.007	0.04	−0.09	0.08	−0.16	0.87
Smoking status	Y	0.55	0.37	−0.18	1.28	1.47	0.1403	0.21	0.44	−0.65	1.07	0.47	0.63
	N	0.00	0.00	0.00	0.00	.	.	0.00	0.00	0.00	0.00	.	.
Subpectoral	Y	−0.05	0.33	−0.7	0.61	−0.14	0.8892	0.14	0.39	−0.62	0.90	0.36	0.72
	N	0.00	0.00	0.00	0.00	.	.	0.00	0.00	0.00	0.00	.	.
ADM versus No-ADM													
Parameter		Major Complications						Minor Complications					
		Estimate	SE	95% CI		Z	Pr > |Z|	Estimate	SE	95% CI		Z	Pr > |Z|
Intercept		−0.38	0.91	−2.15	1.40	−0.42	0.68	0.92	1.16	−1.34	3.19	0.80	0.42
BMI		0.03	0.03	−0.04	0.09	0.81	0.42	−0.01	0.04	−0.09	0.08	−0.14	0.89
Smoking status	Y	0.56	0.37	−0.18	1.29	1.49	0.14	0.19	0.43	−0.66	1.04	0.44	0.66
	N	0.00	0.00	0.00	0.00	.	.	0.00	0.00	0.00	0.00	.	.
ADM	Y	−0.22	0.35	−0.91	0.47	−0.63	0.53	0.54	0.39	−0.23	1.31	1.38	0.17
	N	0.00	0.00	0.00	0.00	.	.	0.00	0.00	0.00	0.00	.	.

SE, standard error; CI, confidence interval.
A period denotes that a value was not able to be calculated by the model.

Nipple Lift Analysis

Out of concern for whether nipple lift height variation would worsen outcomes, a nipple lift analysis determined whether complications differed between patients who received shorter or higher nipple corrections (Fig. 2 and Table 8). Stratification of lifted breasts that experienced minor or no-minor complications demonstrated no difference in nipple lift height. There was also no difference in lift height between major and no-major complications groups.

DISCUSSION

Reconstruction after nipple preservation is challenging in larger and ptotic breasts. Even in mildly ptotic breasts, nipple malposition can occur after reconstruction

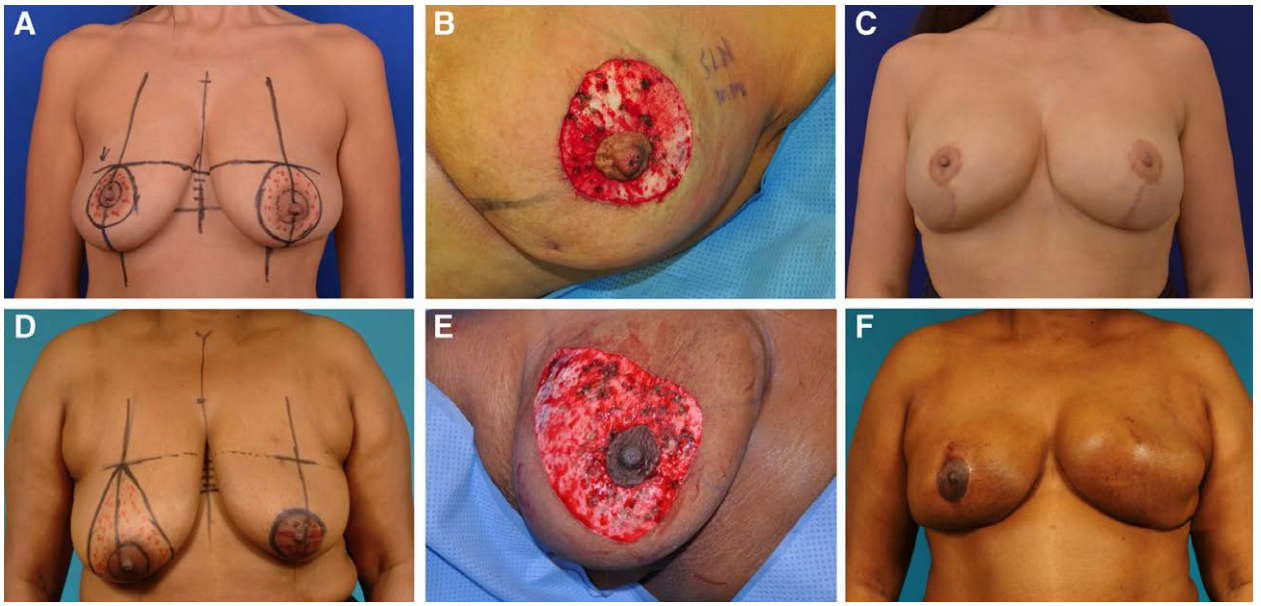

Fig. 2. Mastopexy: variations in lift height. A, Preoperative view and markings of patient with a 2 cm lift (upper left). B, Deepithelialized periareolar area in patient with 2 cm lift (upper middle). C,Postoperative results in patient with 2 cm lift (upper right). D, Preoperative view and markings of patient with 12 cm lift (lower left). E, Deepithelialized periareolar area in patient with 12 cm lift (lower middle). F,Postoperative results in patient with 12 cm lift. The right breast had wound dehiscence at the superior aspect of the periareolar incision that healed by secondary intention. Tissue expander is still in place in this figure, as the patient was lost to follow-up.

Table 8. Nipple Lift Height Analyses

Variable	N = 30	Lift Height (cm) *	*P*
Minor complications	13	3.0 [2.0–4.5]	0.77
No-minor complications	17	3.5 [2.8–4.0]	
Major complications	22	4.0 [3.0–5.0]	0.10
No-major complications	8	3.0 [2.0–4.0]	

*Lift height was calculated as average and 95% CI.

due to skin contracture in the interim between expansion and permanent implant placement.[20] Thus, lack of simultaneous correction of nipple position in ptotic breasts via nipple lift may result in lateralization of the nipple that is difficult to correct.

To further maximize oncological safety of nipple preservation, adequate duct removal with residual NAC thickness of about 0.5–1 mm has been advocated.[9] Clearly, such extensive excision of subareolar tissue additionally reduces vascularity of this area, potentially resulting in ischemia in close to 80% of cases.[1,2,8,9,13] Wijayanayagam and colleagues reported over 80% risk of nipple necrosis when incisions were carried across the NAC.[1] Similar observations have been noted by others with periareolar incisions resulting in NAC ischemia in 48% of cases.[2] In our study, periareolar deepithelialization was performed meticulously, paying attention to preservation of the dermal plexus. Removal of the epidermis was carried out, preferably before the mastectomy, to take advantage of the intact tissue turgor. The circumvertical skin reduction approach used in our patients allows for even distribution of tension along the periareolar incision, which may contribute to more effective healing.[1] Moreover, circumvertical scar placement can be convenient should revision of breast ptosis be indicated later.

Prepectoral breast reconstruction following NSM has been supported in the literature as safe, with lower rates of animation deformity and comparable capsular contracture.[21] However, there is sparse literature on prepectoral reconstructions with concurrent mastopexy and the studies available are small in sample size.[14–17] One of the inherent challenges of prepectoral mastectomy is ensuring adequate implant coverage and preservation of thick mastectomy flaps with a reliable blood supply. Salibian et al's article on prepectoral reconstruction following NSM highly suggests that preservation of thick flaps (0.5–2 cm) can reduce ADM use and prevent flap thinning, ischemia, and necrosis.[18] Theoretically, submuscular placement can provide a more vascularized soft tissue envelope. However, due to varying anatomy, even in dual plane subpectoral reconstruction, nipple position may not fall over the muscle.[20]

Our analysis compared prepectoral and subpectoral reconstructions in NSM, irrespective of lift status, and demonstrated that prepectoral implants were associated with more implant explantation. However, the adjusted *P*-value for lift versus no-lift when controlling for plane of implant placement demonstrated no increase in implant loss. Manrique et al's study on concurrent mastopexy with prepectoral breast reconstruction after NSM found no complications other than two cases of seroma formation requiring aspiration.[15] However, their sample size was small with only 17 reconstructions in nine patients and did not control for potential confounders. Although our study resulted in more overall complications in both groups, we utilized a control group and executed logistic regression models to account for potential confounders. Overall, our study further supported Manrique et al's

conclusions that prepectoral reconstructions with concurrent nipple lift are safe.

ADM has been shown to aid in controlling the breast envelope and enhancing soft tissues. However, its application is associated with increased cost, infection, and seroma formation.[22–24] Interestingly, the present study found that ADM use was associated with more nipple necrosis yet did not result in more surgical debridement. Although the reason for this outcome was not clearly elucidated, we hypothesized that ADM may act as a temporary barrier for diffusive nutrient penetration and may impede blow flow by increasing pressure on the nipple itself. The subsequent analysis of lift versus no-lift controlled for ADM status and demonstrated that ADM use does not affect lift or no-lift outcomes.

Spear and colleagues suggest performing mastopexy and breast reduction before NSM.[11] Gunnarsson et al also advocated for staging mastopexies 3–4 months before NSM, particularly in patients undergoing prophylactic mastectomies.[25] Also implementing a mastopexy stage prior to mastectomy, Hammond and Little found only two of 39 NACs with partial necrosis and no cases of flap necrosis.[26] The study by Hammond and Little involved 84.6% prophylactic mastectomies, whereas prophylactic mastectomies accounted for 63.6% of the reconstructions in our study. A staged reconstructive method could be indicated in patients undergoing prophylactic procedures, but in the presence of active breast cancer disease, delay in mastectomy execution undermines oncological safety and poses a therapeutic dilemma.

Our technique of circumvertical mastopexy accompanying breast reconstruction after NSM was not associated with increased complications, thus simultaneous correction of breast ptosis, particularly in saggy breasts, prevents postmastectomy nipple malposition and aids in establishing satisfactory breast contour. Concurrent mastopexy may reduce the risk of subsequent returns to the operating room to correct nipple malposition. Although our rates of necrosis and necrosis requiring surgical intervention are higher than rates reported in other studies, we have a low threshold for necrosis excision to prevent further complications. We also demonstrated that larger lifts did not result in more deleterious outcomes compared with smaller lifts, which again emphasizes that, in lieu of adequate blood flow, periareolar deepithelization is safe. Additionally, as demonstrated by Hammond et al, interlocking synthetic sutures and undermining the region slightly further protects the periareolar approximations from sources of infection and splitting.[19] To assure adequate blow flow, intraoperative perfusion mapping may be of great use.[27] Unfortunately, this modality was not available to us.

To our knowledge, this is the first article to compare lift and no-lift groups when accounting for and controlling for plane of implant placement, ADM use or not, and nipple lift height. We hope that the presented clinical analysis will help guide informed consent, aid patient decision-making, and shape expectations before embarking on breast reconstruction after NSM.

Limitations

One of the limitations of this study is the small sample size, particularly in the group who received prepectoral implants with concurrent mastopexy. The choice of the surgical approach was dictated by the anatomy of patients presenting for reconstruction. Additionally, patients with prior radiation were not offered mastopexy; therefore, analysis of radiation effects could not be conducted. Another shortcoming of our study stems from intraoperative clinical assessment of mastectomy flap perfusion which likely affected the choice of tissue expander versus direct-to-implant, favoring permanent implant in flaps that appeared well perfused.

CONCLUSIONS

Breast reconstruction with simultaneous NAC lift does not increase the risk of deleterious outcomes. Protectoral reconstruction with mastopexy was demonstrated as a safe procedure and provided effective results as subpectorally placed implants without potentially subjecting the patient to more postoperative pain and animation deformity, irrespective of ADM use. Before correction of the nipple position, adequate perfusion of mastectomy flaps must be assured.

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DISCLOSURE

The authors do not have any disclosures related to the contents of this article.

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