

Impact of Patient and Operative Factors on Nipple-Areola Complex Sensation after Bilateral Reduction Mammoplasty

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Background: Alteration of nipple-areola complex (NAC) sensation following reduction mammoplasty is commonly reported and may impact patient satisfaction. The goal of this study was to evaluate the patient and procedural factors that influence the rates of subjective NAC sensation change.

Methods: A retrospective review of all patients who underwent primary bilateral reduction mammoplasty between January 2014 and August 2018 at the senior author's institution was performed. The primary outcome measured was subjective NAC sensation via digital stimulation of the NAC with the patient reporting sensation as decreased, unchanged, or increased.

Results: In total, 274 patients met inclusion criteria. NAC sensation was decreased in 19% of breasts, unchanged in 74%, and increased in 7.3%. Patients who underwent vertical pattern, superomedial pedicle reductions were more likely to report a decrease in sensation than those who underwent Wise pattern, inferior pedicle reductions (26% versus 13%; $P = 0.0025$). Patients with minor complications were more likely to report decreased NAC sensation than those who did not (23% versus 15%; $P = 0.0264$). The only factor found to be associated with increased sensation was operative time.

Conclusions: Patients were more likely to report decreased sensation if a vertical skin resection, superomedial pedicle was chosen, or if patients experienced a minor complication. The only factor found to correlate with increased NAC sensation was longer operative times. (*Plast Reconstr Surg Glob Open* 2022;10:e4353; doi: 10.1097/GOX.0000000000004353; Published online 2 June 2022.)

INTRODUCTION

Reduction mammoplasty is a safe surgical procedure with more than 100,000 women undergoing the intervention annually.¹ Women report a high degree of satisfaction and improvement in neck pain, back pain, shoulder grooving, intertrigo, ease of exercise, and unwanted attention after surgery.^{2,3} Significant improvements in anxiety, depression, and body image as measured using the Hospital Anxiety and Depression Scale

and the Corporeal Dissatisfaction Subscale of the Eating Disorders Inventory (EDI-2) have also been reported.⁴ Despite these significant merits, a risk of reduction mammoplasty is alterations of nipple areolar complex (NAC) sensation, which can potentially impact patient satisfaction.

In a prospective questionnaire of women undergoing reduction mammoplasty, 79% reported NAC sensation as very important to their sexual lives.⁵ Despite this, a study of 40 women undergoing reduction mammoplasty showed significant reductions in NAC sensation, but no change in the Female Sexual Function Index scores.⁶ This may be due to improved psychosocial and physical symptoms after breast reduction outweighing the negative feelings associated with changes in NAC sensation. Nonetheless, elucidating factors that contribute to changes in NAC sensation may help preserve sensation and contribute to patient satisfaction. The goal of this study was to evaluate the patient and operative factors that influence subjective NAC sensation after reduction mammoplasty.

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MATERIALS AND METHODS

A retrospective review was performed after obtaining institutional review board approval from Baylor Scott & White Health – Texas A & M Health Science Center. Women who underwent primary bilateral reduction mammoplasty (CPT 19318.50) between January 2014 and August 2018 by 10 board certified or board eligible plastic surgeons at a single institution were identified. Exclusion criteria included patients undergoing multiple additional body contouring procedures, revision reduction mammoplasty, asymptomatic macromastia, or if free nipple grafting was performed.

Patient demographics data collected were age, sex, body mass index (BMI), and medical comorbidities. Medical comorbidities were history of diabetes mellitus, hypertension requiring medication, congestive heart failure, nicotine use, chronic obstructive pulmonary disorder, renal disease, immunosuppression, blood dyscrasias, and American Society of Anesthesiologists class. Operative data collected were technique (pedicle, skin resection pattern), operative time, mass of breast tissue excised, and drain placement. Nicotine use was considered active if the patient was using tobacco products within 30 days in the preoperative setting, or at any point in the acute postoperative setting.

The postoperative course, including details of surgical complications, and subjective NAC sensation was obtained through chart review. All surgeons assessed preoperative subjective NAC sensation by drawing a finger from the super aspect of the NAC to the inferior aspect of the NAC, using light pressure. Subjective NAC sensation was assessed in the same manner within 8 weeks after surgery, with the patient reporting perceived sensation as decreased, unchanged, or increased compared with their preoperative baseline. Minor complications were defined as wounds successfully treated without sharp debridement, hematoma, or seroma amenable to observation or aspiration only, fat necrosis less than 1 cm in diameter, and infections resolving with oral antibiotics alone. Major complications were defined as wounds requiring sharp debridement, infections requiring intravenous antibiotics, and any return to the OR within 30 days, including incision and drainage of hematomas, seromas, or abscesses. Medical complications were defined as any inpatient admission for noninfectious or operative reason, deep vein thrombosis, pulmonary embolism, stroke, acute kidney injury, cardiac complications, or pulmonary complications.

Sample characteristics were described using descriptive statistics. Frequencies and percentages were utilized to describe categorical variables. Means and SDs (or medians and ranges where appropriate) were performed to describe continuous variables. A Kruskal-Wallis test was employed to test for differences in continuous variables between the three ordinal sensation groups (decreased, unchanged, and increased). A generalized estimating equation, which accounts for the repeated nature of the data, was used to model the increase of sensation and the decrease of sensation separately. The level of significance was set to a *P* value less than 0.05.

Takeaways

Question: What patient and procedural factors influence subjective nipple-areola complex sensation change after reduction mammoplasty?

Findings: Patients were more likely to report decreased sensation if they underwent vertical reductions with a superomedial pedicle, or had minor complications.

Meaning: If nipple-areola complex sensation is important to a woman undergoing reduction mammoplasty, an inferior pedicle Wise pattern reduction may be preferable to a superomedial pedicle vertical pattern reduction.

RESULTS

A total of 274 patients met inclusion criteria, and were included in the final analysis. The mean patient age was 35.6 years (14–77; ±14.8 years), and mean BMI was 30.3 kg per m² (19.0–46.1; ±4.2 kg/m²). A majority of patients (85%) were healthy, with low American Society of Anesthesiologists classification (I and II), and with relatively low rates of medical comorbidities. The most common comorbidities were hypertension (20%), diabetes mellitus (4.0%), chronic obstructive pulmonary disorder (1.1%), coagulopathy (0.7%), and chronic kidney disease (0.7%). The rate of tobacco use in the perioperative period was low at 2.9% (Table 1). The mean length of follow-up was 133 days (4–1406 ± 171 days).

The employed surgical techniques were: Wise pattern with an inferior pedicle (54%) and vertical pattern with a superomedial pedicle (46%). The authors' techniques are depicted in Figure 1. The mean resection weight was 596 g (97–2248; ±304 g) in the left breast and 613 g (12–2272; ±336 g) in the right breast. The minor complication rate was high at 50% with the majority being superficial wounds or minor delayed healing. The major complication rate was low at 4.4%.

The majority of patients (74%) did not report a subjective change in NAC sensation, while 19% reported a decrease, and 7.3% reported an increase in sensation. There was no difference based on laterality (*P* = 0.999). Among patients who experienced a change, 15% did not

Table 1. Patient Comorbidities

	N (%)	<i>P</i> = Increased/Decreased Sensation
Diabetes mellitus	11 (4)	*/0.5484
HTN	55 (20)	0.7279/0.8413
Active nicotine use	8 (2.9)	0.3266/0.53740
COPD	3 (1.1)	*/0.3036
Ascites	0 (0)	†/†
Renal disease	2 (0.7)	†/†
Immunosuppression	9 (3.3)	*/0.2261
Coagulopathy	6 (2.2)	*/0.4670

No comorbidities were found to be significant predictors of changes in NAC sensation.

P values are reported for increased/decreased NAC sensation. No factors were found to be statistically significant.

*No patients with diabetes mellitus, COPD, immunosuppression, or coagulopathy experienced an increase in sensation; statistics were unable to be performed.

†Insufficient patient numbers were present for statistical analysis.

COPD, chronic obstructive pulmonary disorder; HTN, hypertension.

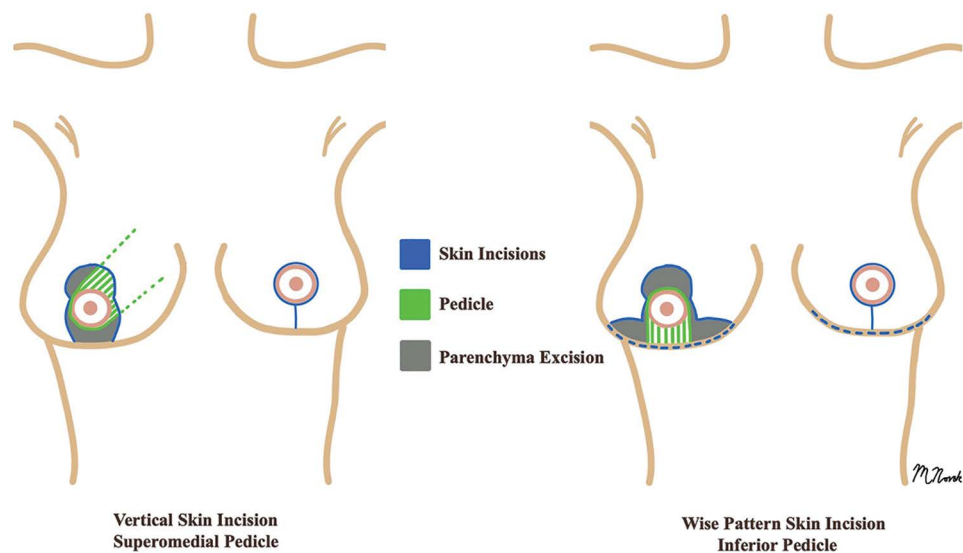


Fig. 1. Depiction of the authors’ preferred techniques. An estimated 127 patients underwent vertical skin incision, superomedial technique reductions. In total, 147 patients underwent Wise pattern skin incision, inferior pedicle reductions. Blue represents the skin incisions. Green represents the pedicle, where skin was de-epithelialized and parenchyma left behind. Gray represents parenchyma and skin that has been excised.

Table 2. Descriptive Statistics

Variable	Mean	Range ± SD	<i>P</i> = Increased/Decreased Sensation
Age (y)	35.57	14–77 ± 14.88	0.7082/0.7470
BMI (kg/m ²)	30.16	19.0–46.1 ± 4.15	0.5237/0.7965
Left breast mass excised (g)	596.21	97–2248 ± 303.62	0.8687/0.3832
Right breast mass excised (g)	613.64	12–2272 ± 335.57	0.7720/0.4304
Operative time (min)	159.22	78–322 ± 36.99	0.0471/0.2837
Length of follow-up (d)	133.28	4–1406 ± 171.02	0.9139/0.5206

Increased operative time was found to be an independent predictor of increased NAC sensation. No other variables were found to be predictors of increased or decreased NAC sensation.

P-values are reported for increased/decreased NAC sensation with significant values in boldface.

experience the same change in the contralateral breast. Patient medical comorbidities were not associated with altered NAC sensation (Table 1). Similarly, there was no statistically significant difference in reported rates of

sensation decrease or increase based on age (*P* = 0.747, and 0.708), BMI (*P* = 0.797, and 0.524), left resection weight (*P* = 0.393, and 0.869), right resection weight (*P* = 0.430, and 0.772), drain placement (*P* = 0.254 and 0.550), or length of follow-up (*P* = 0.521, and 0.914). Increased operative time was not associated with decreased sensation; however, it was a predictor of increased sensation (*P* = 0.284, and 0.047). For every 30 minute increase in operative duration, the odds of heightened sensation increased by 59% (Table 2).

Operative technique (pedicle, skin excision) was a predictor of sensation change. Patients who underwent vertical pattern, superomedial pedicle reductions were more likely to report a decrease in sensation when compared with patients who underwent Wise pattern, inferior pedicle reductions (26% versus 13%; *P* = 0.003). Operative type was not a predictor of increased sensation (*P* = 0.621). Similarly, patients with minor complications were more likely to report decreased sensation (23%

Table 3. Surgical Type, Complications, and Their Impact on NAC Sensation

	Sensation			Total	<i>P</i> = Increased/Decreased Sensation
	Decreased	Unchanged	Increased		
Surgical type					
V, SM	65 (25.6%)	170 (66.9%)	19 (7.5%)	254	0.6207/ 0.0025
W, I	38 (12.9%)	235 (79.9%)	21 (7.1%)	294	
Minor complication					
Yes	63 (22.8%)	186 (67.4%)	27 (9.8%)	276	0.0582/ 0.0264
No	40 (14.7%)	219 (80.5%)	13 (4.8%)	272	
Major complication					
Yes	2 (8.3%)	20 (83.3%)	2 (8.3%)	24	0.9903/0.2221
No	101 (19.3%)	385 (73.5%)	38 (7.3%)	524	

Patients who underwent a vertical pattern superomedial pedicle reduction were more likely to experience a decrease in NAC sensation than those who underwent an inferior pedicle Wise pattern reduction on multivariate analysis. Patients who experienced a minor complication were more likely to experience a decrease in NAC sensation than those who did not have a minor complication. Surgical type and complications were not found to be predictors of increased NAC sensation. *P*-values are reported for increased/decreased sensation, with significant values in boldface.

V, vertical skin excision; SM, superomedial pedicle; W, Wise pattern skin excision; I, inferior pedicle.

versus 15%; $P = 0.003$), but there was no association with increased sensation ($P = 0.058$). There was no association of major complications with either decreased or increased NAC sensation ($P = 0.222$, and 0.990) (Table 3).

DISCUSSION

The NAC has a significant overlap of afferent sensory innervation through the lateral branches of the third through fifth intercostal nerves and the anterior branches of the second through fifth intercostal nerves. The largest and most consistent sensory nerve is the lateral fourth intercostal nerve, which divides into superficial and deep branches. The deep branch emerges lateral to the pectoralis major, traveling 3–5 cm in the submammary space to the midclavicular line before passing through the superficial fascia to innervate the NAC.^{7,8} The path of the deep branch of the lateral fourth intercostal nerve is disrupted with excision of the inferior and lateral breast tissue, and with violation of the pectoralis fascia. This is consistent with our findings of patients undergoing superomedial pedicle, vertical reductions experiencing higher rates of subjective NAC sensation loss (Fig. 2). Our findings are consistent with prior published reports on higher rates of NAC sensory change or loss with the utilization of a superomedial pedicle.^{5,9,10} An inferior pedicle is more likely to preserve the deep lateral branch of the fourth intercostal nerve given its emergence in the inferolateral aspect of the breast. Lateral pedicle or central mound reductions may also preserve this sensation. A study by DeLong et al showed negligible subjective NAC sensation decrease via the Breast-Q in 552 breasts reduced with a central mound technique¹¹

The relative importance of resection weight versus surgical technique has been debated.⁵ Pressure sensitivity thresholds as well as axon reflex flare after electrical stimulation have been shown to be higher in women with macromastia.^{12,13} Slezak et al compared NAC sensation in 13 women presenting for breast reduction consultation to 10 women with A or B cup breasts. Mean sensory and vibratory thresholds were higher in the macromastia patients, and decreased after reduction. He hypothesized that macromastia places traction on nerves, decreasing their function. Breast reduction alleviates this traction, leading to increased sensation.¹⁴ Longo et al established normative cutaneous pressure thresholds of the NACs of 150 White women via a pressure specified sensory device (PSSD), observing that NACs in small breasted women were significantly more sensitive than those of large breasted women. He also concluded that traction on nerves, in addition to lower nerve density in women with larger breasts results in decreased sensation.^{14,15} However, we did not observe an association between resection weight and sensation change (Fig. 3). Consistent with our observations, Nahabedian et al and Mofid et al failed to find an association between mass of excision and NAC sensation.^{9,16} Instead, the only factor observed to correlate with increased sensation in our patients was longer operative times (Fig. 4). Operative time was associated with surgical technique ($P < 0.001$, shorter intervention with superomedial pedicle, and vertical pattern skin excision), and resection weight

Operative Technique and NAC Sensation

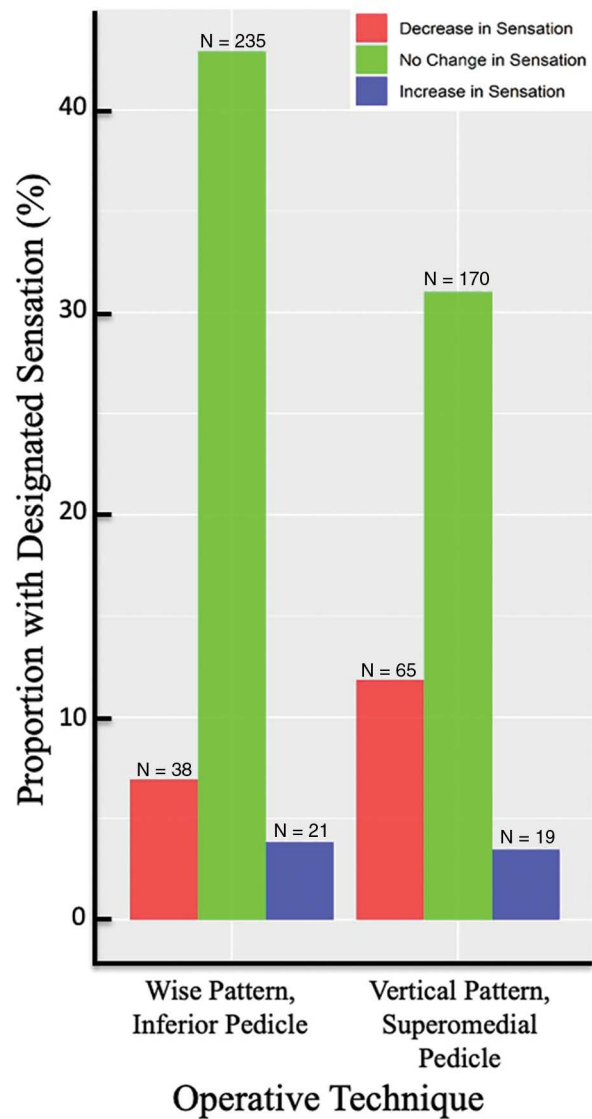


Fig. 2. Operative Technique and NAC sensation. An estimated 127 patients (254 breasts or 46.4%) underwent vertical pattern, superomedial pedicle reductions, whereas 147 (294 breasts or 53.6%) underwent Wise pattern, inferior pedicle reductions. Patients who underwent vertical pattern, superomedial pedicle reductions were more likely to report a decrease in sensation when compared with patients who underwent Wise pattern, inferior pedicle reductions (25.6% vs 12.9%; $P = 0.0025$). Surgical type was not a predictor of increased sensation (7.5% vs 7.1%; $P = 0.6207$).

($P < 0.001$); however, neither resection weight nor operative technique were independent predictors of increased sensation. Additional factors contributing to the association of operative time and subjective NAC sensation include surgical skill, availability of assistants, technical difficulty, and simultaneous versus consecutive resection. However, these details are difficult to quantify.

An interesting finding was the association of minor complications with sensation change, with a statistically significant association with decreased sensation ($P = 0.026$),

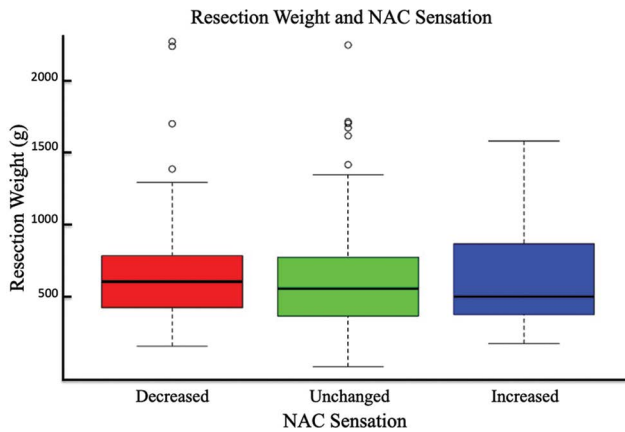


Fig. 3. Resection weight and NAC sensation. No statistically significant difference was observed between resection weight and decreased sensation ($P = 0.3932$ on the left and $P = 0.4304$ on the right), or increased sensation ($P = 0.8687$ on the left and $P = 0.7720$ on the right).

and near significant association with increased sensation ($P = 0.058$) (Fig. 5). This may be related to the subjective nature of our assessment. Women who experienced a minor complication may have scrutinized their breasts to a higher degree postoperatively, or had more postoperative visits, leading to increased awareness. However, no patient reported significant distress with the change of their NAC sensation.

Although our findings are significant, they are limited by the subjective nature of our NAC evaluation. Some studies have utilized two-point discrimination, but the NAC is frequently too small for accurate determination.¹⁷ Semmes-Weinstein testing is an objective measure. However, this method has the weaknesses of a logarithmic scale of pressure discrimination limiting its precision, the tendency of the applied force to degrade over time, and high interobserver variability based on technique.^{18–20} PSSD testing has also emerged as an objective measure of assessing NAC

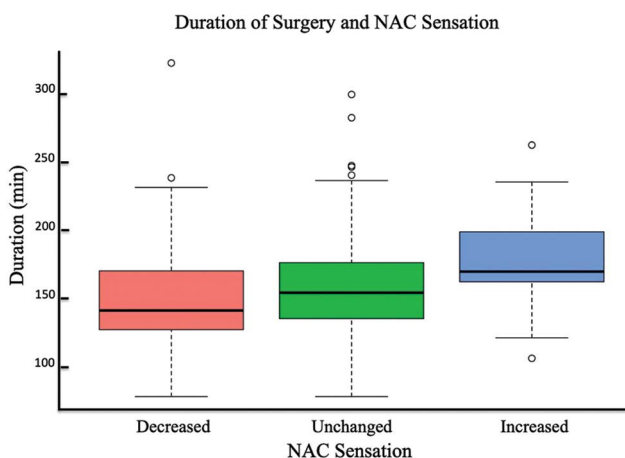


Fig. 4. Duration of surgery and NAC sensation. Operative duration was not associated with decreased sensation ($P = 0.284$); however, it was a predictor of increased sensation ($P = 0.047$). For every 30 minute increase in operative duration, the odds of heightened sensation increased by 59.3%.

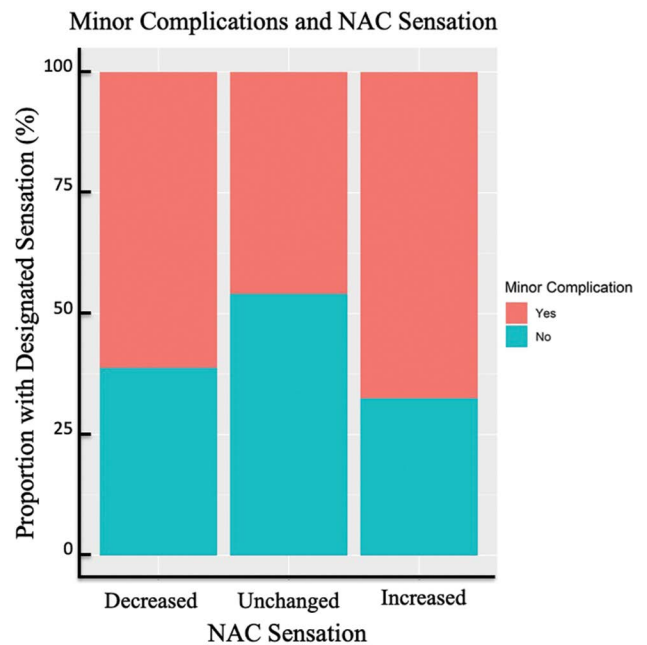


Fig. 5. The relationship between minor complications and NAC sensation. The minor complication rate was 50.4%. Patients with minor complications were more likely to report decreased sensation than those that did not have a minor complication (22.8% versus 14.7%, $P = 0.0264$). Patients with minor complications also reported higher rates of increased sensation; however, this did not meet statistical significance (9.8% versus 4.8%, $P = 0.0582$).

sensation with a high degree of accuracy; however, it is costly and time-consuming.²¹ Few studies have utilized histamine chemical stimulation to assess mechanosensitive C fibers that primarily assess the sensation of itch, but this has been used as an objective measure of sensation in the past.¹³ This has the disadvantage of only assessing fibers responsible for itch, as well as being costly and time-consuming. Regardless, patient satisfaction is largely dependent upon their subjective experience; thus, we feel that our assessment provides useful information toward optimizing their experience.

An additional limitation is the retrospective nature of the study with limited long-term follow-up. Sensory recovery in the long-term after reduction mammoplasty has been variable. Some have found lower sensory thresholds postoperatively via monofilament testing that subsequently improved over 1–2 years.^{3,22,23} In contrast, Longo et al noted that NAC sensation continued to decrease between 6 months and 2 years postoperatively via PSSD in 30 women who underwent superolateral reductions.²⁴ We counsel all of our patients preoperatively that NAC sensation frequently decreases after surgery, but increases in a small number of patients. Regardless of whether sensation is increased or decreased, this may gradually return toward normal, but can be permanent. It has not been our experience that sensation continues to deteriorate or hypersensitize after the acute recovery period (approximately 8 weeks).

Ultimately, this study demonstrates significant subjective reductions in NAC sensation in women who underwent

superomedial pedicle reductions and in those who experienced minor complications. Increased subjective NAC sensation was observed in patients with longer operative times, though the causality is uncertain. This retrospective review serves as the groundwork for a prospective study assessing objective preoperative and postoperative sensation at multiple long-term intervals. The preoperative measurement would allow patients to serve as their own control. Moreover, breast measurements could be compared, subjective sensation could be compared with objective sensation, and additional correlations could be identified.

CONCLUSIONS

Reduction mammoplasty is a safe surgical procedure with low rates of major complications, but with a risk of NAC sensory changes. Patients were more likely to report decreased sensation with a vertical skin pattern, superomedial pedicle reduction mammoplasty, or if they experienced a minor complication.

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