



# Delay techniques for nipple-sparing mastectomy: a retrospective review of outcomes in 47 patients

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**Background:** Nipple-sparing mastectomy (NSM) has become a popular method of oncologic breast surgery, allowing for more natural-appearing reconstructed breasts. Ischemic complications from NSM can lead to prosthetic explantation and need for revision. Several papers have been published describing delay techniques in NSM patients. Our goal is to demonstrate outcomes in patients who underwent a delay procedure prior to NSM.

**Methods:** We conducted a retrospective review of patients who underwent a delay procedure. The first stage involved undermining the nipple areolar complex and mastectomy flap. At this time, a retroareolar biopsy was performed. Subsequently, patients underwent NSM. Patient data including age, comorbidities, breast scars, smoking, delay characteristics, and complications were recorded.

**Results:** Forty-seven patients (88 breasts) were included in the study. Half of the mastectomies were performed on biopsy-positive breast cancer, the other 44 mastectomies were prophylactic. Eight patients were BRCA positive. The average time between delay and NSM was 15.7 days. Three patients had positive retroareolar biopsies and underwent skin-sparing mastectomy. Mean follow-up was 18 months; all patients reviewed had at least six-month follow-up. Two patients had areas of nipple necrosis that resolved without reoperation, four cases of skin necrosis required re-operation. In these patients, three had previous breast surgery and one patient was a smoker. The overall complication rate was 7%.

**Conclusions:** A two-stage approach to NSM can reduce risk of skin and nipple areolar complex necrosis, while allowing for retroareolar and sentinel lymph node biopsies to be performed. This is especially important for patients at high-risk for ischemic complications.

**Keywords:** Nipple-sparing mastectomy (NSM); nipple delay; delay procedure; nipple-sparing mastectomy reconstruction (NSM reconstruction); breast reconstruction

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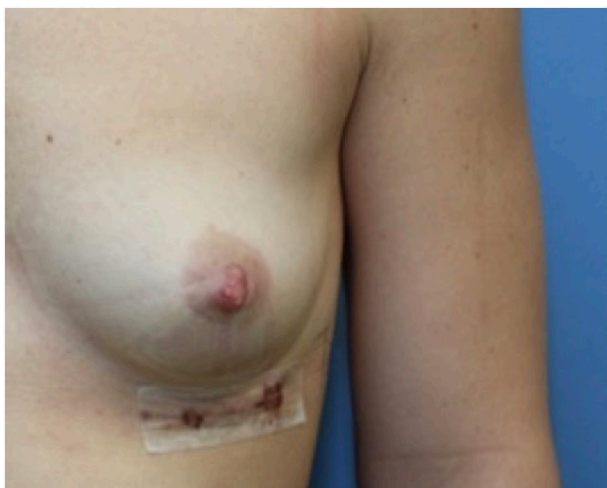
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## Introduction

Nipple-sparing mastectomy (NSM) has become a popular technique of breast cancer surgery when oncologically feasible. Studies have shown that women are more satisfied with the results of breast reconstruction surgery if their own nipple and areola are able to be preserved, as they feel

that their reconstructed breasts are more like their own (1,2). In NSM, the breast surgeon is tasked with removing the entire breast, while keeping both the skin flaps and the nipple-areolar complex (NAC) from becoming too thin and devascularized. Necrosis of the soft tissue envelope surrounding a breast prosthesis could lead to revision



**Figure 1** Inframammary incision used in delay procedure.



**Figure 2** Curvilinear incision used in delay procedure.

procedures and ultimately device explantation.

The reported risk of NAC necrosis is between 7–17% (3,4). Risk factors that have been described leading to the development of NAC necrosis include ptosis, periareolar scars, high body mass index (BMI), radiation therapy and smoking (4,5). In order to attempt to preserve vascular supply to the nipple, a surgical delay procedure can be performed in the weeks prior to NSM. This is typically performed as an outpatient and can be coupled with sentinel lymph node biopsy and retroareolar biopsy. By performing a retroareolar biopsy in the weeks prior to mastectomy, the decision of whether to preserve the nipple can be based off of permanent pathology results rather than frozen section

which has a false negative rate of up to 15% (6).

Many delay techniques have been described for NSM, with various incision types and methods of flap undermining. This article aims to describe a single author's (K.T.N.) technique for delay prior to mastectomy, along with a retrospective review of the patient demographics, risk factors, and associated outcomes. We present the following article in accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/abs-20-61>).

## Methods

A retrospective review of a single-surgeon's (K.T.N.) patients who underwent a delay procedure prior to NSM from 2012 to 2017 was performed. Patient demographics were collected, along with history of chemotherapy and radiation, current or previous history of smoking, history of previous breast surgeries and incision location, presence of comorbidities, body mass index, and degree of breast ptosis. The timing and technique of surgical delay was recorded, along with whether the delay was combined with other procedures. Surgical outcomes, including any complications, were also collected. The study was approved by the Institutional Review Board of Rutgers-New Jersey Medical School (IRB Approval Number: XX1102930) and conducted in accordance with the Declaration of Helsinki (as revised in 2013). Informed consent was obtained from all the patients, providing permission for their medical records and media including photographs to be used for research purposes. Statistical analysis was performed using Microsoft Excel. Categorical data were analyzed by Pearson chi-squared test for independence and continuous data were analyzed by a *t*-test for comparison of means. A *P* value of <0.05 was used to determine significance.

The surgical delay procedure was performed by a single surgeon (K.T.N.), typically 7–21 days (mean 15 days) prior to NSM. Incisions were made either in the inframammary fold (*Figure 1*) or in a lateral curvilinear (*Figure 2*) or periareolar fashion, with the exception of one patient who had a previous breast incision that was used. Sharp dissection was performed along the chosen incision pattern with a 15-blade, then Bovie electrocautery was used for dissection through the subcutaneous tissues until the breast capsule was visualized. Dissection was then performed in the avascular plane separating the subcutaneous tissues from the breast tissue until the tissues beneath the NAC were completely undermined. At this time, a retroareolar biopsy was performed and sent for permanent pathology.

**Table 1** Patient characteristics

| Characteristics                          | Number, n (%) |
|--|---------------|
| Age (years)                              |               |
| 30–40                                    | 8 (17.0)      |
| 41–50                                    | 21 (44.7)     |
| 51–60                                    | 16 (34.0)     |
| >60                                      | 2 (4.3)       |
| Mean age [range]                         | 48 [30–64]    |
| BMI (kg/m <sup>2</sup> )                 |               |
| <21                                      | 11 (23.4)     |
| 21–25                                    | 21 (44.7)     |
| 26–30                                    | 13 (27.6)     |
| >30                                      | 2 (4.3)       |
| Mean BMI, kg/m <sup>2</sup>              | 24.1          |
| Laterality                               |               |
| Unilateral                               | 6 (12.8)      |
| Bilateral                                | 41 (87.2)     |
| Indication for mastectomy (# of breasts) |               |
| Therapeutic                              | 44 (50.0)     |
| Prophylactic                             | 44 (50.0)     |
| BRCA status                              |               |
| BRCA positive                            | 8 (17.0)      |
| BRCA negative or unknown                 | 39 (83.0)     |

BMI, body mass index.

Hemostasis was obtained with Bovie electrocautery and skin was closed in the usual fashion with 3-0 monocryl deep dermal sutures and a 4-0 monocryl subcuticular suture.

## Results

Forty-seven patients (88 breasts) who underwent a delay procedure prior to nipple sparing mastectomy were included in the study. The average age was 48 (range, 30–64) and the average BMI was 24.1. The majority of patients were without significant comorbidities; one patient was diabetic, one patient had a diagnosis of Li Fraumeni syndrome, and six patients had hypertension. Ten patients had ptotic breasts, the majority of these patients had pseudoptosis or grade 1 ptosis. Thirty-two patients had prior breast surgery. Forty-four mastectomies were performed prophylactically,

the other 44 mastectomies were performed for biopsy-proven breast cancer. Eight (17%) patients were BRCA positive. Seven patients underwent preoperative radiation therapy, three underwent postoperative radiation. Twelve patients had neoadjuvant chemotherapy and two received adjuvant therapy. Thirty-two patients had previous breast surgeries prior to the delay and mastectomy. There were three patients with history of cigarette smoking, two patients who were current smokers. Patient characteristics and risk factors are listed in *Tables 1* and *2*, respectively.

The majority of patients (68.2%) underwent a delay procedure via an inframammary fold incision (*Figure 1*). Alternatively, a curvilinear incision was used in 23.9% of patients (*Figure 2*). The average time between delay and NSM was 15.7 days. There were no complications noted after the initial delay procedure. Three patients had a positive retroareolar biopsy and underwent skin-sparing mastectomy. The vast majority of patients underwent implant-based reconstruction with a tissue expander and acellular dermal matrix placed at the time of mastectomy. Five (5.7%) patients had latissimus flap reconstruction with a permanent implant. These results are displayed in *Table 3*. Post-operatively, two patients had areas of nipple necrosis that resolved without reoperation, four cases of skin necrosis required re-operation. In these patients, three had previous breast surgery and one patient was a smoker. There were three hematomas observed and six incidences of infection, two requiring prosthetic removal. The overall complication rate was 7%, lower than the reported rate in the literature. Complications are listed in *Table 4*. Three patients who underwent a delay procedure prior to NSM and reconstruction are shown in *Figures 3–5*. Average follow-up was 13 months (range, 1–48 months).

## Discussion

Nipple sparing-mastectomy has become a popular choice for women with smaller breasts and peripheral breast lesions and in patients seeking to obtain prophylactic mastectomy who are BRCA positive (7). This option has also become available in patients with larger, more ptotic breasts, as a mastopexy or reduction could be performed in the weeks prior to NSM, allowing for improved positioning of the nipple on the breast mound (8). One of the complications of NSM is partial or complete necrosis of skin flaps and NAC. Studies publish the rates of necrosis around 7–17% (9–11).

As shown in our study, delay procedures prior to mastectomy can allow for improved perfusion to the

**Table 2** Patient risk factors

| Factors                             | Number, n (%) |
|-------------------------------------|---------------|
| Comorbidities                       |               |
| Diabetes                            | 1 (2.1)       |
| Hypertension                        | 6 (12.8)      |
| Prior breast surgery (# of breasts) |               |
| Periareolar                         | 10 (11.4)     |
| Inframammary fold                   | 6 (6.8)       |
| Marginal                            | 16 (18.2)     |
| Any incision                        | 32 (36.4)     |
| Preop ptosis                        |               |
| Pseudoptosis                        | 8 (9.1)       |
| Grade 1                             | 8 (9.1)       |
| Grade 2                             | 1 (1.1)       |
| Grade 3                             | 1 (1.1)       |
| Any nipple ptosis                   | 10 (21.3)     |
| Tobacco                             |               |
| Previous                            | 3 (6.4)       |
| Active                              | 2 (4.3)       |
| Radiation (# of breasts)            |               |
| Preoperative XRT                    | 7 (8.0)       |
| Postoperative XRT                   | 3 (3.4)       |
| No XRT                              | 78 (88.6)     |

XRT, radiation therapy.

NAC, decreasing the likelihood of necrosis following NSM. Palmieri was one of the first to describe the use of a delay procedure prior to NSM. As an outpatient under local anesthesia, he described laparoscopically coagulating the deep vascular network beneath the NAC and placing collagen fleece in that region to prevent regeneration of the interrupted blood supply (12). His study also introduced the idea of a subareolar biopsy at the time of delay, allowing for improved detection of cancer extension to the NAC. They observed no NAC necrosis in any of the 18 patients in their series.

There are now several delay techniques described in the literature, shown to be especially useful in patients deemed “high risk” for NAC necrosis (11). Risk factors that have been associated with NAC necrosis in the literature include previous breast scars, high BMI, significant ptosis,

**Table 3** Incision type, reconstruction type, duration of delay, follow-up, and retroareolar biopsy results

| Variables                                       | Number, n (%) |
|---|---------------|
| Incision used for delay (# of breasts)          |               |
| Inframammary fold                               | 60 (68.2)     |
| Lateral curvilinear                             | 21 (23.9)     |
| Periareolar                                     | 6 (6.8)       |
| Previous breast incision                        | 1 (1.1)       |
| Follow up (# of patients)                       |               |
| >5 months                                       | 14 (20.8)     |
| >12 months                                      | 22 (46.8)     |
| >24 months                                      | 11 (23.4)     |
| Mean follow-up, months [range]                  | 18–26 [5–50]  |
| Time between delay & mastectomy (# of patients) |               |
| 7-14 days                                       | 10 (21.3)     |
| 14-21 days                                      | 33 (70.2)     |
| >21 days  | 4 (8.5)       |
| Mean # of days                                  | 15.7          |
| Retroareolar biopsy (# of breasts)              |               |
| Positive  | 3 (3.4)       |
| Negative  | 85 (96.6)     |
| Type of reconstruction (# of breasts)           |               |
| Tissue expander + acellular dermal matrix       | 83 (94.3)     |
| Latissimus + prosthetic                         | 5 (5.7)       |

chemotherapy, radiation, and smoking (11,13,14). Tobacco use has been shown to lead to skin flap necrosis in both implant-based and autologous breast reconstruction procedures. Olson showed that even in patients who had quit smoking two weeks prior to surgery, tobacco use was associated with an increased risk of infection (10). In our patient population, one patient who was a smoker five years prior to surgery had incisional breakdown and skin flap necrosis.

In addition to Palmieri’s procedure previously described, there have been various other delay techniques described in the literature. Jensen described radial undermining 5 cm from the nipple circumferentially 3 weeks prior to NSM; no patients in his study had partial or total NAC loss (4). Martinez performs delay procedures via an IMF incision with cephalad undermining around the NAC.

He also advocates placement of a silicone sheet in the pocket to prevent revascularization (13). In another study by Martinovic, patients underwent delay via previously made breast scars if possible; otherwise delay incisions were made at the inframammary fold, superolateral or

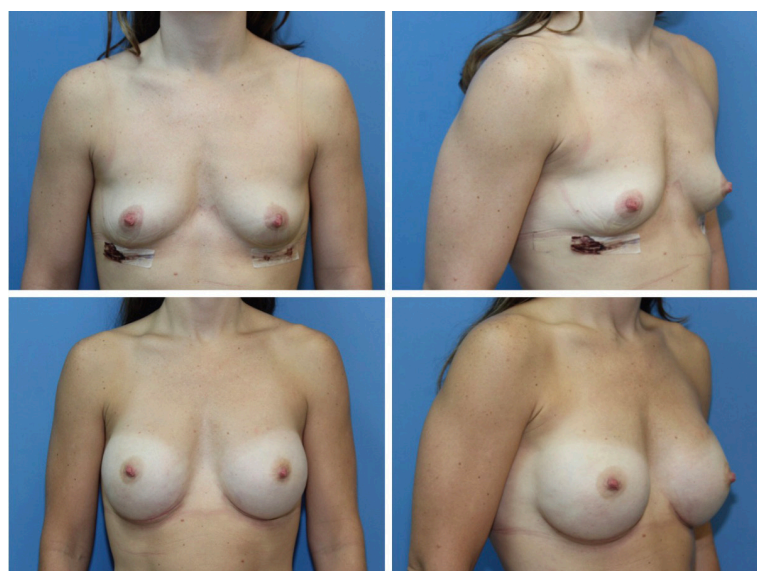
inferolateral to the NAC, or lateral radial. No patients in the study had significant nipple loss and there were only a few cases of epidermolysis that resolved with local wound care (11).

There have been a number of studies showing the utility of a delay procedure in allowing for improved vascularity in patients with ptosis. Spear *et al.* described the use of a preoperative mastopexy or reduction to allow for improved NAC positioning prior to NSM (8). Schwartz described his results in four patients with ptotic breasts who underwent a delay procedure in the weeks prior to NSM. In their series, they performing a supra-areolar delay incision and undermining down to the inframammary fold, creating an inferior pedicled NAC that is able to be easily maneuvered into an appropriate anatomic position during mastectomy (15). One of the four patients in their series had a small area of nipple necrosis that was treated conservatively, the remainder had no complications.

One of the presumed risk factors for NAC necrosis in NSM is the presence of prior incisions in the periareolar region. Removing the underlying breast tissue forces the NAC to rely solely on the subdermal plexus for perfusion; scars close the nipple can disrupt this dermal blood supply and lead to necrosis. Olson *et al.* recently published an article regarding whether NSM was safe in patients with prior breast scars. Their study showed no association

**Table 4** Patient complications

| Complications                      | Number, n (%) |
|------------------------------------|---------------|
| Nipple necrosis                    |               |
| Resolved with local wound care     | 2 (2.3)       |
| Required reoperation               | 0 (0)         |
| Mastectomy skin flap necrosis      |               |
| Resolved with local wound care     | 0 (0)         |
| Required reoperation               | 4 (4.5)       |
| Overall ischemic complication rate | 0.07          |
| Infection                          |               |
| Resolved with oral antibiotics     | 4 (4.5)       |
| Requiring prosthetic removal       | 2 (2.3)       |
| Hematoma                           |               |
| Yes                                | 3 (3.4)       |
| No                                 | 85 (96.6)     |



**Figure 3** A 32-year-old BRCA positive patient with no history of prior breast surgery or radiation. Top L/R: delay procedure performed via inframammary fold incision. Bottom L/R: 1 month follow-up following NSM and implant-based reconstruction. NSM, nipple-sparing mastectomy.



**Figure 4** A 47-year-old patient with history of right breast lumpectomy and radiation, planned to undergo right therapeutic mastectomy and left prophylactic mastectomy. Top L/R: delay procedure performed through lateral curvilinear incision. Patient had post-operative marginal ischemia along the superior aspect of the incision that resolved with local wound care. Bottom L/R: one-month post-operative result following nipple-sparing mastectomy with right breast reconstruction with latissimus flap and implant and right breast implant-based reconstruction.

between scar location and postoperative infection, skin flap necrosis, or NAC necrosis (10).

NSM in our study was performed both in patients with a confirmed breast cancer diagnosis and also prophylactically in patients who were diagnosed as BRCA positive. It has been shown that more aggressive malignant cancer types were not associated with increased incidence of NAC necrosis (16). In our study, cancer stage did not affect outcomes in patients who underwent NSM.

It is known that radiation can poorly affect outcomes of all types of breast reconstruction, as it can impair wound healing and cause lasting effects on the microcirculation of the tissues. In some studies, operative revision rates and complications often leading to explantation have been shown to be higher in patients undergoing radiation therapy (17). However, there are limited studies on the effects of radiation on the NAC. Alperovich described the results of radiation prior to NSM on 26 patients. Their study only showed one incidence of partial NAC necrosis and one incidence of complete NAC necrosis, with no significant difference between irradiated and non-irradiated breasts (18). A meta-analysis published by Zheng *et al.* in 2017 showed no difference in the odds of NAC necrosis in

patients receiving radiation therapy; their study did show, however, a higher likelihood of skin flap necrosis in the patients receiving radiation (19).

Chemotherapy is often used in aggressive breast cancer types as an adjunct treatment with surgery and radiation therapy. Neoadjuvant chemotherapy has been associated with an increased risk of NAC necrosis and implant explantation; this risk is increased when combined with adjuvant therapy (10,20). Chemotherapeutic drugs tend to impair wound healing, and it can be elucidated that this effect leads to poorer outcomes and greater likelihood of ischemic complications.

The importance of NSM for psychosocial well-being of women either diagnosed with breast cancer or with a strong genetic predisposition cannot be underestimated. Studies have shown that level of satisfaction with breasts, body image, and sexual functioning is improved in patients who retain their native NAC during mastectomy (2). While certain limitations do exist for our study, as it is a retrospective review of the outcomes of a single-surgeon, our study shows that the use of a delay procedure prior to NSM, especially in high risk patients, can benefit women by decreasing the likelihood of reoperation for NAC loss or



**Figure 5** A 49-year-old female with history of prior lumpectomy and radiation of her right breast who underwent therapeutic nipple-sparing mastectomy of her right breast. Delay of her right breast was performed via an inframammary fold incision two weeks prior to NSM. Her right breast was reconstructed with a latissimus flap and breast implant with no post-operative complications. Top: pre-operative photo. Bottom: post-operative photo following right breast reconstruction and left breast reduction for symmetry. NSM, nipple-sparing mastectomy.

explantation. Further research to continue to improve delay techniques in high risk patients should be performed.

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