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## Surgical Delay of the Nipple–Areolar Complex: A Powerful Technique to Maximize Nipple Viability Following Nipple-Sparing Mastectomy

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### ABSTRACT

**Objectives.** Nipple-sparing mastectomy (NSM) improves cosmetic outcome of mastectomy, but many patients are not candidates for this procedure because of concerns about nipple-areolar viability. Surgical delay is a technique that has been used for more than 400 years to improve survival of skin flaps. We used a surgical delay procedure to improve nipple viability in patients who were identified to be at high risk for nipple necrosis following NSM.

**Methods.** Patients at high risk for nipple necrosis following NSM underwent a surgical delay procedure 7–21 days prior to mastectomy. Subareolar biopsy and sentinel node biopsy, if indicated, were performed at the time of the delay procedure. Nipple viability was assessed before and after NSM. If the subareolar biopsy revealed malignancy, the NAC was removed at the time of mastectomy.

**Results.** 31 NAC in 20 patients underwent surgical delay. All of the NAC subjected to a surgical delay survived following the delay procedure. In 2 patients, the subareolar biopsy was positive and 3 NAC were removed at the time of mastectomy (1 for purposes of symmetry). Of the 28 delayed NAC left at the time of NSM, all survived the post-mastectomy course.

**Conclusion.** A procedure to surgically delay the NAC 7–21 days prior to NSM is demonstrated to ensure viability of NAC in patients previously thought to be at high risk for nipple loss.

As the evidence supporting the oncologic safety of nipple-sparing mastectomy grows, more women are considering this alternative.<sup>1–14</sup> However, not all women are ideal candidates for this technique, as there is a known risk of nipple necrosis. In her landmark study from Sweden, Kristin Benediktsson reported a 7 % rate of nipple necrosis.<sup>1</sup> Gerber reported a 10 % rate of nipple loss and Sacchini an 11 % rate.<sup>2,3</sup>

What pre-existing factors might make nipple necrosis more likely following nipple-sparing mastectomy? Patients with significant breast ptosis have long, thin, mastectomy skin flaps. Such flaps are known to be more susceptible to necrosis than shorter, thicker flaps. If the circulation of the mastectomy flap is compromised by a previous scar, particularly around the nipple–areolar complex, the risk of necrosis would be higher. Furthermore, cigarette smoking is well known to correlate with necrosis in skin flaps.

The “delay phenomenon” has been used for more than 400 years to improve the blood supply of tissues which are to be transferred.<sup>15</sup> There is controversy about how a surgical delay procedure works.<sup>16,17</sup> However, there is little controversy that it does work: creating a surgical wound stimulates the body to improve blood supply to the wounded tissue. To extend the benefits of nipple preservation to patients who are perceived to be at higher risk for nipple necrosis, we have used a delay procedure for the nipple–areolar complex to be done prior to nipple-sparing mastectomy.

### METHODS

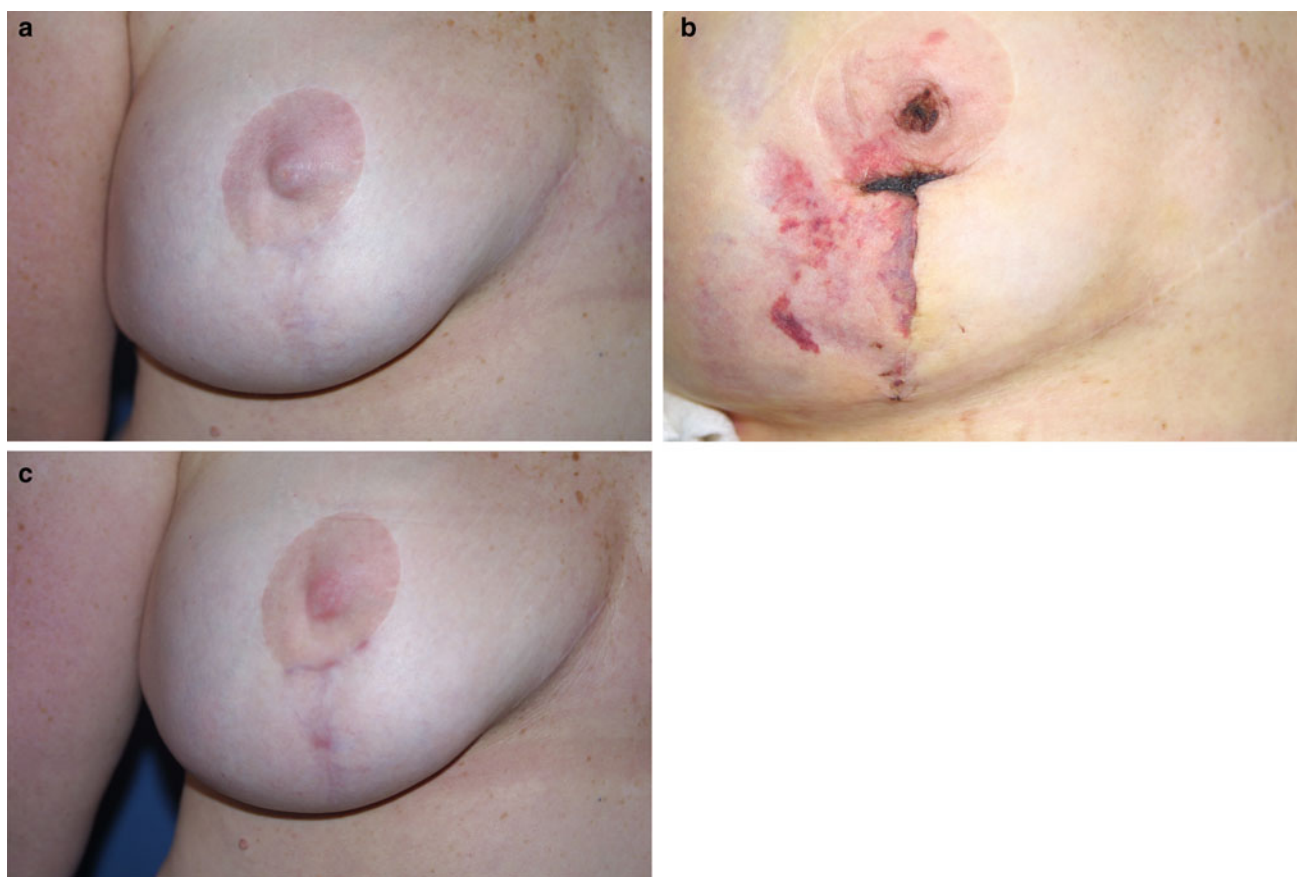
Patients were considered to be at higher risk for nipple necrosis following nipple-sparing mastectomy if they met one or more objective risk factors: breast ptosis (defined by location of the nipple–areolar complex below the

inframammary crease and suprasternal notch to nipple distance of 26 cm or more), pre-existing breast scars, and history of active cigarette smoking.

The delay procedure is performed 7–21 days prior to mastectomy: the skin flap is elevated in the plane of a therapeutic mastectomy beneath the nipple–areolar complex and surrounding mastectomy skin. Special attention is paid to transection of the ducts connecting the breast gland to the nipple. A 1-cm-thick biopsy of this ductal tissue (directly beneath the nipple) is submitted for permanent section pathology. Approximately 4–5 cm of surrounding mastectomy skin is undermined. When possible, the incision for the delay procedure is placed through a pre-existing scar such as the inferior vertical limb of a previous breast reduction or mastopexy procedure (Fig. 1). When patients have not had such a procedure, a vertical incision from the edge of the areola toward the inframammary crease or an incision lateral to the nipple–areolar complex extending toward the axilla is used (Fig. 2). Attention is paid to the concept of “degrees of perfusion” of the

nipple–areolar complex.<sup>14</sup> Whenever possible, blood supply was maintained for 360° of perfusion for the retained nipple–areolar complex. In patients who have had previous circumareolar incisions (Fig. 1) or periareolar incisions (Fig. 2), special attention is directed at maintaining the existing blood supply through the scar tissue by not using the previous incision around the nipple–areolar complex.

In patients with breast ptosis (nipple location beneath the inframammary crease and nipple to notch distance of 26 cm or greater), a “hemi-batwing” procedure is performed (Fig. 3). This approach involves reducing the existing skin envelope at the time of mastectomy. The delay procedure is performed in the plane of therapeutic mastectomy as described above, but only the skin which is to remain after the mastectomy is undermined. The skin inside the hemi-batwing pattern remains undisturbed during the delay procedure and is removed with the underlying breast gland at the time of mastectomy. This skin pattern involves an incision approximately halfway around the superior aspect of the areola at the time of the delay



**FIG. 1** A patient with history of reduction mammoplasty (a) wished to have nipple-sparing mastectomies. The delay procedure was performed in the plane of oncologic mastectomy through the vertical component of the previous reduction incision (b) so as to preserve

360° of nipple–areolar complex (NAC) perfusion. The NAC shows signs of ischemia 14 days following the delay procedure. One month after mastectomy, the nipple–areolar complex is demonstrated to have survived (c) in spite of the prior circumareolar incision



**FIG. 2** A patient with history of augmentation mammoplasty (a) using an infra-areolar incision wished to have nipple-sparing mastectomy. At operation (with the patient's head to the left) a ruler (b) demonstrates (on the right breast) that undermining in the plane of mastectomy is done for approximately 5 cm beneath the nipple–areolar complex and beneath the superior and inferior mastectomy

skin flaps. Bruising is seen 14 days after the delay procedure, but the patient's nipple–areolar complexes showed no epidermolysis (c). A month after nipple-sparing mastectomy and placement of breast implants, the patient is noted to have no loss of her nipple–areolar complexes

procedure and undermining of the nipple–areolar complex with the subareolar biopsy as described above. Therefore, after this delay procedure, the blood supply to the nipple is limited to 180° of perfusion through the inferior mastectomy flap.

Sentinel node biopsy is done when indicated by injecting dye around the tumor at the time of the delay procedure. A separate axillary incision is used for this procedure. Sentinel nodes are submitted for permanent section analysis.

Drains are not routinely left beneath the nipple–areolar complex and surrounding skin following this delay procedure. Hemostasis must be carefully controlled.

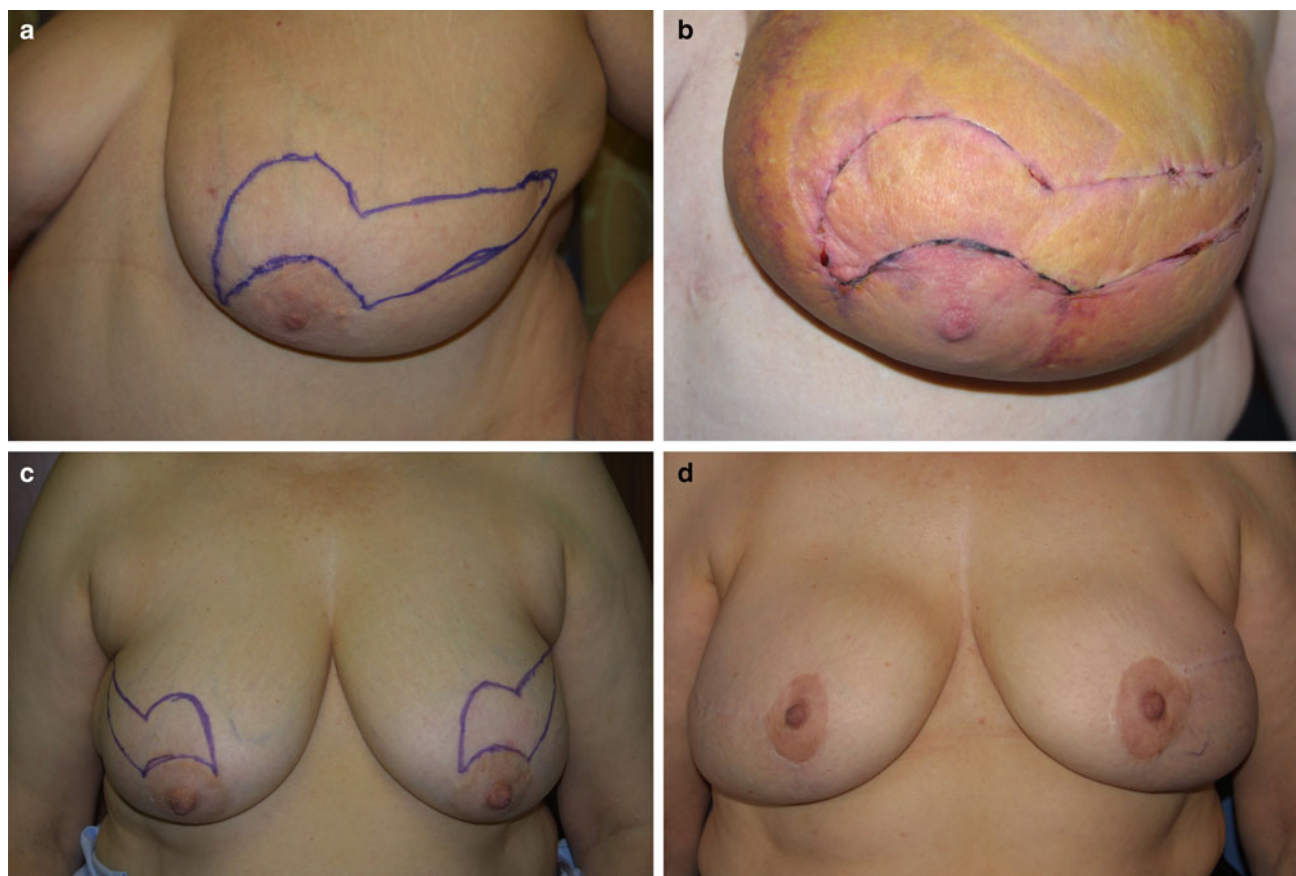
If the subareolar biopsy is found to be positive on permanent section analysis, the involved nipple is removed at the time of mastectomy. Likewise, if sentinel node biopsy is positive on permanent section, an axillary dissection is performed at the time of mastectomy.

Nipple–areolar complexes were followed for epidermolysis and frank necrosis after the delay procedure and after the mastectomy procedure.

This study was reviewed and approved by the Institutional Review Board at the John Wayne Cancer Institute at St. John's Hospital in Santa Monica, CA.

## RESULTS

The mean age of the study population was 50 years (range 32–67 years). Of the 20 patients studied, 19 were undergoing treatment for breast cancer [5 ductal carcinoma in situ (DCIS) and 14 invasive] and one patient was treated only for *BRCA* mutation. Six of the patients had been treated previously with lumpectomy and radiation therapy. Eleven patients underwent bilateral mastectomies, and nine patients had unilateral mastectomies. Mean tumor size was 2.7 cm (range 0.5–14 cm). The 20 patients included five



**FIG. 3** In patients with significant breast ptosis, the skin of the nipple–areolar complex and surrounding mastectomy skin can be surgically undermined prior to mastectomy using a “hemi-batwing” design (a). The skin inside the markings will be removed at the time of mastectomy and is not undermined at the time of the delay procedure, but the skin outside the markings is undermined approximately 5 cm superiorly and inferiorly. A subareolar biopsy is taken at

the time of the delay procedure. Ten days following the delay procedure (b), the nipple and surrounding skin appears bruised but not necrotic. Premastectomy delay of this skin allowed a patient with a relatively long nipple to notch distance (30 cm) and grade III ptosis (c) to enjoy the benefits of nipple-sparing mastectomy (d) with elevation of the nipple–areolar complexes

stage 0 patients, eight stage 1 patients, three stage 2 patients, three stage 3 patients, and one patient with only a genetic mutation. Ductal carcinoma was seen in 10 patients, lobular in 2, and multicentric tubular carcinoma in 1.

The nipple–areolar delay procedure was performed on 31 nipples in 20 patients. Indications for the delay procedure (Table 1) included previous circumareolar incision in six patients, previous breast incision restricting nipple perfusion (including periareolar incisions and lumpectomy incisions) in six patients, breast ptosis in eight patients, and chronic smoking in two patients. (Two patients had more than one defined risk factor.) Previous radiation therapy was not considered a risk factor for nipple necrosis. The delay procedure was done through a vertical incision in six patients, a lateral incision in six patients, and a lateral incision with superior periareolar extension with excision of some skin (hemi-batwing incision) in eight patients.

**TABLE 1** Indications for premastectomy surgical delay procedure of the nipple–areolar complex

Previous circumareolar incision	6 patients
Other breast scar (i.e., periareolar)	6 patients
Breast ptosis	8 patients
Smoking	2 patients

All nipples survived the delay procedure, but in two patients the subareolar biopsy was positive for tumor on permanent section. Both of these patients had the involved nipple removed at the time of mastectomy. One of these patients also requested that the contralateral nipple be removed, as she was to undergo bilateral mastectomies. In two patients, some epidermolysis was observed in the delayed nipple, but all nipples survived the delay procedure. Of the 28 nipples which were left following nipple-sparing mastectomy, all survived.

Breast reconstruction was done using a tissue expander/implant approach in 13 patients, a latissimus flap with an implant in 4 patients, with a free transverse rectus abdominis myocutaneous (TRAM) flap in 1 patient, and with implants without expander in 2 patients. Surgical complications included: hematoma in one patient following reconstruction and removal of implant due to recurrent seroma in one patient in whom allograft had been used. No patient developed wound infection within the first 4 weeks after surgery.

## DISCUSSION

In his initial report on nipple-sparing mastectomy, Bromley Freeman described removal of the breast gland through an inframammary incision and immediate or delayed insertion of a breast implant.<sup>18</sup> The decision to delay placement of the breast implant (the only common choice of breast reconstruction used at the time of his 1961 presentation) allowed the retained skin and nipple–areolar complex to adapt to the ischemic insult which is inevitably produced by mastectomy; this adaptation likely involves the enlargement of blood vessels and/or the growth of new blood vessels parallel to the surface of the skin.<sup>16</sup> When the implant is subsequently inserted, the chance of ischemic necrosis of the skin or nipple–areolar complex is much reduced. The idea of using a surgical operation to improve the survival of tissue to be transferred dates back at least 400 years to the work of Tagliocozzi.<sup>15</sup>

Palmieri and coworkers reported a technique based on the use of laparoscopic instruments to undermine the nipple–areolar complex and surrounding skin 3 weeks prior to mastectomy.<sup>19</sup> Their technique was used in patients without previous breast scars or breast ptosis. Using an incision lateral to the nipple–areolar complex (which leaves 360° of nipple perfusion), Stolier and colleagues were able to perform 82 consecutive nipple-sparing mastectomies without nipple necrosis, and their technique emphasized 360° of nipple perfusion.<sup>13</sup> This experience was obtained in a patient population without adverse risk factors, and patients who smoked or were overweight were not considered good candidates for the procedure. Stolier's work argues that delay of the nipple–areolar complex is not needed in patients without defined risk factors for necrosis as long as 360° perfusion of the nipple–areolar complex is preserved. When an incision involved more than “30 %” of the nipple–areolar complex (which we would translate as allowing approximately 250° of perfusion), Garwood and coworkers observed significantly increased necrosis rates without using a delay procedure.<sup>11</sup>

In an earlier report of our experience with nipple-sparing mastectomy, we demonstrated that patients with previous

circumareolar incisions could undergo nipple-sparing mastectomies with the use of a delay procedure.<sup>14</sup> We should emphasize that, while none of the patients with circumareolar incisions in this report had postmastectomy nipple necrosis, we preserved 360° of nipple perfusion during both the nipple delay procedure and the subsequent mastectomies. In these cases, because the patients had previously undergone either reduction mammoplasty or mastopexy procedures, the position of the nipple was generally quite acceptable (above the inframammary crease and approximately 21–23 cm from the suprasternal notch).

Historically, patients with significant breast ptosis (grade II and grade III ptosis) have not been considered good candidates for nipple-sparing mastectomy.<sup>20</sup> However, in this report, we demonstrate that, in patients with significant breast ptosis, the nipple can be elevated into a more normal position and the excess skin removed using a hemi-batwing incision (Fig. 3). This incision allows the suprasternal notch to nipple distance to be shortened (with elevation of the nipple) by keeping the nipple attached to a broad-based mastectomy skin flap. We believe that this is most safely performed using a premastectomy surgical delay procedure.<sup>21</sup>

Spear and coworkers recently reported their experience with nipple-sparing mastectomy in patients with breast ptosis.<sup>22</sup> Their approach is to do a “circumvertical reduction” technique through a standard Wise pattern mastopexy/reduction incision. Critical to the success of this approach is that the skin surrounding the nipple is deepithelialized but not divided, thus preserving the subdermal blood supply to the nipple–areolar complex. These investigators waited “a minimum of 3–4 weeks” prior to performing the nipple-sparing mastectomy. (The average time in their study was 3.4 months.) Using the delay of the hemi-batwing technique described here, the time between the delay procedure and the nipple-sparing mastectomy was 7–21 days. In patients with breast cancer, the interval between the delay procedure and the nipple-sparing mastectomy must be kept to a minimum to address oncologic concerns and patient anxiety. In some cases, Spear was able to combine the first stage of his procedure with the patient's lumpectomy procedure. We never perform a nipple–areolar delay procedure with a lumpectomy procedure, because if the patient decides to have radiation rather than mastectomy, she will suffer long-term nipple numbness using our technique. However, we are still quite obviously in the very early days of offering nipple-sparing mastectomy to patients with macromastia or significant breast ptosis, and more studies will need to be done to compare the different techniques and to determine which technique will be best for which patient.

Another advantage of the premastectomy surgical delay procedure is the information obtained from the subareolar

biopsy and/or sentinel lymph node biopsy. Making clinical judgments on the basis of frozen-section analysis of the subareolar ducts or the sentinel lymph node is less accurate than making the judgments on the basis of the permanent sections. If the subareolar ducts show tumor cells, the reconstructive algorithm might logically change: patients desiring complete preservation of their skin envelope without the nipple–areolar complex might opt for placement of a myocutaneous flap to replace the lost nipple and areolar skin. If a sentinel lymph node is found to be positive on permanent section, the axilla will require dissection at the time of the mastectomy.

These data demonstrate that surgical delay of the nipple areolar complex 7–21 days before nipple-sparing mastectomy allows safe preservation of the nipple–areolar complex in patients who generally would not be considered candidates for nipple-sparing mastectomy.

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