

Nipple-Sparing Mastectomy in Breast Cancer: Impact on Surgical Resection, Oncologic Safety, and Psychological Well-Being

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Abstract

Nipple-sparing mastectomy (NSM) is a surgical option to improve patient satisfaction with aesthetic outcome. It can be utilized to decrease body image disturbance by preserving the woman's skin and areolar complex. Data for cancer treatment and risk reduction in NSM shows the procedure is oncologically safe. Nipple-sparing mastectomy preserves the nipple to improve cosmetic appearance. Patient satisfaction is higher for NSM compared with traditional mastectomy. PubMed and Cochrane databases were searched from January 1, 2013, to December 22, 2019. The following search terms and keywords were used: nipple-sparing mastectomy, microvascular breast reconstruction, breast cancer, and nipple necrosis. Studies published in scientific journals that reported objective results (specific outcomes of skin flap and nipple-areola complex necrosis) were included. Nipple-sparing mastectomy should be discussed as a surgical option for women who meet the selection criteria to assist with psychological benefits related to body image. Research comparing levels of distress and body image disturbances in women undergoing NSM with traditional mastectomy would be helpful in addressing the psychological care of these women. Ongoing data collection needs to continue to validate that NSM is safe from a surgical and an oncologic standpoint.

The first mastectomy with preservation of skin and nipple-areola complex (NAC) was performed for benign disease in 1951 (Orzalesi et al., 2016). Early experience with immediate breast reconstruction came from women having mastectomies for benign disease. Nipple-sparing mastectomy (NSM) has been used in ductal carcinoma in situ (DCIS) and invasive ductal carcinoma in Europe. In the United States, the surgical procedure has been slowly

adopted in breast cancer (Long, 2013). Since the late 1990s, NSM has been explored as a form of breast-conserving surgery in the oncology setting (Laronga & Smith, 2014). The first NSM was reported at the Southwestern Surgical Congress in 1999 (Laronga & Smith, 2014). Initially, NSM was performed with prophylactic mastectomy in high-risk women, such as *BRCA*-positive mutation carriers.

The concerns with NSM are both oncologic and surgical. The main surgical concern is nipple necrosis due to compromising the vascularity and causing ischemia during removal of glandular and ductal tissue. The main supply to the NAC is branches of the internal mammary and lateral thoracic vessels. After NSM, the NAC relies on the subdermal plexus for vascularity (Carlson et al., 2014). Nipple-areola complex necrosis results in poorer cosmetic appearance with flattening, deformity, hypopigmentation, and loss of the NAC (Figure 1; Ahn et al., 2018). The reported rate of nipple ischemia is 0% to 48%, with 10% to 15% being the most commonly reported rate (Carlson et al., 2014). However, in the case of inverted nipples, there is spontaneous improvement after NSM as tethering tissues are released (Yim & Lee, 2016).

The primary goal in breast cancer is removal of all areas of malignancy with clear surgical margins (Smith & Coopey, 2018). The oncologic concern is that the NAC with glandular and ductal tissue retained could be a source of cancer recurrence (Figure 2; Smith et al., 2017). Early approaches to

NSM left 0.5 cm to 1 cm of breast tissue beneath the nipple and areola to preserve blood supply to the nipple (Smith & Coopey, 2018). This technique preserved nipple perfusion, but increased the risk of cancer recurrence by leaving breast tissue that could reoccur with cancer (Smith & Coopey, 2018). This concern can be reduced by sending a frozen section during surgery for evaluation of clear surgical margins. If the nipple has tumor at the surgical margin, the nipple is removed with the option of retaining the areola (Smith & Coopey, 2018). The areola is not breast tissue but an appendage of the skin and cannot develop recurrent breast cancer (Laronga & Smith, 2014). Locoregional recurrence rates range from 0% to 4.6% at 10- to 60-month follow-up (Karian et al., 2017; Smith et al., 2017). The evidence on oncologic safety is based on observational studies (Weber et al., 2018). National Comprehensive Cancer Network Guidelines recommend removal of the NAC during mastectomy, but NSM may be considered for early stage, node-negative, peripheral tumors (Alsharif et al., 2019; Hieken et al., 2016). The Oncoplastic Breast Consortium consensus conference on NSM recommends NSM for early breast cancer and DCIS. The panel felt strongly that only specialized surgeons performing in high-volume centers should perform NSM (Weber et al., 2018).

METHODS

PubMed and Cochrane databases were thoroughly searched from January 1, 2013, to December



Figure 1. Grade 4 nipple ischemia. Reproduced with permission from Bridget Oppong, MD, The Ohio State University Comprehensive Cancer Center.

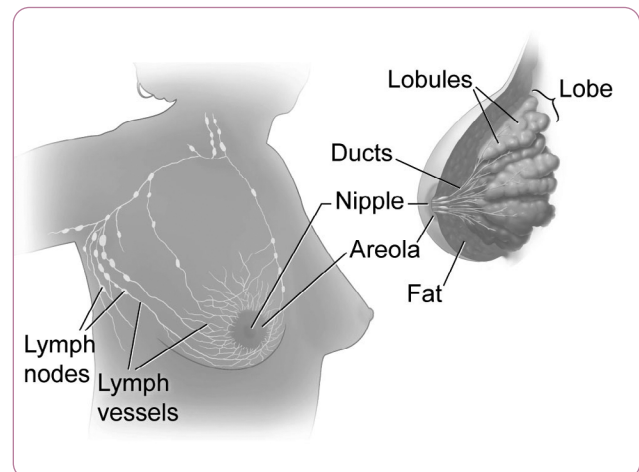


Figure 2. Breast anatomy. Reproduced from the National Cancer Institute, Don Bliss (Illustrator).

22, 2019, to determine best practices in NSM. The following search terms and keywords were used: nipple-sparing mastectomy, microvascular breast reconstruction, breast cancer, and nipple necrosis. Studies published in scientific journals that reported objective results (specific outcomes of skin flap and nipple-areola complex necrosis) were included. A total of 165 articles were reviewed using The Iowa Model of Evidence-Based Practice (Buckwalter et al., 2017). Levels of evidence and quality of the articles were evaluated to review the papers on NSM and care of microvascular breast reconstruction. A total of 12 research articles were included in the analysis (see Table 1).

RESULTS

Patient Selection

General guidelines for patient selection include tumor size of 3 cm or less and at least 2 cm from the center of the nipple (see Table 2; Long, 2013). Candidates are usually young, healthy, nonsmoking patients with small to moderate-sized breasts

with no prior radiation or breast surgery. MRI is used to evaluate breast duct anatomy. The patient should have negative sentinel nodes and no skin involvement. Excessively large or ptotic breasts are not candidates for NSM due to increased risk of postoperative nipple or areolar necrosis (Kim et al., 2019). The final decision for NSM is made in the operating room after the breast tissue at the base of the nipple is removed and sent for biopsy. If any cancer cells are found on the frozen section, the NSM is aborted.

Contraindications

Inflammatory breast cancer is an absolute contraindication even in the absence of clinical symptoms for NSM (Weber et al., 2018). Nipple-sparing mastectomy is also contraindicated in T4 cancer, including Paget disease and tumors with clinical or radiologic extension into the NAC or with pathologic nipple discharge (Hieken et. al., 2016). Patients who smoke are not candidates for immediate breast reconstruction due to poor tissue

Table 1. Literature Review of Selected Articles

Study	Design and purpose	Sample	Outcomes
Ahn et al., 2018	A single-institution retrospective analysis of patients who underwent NSM and immediate reconstruction utilizing a nipple-areolar grading system.	220 breasts in 1 institution from May 2010 to December 2016.	Ischemia occurred in 141 (64.1%) breasts. Necrosis required surgical reoperation in only 69 (31.3%).
Alsharif et al., 2019	A single-institution retrospective analysis of patients who underwent NSM and immediate reconstruction. The aim of the study was to compare long-term nipple distance and short-term nipple distance.	266 patients in 1 institution from January 2008 to December 2014. 21 patients were lost to follow-up.	Long-term follow-up was 60.5 months. A total of 4 patients died. There was no statistically significant difference between the two groups in disease-free survival and local recurrence-free survival.
Carlson et al., 2013	A single-institution prospective analysis. Primary endpoint was nipple ischemia. A number of variables were examined for association with nipple ischemia.	71 consecutive NSMs in 45 patients from 2009 to 2011.	Partial nipple necrosis occurred in 20 cases (25.2%). 1 case required secondary nipple reconstruction. 19 cases healed uneventfully. Periareolar incisions and dissection of nipple ducts have high risk of nipple necrosis.
Cavalcante & Lima, 2018	A single-institution, descriptive, cross-sectional study with emphasis on rate of complications, local disease control, and cosmesis.	31 patients with periareolar incision and two-stage reconstruction between 2013 and 2017.	5 complications were observed: 1 seroma (3.2%), 3 with necrosis (3.96%), 1 debridement (3.2%). Cosmesis excellent in 27 (96.8%).
Dent et al., 2014	A single-institution retrospective study of nipple ischemia.	318 patients with NSM between July 2006 and October 2012.	Partial- and full-thickness NAC ischemia occurred in 44 (13.8%) and 21 (6.6%) cases, respectively.

Note. NSM = nipple-sparing mastectomy; NAC = nipple-areola complex.

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Table 1. Literature Review of Selected Articles (cont.)

Study	Design and purpose	Sample	Outcomes
Frey et al., 2017	A single-institution retrospective analysis examining smoking as a risk factor for nipple ischemia.	543 patients from 2006 to 2014, with 49 smokers.	NSM may be safely offered to those with a smoking history, although > 10-pack history or < 5 years-to-quitting may impart higher risk of complications (necrosis).
Karian et al., 2017	A systematic review for patients undergoing NSM.	Literature search of PubMed and Cochrane databases from January 1945 through April 15, 2016, yielded 242 with 5 meeting criteria for 101 patients.	Partial necrosis in 9 patients (8.9%). 3 of 5 studies reported positive retroareolar biopsy in 7 patients (6.9%).
Kim et al., 2019	A single-institution retrospective study looking at nipple loss and necrosis.	30 patients from September 2016 to February 2019.	No nipple loss or necrosis was reported.
Ng et al., 2019	A single-institution retrospective review for patients undergoing NSM followed by immediate implant-based reconstruction using AlloDerm and sharp dissection compared with electrocautery.	62 patients underwent a NSM with 116 breasts operated on from 2014–2017.	Patients who underwent NSM followed by immediate implant-based reconstruction using AlloDerm and the sharp dissection technique had lower rates of skin flap necrosis.
Orzalesi et al., 2016	A large multi-institutional review of Italian National database of NSM both retrospectively and prospectively assessing surgical and oncologic safety.	913 women for a total of 1,006 procedures between January 1, 2009, and December 31, 2014.	NAC necrosis (4.8%) and skin flap necrosis (2.3%), with smoking as the only significant risk factor. Overall skin/NAC recurrence rate was 1.4%. 1.0% had distant metastases in 30 months.
Sherman et al., 2017	Two institutions' prospective review of NSM assessing body image, depression, anxiety, and stress.	75 women completed online questionnaires between 2009 and October 2013.	Moderately low levels of psychological distress and body image disturbance suggest NSM may minimize adverse psychological impacts of mastectomy.
Smith et al., 2017	A single-institution retrospective review of oncologic safety.	2,182 NSMs performed between 2007 and 2016.	Median follow-up of 51 months had 3.7% locoregional recurrences and 2.7% distant recurrences. There were no recurrences in NAC.

Note. NSM = nipple-sparing mastectomy; NAC = nipple-areola complex.

healing from nicotine-induced vasoconstriction, inhibition of capillary blood flow, and release of catecholamines (Carlson et al., 2013; Frey et al., 2017; Hieken et al., 2016).

Risk Factors

Patients at higher risk for postoperative nipple or areolar necrosis include older patients, patients with a body mass index (BMI) greater than 30, patients with large or ptotic breasts, prior chest wall radiation, or prior breast augmentation or reduction mastopexy (Dent et al., 2014; Hieken et al., 2016). Diabetes is also a risk factor due to poor tissue perfusion (Dent et al., 2014).

Psychological Benefits

Preservation of a woman's body image can help her cope with the diagnosis and treatment of breast cancer. Women report depression, anxiety, and stress, which is especially heightened after a poor surgical cosmetic outcome (Sherman et al., 2016). Some women still experience body image-related psychological distress a year after surgery and treatment. The link between body image and psychological distress is more pronounced in women under the age of 40 than in older women (Sherman et al., 2016). Women who underwent NSM stated that they felt less mutilated, were more natural appearing, and had higher sexual

well-being than women without NSM (Dent et al., 2014; Long, 2013; Wei et al., 2016). Women also had higher satisfaction with breast size, softness, and sexual sensitivity. Nipple sensitivity is normally rated fair to poor due to the nipple being insensate, but women still feel greater satisfaction due to cosmetic appearance (Wei et al., 2016).

Incisions for NSM

Nipple perfusion is primarily from blood vessels of the skin. One third of blood vessels to the nipple travel through the nipple ducts; the rest is through the skin. Areolar perfusion is through skin vessels (Smith & Coopey, 2018).

The extent of the breast tissue resected in NSM is the same as in a total mastectomy (Hieken et al., 2016). Most surgeons agree that radial, lateral, vertical, and inframammary fold incisions are safer than periareolar incisions for preserving blood supply to the NAC (Figure 3). Placement of incisions depends on preoperative breast size (Karian et al., 2017).

The radial incision is the most common incision used (Hieken et al., 2016). With the radial incision, a superficial dissection is carried out superiorly for several centimeters followed by inferior superficial dissection for several centimeters. Sharp dissection along the plane deep to the anterior fascia prevents accidental resection of the subdermal vessels supplying the nipple. Once dissection is complete, the breast is removed from the pectoralis muscle (Hieken et al., 2016).

A vertical incision can be used for women who have had previous breast reduction surgery. Incisions are made through the vertical limb with or without lateral extension.

The inframammary incision is made along the inframammary ridge and lateral to the midline of the breast to avoid the superficial branch of the superior epigastric artery that transverses the inframammary ridge medially (Hieken et al., 2016). Dissection is to the chest wall. The breast is lifted off the pectoralis muscle and lifted up to the level of the clavicle.

Most studies show that incisions around or through the NAC increase nipple necrosis rates (Hieken et al., 2016). The main blood supply to the NAC comes from branches of the internal mammary and lateral thoracic vessels. After NSM, the blood supply to the NAC is dependent on the sub-

Table 2. Inclusion and Exclusion Criteria for Nipple-Sparing Mastectomy

Inclusion

- Female, 18 years or older
- Breast cancer or sarcoma diagnosis
- Tumor size is ≤ 3 cm on preoperative imaging
- Tumor margin > 2 cm from areolar edge and from posterior margin of nipple-areolar base on preoperative imaging
- Sentinel lymph node biopsy is node negative
- Prophylactic mastectomies

Exclusion

- Female, older than 85 years
- History of breast cancer with radiation therapy
- Irradiation to the breast area for other cancers
- Greater than 3 cm ductal carcinoma
- Cancer is multicentric, within 2 cm of areolar margin and post aspect of the nipple-areolar base
- Palpable axillary lymph nodes
- Smoking within the past 6 weeks
- BMI > 30

Note. Adapted from Larongna & Smith (2014).

dermal plexus that forms an anastomotic network around the areola. A periareolar incision disrupts this blood supply.

Some surgeons recommend excising the central core of the nipple to remove for oncologic safety, but this is associated with high rates of nipple necrosis (Hieken et al., 2016). Most surgeons remove the tissue from the base of the NAC without coring out the nipple. This decreases nipple necrosis rates and is associated with a low NAC recurrence rate (Hieken et al., 2016).

A common mastectomy technique involves use of the electrocautery to dissect breast tissue, which decreases skin flap vascularity. In the 1990s, a technique was developed that used infiltration of the breast tissue with local anesthetic into the subcutaneous space to create a bloodless plan to dissect with scissors. This technique has been in use ever since (Ng et al., 2019).

Postoperative Care

Prevention of hypotension and hypothermia is important to maintain adequate blood perfusion

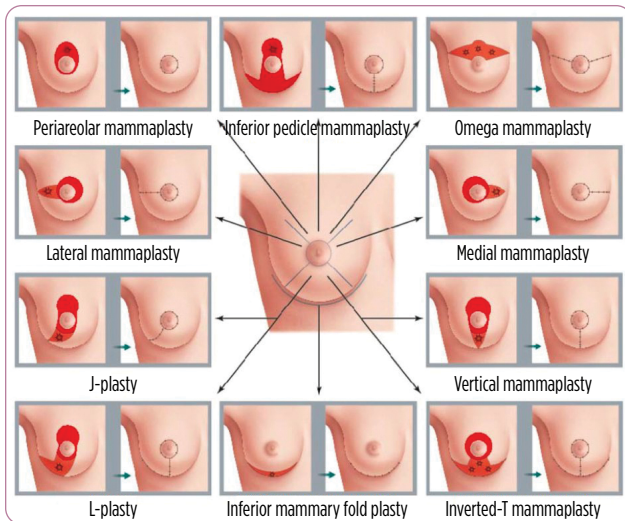


Figure 3. Surgical incisions for nipple-sparing mastectomy.

through the anastomosis. Thrombus formation occurs with sluggish blood flow through a fresh microvascular anastomosis, which may be attributed to hypotension or hypothermia.

Assessing vital signs and reporting any deviations to the provider is essential. If the patient becomes hypotensive, providers should administer IV fluid resuscitation. Epinephrine-containing medications, which cause vasoconstriction and reduced blood flow through the anastomosis, should be avoided. The patient's room should be maintained at a temperature of 70°F or warmer to prevent vasoconstriction and promote blood flow (Nahabedian & Nahabedian, 2016). Nitropaste may be used to increase blood flow to the nipple. Antibacterial petrolatum gauze and a loose bra may be used to prevent irritation and to support the reconstructed breast (Dent et al., 2014; Hieken et al., 2016). Subcutaneous heparin is utilized in women with a BMI > 30 to promote venous flow and to prevent thromboembolic events.

Physical assessment should include:

1. Skin color: Skin should not be cool, pale, ashen, mottled, or purplish (see Table 3).
2. Capillary refill time: Capillary refill time greater than 2 seconds may indicate poor perfusion.
3. Skin turgor: Well-hydrated tissue will immediately return to a normal flat state when pinched. Dehydrated tissue has reduced turgor and slower return to normal state.

Table 3. Nipple-Areola Complex Ischemia Grades

0: No ischemia
1: Partial nipple or areolar ischemia
2: Partial nipple and areolar ischemia
3: Total nipple ischemia
4: Total nipple and partial areolar ischemia
5: Total nipple and areolar ischemia

Note. Adapted from Ahn et al. (2018).

4. Skin temperature: Warm temperature suggests good arterial flow. Soft tissue suggests good venous outflow. If vasoconstriction is suspected, increasing the room temperature or using a forced air warming system is recommended (Nahabedian & Nahabedian, 2016).
5. Sensation: May return gradually as swelling decreases. Up to 79% of women report return of some nipple sensation, but may be limited to light touch and pain (Long, 2013).

Patient positioning is important. Patients should never be placed in a prone position. This could decrease circulation and blood perfusion through the anastomosis. Nursing should monitor drain output. If edema at the surgical site develops, the provider should be notified to rule out hematoma or seroma (Nahabedian & Nahabedian, 2016).

Enhanced Recovery After Surgery (ERAS) protocols are recommended to recover these patients (Nahabedian & Nahabedian, 2016). Multimodal analgesia is primarily utilized and may include patient-controlled analgesia. Patients are instructed to ambulate on postoperative day (POD) 1 and to sit in the chair. Early mobilization reduces the risk of deep vein thrombosis and assists with lung expansion to prevent atelectasis. The surgical dressing is removed POD 2. Patients are encouraged to shower. Patient range of motion on the affected surgical side is limited in order to decrease seroma formation. However, the patient should maintain shoulder range of motion.

If a scab or eschar of the nipple or areola develops due to partial nipple necrosis, premature debridement should be avoided. Partially ischemic nipples heal over time with a good cosmetic result (Smith & Coopey, 2018).

Patient education before and after surgery is imperative. Patients can become depressed due to the stress of surgery and the loss of natural breast tissue (Nahabedian & Nahabedian, 2016). Preparing the patient may decrease their anxiety and apprehension. Postoperatively, patients should avoid heavy lifting for 4 to 6 weeks. They will resume their normal diet POD 1.

Self-compassion is a coping mechanism that can be utilized by the patient when she undergoes psychological distress. Self-compassion is treating one's self with kindness and acceptance while in distress. Through self-compassion, the patient is able to view oneself as part of the human situation instead of feeling isolated and alone. This is associated with improve psychological well-being and decreased stress in various situations. Oncology research on self-compassion is ongoing (Sherman et al., 2017). Self-compassion appears to function as a protective mechanism with body image disturbance and psychological distress.

Women who place an emphasis on physical appearance have a greater risk of longer adjustment. Altered body image is associated with depression and body shame. Assisting the patient with efforts to achieve attractiveness through attractive scalp caps, makeup, etc., may improve a woman's quality of life and satisfaction with her appearance (Sherman et al., 2017). Most psychological distress levels return to prediagnosis levels after 12 months (Sherman et al., 2017).

IMPLICATIONS FOR PRACTICE

Nipple-sparing mastectomy should be discussed as a surgical option for women who meet the selection criteria to assist with psychological benefits related to body image. Being able to identify women with low self-compassion and greater appearance investment preoperatively would assist in intervening with psychological support. Research comparing levels of distress and body image disturbances in women undergoing NSM with traditional mastectomy would be helpful in addressing the psychological care of these women.

Care of the patient undergoing NSM requires careful monitoring of vascular supply and developing tissue necrosis. Health-care providers should be aware of the special postoperative care that these patients require. ●

Disclosure

The author has no conflict of interest to disclose.

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