The Changing Face of Mastectomy: An Oncologic and Cosmetic Perspective

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**Background:** The history of surgical treatment of breast cancer is rich with contributions from many surgeons over the centuries. Among the recent advances in technique is the nipple-sparing mastectomy, which reflects the emerging focus on cosmetic outcomes.

**Methods:** We took a backward glance at the literature illustrating the evolution of surgical management of breast cancer, culminating with nipple-sparing mastectomy. The growing clinical data with nipple-sparing mastectomy are explored.

**Results:** The demand for nipple-sparing mastectomy has been steadily increasing at many institutions. Based on the clinical data reported, nipple-sparing mastectomy is an oncologically safe procedure for selected women who have or are at high risk for breast cancer.

**Conclusions:** For women facing mastectomy and their surgeons, the optimal aesthetic result centers on preservation of the nipple. However, nipple-sparing mastectomy is technically challenging, with long-term safety not yet confirmed. Evidence-based data are needed to document local tumor recurrence, distant metastasis, cosmetic outcomes, patient satisfaction, and procedural complications.

**Introduction**
Surgical management of breast cancer has evolved dramatically over the years. The guiding principles are based on patient safety followed by oncologic safety. Recent advances have also taken into account cosmetic outcome. The optimal cosmetic outcome following mastectomy with reconstruction includes preservation of the nipple-areola complex. This article reviews the “changing face of mastectomy” from a historic perspective, culminating in an in-depth look at the current status of nipple-sparing mastectomy from an oncologic and cosmetic perspective. The focus is solely on mastectomy rather than breast-preserving surgery.

**A Historic Perspective: The Early Years**
Over the years, dramatic changes have occurred in the surgical management of breast cancer. In fact, the oldest recorded history comes from ancient Egypt in 1600 BC, where a scroll titled "Instructions concerning tumors of his breast" stated that there was no treatment for breast cancer.1 Twelve hundred years later, Hippocrates described a woman with bloody nipple discharge and breast cancer and also recommended...
no surgical management as it would certainly only hasten her death. For the next 500 years, women with breast cancer were offered no treatment.

It was not until the first century AD that a Greek physician, Leonides, performed the first operation for breast cancer. The technique, which came to be known as the “Escharotomy” method, consisted of using a hot poker to make repeated incisions into the breast until the breast was completely burned off the chest wall. Women then applied a homemade poultice for wound care. As expected, most of these women died of infection. The first surgical cure for breast cancer using this method did not take place for another 100 years and is credited to Galen.

With limited success and high mortality, this technique did not gain much favor, and by the Renaissance era, physicians were searching for new ways to remove the breast. Surgical instruments were being created at a rapid pace; however, without the advent of anesthesia and antisepsis, the goal was to remove the breast as swiftly and completely as possible. The new technique was thus nicknamed the “Guillotine” method because surgeons literally amputated the breast with a large sharp knife. In fact, stories are told of the surgeon arriving unannounced at a woman’s house to perform the operation, with a few male helpers to hold the woman down on her own kitchen table during the procedure. The skin was not reapproximated, and the woman was bound to stop bleeding. Not surprisingly, many of these women died of exsanguination. Those who survived the acute postoperative period succumbed to infection or endured significant morbidity.

This practice continued into the 18th century. Interestingly, during that time, a surgeon, Jean Louis Petit, advocated leaving all the skin not involved with the tumor, including the nipple-areola complex, and in essence described the concept of nipple-sparing mastectomy. Unfortunately, he was considered a heretic, and his beliefs and methods were not adopted. In fact, the number of “mastectomies” being performed dropped off precipitously in the 18th century and early 19th century due to poor results and “indiscriminant mutilation.” Even the development of primary skin closure of wounds by Joseph Pancoast and Samuel Gross did not result in a return of “mastectomy.” However, in the late 19th century, a revolution was about to begin.

William Halsted is credited with describing the exact technique to safely perform a radical mastectomy, an operation that bears his name to this day. Halsted had two advantages over his predecessors: the advent of anesthesia and the concept of antisepsis. With these advances, he advocated a meticulous dissection with avoidance of a hematoma or hemorrhage.

Early in his career, his operation entailed complete removal of the breast with all the overlying skin (thus requiring a skin graft for coverage of the chest wall), removal of levels I, II, and III axillary lymph nodes, and removal of the pectoralis major and minor. Later in his career, he recommended the additional removal of the latissimus dorsi, subscapularis, teres minor, and serratus. With the Halsted methodology plus anesthesia and antisepsis, the operative mortality declined tremendously, and the tides turned to reconsidering surgical management of breast cancer. Thus, the Halsted radical mastectomy became the standard of practice, the primary treatment of breast cancer, for the next 70 years.

From the Halsted Revolution to the Present

During the Halsted revolution, Cushman Haagensen, a surgeon and pathologist at Columbia University in New York, noted that although the operation became more “radical,” the survival rates from breast cancer did not likewise increase over those achieved with the less “radical” mastectomy. This observation was also noted by European colleagues (Veronesi) and opened the door to consideration of a less radical operation.

In 1948, Patey and Dyson introduced the concept of the modified radical mastectomy — removal of the entire breast, levels I, II, and III lymph nodes, and the necessary skin (including the nipple-areola complex) — to allow primary closure flat against the chest wall with minimal redundancy of skin. No muscles would be removed during the operation, including the pectoralis major and minor.

Shortly thereafter, in the 1950s, silicone gel implants came on the scene. However, women with breast cancer were not offered immediate reconstruction but rather delayed reconstruction for two reasons. First, it was well known that if a woman was going to develop a recurrence or distant disease, these events would most likely happen within 3 years of her cancer diagnosis. Thus, they wanted to declare the woman a survivor before performing any breast reconstruction. Second, the techniques of immediate reconstruction after mastectomy were still in their infancy. If the woman lived flat-chested, with all the imperfections of a mastectomy without reconstruction for a significant period, she would be much more appreciative of any reconstructive outcome she had.

As such, early experience with immediate breast reconstruction came from women having subcutaneous mastectomies for benign disease. Without the benefit of mammography, breast ultrasonography, and core needle biopsies, many women had multiple open surgical biopsies in the 1960s and 1970s for benign disease (fibrocystic changes and fibroadenomas). Repetitive biopsies led to scarring, pain, anxiety, and deformity, and thus these women opted to have their breasts removed.

A subcutaneous mastectomy was performed, most commonly via an inframammary incision, with removal of most of the breast tissue, leaving a rim of normal breast tissue on the undersurface of the native breast skin (especially subareolar). No muscles or lymph nodes were removed, nor was any of the skin (including the nipple-areola complex). Thick...
mastectomy flaps (> 10 mm) were raised, leaving a cushion of tissue anterior to the implant and beneath the skin. This cushion maintained skin viability and created a more natural “feel” to the reconstruction. As this technique was for benign disease, oncologic safety was not questioned, and it actually provided an excellent risk-reduction benefit to these women. However, most women in the 1960s were still treated with the Halsted radical mastectomy. Without any available muscles or native breast skin, implant reconstruction was not possible.

Fortunately, by the 1970s, the modified radical mastectomy was gaining traction. Now plastic surgeons had some native breast skin, albeit thinner than a subcutaneous mastectomy, to provide coverage over the implant. However, the high risk of implant exposure from wound dehiscence was quickly discovered. The implant was too heavy for the delicate mastectomy skin, but women were demanding immediate reconstruction. This led to the development of tissue expanders.

Tissue expanders are essentially deflated balloons placed beneath the pectoralis major muscles at the time of mastectomy. They are then slowly inflated with saline over time (weekly or bimonthly injections), stretching the pectoralis major until the intended breast size is achieved. The rate of expansion is adjusted per patient based on skin integrity and patient tolerance. The expanders are subsequently exchanged for a permanent, more natural-appearing implant a few months later as an outpatient procedure, without risk of skin compromise. As the nipple-areola complex is always removed with a modified radical mastectomy, the nipple can be reconstructed during a third operation at least 6 weeks later; the areolar disc can later be tattooed.

The Evolution of Nipple-Preservation Techniques

Plastic surgeons recognized early the importance of preserving the nipple. The nipple-areola complex defines a breast as a breast and therefore likewise defines a reconstructed breast mound. As such, women were offered a choice of having nipple reconstruction using skin from the local area or donated from the groin area. Alternatively, the nipple-areola complex could be harvested at the time of mastectomy, with “banking” of the nipple in the patient’s groin as a full-thickness skin graft and later replacing it on the reconstructed breast (Fig 1). Attempts to maintain the nipple in a tissue bank for future reimplantation resulted in poor viability of the preserved nipple-areola complex. However, whether it was “banked” in the groin or the biorepository, concerns about transplanting cancer contained within the preserved nipple started to appear in the literature, and this practice fell out of favor.8-10 Focus shifted back to improving the techniques of nipple reconstruction and investigating the psychological importance of re-creating a nipple on a reconstructed breast mound.11

Improving nipple reconstruction techniques became paramount in the 1980s, as new methods of breast reconstruction were being developed, namely autologous tissue transfers. These modalities (latissimus dorsi myocutaneous flaps, transverse rectus abdominis myocutaneous flaps [TRAMs]) offered an alternative to tissue expander/implant reconstruction and provided the ability to create a larger breast mound with ptosis if needed to match the contralateral natural breast.

In concert with these improved reconstruction options, Toth and Lappert12 introduced the concept of the skin-sparing mastectomy in 1984. A skin-sparing mastectomy still removes the entire breast and provides access to the axilla for removal of lymph nodes (level I/II axillary node dissection at this time) but preserves more of the native breast skin than would a traditional modified radical mastectomy with immediate reconstruction. In fact, by definition, a skin-sparing mastectomy removes < 20% of the native breast skin but always removes the nipple-areola complex. By preserving the maximal amount of breast skin, the breast/general surgeon can provide the plastic surgeon with an envelope that is the same size, color, contour, and ptosis as the original breast. Toth and Lappert12 also recommended avoiding incisions in the upper portion of the breast, which could impact cosmesis.

Undeniably, this approach would improve cosmesis, but it was technically more challenging. Initial concerns existed regarding the oncologic safety of preserving additional skin (echoes of Halsted). Thus, in the first several years after the introduction of the skin-sparing mastectomy, the literature focused on technical feasibility and local recurrence rates.13-18 Studies had shown that if the undersurface of the remaining native breast skin and the anterior surface of the pectoralis major muscles are scraped after a mastectomy, approximately 1 g of normal breast epithelial cells could be identified.19 Despite the assumption that leaving more skin behind would increase the number of remaining breast cells, the local recur-
Re-creating the Nipple

A multitude of techniques have been developed to re-create the nipple. However, they all fall into one of three groups. The first method is called composite grafting. This approach entails transfer of tissue from a distant source (contralateral normal nipple, cartilage graft from the ear, skin from the groin area), use of various acellular dermal matrices, or use of fillers that can be injected/placed under the breast skin. The second approach involves local flaps, which employ the breast skin itself to re-create a projecting nipple with primary closure of the donor site. The final option is a similar re-creation of the nipple with local breast skin, but rather than closing the donor site primarily, a skin graft is used to cover the area to create the nipple. Typically, this option manifests itself as a round graft mimicking an areolar disc.

Each technique has its own advantages and disadvantages. The greatest long-term projection of the reconstructed nipple is attributed to the last of these methods, typically referred to as a “Skate” flap. The disadvantage is the need for an additional scar to harvest the skin graft. This graft is usually taken from the groin, suprapubic area, upper inner thigh, or even in some instances the labia. The second method allows adequate projection initially but does tend to lose this projection over time. The first methods are less reliable, and when using foreign material, can increase the risk of infection or exposure of the graft.

For a time in the 1970s, “banking” the nipple was a popular option. This option entailed removing the native nipple-areola complex and grafting it into the groin or upper thigh. After the reconstruction was complete, this “banked” nipple would be harvested and placed back over the reconstructed breast mound. This technique fell out of favor due to reports of transposing breast cancer to the “banked” grafting sites.

Despite numerous advances in nipple reconstruction, loss of projection as well as diminished color variation and asymmetry continued to plague plastic surgeons. Thus, in the 1990s, general surgeons and surgical oncologists began to explore the option of areola-sparing mastectomy. Akin to skin-sparing mastectomy, this technique needed to be defined and a decision made as to the use of the areolar disc. Two options evolved: the areolar disc could be left in situ and a nipple created using donor skin from an autologous tissue transfer, or alternatively, the areolar disc could be used to create a nipple, and the surrounding skin could be tattooed later to re-create an areolar disc around the newly created nipple.

We have learned that the areola makes a natural-appearing nipple and does a better job maintaining its projection than a re-created nipple using donor skin, especially if the nipple creation is performed during the initial reconstruction operation. On the negative side, the color tones and pigmentation within the areola are typically variegated and highly individual, defying an exact match, even by the most skillful tat-

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too artist. We have also discovered that areola-sparing mastectomy is not only technically feasible but oncologically safe. To date, there have been no reports of a de novo breast cancer arising from the preserved areolar disc regardless of whether it is maintained as an areolar disc or used to create the nipple.22

The Birth of Nipple-Sparing Mastectomy
The time had come to re-explore the option of nipple-sparing mastectomy. To take the next leap to spare the nipple, many surgeons searched for factors that might predict occult nipple involvement. Common themes from prior studies of occult tumor involvement of the nipple included poorly differentiated primary tumors > 2 cm and centrally located tumors. Multicentric tumors, lymphovascular tumor invasion, and lymph node involvement were also common features, which formed the basis for initial eligibility criteria. Interestingly, these same criteria would also define an ideal candidate for breast conservation. Yet a portion of these women were requesting nipple-sparing mastectomy. Perhaps, they considered the local recurrence rate of approximately 10% after whole breast irradiation too high compared with 3% following mastectomy without irradiation. Maybe the concept of receiving radiation in and of itself was enough of a deterrent, or perhaps this was a way for women to gain control and take charge by choosing the best risk-reduction prevention strategy for breast cancer development. After all, women who have had breast cancer are at the highest risk to develop it again.

The 1990s also saw the dawn of genetic testing for breast cancer risk assessment. With increased testing and public awareness via the Internet and advocacy groups, the number of mastectomies being performed was on the rise. Over the past 5 years, the trend is toward an equalization of lumpectomy vs mastectomy selected by patients. The true explanation of this phenomenon is largely speculative.

Whatever the reason, demand for nipple-sparing mastectomy steadily increased, and the next step was technical development of the procedure itself. The design of the incision had to allow complete removal of the breast as well as access to the axilla for staging. Additionally, the ability to easily obtain tissue from the base of the nipple for assessment of atypia or occult cancer was an absolute requirement. The base of the nipple could be examined by imprint cytology or frozen section, depending on each institution’s expertise. If any atypical or cancerous cells were identified, the nipple would be sacrificed intraoperatively. Similarly, if vascular viability was of concern to the plastic surgeon, the nipple would likewise be sacrificed.

The Growing Clinical Data
Introduction of nipple-sparing mastectomy was first presented as a case report at the Southwestern Surgical Congress in 1999, followed by an editorial in 2000 describing the technique.25 The first reported series came from separate institutions, both in 2006,26,27 The Petit group in Milan, Italy, described a subcutaneous mastectomy (a type of mastectomy intentionally leaving a 1-cm to 1.5-cm cuff of breast tissue on the mastectomy flaps, especially in the area of the nipple base). Because of the thickness of the mastectomy flaps and the inherent increased risk of occult or secondary cancer, they coupled their operation with the use of 16 Gy of intraoperative radiation therapy with electrons (ELIOT) to the nipple-areola complex and remaining breast tissue.26 At 6 months of follow-up in 25 patients, no local recurrences in the nipple areolar complex were reported. There was one local recurrence at 13 months of follow-up far away from the nipple in the infraclavicular region.

Gerber et al27 studied 61 patients having nipple-sparing mastectomy and compared them with women having skin-sparing or non–skin-sparing mastectomy. At a mean follow-up of 4.9 years, the local recurrence rate was the same (5%) in all three cohorts. The following year, Crowe et al28 reported on 44 patients having nipple-sparing mastectomy for breast cancer treatment or prophylaxis, with no local recurrences noted at a short mean follow-up of 6 weeks.

As surgeons worldwide learned of this “new” technique, they began offering the procedure to their patients. Initially, many nipple-sparing mastectomies were performed prophylactically in high-risk women. In these women, many of whom were later confirmed to be BRCA mutation carriers, the nipple-sparing mastectomy was performed as a subcutaneous mastectomy. However, the development of a primary breast tumor in the residual breast tissue was higher than anticipated29,30 (1.9% at a median follow-up of 6.4 years in a study by Rebbeck et al30) and begs the question of oncologic safety in this high-risk population. From 2004 to 2008, the literature was bare on this topic, as surgeons were grappling with learning the technique, deciding whether to perform the cosmetically more appealing subcutaneous mastectomy or the true nipple-sparing mastectomy, and defining eligibility criteria from both oncologic safety and cosmetic standpoints.

In 2008 and 2009, a plethora of reports spouting technical feasibility surfaced in the literature but with small numbers of patients and short-term follow-up.31-35 Some articles focused on generating an algorithm for eligibility without providing much information about their own institutional experience or outcomes from a cosmetic standpoint.34,35 For example, in the Memorial Sloan-Kettering Cancer Center experience, 25 women had 42 nipple-sparing mastectomies, of which 81% were prophylactic.35 All of these women had tissue expander/implant reconstruction. Partial nipple loss was seen in 5% of mastectomies, and complete nipple loss occurred in 2% of the women. Additionally, at 2 weeks following surgery, 48% had nipple discoloration or ischemia.

The choice of incision appears to affect cosmesis, technical ease of performing the operation, and vascula-
lar viability of the nipple. Ischemia was most common with a lateral incision (curvilinear at the edge of the breast in the lower outer quadrant). In a recent update of the Memorial Sloan-Kettering Cancer Center experience, de Alcantara Filho et al\textsuperscript{36} reported that since 2005, eligibility criteria have changed to encompass more women with breast cancer. Approximately 4% of all mastectomies performed at this institution are nipple-sparing, demonstrating continued careful selection of patients resulting in no local recurrences on short-term follow-up and only 1 patient with distant metastasis.

None of the nipple-sparing mastectomies performed at Memorial Sloan-Kettering Cancer Center used an inframammary approach. In that regard, the study by Kiluk et al\textsuperscript{37} bears further mention. An inframammary incision was made in all patients akin to that used in breast augmentation or subcutaneous mastectomy, utilized for the performance of a true nipple-sparing mastectomy. No counter incision was made in the axilla for sentinel lymph node biopsy. Demonstrating technical feasibility of the inframammary incision to accomplish all the goals (complete removal of the breast, access to the axilla for staging, and ease of obtaining pathological assessment of the base of the nipple) set the bar high for nipple-sparing mastectomy. The inframammary incision has become the preferred incision by women (patients) and plastic surgeons.

As others were reporting technical feasibility at short-term outcomes, the original pioneers were publishing updates.\textsuperscript{38-40} Gerber et al\textsuperscript{39} presented longer follow-up on 60 of the original 61 nipple-sparing mastectomy patients. At a median follow-up of 101 months, the local recurrence rate was higher, at 11.7%, but it was not statistically different from that of their skin-sparing and non–skin-sparing cohorts. This study was nonrandomized and retrospective, and although the local recurrences rates are higher than those reported in the literature, they represent a single institution/same surgeon clinical experience.

Also in 2009, Petit et al\textsuperscript{40} reported on 1,001 patients having subcutaneous mastectomy with ELIOT; at 20 months, the local recurrence rate was 1.4%. Nipple-sparing mastectomy has become a prominent entity at their institution. In fact, at the San Antonio Breast Cancer Symposium in 2010, Petit stated that 37% of their mastectomies are nipple-sparing.\textsuperscript{41} Their current eligibility criteria for nipple-sparing mastectomy include all clinical stage T1 and T2 invasive breast cancers but exclude those with a history of breast irradiation. They use a radial incision in the upper outer quadrant of the breast from the areolar border to the axilla and always perform an intraoperative frozen section of the base of the nipple. All patients receive 20 Gy of intraoperative radiation using ELIOT.

Immediate complications included infection (2.1%) and the need to remove the tissue expander/implant (4.2%). In their hands, TRAM reconstruction offers the best cosmetic outcome; when the reconstruction is a tissue expander/implant, the majority (75%) have implant-alone reconstruction (“one-step” procedure). Other complications included partial necrosis of the nipple in 6.5% of patients and full-thickness necrosis of the nipple in 3.9%. Necrosis was more common in larger-breasted women than in others. Depigmentation of the nipple occurred in 31% of women. Sixty-four percent of the nipples were insensate or had minimal sensation, but 82% and 84% of the patients and surgeons, respectively, reported the cosmetic outcome as good to excellent. Complications specific to tissue expander reconstruction was tilting (radiodystrophy) of the nipple toward the axilla and delayed capsular contracture, which occurred in 16.5% of patients. Overall, the women expressed a positive effect on body image, intimacy/sex, and satisfaction.

Several months later, at the 16th Annual Multidisciplinary Symposium on Breast Disease in Amelia Island, Florida, Veronesi\textsuperscript{42} reiterated his associate’s presentation in San Antonio and included some further updates. Their group has now performed over 2,000 nipple-sparing mastectomies. The complication rates are similar, but they now have 53.2 months of follow-up in terms of oncologic outcomes. The local recurrence rate was 3.9%, with 12 of 39 (31%) local recurrences being de novo cancers involving the preserved nipple (11 noninvasive cancers, 1 invasive cancer) despite intraoperative radiation. Interestingly, 75 additional patients had a nipple base with cancer (25 invasive cancers, 50 noninvasive cancers) found on final pathology review at the time of the nipple-sparing mastectomy. These nipples were observed in situ, and none developed local tumor recurrence, most likely due to intraoperative radiation. Yet that does not explain the occurrence of the aforementioned de novo cancer (1.2%), as these patients also received the same intraoperative radiation dose. Eight percent of women have developed distant disease, with a mortality rate of 2.7%.

Another group to report 5-year data is the John Wayne Cancer Center.\textsuperscript{43} In this series of 99 patients, 14% had their nipples removed due to atypical cells or cancer cells in the base of the nipple (apart from the Italian group, intraoperative radiation is not routinely performed with nipple-sparing mastectomy). Six percent of patients had the nipple sacrificed for vascular insufficiency. As a result, they have modified their technique to incorporate a “delay” procedure. A delay procedure entails making an inferior circumareolar incision to obtain a nipple base biopsy and detaching the entire nipple-areola complex from the breast mound. Two weeks later, after skin collateralization has occurred to the nipple and pathological assessment of the base of the nipple shows no tumor, the nipple-sparing mastectomy is performed. In their hands, this modified technique has decreased vascular compromise to the nipple and thus nipple loss. Additionally, this strategy should lead to fewer local recurrences. Early in their se-
ries, patients with a positive nipple base for cancer intraoperatively had a 14% local recurrence rate. By identifying these patients beforehand, they can declare them ineligible for nipple-sparing mastectomy.

The Moffitt Experience
Over the past several years, Moffitt Cancer Center has performed nipple-sparing mastectomy for genetic carriers and in select women with breast cancer (Fig 2). About 5 years ago, we established stringent eligibility criteria based on oncologic factors and technical/cosmetic constraints (Table). Due to concerns over the 1.2% de novo cancer rate evidenced by the Milan group, our nipple-sparing mastectomy is not performed as a subcutaneous mastectomy. Our mastectomy flaps are 3 mm to 5 mm thick and extend directly onto the base of the nipple. Initially, we cored the nipple proper, but based on the data from Stolier et al, we no longer core the nipple. Rather, we perform intraoperative frozen sections of the nipple base; if atypical or malignant cells are identified, the nipple (not the areolar disc) is sacrificed.

We recently reviewed our complications following 187 nipple-sparing mastectomies performed on 111 patients (108 women, 3 men). The median age was 48.5 years (range, 18 to 82 years), and the median body mass index (BMI) was 23 kg/m² (range, 17 kg/m² to 34 kg/m²). The majority (68%) had bilateral nipple-sparing mastectomy, with 80% of patients having nipple-sparing for an invasive cancer. The majority of women (> 80%) experienced some amount of epidermolysis to the nipple tip at 5 to 10 days after surgery. No intervention was warranted, and the area healed without sequelae. Other complications during the immediate postoperative period (< 30 days) included partial or complete nipple loss (5.6% or 0.6%, respectively), infection requiring removal of a tissue expander (1.2%), skin flap necrosis (6.8%), and malposition or leakage of the tissue expander (3.7%). Delayed complications consisted of asymmetry of the nipples (8%), depigmentation of the nipples (1.2%), infection requiring intravenous antibiotics (5.6%), irritation of the surgical site (4.2%), or removal of the tissue expander/implant/acellular dermal matrix (12.9%). The median time to these delayed infections was 7 months (range, 1 to 51 months).

Assessment of oncologic safety is limited by a short mean follow-up of only 22 months (range, < 1 to 57 months). Of the patients intended for nipple-sparing mastectomy, 93% ultimately maintained their nipples. Four nipples (2.1%) were sacrificed for atypia or cancer at the nipple base on pathology review. Local regional recurrences occurred in 5 of 187 patients (2.7%). Distant metastases developed in 1 patient (0.5%). Overall survival was 97%. The cause of death was unknown in 2 patients who were lost to follow-up in 2007; a third patient died 48 months after nipple-sparing mastectomy, secondary to widely metastatic ovarian cancer.

All of the studies to date offer the same message: nipple-sparing mastectomy is an oncologically safe procedure for women who have or are at high risk for breast cancer. Knowing that the local recurrence rates for skin-sparing mastectomy are comparable to those for non–skin-sparing mastectomy, logic predicts that the addition of leaving the nipple in situ should have minimal risk of increased local tumor recurrence. In fact, a study by Stolier et al demonstrated that only 25% of nipples possess a terminal duct lobular unit, which is the progenitor of all breast cancers. More important, the terminal duct lobular unit is always found at the base of the nipple, not within the nipple proper. This information has led to a change in our surgical technique, away from “coring out” the nipple proper to frozen sections at the base of the nipple alone. Coring of the nipple has been associated with a higher rate of vascular compromise to the nipple. Avoidance of this maneuver has decreased our nipple loss rate (partial and full) as well as the amount of epidermolysis to the nipple tip at 5 to 10 days after surgery. Assessment of oncologic safety is limited by a short mean follow-up of only 22 months (range, < 1 to 57 months). Of the patients intended for nipple-sparing mastectomy, 93% ultimately maintained their nipples. Four nipples (2.1%) were sacrificed for atypia or cancer at the nipple base on pathology review. Local regional recurrences occurred in 5 of 187 patients (2.7%). Distant metastases developed in 1 patient (0.5%). Overall survival was 97%. The cause of death was unknown in 2 patients who were lost to follow-up in 2007; a third patient died 48 months after nipple-sparing mastectomy, secondary to widely metastatic ovarian cancer.

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g is associated with an overall increase in complications (especially wound dehiscence), and a sternal notch-to-nipple distance of > 26 cm is associated with a general increase in complications. Thus, reporting of all complications is paramount to make technical improvements and expand patient eligibility criteria. As such, we have modified our initial eligibility criteria to a less stringent (oncologically and cosmetically) checklist (Table).

**Evaluating Patient Satisfaction**

Additionally, we have launched a prospective clinical trial evaluating body image, quality of life, and skin/nipple sensation before surgery and after surgery at 6 months and at 1 year. We are comparing women having skin-sparing vs nipple-sparing mastectomy to ascertain what impact the nipple itself has on these components. All women enrolled must meet our eligibility criteria (Table) regardless of the cohort assigned. Such a study is important, as a dearth of literature currently exists regarding patient satisfaction and sensation of the preserved nipple.

In one report by Yueh et al, two-thirds of patients were satisfied with their aesthetic result. Although 75% reported preservation of nipple sensation, this sensation was rated poorly on a scale of 1 to 10, with a mean of only approximately 3. In a similar study, patients assessed the appearance, symmetry, color, position, and texture of the breast mound, with a majority of the results rated as good or excellent.48

This finding correlated with independent observers' ratings. However, although preserved sensation was acknowledged by a majority of patients, it was reported to be only fair or poor.48

Recently, the MD Anderson Cancer Center reported its experience with nipple-sparing mastectomy, including evaluation of nipple sensation in terms of responsiveness to touch preoperatively and postoperatively at 6 months and at 1 year. Although response time to "erection" slowed at 6 months (remained constant at 1 year), data are limited to only 11 evaluable breasts at 1 year. The majority of women had displacement of the nipple position (75%) and breast mound (58%), resulting in an excellent to very good overall appearance of the nipple (23%) and mound (35%), and most women were "not at all" self-conscious in their clothes.

**Conclusions**

Similar studies worldwide will help to assess the value of nipple-sparing mastectomy to individual women. From the perspective of breast/general surgeons and plastic surgeons, preservation of the nipple is the ultimate in aesthetic outcome for a patient facing mastectomy. However, it is technically challenging, and long-term oncologic safety is unknown (albeit predicted to be low risk). Demonstrating the importance of preserving a nipple, whether sensate or not, will encourage surgeons to not only remain steadfast in their learning curve, but also acquire evidence-based data documenting local tumor recurrence, distant metastasis, cosmetic outcomes, patient satisfaction (quality of life, body image, nipple sensation), and procedural complications/risks.

**Table. — Inclusion and Exclusion Criteria for Nipple-Sparing Mastectomy**

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>Histologically proven diagnosis of breast cancer: unifocal invasive ductal, invasive lobular, or a sarcoma</td>
<td>Age older than 85 years at the time of surgery</td>
</tr>
<tr>
<td>Invasive tumor 3 cm or smaller based on preoperative breast imaging</td>
<td>Extensive ductal carcinoma in situ (area &gt; 3 cm)</td>
</tr>
<tr>
<td>Tumor margin &gt; 2 cm from the areolar edge based radially and 2 cm from the posterior margin of the nipple-areola base based on preoperative breast imaging</td>
<td>History of breast cancer (invasive or noninvasive) with radiation</td>
</tr>
<tr>
<td>Lymph node-negative status and performance of a sentinel lymph node biopsy at the time of the mastectomy on the cancer side (not required for a prophylactic mastectomy)</td>
<td>History of irradiation to the breast area (ie, mantle radiation for lymphoma)</td>
</tr>
<tr>
<td>Prophylactic mastectomy (unilateral or bilateral) for risk reduction for a nipple-sparing mastectomy of the breast without cancer</td>
<td>Invasive cancer &gt; 3 cm, multicentric, within 2 cm from the areolar margin or within 2 cm from the posterior aspect of the nipple-areola base</td>
</tr>
<tr>
<td>Female, age 18 to 85</td>
<td>Clinically suspicious axillary lymph nodes on palpation or by fine-needle aspiration</td>
</tr>
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</table>

**References**


15. Fersis N, Hoening A, Reikas K, et al. Skin-sparing mastectomy and immedi-


