

Chapter 4

Conservative Mastectomies for Breast Cancer

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Abstract

Conservative breast surgery (as lumpectomy or quadrantectomy) began replacing Halsted or modified mastectomy as treatment for breast cancer from the 1980s. Conservative surgery (combined with radiotherapy) is currently standard for early breast cancer: it has equivalent survival to mastectomy but aesthetic outcome is generally superior. In recent years the proportion of early breast cancer patients receiving mastectomy has increased. One reason for this is that conservative mastectomies have been developed. The two main types of conservative mastectomy are skin-sparing and nipple-sparing. Both are characterized by preservation of most of the breast skin which serves to accommodate either an autologous graft or an implant, to thereby facilitate immediate breast reconstruction. Aesthetic outcomes can be excellent, particularly for nipple-sparing mastectomy which by preserving the nipple-areolar complex contributes substantially to patient satisfaction with the reconstructed breast. This chapter presents the skin-sparing and nipple-sparing mastectomies, discusses indications, contraindications, and oncological safety, and describes surgical techniques.

Introduction

Breast cancer was recognized in ancient times, while mastectomy as a treatment for the disease has been practiced at least since of the days of the Byzantine Empire [1]. In medieval Europe the “guillotine method” was wide-

spread: the breast was amputated with a sharp knife without re-approximation of the skin: most women no doubt died of blood loss or subsequent infection. During the Renaissance the wound came to be sealed by cauterization, reducing blood loss and infection [2].

The mastectomy introduced by William Halsted at the end of the 19th century proved to be a milestone in breast cancer treatment: it included anaesthesia and the use of antiseptic agents, and involved complete removal of the breast gland, all overlying skin, the three lymph node levels of the axilla, and the pectoralis major and minor muscles [3]. Results in terms of survival and local recurrence were good, and Halsted's radical mastectomy remained the principal treatment for breast cancer for over eighty years. However the morbidity associated with this technique was often marked and included arm lymphedema, limitation of arm movement, damage to the rib cartilages, and pneumothorax [3]. Later a modified radical mastectomy was introduced by Patey. This was a total mastectomy plus axillary lymph node dissection, but sometimes the pectoralis major and minor muscles were conserved.

Conservative breast surgery was introduced by Umberto Veronesi [4] in the 1970s and proved to be a major development in the treatment of breast cancer: overall survival by Veronesi's conservative approach called quadrantectomy was not worse than with Halsted mastectomy, yet the woman's breast was preserved and the aesthetic outcome could be quite good [5].

However breast-conserving surgery does not provide the best chance of long-term disease control in some cases, so mastectomy remains the surgical treatment of choice for many women with breast cancer. In fact mastectomy is indicated for multicentric disease, large size cancer, small size breast, certain cases of locally advanced disease, extensive ductal carcinoma in situ [DCIS], and always in inflammatory breast cancer.

The term oncoplastic surgery was first coined by Werner Audrescht [5] in the early 1990s to refer to the introduction of plastic surgery techniques to obtain improved cosmetic results in breast cancer patients undergoing mastectomy. Breast surgeon and plastic surgeon increasingly collaborate to perform what are now called conservative mastectomies in which, following gland removal by the breast surgeon, an immediate breast reconstruction is performed by the plastic surgeon using either an implant or an autologous graft. As discussed below, conservative mastectomies achieve excellent oncological results and also superior aesthetic outcomes. Some women eligible for breast-conserving surgery are now opting for conservative mastectomy with breast reconstruction in view of the superior aesthetic results these techniques afford.

The main types of conservative mastectomy are skin-sparing mastectomy, nipple-sparing mastectomy, and for selected cases with large and/or ptotic breasts, skin-reducing mastectomy. However mastectomy techniques have

continued to evolve and nipple-sparing mastectomy using a robotic technique has been described recently [6] .

Skin-sparing mastectomy was first explicitly described in 1991 by Toth and Lappert [7]. Its aim was to maximize skin preservation so as to provide a more cosmetically pleasing result after reconstruction. Sparing of the nipple-areola complex as well as the breast skin (nipple-sparing mastectomy) was a subsequent development [8] and proved to be important for optimizing aesthetic results and maximizing patient satisfaction, not only in high-risk patients but also those with early breast cancer. In the following sections we describe these conservative mastectomies

Skin-Sparing Mastectomy

In 1991, Toth and Lappert [7] described a mastectomy [simple or modified radical] in which a minimum amount of skin was removed. The aim was to maximize skin preservation so as to facilitate immediate breast reconstruction. The operation removed the gland, the nipple-areolar complex, the biopsy scar if present, and the skin overlying the cancer if the cancer was superficial, but conserved most of the breast skin and also the inframammary fold. The initial incision was made so as to facilitate access to the axilla. Immediate breast reconstruction followed, performed by the plastic surgeon who was also involved in preoperative planning. The authors noted that

when appropriately applied, skin-sparing mastectomy greatly improved the final aesthetic result.

Also in 1991, Kroll et al. [8] published their experience with 100 breast cancer patients who underwent skin-sparing mastectomy with immediate reconstruction. After a follow-up of around 23 months, there was one local recurrence. Since then numerous retrospective studies on skin-sparing mastectomies have been published [9-12] which have made it possible to define indications for the procedure.

Indications

Skin-sparing mastectomy is indicated for early stage breast cancers with a large tumour-to-breast ratio, selected stage III cancers, extensive DCIS, local recurrence after conservative treatment, and multicentric disease, as well as in patients with locally advanced breast cancer who respond poorly to neoadjuvant chemotherapy. Skin-sparing mastectomy is also indicated as a risk-reducing procedure for patients carrying a BRCA mutation [12]. The operation is strongly contraindicated for inflammatory carcinoma, and locally advanced breast cancer with skin involvement.

Classification and Surgical Technique

The incisions chosen for skin-sparing mastectomies depend on various factors including breast size, degree of ptosis, size of the nipple-areola complex, tumour location, position of the biopsy scar, whether axillary surgery is

necessary, and reconstructive technique, as well as patient and surgeon preferences. Four types of skin-sparing mastectomy [Table. 1, Figure. 1] have been defined by Carlson et al. [9] depending on the type of incision and amount of skin removed.

Table 1: Classification of Skin-Sparing Mastectomies after Carlson et al. [9].

Type	Amount of skin removed
I	Only nipple-areola complex removed
II	Nipple-areola complex, skin overlying superficial cancer, and previous biopsy incision, all removed in continuity
II	Nipple-areola complex removed, skin overlying superficial cancer and previous biopsy incision removed without intervening skin
IV	Nipple-areola removed with inverted or reduction pattern skin incision

Types I to III are intended for small non-ptotic breasts, and require a periareolar incision through which the gland is removed. The type I operation is commonly used as a risk-reducing procedure in carriers of a BRCA mutation (Figure 1). It may be necessary to perform a separate incision in the axilla to gain optimal access to the axillary tail [13]. The type II operation is used when the cancer is close to the skin, and the biopsy scar is close to the areola (Figure 1), The type III approach is used when the cancer is close to the skin and the previous biopsy incision is distant from the areola. The type IV approach is used when the breasts are large and ptotic, and when a reduction is also planned for the opposite breast.

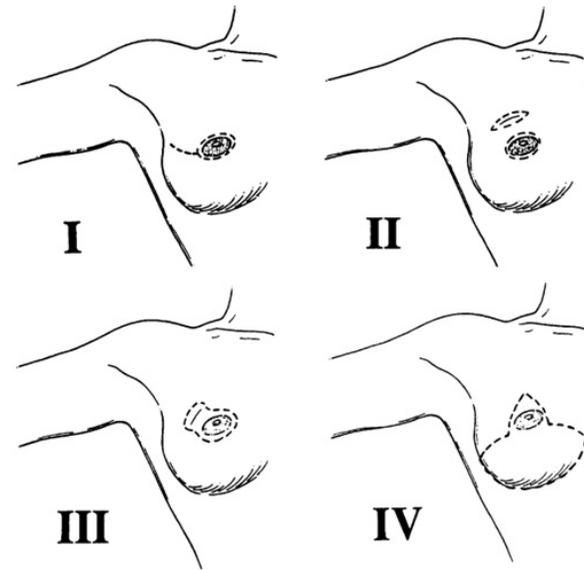


Figure 1: Incisions associated with the four main types of skin-sparing mastectomy (after Carlson et al. 1997).

It is essential that the skin flaps are prepared with great care in order to reduce to a minimum the risks of (a) leaving residual breast gland attached to the skin flap (with increased risk of recurrence) and (b) removing too much subcutaneous fat so as to compromise blood supply and increase risk of flap necrosis, which may be further increased by tension due to the implant when reconstruction is immediate. The dissection should be made in the fascia superficialis between the gland and the subcutaneous adipose; this however is not a smooth plane, but has a

sinewy appearance and its distance from the dermis varies. It is a fairly avascular plane, so presence of bleeding indicates the plane is being missed [14]. The dissection must respect the following boundaries: anterior margin of the latissimus dorsi muscle, inframammary fold, margin of the sternum, and the upper pole of the breast usually located at the level of second rib. It is essential to preserve the inframammary fold. Once removed the specimen should be marked with clips or sutures to facilitate orientate. The nipple-areola complex also serves as a landmark for orientating the surgical specimen.

Breast Reconstruction

Reconstruction is immediate whenever feasible and begins by preparing a large pocket to receive the prosthesis: the lower insertion of the pectoralis major is detached and then attached to the previously de-epithelialized lower flap. The breast envelope is filled either with an implant, a temporary expander, a pedicle flap, or a free flap. Myocutaneous flaps produce a good breast shape but are challenging procedures and go against the conservative philosophy of conservative mastectomies [15]. The contralateral breast will often require reduction or augmentation surgery in order to achieve a balanced outcome.

Because of lack of subpectoral volume or noncompliance of the pectoralis major muscle, complete coverage of the implant cannot always be achieved. However by using a pre-shaped sheet of acellular dermal matrix (ADM) it

is possible to increase the volume of the lower part of the pocket [16]. The inferolateral attachments of the pectoralis major muscle are severed and a patch of ADM is sutured to the lower margin of the muscle. The other margin is sutured to the inframammary fold, thus enlarging the pocket [17]. Long-term experience indicates that immediate single-stage implant reconstruction using ADM is safe, cost-effective, and characterized by low complication rates [18].

Both neoadjuvant radiotherapy and post-mastectomy radiotherapy [19] are known to increase the risk of major complications in women who undergo breast reconstruction after mastectomy. According to some experience [20] such complications are less frequent with autologous transplants than with expanders or implants. The best reconstruction option for patients who receive radiotherapy seems to be a myocutaneous flap [21,22].

Complications

Complications commonly encountered in skin-sparing mastectomy with reconstruction are flap necrosis, seroma, hematoma, and infection [23,24]. Necrosis and infection can lead to total flap loss. The risk of flap necrosis can be reduced by painstaking flap preparation. However other factors are associated with increased risk of necrosis, including comorbidities (particularly diabetes) and smoking [25,26]. Flap necrosis occurs in around 3. 5-15% of cases undergoing conservative mastectomy [23]; however

this appears similar to the 5-8% necrosis rate reported in patients undergoing conventional mastectomies [24].

Oncological Safety

No randomized clinical trials have compared outcomes in patients who received skin-sparing mastectomy with those who had a traditional mastectomy. However accumulated retrospective experience indicates that outcomes are equivalent [25]. In particular a 2010 meta-analysis of nine studies, comprising 3739 patients found no significant difference in local recurrence between skin-sparing and other types of mastectomy, while the skin-sparing patients had a lower percentage of distant relapses [26].

Nipple-Sparing Mastectomy

Definition

In 1962 Freeman [27] used the term subcutaneous mastectomy to refer to an operation for benign breast disease which removed the breast gland, but left the breast skin including the nipple-areola complex [NAC], and was followed by immediate reconstruction. This operation, slightly modified, is now widely known as nipple-sparing mastectomy although it has also been called total skin-sparing mastectomy [28]. Like skin-sparing mastectomy, this operation is normally followed by immediate breast reconstruction. Leaving the real nipple and areola affords

a more natural appearance to the reconstructed breast. Several studies have shown that NAC-sparing in mastectomy has a positive impact on patient satisfaction, body image and psychological adjustment [29,30].

While it is accepted that skin-sparing mastectomy is associated with similar recurrence and survival rates to conventional mastectomy [31], for a considerable period there was concern that preservation of the NAC would lead to high local recurrence rates. In fact earlier data had indicated that the NAC could be involved by disease in up to 37% of cases [32]. Evidence suggests that short tumour-to-nipple distance [<2 cm], lymph node metastasis, lymphovascular invasion, presence of extensive intraductal component, HER2 overexpression, multicentricity and retroareolar location increase the incidence of occult nipple disease [33].

Nipple-Sparing Mastectomy at the European Institute of Oncology

From March 2002 to December 2007, 934 women underwent nipple-sparing mastectomy at the European Institute of Oncology in Milan [33]. 772 patients had invasive carcinoma and 162 had in situ disease. After a median follow-up of 50 months, 28 [3.6%] local recurrences were recorded in the invasive group, six [0.8%] of which occurred in the preserved the NAC. In the in situ group there were 9 [4.9%] recurrences in the breast and 5 [2.9%] in the NAC. Five-year overall survival was 95.5% in the

invasive group and 96.4% in whole series. These outcomes are fully consistent with other experience on nipple-sparing mastectomy and also other types of mastectomy [34].

Indications

After initial caution, the 2016 guidelines of the US National Comprehensive Cancer Network [NCCN] [35] advised that nipple-sparing mastectomy could be an option in breast cancer patients who are carefully selected by experienced multidisciplinary teams. Selection criteria were: early, biologically favourable (e. g. Grade I-II, node negative, HER2-negative, no lymphovascular invasion), peripherally located (>2cm from nipple) invasive cancer or DCIS. Evidence of nipple involvement such as Paget's disease, other nipple discharge associated with malignancy, or imaging findings suggesting malignant involvement of the nipple or subareolar tissue were clear contraindications for nipple-sparing mastectomy. The NCCN further advised that nipple margin assessment was mandatory. Chung and Sacchini [36] have stressed the importance of removing all ductal tissue at the nipple core to reduce the risk of NAC recurrence.

Other absolute contraindications are: inflammatory breast cancer, previous chest irradiation, bloody nipple discharge, or discharge positive for cancer cells, Paget's disease, and retraction. In patients who are smokers the risk of flap necrosis is high so smoking a strong but relative contraindication to skin-sparing mastectomy.

Surgical Technique

The preparation of the skin flaps must be just as meticulous as described for skin-sparing mastectomy. The main incisions practiced for nipple-sparing mastectomy are illustrated in Figure 2. Other incisions have been described including an inframammary fold incision [37-39]. The scar from a periareolar incision usually produces an aesthetically excellent result. However this incision is associated with a relatively high risk of nipple necrosis [40]. To increase operating field visibility, the upper lower semi-areolar incision can be extended with a lateral radial incision. The upper external incision provides good access to the axillary tail and axilla for sentinel node biopsy, leaving the nipple-areola complex untouched [41,42]. Incision approaches inferior or lateral the inframammary fold [42] are suitable for a variety of breast volumes, allow variation in implant volumes, give excellent aesthetic outcomes, and low rates of NAC necrosis. With larger breasts, an inframammary incision may not allow for complete excision superiorly, and alternative incisions should be planned. With more ptotic breasts (and when the patient expresses a desire for a smaller breast), a reduction of the skin envelope will be necessary, and this can be performed with only a vertical component or with a combined variant-size horizontal component [43]. A Wise pattern incision is frequently used to reduce the skin envelopes. The main benefits of Wise pattern incision are good surgical access in patients with large breast and moderate to severe ptosis. The omega-type elliptical incision, described

by Chen et al. [39] is also suitable for women with large ptotic breasts. Like the periareolar incision with lateral extension; the omega-type approach afford easy access to the entire breast and the axilla.

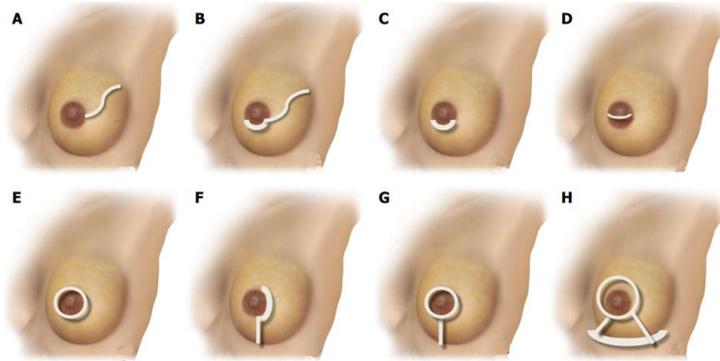


Figure 2: Commonly used incisions for nipple-sparing mastectomy. A: Radial lateral incision; B: Periareolar with lateral extension; C: Hemi-periareolar (superior and inferior); D: Transareolar; E: Circumareolar; F: Periareolar with vertical extension; G: Circumareolar with vertical extension; H: Wise-pattern.

During nipple-sparing mastectomy a portion of retroareolar tissue must be sent to pathologist for frozen section examination to assess the possible presence of tumour in the retroareolar ducts [41,44,45]. If the frozen section is positive for tumour, the nipple-sparing mastectomy must be abandoned for a skin-sparing mastectomy, and the whole NAC removed. During dissection of the breast gland in the area of the NAC, most authors prefer to evert the nipple so as to facilitate removal of tissue within, leav-

ing a maximum thickness of 2-3 mm of tissue underlying the NAC. By contrast, Petit et al. [44] state that “a glandular layer 0.5 cm thick” should be left beneath the areola to preserve NAC blood supply. Randall et al. [45] have described a technique they call “apple coring” in which the entire tip of nipple is removed with its contents, thereby assuring removal of all ductal components. Manning et al. [46] infiltrate the retroareolar space with 10 mL of saline at the beginning of the operation to help develop the tissue plane between the breast and the NAC. Palmieri et al. [47] propose a pre-mastectomy [outpatient] “vascular autonomization” treatment to leave only the dermal plexus as NAC blood supply and hence improve vascular support to the NAC. Figure 3 shows pre- and post-operative views of a patient who underwent bilateral nipple-sparing mastectomy.

Robotic Mastectomy

Toesca et al. [6] were the first to describe a robotic nipple-sparing mastectomy combined with immediate robotic breast reconstruction with implant. A 3 cm extramammary axillary incision was made along the mid-axillary line in the axillary fossa. A subcutaneous flap was prepared by electrocautery to obtain a working space for the introduction of the single robot port. The reconstruction and insertion of implant or expander was done through the same incision. Experience with 29 patients was reported and a low conversion rate to open surgery,

rapid learning curve and low rate of postoperative complications were noted.

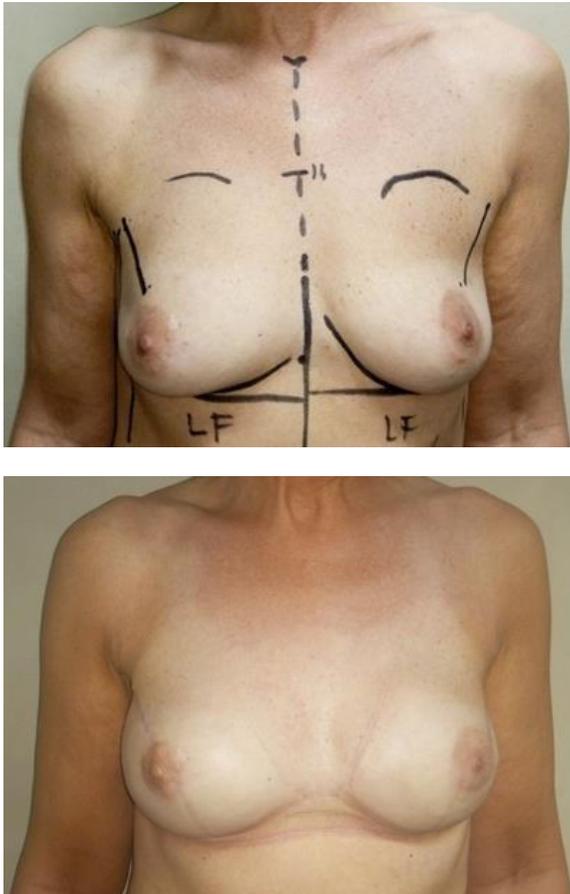


Figure 3: Views of a patient who underwent bilateral nipple-sparing mastectomy. Left preoperative; right six months after reconstruction with implant.

Breast Reconstruction

Nipple-sparing mastectomy is widely performed in association with immediate breast reconstruction that uses autologous tissue, a breast implant, or an expander, and does not produce an additional scar as occurs if reconstruction is delayed. An implant is almost always placed in a submuscular pocket that is prepared during the mastectomy. However subcutaneous placement is an option in patients with thick skin flaps and little risk of vascular compromise.

It is important to assess the vitality of the prepared skin flap and the NAC. If these show signs of vascular damage, it is advisable to place an expander, and insert a permanent implant with final reconstruction later. Use of a tissue expander also makes it possible to progressively enlarge by inflating the expander the muscular pocket. If the patient is indicated for radiotherapy, an expander is a better option than immediate reconstruction. As noted previously, acellular dermal matrix is often used obtain a larger subpectoral pocket and also to reduce the risk of capsular contracture following irradiation. Several studies report low complication rates and good aesthetic outcomes when acellular dermal matrix is used in conjunction with reconstruction and implant [48-52].

Autologous reconstruction of mammary volume is a proven option for breast reconstruction after nipple-sparing mastectomy. The donor site is mainly influenced by

the volume requirements of the new breast and the most common donor sites are the abdomen and back. The abdomen affords a good quantity of tissue, and abdominal skin is a good match for breast skin if the latter has to be replaced. The abdomen can be used as source of pedicle-TRAM [transverse rectus abdominis], free TRAM, DIEP [deep inferior epigastric perforators], and SIEA [superficial inferior epigastric artery] flaps. Other sites to be considered, if the abdomen is not suitable are the posterior thorax, and the gluteal and thigh regions.

Complications

Complications of nipple-sparing mastectomy do not differ greatly from those of skin-sparing mastectomy. The most frequently encountered complications in both are: wound dehiscence, infection, implant loss, seroma, hematoma, radio-dystrophy, asymmetry, and capsular contraction. Skin flap necrosis is also frequent, as is NAC necrosis after nipple-sparing mastectomy [39,44]. Loss of skin and NAC sensitivity is another frequent problem although it is more an expected outcome of the operation than a complication. The problem of skin flap/NAC necrosis has been widely investigated. The main risk factors are obesity, smoking, large breast volume [$>800\text{cc}$], pre-operative or post-operative radiotherapy, age >55 years and periareolar incision. The risk of NAC necrosis is also increased by one-stage reconstruction with implants because of the pressure exerted on the NAC [53-55].

NAC necrosis rates in the literature are in the range 0-29%, with failure of NAC preservation due to necrosis in the range 0.7-9% [44,56,57]. Some studies have evaluated NAC vascularization preoperatively to identify those at high risk of necrosis and hence modify the surgical approach. A 2015 [57] study evaluated nipple perfusion by MRI with contrast in 52 breasts, finding that the main NAC blood supply sources varied but the superomedial source predominated. Preoperatively defining NAC blood supply may aid planning for oncoplastic procedures. Another 2015 study [58] used indocyanine green for the intraoperative imaging of perfusion in 39 breasts. Three perfusion patterns for the NAC were identified. The authors concluded that the method was useful for directing the placement of mastectomy incisions and minimising ischemic complications [59].

Conclusion

Conservative mastectomies are a relatively recent development. Their main aim is to facilitate immediate breast reconstruction and thus make possible a cosmetic outcome superior to that achieved by breast-conserving surgery. Combining mastectomy with immediate breast reconstruction requires the involvement of a plastic surgeon and close cooperation between this surgeon and the breast surgeon. The aim is also to achieve the same oncological radicality as conventional (modified) mastectomy. Although no randomized trials have been conducted (or

are likely to be conducted) accumulating experience indicates that outcomes for conservative mastectomies are closely similar to those obtained with non-conservative mastectomies. In the United States the proportion of women opting for a conservative mastectomy instead of lumpectomy has increased in recent years as confidence has grown that modern treatments can achieve long-term disease control, and women are increasingly interested achieving the best possible surgical outcome: one that not only preserves their breast appearance, body image and femininity, but also provides an opportunity for breast remodelling that many enhance these characteristics. It is expected that the proportion of women opting for conservative mastectomy as part of their treatment for breast cancer will grow strong in the coming years.

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