Skin-Sparing Mastectomy

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20.1 Introduction

The term skin-sparing mastectomy was designated by Toth and Lappert in 1991 to describe mastectomy incisions that maximized skin preservation in an attempt to facilitate immediate breast reconstruction [1]. Skin-sparing mastectomy removes the breast and nipple-areola complex, and can incorporate the skin over superficial tumors, previous excisional biopsy, or lumpectomy sites. The technique builds on previous descriptions of subcutaneous mastectomy and immediate implant-based reconstruction from the 1980s [2, 3].

Skin-sparing mastectomy is now routinely utilized as the mastectomy technique for patients selected as suitable for immediate breast reconstruction. Preservation of the native skin and in the inframammary fold enhances the cosmetic outcome for patients undergoing implant or, indeed, autologous immediate reconstruction. Multiple studies over the last 15 years have demonstrated low locoregional recurrence rates following skin-sparing mastectomy, comparable to those for women undergoing modified radical mastectomy.

The indications for mastectomy in the surgical management of breast cancer including ductal carcinoma in situ will depend on a variety of patient and tumor factors. Established tumor factors such as multicentric disease, T4 disease, and large or central tumors in a small breast are all elements that would exclude breast-conserving surgery as a management option, therefore necessitating a mastectomy.

Inflammatory breast cancer is an absolute contraindication to skin-sparing mastectomy. Authors have advocated its use in some locally advanced cases with limited skin involvement that is amenable to inclusion in the area of the skin removed. However, there is a paucity of data to provide definitive support. Rigorous evaluation of preoperative breast imaging is required when evaluating suitability for skin-sparing mastectomy. In certain cases of ductal carcinoma in situ, calcifications can encroach close to the skin, and, if identified, consideration should be given to inclusion of this area in the skin component being resected (Fig. 20.1).

As the indications for neoadjuvant chemotherapy expand, mirrored by improvements in both clinical and pathological response rates, more patients who may have been deemed not suitable for a skin-sparing mastectomy may be in a position to consider this approach with successful completion of neoadjuvant therapy. There are no trials with sufficient follow-up of comparative patients after skin-sparing mastectomy with or without the use of neoadjuvant chemotherapy. However, data from the American College of Surgeons National Surgical Quality Improvement Program actually found that after mastectomy, morbidity rates were lower in patients who had received neoadjuvant chemotherapy [4]. The findings were applicable to patients who did not have and who did undergo an immediate breast reconstruction. The mechanisms underlying this reduction in morbidity have yet to be elucidated, but the findings do support the safety of neoadjuvant chemotherapy in patients scheduled for a mastectomy and immediate reconstruction.

The predicted need for adjuvant chest wall radiotherapy following mastectomy may impact the reconstruction decision process. It has been shown that radiotherapy has a negative effect on health-related quality of life and breast satisfaction metrics in patients with implant-based reconstructions [5].

20.2 Surgical Technique

20.2.1 Incisions and Carlson Classification

The classification system for skin-sparing mastectomy defined by Carlson in 1997 has prevailed for describing skin-sparing mastectomy based upon the type of incision used and

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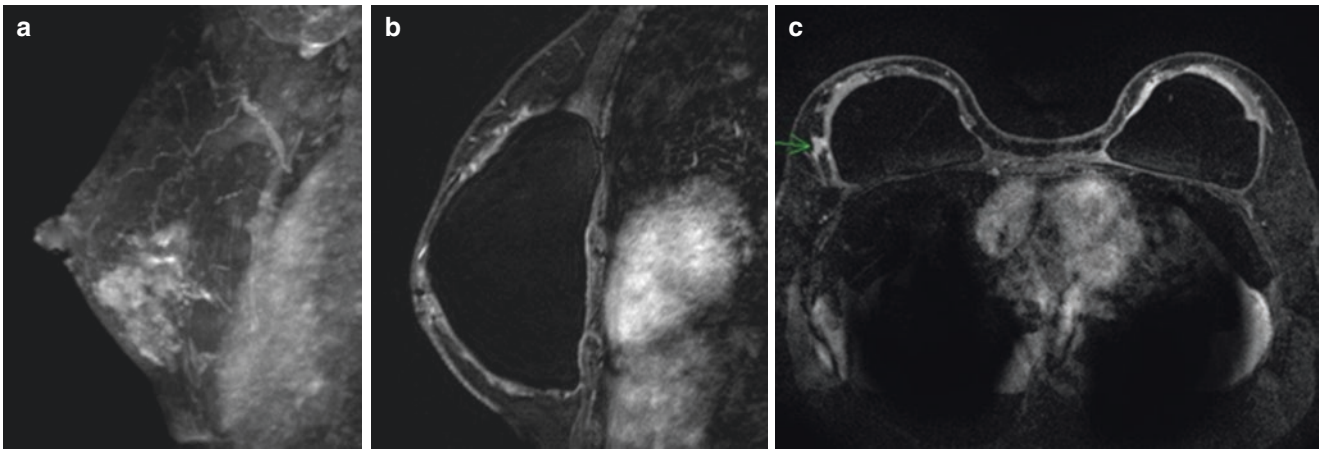

Fig. 20.1 Use of MRI in patient selection for skin-sparing mastectomy. (**a**) MRI showing extensive mass enhancement in close proximity to the skin in the lower pole of the breast. (**b**, **c**) MRI post-skin-sparing mastectomy for ductal carcinoma in situ with implant reconstruction demonstrating evidence of residual areas of calcifications and enhancement

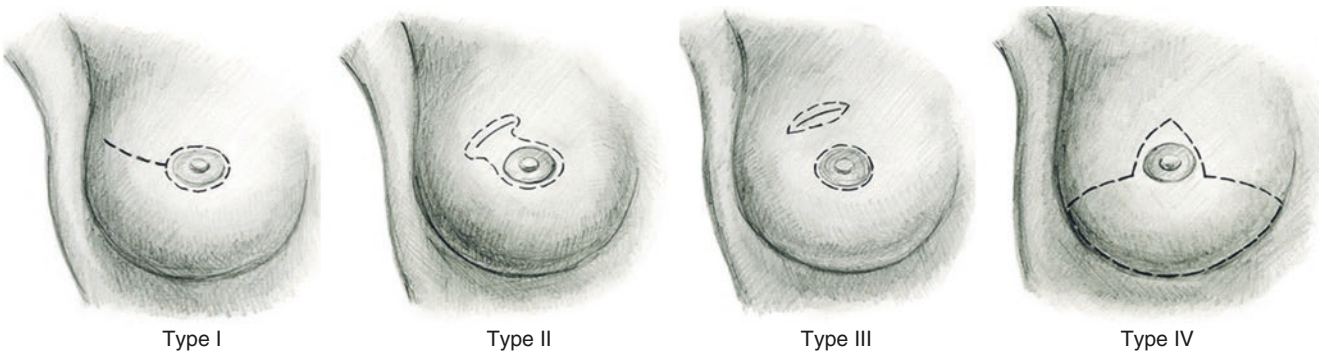

Fig. 20.2 Types of incision for skin-sparing mastectomy based on Carlson classification (Reproduced with permission from Chapter 2: Oncoplastic Breast Surgery: A Guide to Clinical Practice Edition 1: 2010. Pages 134 -135. Editors: Florian Fitzal and Peter Schrenk. Published by Springer Wien New York (ISBN: 978-3-211-99316-3.)

the amount of skin removed [6]. The four types of skin-sparing mastectomy incisions (Fig. 20.2) described are:

- *Type I*: Removal of the nipple and areola only. This approach is frequently used in prophylactic cases. In patients with a small-diameter areola, a lateral extension to the incision is sometimes required to improve access to the axillary tail and upper outer quadrant. In cases where the planned immediate reconstruction is with a tissue expander, we revert to an elliptical rather than a circumareolar incision, as these circular incisions are often revised to an ellipse to allow a flat skin closure.
- *Type II*: Removal of the nipple and areola complex as well as the skin overlying superficial tumors and/or previous biopsy incisions. These incisions are suitable if the biopsy incisions or superficial tumors are in close proximity to the areola allowing removal in continuity with the nipple-areola complex.
- *Type III*: Removal of the nipple-areola complex as well as skin overlying superficial tumors and/or previous biopsy incisions (without resecting intervening skin). The bridge of intervening skin is vulnerable to ischemia, and care must be taken to ensure viability.
- *Type IV*: Removal of the nipple-areola complex with an inverted or reduction pattern skin incision, suitable for large or ptotic breasts. This reduction of an excessive skin envelope is referred to as a skin-reducing mastectomy in contemporary terms. The degree of skin reduction must be carefully measured and marked preoperatively.

20.2.2 Mastectomy

The patient should be positioned supine on the operating table with arms at 90° on arm boards. The prepped operative field should include both breasts from above the sternal notch to the just below the costal margins. We include both arms prepped to the level of the wrist and then enclosed in a sterile sleeve to the mid-humerus level and secured with a circumferential wrap. After incision of the skin and dermis, electrocautery can be used to elevate the skin flaps. We use the pinpoint coagulation mode. Some surgeons prefer to use

a scalpel or scissors due to concern over the risk of "burn" injury to the mastectomy skin flap.

Much debate and agonizing have taken place over the optimal mastectomy skin flap thickness that would minimize the risk of leaving residual breast tissue while not denuding the skin flap of its blood supply. The skin flap thickness is dependent on the patient body habitus and breast size, and, simply put, a single specific universal thickness for mastectomy skin flaps cannot be recommended [7]. However, in a skin-sparing mastectomy, the skin flaps are longer than in a non-skin-sparing mastectomy. Maintaining flap viability is therefore important to reduce the risk of a poorer cosmetic outcome that may result from scarring after necrosis, and due to the risk of implant loss, which is increased with the development of flap necrosis. Breast tissue does extend closer to the skin in the lower pole of the breast. In most cases, there is an identifiable plane between the breast and subcutaneous fat delineated by a distinct layer of superficial fascia. The thickness of this layer is variable and difficult to predict preoperatively.

Elevation of the skin flaps initially with sharp hooks allows counter traction to be applied to the underlying breast that reveals the surgical plane of dissection. Encountering excessive bleeding indicates that the dissection is not in the correct anatomical plane. The plane of dissection extends from the sternal edge medially to the latissimus dorsi laterally, and from the clavicle to the inframammary fold in the cranio-caudal direction. In contrast to a traditional simple mastectomy where dissection proceeds logically, from the upper flap to the lower flap, in a skin-sparing mastectomy, the smaller incision requires progressive rising of the skin flaps in a circumferential manner. At the sternal edge, it is common to encounter perforating vessels from the internal mammary artery, the largest in the second or third intercostal spaces. If injured, these vessels should be ligated or clipped due to their size; however, they represent an important part of the blood supply to the mastectomy skin flaps, and every effort should be made to preserve these perforators. When circumferential elevation of the skin flaps has been completed, the breast and pectoral fascia are dissected off the pectoralis muscle fibers from superior to inferior.

20.2.3 Reconstruction

A variety of both implant-based and autologous reconstructive options are available for immediate reconstruction after a skin-sparing mastectomy. The choice of reconstruction will be based on a range of both patient and surgeon factors.

20.2.3.1 Two-Stage Expander-Implant-Based Reconstruction

Placement of a submuscular tissue expander underneath the pectoralis major muscle reinforced laterally with a pocket created in serratus anterior allows for a gradual expansion of the implant pocket prior to the definitive placement of a permanent implant at a second operation.

20.2.3.2 One-Stage Implant Reconstruction with Acellular Dermal Matrix

In suitable patients, a one-stage or direct-to-implant strategy may be used. This incorporates the use of a commercially available acellular dermal matrix to provide coverage of the permanent implant. After creation of the submuscular pocket to accommodate the implant, the lower divided edge of pectoralis major is approximated to the acellular dermal matrix, and the lower, free edge of this is then used to refashion the inframammary fold. The benefit of this approach is that it negates the need for a second procedure. Multiple studies have found the risk of complications with a one-stage approach comparable to those with a two-stage strategy [8].

20.2.3.3 Implant Reconstruction with a De-Epithelialized Dermal Flap

This represents a skin-reducing mastectomy whereby the excess skin of the lower pole is de-epithelialized and then fashioned as a dermal sling to provide implant coverage. The upper edge of this de-epithelialized skin flap is then sutured to the lower divided edge of pectoralis major. These patients usually require a symmetrizing contralateral procedure, the timing of which can be adjusted based on the predicted need for adjuvant radiotherapy [9].

20.2.3.4 Autologous Breast Reconstruction

A pedicled flap, such as a TRAM or LD, or a free flap, such as a DIEP, can be utilized for reconstruction. In these cases, we elect to perform the mastectomy through a circumareolar incision.

These concepts and techniques are discussed in more detail in Sect. 20.4.

20.3 Complications

Aside from the instinctive complications associated with simple mastectomy, most attention on complications following skin-sparing mastectomy is directed toward the risk of skin flap necrosis. In the 1997 paper that classified the incision types for skin-sparing mastectomy, Carlson et al. noted epidermolysis or skin loss requiring debridement and local wound care in 10.7% of 327 skin-sparing mastectomies, a rate that was the same as that seen in patients undergoing non-skin-sparing mastectomy [6]. The subsequent literature assessing the risk of skin flap necrosis is somewhat inconsistent due to differing definitions of mastectomy skin flap necrosis. Contemporary studies still report rates in

excess of 10% for any degree of skin flap necrosis, with somewhere in the range of 2–10% of patients requiring a return to the operating room for surgical debridement [10–12]. The implications of mastectomy skin flap necrosis can be considerable, requiring additional operations, prolonged wound management, reconstruction failure, and implant loss as well as causing delays in beginning adjuvant systemic therapy if indicated.

A variety of both patient factors (smoking, older age, obesity, smoking, hypertension) and surgeon factors (type of incision: higher rates of skin flap necrosis are seen with a Wise-type incision and volume of tissue expander) have been identified as risks for the development of mastectomy skin flap necrosis [11–16]. The native breast size is an important factor in determining the type of reconstruction selected, but also affects the complication rate. In patients undergoing an implant-based reconstruction, surrogates of breast size including BMI [17], cup size [18], weight of excised specimen, increased size of expander, and increased sternal notch to nipple [12, 14] length all reflect the presence of a longer mastectomy skin flap that has been shown to be associated with an increased risk of skin flap necrosis. Rates of implant loss following immediate reconstruction range from 0.8% in multi-institutional datasets [19] to anywhere between 0.7% [12] and 12% [20, 21] in single-institutional studies.

20.4 Cosmetic Outcome

Mastectomy and reconstruction, irrespective of the type, can exert a profound impact on a woman's sense of self and body image. A variety of measurement tools have been used to assess patient-reported outcomes after mastectomy and reconstruction, ranging from ad hoc questionnaires to general breast cancer quality-of-life questionnaires to some breast surgery-specific instruments [22]. The Breast-Q measurement tool [23], first described in 2009, provides a useful and validated framework to assess the impact and effectiveness of breast surgery from the patient's perspective. It is administered both preoperatively and postoperatively, and assesses both quality-of-life and patient satisfaction domains.

Studies have consistently shown that patients who have mastectomy without reconstruction report the lowest score for breast satisfaction postoperatively [24]. The 2010 meta-analysis of skin-sparing mastectomy acknowledged the problems in reporting differences that have made study comparisons between quality-of-life and cosmetic satisfaction outcomes difficult [25]. A number of studies have demonstrated excellent cosmetic outcomes following skin-sparing mastectomy. The degree of satisfaction is heavily influenced by the type of reconstruction employed [26–28].

20.5 Oncologic Safety

When performing a skin-sparing mastectomy, most surgeons remove all the breast tissue that they would have removed with a non-skin-sparing mastectomy. This premise would suggest that skin-sparing mastectomy should be as safe from an oncologic perspective as a non-skin-sparing mastectomy. It has long been acknowledged that even a traditional total mastectomy does not remove all breast tissue. A number of studies incorporating varying methodologies, from cadaveric analysis to intraductal dye injection of mastectomy specimens and biopsy of residual skin flaps following mastectomy, have demonstrated the presence of residual breast tissue in anywhere between 6% and 60% of cases [29–32]. These studies do support the hypothesis that the risk of superficial mastectomy margin positivity is increased with thicker skin flaps, but do not provide a reliable quantification of what constitutes an ideal skin flap thickness. As our understanding of the molecular basis for breast cancer expands, it is appreciable that biological subtype is not only a predictor of distant disease recurrence, but also of local recurrence [33].

No randomized study of skin-sparing versus non-skin-sparing mastectomy has been performed. The adoption of the technique into routine practice has been on the basis of a number of comparative and non-comparative studies. Comparative studies up until 2009 were synthesized in a meta-analysis by Lanitis et al. [25]. There is considerable heterogeneity between the studies in terms of duration of follow-up, inclusion criteria, and patient populations studied. Table 20.1 [6, 28, 34–38] and Table 20.2 [39–48] provide an overview of some of the larger comparative and non-comparative trials that have examined locoregional recurrence, in patients with breast cancer, following skin-sparing mastectomy.

The majority of comparative studies recruited patients in the 1990s, and considerable advances have been made in adjuvant systemic therapies since that period, which may have further influence on local recurrence rates. This may partly explain the lower rate of recurrence at 4.1% seen in the series of non-comparative studies that were performed in a more contemporary period. Taken in conjunction, at a follow-up of around 5 years, a local recurrence rate of <6.0% should be expected for a properly selected patient with breast cancer electing to undergo a skin-sparing mastectomy. A Cochrane review of skin-sparing mastectomy is underway, but is unlikely to be in a position to draw further conclusions than previous reviews in the absence of either contemporary comparative studies or reports on already-studied cohorts that review longer term (10- or 15-year) local recurrence rates. One study with 10-year follow-up

Table 20.1 Comparative studies of local recurrence following skin-sparing mastectomy and non-skin-sparing mastectomy

Author and year	Country	Study period	No. of patients		Duration of follow-up (mos)		% of local recurrence	
			SSM	Mx	SSM	Mx	SSM	Mx
Horiguchi (2001) [34]	Japan	1993–1999	133	910	66	81	3.8%	1.3%
Carlson (1997) [6]	USA	1989–1994	187	84	38	48	4.8%	9.5%
Greenway (2005) [35]	USA	1989–2004	225	1022	49	49	7.1%	5.4%
Gerber (2009) [36]	Germany	1994–2000	48	130	101	101	10.4%	11.5%
Simmons (1999) [37]	USA	1990–1998	77	154	16	32	3.9%	3.2%
Ueda (2008) [28]	Japan	2000–2004	41	178	47	54	2.4%	1.7%
Kroll (1999) [38]	USA	1986–1990	114	40	>60	>60	7.0%	7.5%
Total			**825**	**2518**	**Mean: 51 mos**	**Mean: 63 mos**	**5.7%** (95% CI 4.2–7.5%)	**4.0%** (95% CI 3.3–4.9%)

These studies have all been cited in the 2010 meta-analysis by Lanitis et al. [25]
SSM skin-sparing mastectomy, *Mx* non-skin-sparing mastectomy, *mos* months, *CI* confidence interval

Table 20.2 Single-institution non-comparative studies of local recurrence following skin-sparing mastectomy

Author and year	Country	Study period	No. of patients	Duration of follow-up (mos)	% of local recurrence
Yoo (2014) [39]	South Korea	2001–2010	581	31	2.1%
Missana (2013) [40]	Monaco	1992–2002	400	88	3.5%
Carlson (2003) [41]	USA	1989–1998	375	65	8.1%
Newman (1998) [42]	USA	1986–1993	372	50	6.2%
Liang (2013) [43]	Taiwan	1995–2010	249	53	1.2%
Boneti (2011) [44]	USA	1998–2010	227	38	5.0%
Medina-Franco (2002) [45]	USA	1988–1999	173	73	4.5%
van Mierlo (2013) [46]	The Netherlands	2004–2011	157	39	2.9%
Romics (2012) [47]	UK	1995–2000	153	119	3.9%
Doddi (2011) [48]	UK	1999–2005	108	58	2.8%
Totals			**2849**	**Mean: 59 mos**	**4.1%** (95% CI 3.4–4.9%)

Minimum 100 cases per series. Data extracted only for cases of breast cancer if studies included patients who underwent a skin-sparing mastectomy as prophylactic surgery or for treatment of ductal carcinoma in situ only
mos months, *CI* confidence interval

identified an average time to locoregional recurrence of 24 months, with 13% of locoregional recurrences occurring after 5 years of follow-up [47]. The already published non-randomized studies with average follow-up periods of around 5 years are likely to have captured the majority of local recurrence events; there is scope for further reporting of long-term recurrence rates given the paucity of randomized control trials.

20.6 Conclusion

Skin-sparing mastectomy has been accepted as an oncologically safe procedure for appropriately selected patients proceeding to either therapeutic or risk-reducing mastectomy. Preservation of the skin envelope and inframammary fold considerably enhances the cosmetic outcome with immediate breast reconstruction.

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