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Review

Skin-sparing mastectomy

Giles H. Cunnick, M.D.[a], Kefah Mokbel, M.S.[a,b,*]

[a]*Department of Breast Surgery, St. George's Hospital, Tooting, London, United Kingdom*
[b]*Brunel Institute of Cancer Genetics and Pharmacogenomics, Department of Breast Surgery, St. George's Hospital, Blackshaw Rd., Tooting, London SW17 0QT, United Kingdom*

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Abstract

Background: Skin-sparing mastectomy represents a new surgical approach that allows a mastectomy while preserving the natural skin envelope of the breast. It facilitates immediate breast reconstruction using an implant or myocutaneous flap, resulting in excellent cosmesis.
Data sources: A PubMed database literature search was performed.
Conclusions: Skin-sparing mastectomy is an oncologically safe technique in selected cases; T1/T2, multicentric tumors, ductal carcinoma in situ, and prophylactic mastectomies are particularly suited to this technique. Further research is required to confirm oncologic safety in T3 tumors. In selected cases, the nipple-areola complex can be preserved. A modification of skin-sparing mastectomy includes the removal of the nipple while preserving the areola. The balance of evidence suggests that skin-sparing mastectomy does not increase the risk of locoregional recurrence. Furthermore, it does not delay adjuvant therapies. Contraindications to skin-sparing mastectomy approaches include inflammatory breast cancer and extensive skin involvement by tumor. Preoperative and postoperative radiotherapy are not a contraindication to skin-sparing mastectomy.

Keywords: Skin-sparing mastectomy; Safety; Nipple-areola complex; Radiotherapy

Aesthetic results in breast reconstruction after conventional mastectomy are often compromised by either prominent scars on the new breast or an island of skin that differs in color and texture from the native breast skin. Skin-sparing mastectomy (SSM) entails complete removal of the breast tissue with preservation of as much of the overlying skin as possible to prepare the patient for an immediate breast reconstruction, thus avoiding the potentially unsightly island of skin. The preservation of the natural skin envelope during SSM improves the aesthetic outcome of immediate breast reconstruction (Fig. 1). Furthermore, SSM approaches reduce the need for contralateral breast adjustment in order to achieve symmetry [1]. This article reviews the literature on SSM and, in particular, focuses on the controversies surrounding this technique and also the modifications of the technique. Using the PubMed database and entering the following keywords facilitated the literature review: skin, sparing, mastectomy, radiotherapy, subcutaneous, ductal carcinoma in situ (DCIS).

F1

Oncologic safety

The aim of mastectomy for breast cancer and for cancer prophylaxis is to remove as much breast tissue as possible. The only difference between SSM and conventional non–skin-sparing (NSSM) should be that the skin envelope is preserved in the latter; the same amount of breast tissue should be removed. Skin-sparing mastectomy also entails excision of the biopsy scar, skin obviously involved by tumor or overlying a superficial tumor in order to reduce the risk of local recurrence [2]. If there is any doubt as to whether clearance has been obtained, intraoperative pathological evaluation of the suspicious margin should be performed. For obvious extensive skin involvement, an NSSM is a safer option.

The technique of dissecting the skin flaps during SSM is similar to that of NSSM in that dissection is carried out superficial to the superficial fascia, separating the breast tissue from the overlying subcutaneous fat and dermis. This minimises the likelihood of residual breast tissue on the posterior aspect of the flaps and, therefore, the risk of subsequent local recurrence. However, the superficial layer is only present in 56% of breasts [3]. Care must be taken to

* Corresponding author. Tel.: +44-0-207-9082040; fax: +44-0-207-9082275.
E-mail address: kefahmokbel@hotmail.com

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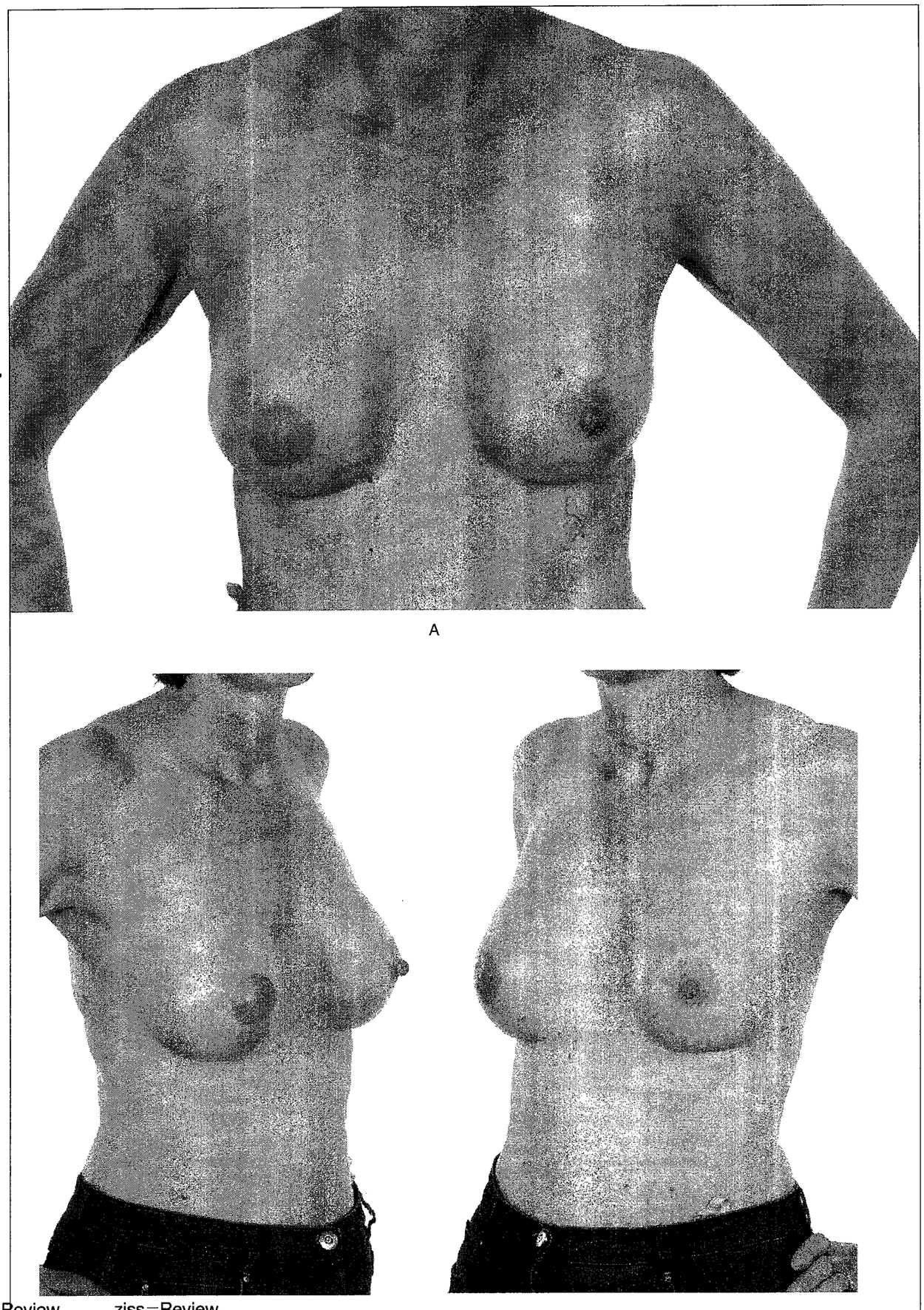

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AQ: 1 Fig. 1. This 51-year-old woman underwent a standard right skin-sparing mastectomy and immediate breast reconstruction using the latissimus dorsi myocutaneous flap followed by reconstruction and tattooing of the nipple-areola complex.

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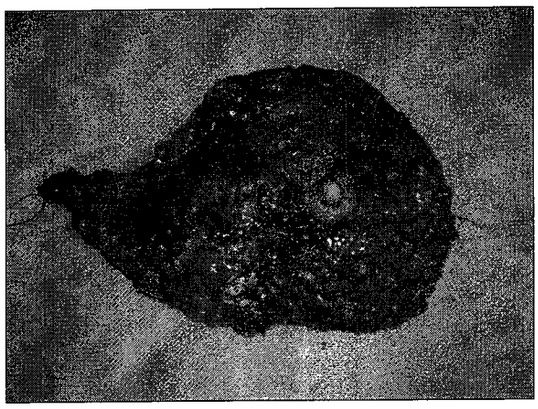

Fig. 2. Specimen of a standard skin-sparing mastectomy.

avoid skin flaps that are unnecessarily thin, as this increases the likelihood of skin necrosis. This may be difficult in view of the smaller incisions used in this technique. The incidence of skin flap necrosis has been estimated to be 11% and is similar in SSM and NSSM [4].

The main difference between SSM and NSSM is that the standard incision for SSM is periareolar, rather than removing a large ellipse of breast skin [5,6]. Skin-sparing mastectomy combined with sentinel node biopsy (SNB) or axillary node clearance can be safely performed through this periareolar approach [1,6]. It is our practice to perform an intraoperative frozen section histopathologic assessment of the sentinel node and perform an immediate axillary node clearance if the SNB is positive for malignancy. This technique means that the only skin removed with the breast F2 tissue is the nipple-areola complex (Fig. 2). Depending on the size of the breast, the need to perform an axillary operation or not, and the surgeon's preference, a lateral extension to this incision may be added. The latter, however, may cause subsequent lateral deviation of the nipple due to contracture of the lateral scar. Therefore, if better access is required, small medial and lateral extensions may be more desirable.

Another option is to perform the axillary procedure through a small incision in the axilla [7,8]. This incision is hidden from view, facilitating good cosmesis, and avoids the lateral extensions around the areola. Furthermore, to facilitate good cosmesis in SSM, the dissection should not continue beyond the inframammary fold [2]. In women with very large ptotic breasts, SSM can be performed through the standard incisions used for reduction mammoplasty [9]. In this situation, symmetry may be achieved by performing a simultaneous, or delayed, contralateral reduction mammoplasty using the same incisions.

The concern about SSM relates to the possibility of leaving residual tumor within the skin envelope. Ho et al [10] histologically examined the skin and subcutaneous tissue of 30 total mastectomy specimens. They found that the skin flaps (excluding the nipple-areola complex) were involved in 23% (7 of 30) of cases. In 5 women, the skin involved was directly over the tumor, but in 2 cases, the skin involvement was at another site, implying spread via the dermal lymphatics. The authors also observed that skin involvement was significantly related to the site and size of the tumor and skin tethering. Three of 25 patients (12%) of T1 and T2 tumors had skin involvement, compared with 3 of 5 (60%) T3 tumors. This led them to conclude that it would be oncologically safe to perform SSM in T1 and T2 tumors as long as there was no skin tethering.

The incidence of local recurrence after SSM for invasive breast cancer has been retrospectively investigated by several authors and is summarized in Table 1 T1 [8,11–17,19,20,29]. The largest series [11] observed 539 patients over a mean follow-up time of 65 months; 30.6% of cases had noninvasive disease. The overall local recurrence rate was 5.5%. Furthermore, the incidence of local recurrence was related to the size of the tumor, nodal status, grade, and lymphovascular invasion. The incidence of local recurrence for T1 (n = 175), T2 (n = 135), and T3 (n = 173) tumors was 3%, 10%, and 11%, respectively. Interestingly, the incidence of local recurrence was similar for T2 and T3 tumors, which contrasts with the study by Ho et al

Table 1
Oncological safety of skin-sparing mastectomy for invasive breast cancer—summary of recent studies

Authors	Year	Sample size	Local recurrence (%)	Follow-up (months)	Notes
Slavin et al	1998	51	2.0	45	26 DCIS cases
Newman et al	1998	372	6.2	26	T1/T2 tumors
Simmons et al	1999	77	3.9	60	
Toth et al	1999	50	0	51.5	
Kroll et al	1999	114	7.0	72	T1/T2 tumors
Rivadeneira et al	2000	71	5.1	49	
Foster et al	2002	25	4.0	49	Locally advanced
Medina-Franco et al	2002	176	4.5	73	
Spiegel and Butler	2003	177	5.6	118	
Carlson et al	2003	539	5.5	65	30.6% DCIS
Gerber et al	2003	112	5.4	59	

DCIS = ductal carcinoma in situ.

[10] (see above) who found much higher recurrence rates for T3 tumors than T1/T2 tumors. Other studies found lower local recurrence rates. Medina-Franco et al [12] found a local recurrence rate of 4.5% after a median follow-up of 73 months of 176 breast cancers and observed that tumor size, stage, lymph node positivity, and poor differentiation were significant risk factors for local recurrence after univariate analysis. Spiegel and Butler [13] reported a local recurrence rate of 5.6% in 177 patients treated by SSM for invasive disease after a mean follow-up interval of 9.8 years. Newman et al [14] reported a local recurrence rate of 6.2% (23 of 372) in patients with T1/T2 tumors treated by SSM and immediate breast reconstruction after a median follow-up of 26 months. Similarly, Kroll et al [15] observed 7% (8 of 114) local recurrences in patients with T1/T2 tumors treated in the same way. They found a similar local recurrence rate of 7.5% (3 of 40) in women treated by NSSM and immediate breast reconstruction. Slavin et al [16] reviewed 51 patients who underwent SSM (26 noninvasive disease) and only observed 1 local recurrence (2%) after a mean follow-up of 45 months. However, if the DCIS cases are excluded, the local recurrence rate is 4%. Toth et al [8] reported that there were no local recurrences in their series of 50 patients who underwent SSM and immediate breast reconstruction after a median follow up of 51.5 months, although there were 5 distant recurrences. Foster et al [17] analyzed the outcome of SSM and immediate breast reconstruction for 25 cases of locally advanced breast cancer after a median follow-up of 49 months and concluded that it was an oncologically safe and effective treatment with low morbidity (1 local recurrence only).

The local recurrence after a NSSM in tumors up to 4 cm was shown to be 10% after 20 years of follow-up [18], which equates to 0.5% per year. The above studies have demonstrated that the average local recurrence rate after SSM and immediate breast reconstruction is not dissimilar from that reported for NSSM, although the SSM follow-up duration is much shorter. This conclusion was also made by Rivadeneira et al [19] after a critical analysis of 198 cases in which the two techniques were compared. Similarly, Simmons et al [20] found that local and distant recurrence rates of 77 SSMs and 154 NSSMs were not dissimilar (local recurrences were 3.9% and 3.25%, respectively).

Despite the retrospective nature of the above studies, there is sufficient evidence that SSM is a safe oncologic operation for T1, T2, and multicentric tumors. Moreover, there is evidence that SSM combined with immediate breast reconstruction has been shown not to significantly delay adjuvant therapy [21]. Many T1/T2 tumors, however, can be treated adequately by breast conservation surgery followed by radiotherapy [18,22], which may be the preferred option if cosmesis is the main issue. Many patients requiring mastectomy have T3 tumors, yet the evidence for the safety of SSM for these tumors is less clear, but encouraging. One may have expected a higher risk of leaving tumor cells behind adjacent to the skin envelope due to the larger tumor bulk in these cases, yet the local recurrence rate does not appear to be too dissimilar to that of T2 tumors. Measuring the distance between the skin and the anterior surface of the tumor using preoperative ultrasonography may help predict those with a higher risk of developing local recurrence (ie, those tumors close to the skin) so that SSM is avoided. However, no published evidence for this approach exists currently. Another option for T3 tumors is to offer neoadjuvant chemotherapy in an attempt to shrink the tumor. If shrinkage does occur, it may facilitate performance of SSM in a breast that may otherwise have required a NSSM.

Ductal carcinoma in situ and skin-sparing mastectomy

Total mastectomy (NSSM) for DCIS achieves cure rates approaching 98% (local recurrence rate of 1.4% and breast cancer–specific mortality of 0.59%) [23]. Additionally, no adjuvant therapy is required after such treatment. Therefore, SSM and immediate breast reconstruction would seem an ideal option for patients necessitating or requesting mastectomy and reconstruction for DCIS, provided clear margins are achieved. This was examined in detail by Rubio et al [24]. In that study 95 patients underwent SSM and immediate breast reconstruction for DCIS. After a median follow-up time of 3.7 years, 93 (98%) were alive and disease free. In 35 cases, the margins were closely examined by performing intraoperative specimen radiography and histological examination of serial sections. Margins were found to be negative in 77% of the patients. In the remainder, additional tissue was removed. None of these 35 cases developed local recurrence; 3 of the 58 other cases developed local recurrence. The overall local recurrence rate was, therefore, 3 of 93 (3%). The series by Carlson et al [11] included 175 cases of DCIS. There was only 1 local recurrence rate in this group (0.6%) after the 65-month follow-up period. None of the 26 DCIS patients developed local recurrence in the study by Slavin et al [16] but the follow-up period was only 45 months. Finally, Spiegel and Butler [13] retrospectively studied a cohort of 44 patients who underwent SSM and immediate breast reconstruction for DCIS and observed no local or distant recurrences after a mean follow-up of 9.8 years. The authors of the above studies concluded that SSM for DCIS was an oncologically safe procedure. The outcome of SSM and immediate breast reconstruction for DCIS is summarized in Table 2. T2

Preservation of the nipple-areola complex

The conventional SSM described earlier involves removal of the nipple-areola complex. This has a significant impact on the overall cosmetic effect of the breast reconstruction. The nipple-areola complex is removed because of the belief that the nipple-areola complex and its adjacent ducts may also harbour tumor cells that have spread distally

Table 2
Outcome of skin-sparing mastectomy for ductal carcinoma in situ—summary of recent studies

Authors	Year	Sample size	Local recurrence (%)	Follow-up
Slavin et al	1998	26	0	45 months
Rubio et al	2000	95	3	3.7 years
Spiegel and Butler	2003	44	0	9.8 years
Carlson et al	2003	175	0.6	65 months

along the ducts from the primary tumor. This belief was based on older studies that had demonstrated occult tumor in the region of the nipple-areola complex [2]. However, some surgeons believe that the risk of tumor involvement of nipple-areola complex in patients with breast cancer has been overestimated and, therefore, attempt to preserve the nipple-areola complex.

Laronga et al [25] retrospectively examined 286 SSM specimens to determine the true incidence of involvement of the nipple-areola complex by tumor. Sixteen (5.6%) of 286 nipple-areola complex specimens contained occult tumor. Nodal positivity, subareolar tumor location, and multicentricity were found to be significant risk factors for nipple-areola complex involvement. Moreover, if multicentric and subareolar tumors were excluded, the nipple-areola complex was only involved in 3% of cases in this series. Similarly, Vyas et al [26] found tumor size and nodal positivity to be significant risk factors in a study of 140 mastectomy specimens. In addition, all of the 22 tumors in which the nipples were positive for tumor were located within 2.5 cm of the areola. By contrast, in a similar retrospective study involving 217 mastectomy specimens, Simmons et al [27] reported nipple-areola complex tumor involvement in 23 cases (10.6%), leading them to conclude that nipple-areola complex preservation was unsafe. The authors also observed that only 6.7% of small tumors with up to two positive lymph nodes only had nipple-areola complex involvement.

The true incidence of nipple-areola complex involvement may, however, be much higher. A literature review by Cense et al [28] found that the nipple-areola complex was involved in as many as 58% of mastectomy specimens. Furthermore, nipple-areola complex involvement correlated with tumor size, the distance of the tumor from the nipple-areola complex, nodal positivity, and clinical suspicion. It was concluded that the best candidates for nipple-areola complex conservation were T1 tumors more than 4 cm from the nipple, although many of these tumors would be amenable to breast conservation surgery.

More recently, Gerber et al [29] performed 112 SSMs in women whose primary tumor was greater than 2 cm from the nipple. In addition, histological examination of intraoperative frozen sections of the subareolar tissue behind the nipple-areola complex was performed in an attempt to predict the likelihood of nipple-areola complex involvement. The retroareolar biopsies were negative for malignancy in 61 cases (54.5%), thus enabling conservation of the nipple-areola complex. In the remaining 51 patients, the nipple-areola complex was excised, and immediate breast reconstruction was performed with either a latissimus dorsi myocutaneous flap or transverse rectus abdominis myocutaneous (TRAM) flap. The aesthetic results after SSM were evaluated as excellent or good in 91.1% of patients (102 of 112) and were significantly better after preservation of the transverse rectus abdominis myocutaneous ($P = 0.001$) when judged by surgeons. These differences were not seen when judged by the patients themselves. Six recurrences (5.4%) occurred in 112 patients who underwent SSM compared with 11 (8.2%) of 134 patients who had undergone modified radical mastectomies during the same 6-year period. Only 1 local recurrence occurred in the nipple-areola complex conservation SSM group. This was widely excised, and the patient was still alive with no evidence of recurrent disease 4 years later.

This article shows that SSM with nipple-areola complex preservation appears oncologically safe in practice, provided the tumor is not close to the nipple and the same frozen section protocol is followed. However, it is possible that the subareolar biopsy zone is tumor-free, yet other areas of the nipple-areola complex (not biopsied) contain tumor cells. In view of this, it may be prudent to restrict nipple-areola complex preservation to peripherally located T1 and T2 tumors, as T3 lesions involve the nipple-areola complex in more than 50% of cases [28]. One drawback of nipple-areola complex preservation is the incidence of skin and nipple loss after this procedure. This may occur in as many as one third of patients [30]. If it does occur, further surgical reconstruction may be necessitated. If the nipple-areola complex is conserved, it may be prudent to keep a small island of skin from the underlying autogenous flap visible at the lateral end of the breast incision so that the flap viability can be monitored clinically [2]. That has not been clinically verified, however, and impairs the cosmetic outcome. Several studies have now demonstrated the oncologic safety of subcutaneous mastectomy (nipple-sparing SSM) in selected patients.

A further alternative to nipple-sparing SSM is to remove the nipple but preserve the areola. This is supported by the findings of Simmons et al [27] who found that of the 23 cases of nipple-areola complex involvement, the areola was only involved in 2 cases. That represented 0.9% of all the mastectomy specimens. Surgical access for areola-sparing SSM is facilitated by medial and lateral extensions to the incision encircling the nipple. That may achieve a superior cosmetic outcome, only requiring a subsequent nipple reconstruction, if requested by the patient. Unfortunately, nipple reconstruction using a local flap technique is problematic. Subsequent nipple reconstruction requires free-graft transfer from another site (eg, contralateral nipple).

Further studies on the oncologic and aesthetic outcomes of areola-sparing SSM are required.

Radiotherapy and skin-sparing mastectomy

The majority of women undergoing mastectomy do not require postoperative radiotherapy. However, patients with at least four positive regional lymph nodes or large (>5 cm) tumors are offered such treatment because it reduces the incidence of locoregional recurrence and improves survival [31]. Consequently, radiotherapy is indicated in some women who have undergone SSM and immediate breast reconstruction. Postmastectomy radiotherapy is, however, associated with local complications, thus causing some debate as to the safety of performing SSM and immediate breast reconstruction in women who will require postmastectomy radiotherapy.

The complication rate of radiotherapy after autogenous reconstruction varies from 5% to 16% [2], the most common complications being fat necrosis (16%) and radiation fibrosis (11%) [32], although the latter study included only 19 patients who had undergone TRAM flap reconstruction. These complications may cause subsequent shrinkage of the reconstructed breast. Indeed, some surgeons deliberately oversize the reconstruction if radiotherapy is anticipated. The main concern regarding radiotherapy in the reconstructed breast, however, is related to the use of implants, either alone or in conjunction with a flap reconstruction. Evans et al [33] compared 39 irradiated implant reconstructed breasts with 338 nonirradiated reconstructions and showed a significant negative effect on the reconstructive outcome with implants. The main complications were capsular contracture and postoperative pain. The majority developed contracture and 43% underwent a subsequent capsulotomy. In view of this, many surgeons encourage women who are likely to need postoperative radiotherapy, such as those with clinically involved nodes or a positive SNB, to undergo a delayed breast reconstruction. This approach would mean that these women would not be able to undergo SSM. However, it has been suggested that a SSM can be performed in these patients if a temporary tissue expander is placed under the skin envelope deep to the pectoralis major muscle. After radiotherapy, the delayed reconstruction can be carried out using a myocutaneous flap after removing the tissue expander [2].

More specifically, Hultman and Daiza [34] investigated the incidence and outcome of SSM flap complications after reconstruction. Transverse rectus abdominis myocutaneous and latissimus dorsi flaps and implant reconstructions were all included in this study. Nine of 37 (24%) had a SSM flap complication, in which 7 were cases of moderate or severe skin loss, 4 were dehiscences, and 5 required repeat operations. They found that previous irradiation (5 cases) and diabetes mellitus were significant risk factors for SSM flap complications, but they did not address the issue of postoperative radiotherapy. The concern regarding radiotherapy preceding SSM was addressed by Disa et al [35]. Eleven patients in whom local recurrence developed after breast conserving surgery and whole breast radiation subsequently underwent SSM and immediate breast reconstruction, using either TRAM or latissimus dorsi flaps. All the flaps survived, 1 patient developed partial thickness SSM skin flap loss and 2 developed capsular contractures, demonstrating that SSM and immediate breast reconstruction can be safely performed in previously irradiated breasts. In addition, Benediktsson and Perbeck [36] have shown that radiotherapy does not significantly compromise the skin circulation of the breast. Therefore, as long as a slightly higher complication rate is accepted, it appears safe for women to undergo SSM and immediate breast reconstruction in previously irradiated breasts in the majority of cases. However, larger studies with longer follow-up are required to confirm this observation.

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000 Skin-sparing Mastectomy

Giles H. Cunnick, and Kefah Mokbel

This review of skin-sparing mastectomy discusses operative techniques, oncological safety, local recurrence rates, ductal carcinoma in situ, and radiotherapy. Controversies, new variations, indications, and contraindications are also discussed.

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