32 Skin-Sparing and Nipple-Sparing Mastectomies

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32.1 Introduction

The traditional mastectomy surgery for breast cancer includes removal of the breast tissue together with the nipple-areolar complex (NAC) and the excess breast skin, leaving just enough skin to cover the chest wall. In 1962, Freeman [1] pioneered the subcutaneous mastectomy for primary breast cancer and risk reduction that included removal of breast tissue and sparing the skin and the NAC. That approach was eventually discredited because of unclear selection criteria, poor cosmetic results, high rate of complications, and lingering questions about its oncologic safety and efficacy. Subsequently, breast surgeons resumed the traditional mastectomy technique.

The 1990s witnessed a growing interest in immediate breast reconstruction [2]. This revived the possibility of sparing the skin envelope of the breast to accommodate the reconstruction (alloplastic or autologous), and it was termed skin-sparing mastectomy (SSM). The concept of sparing the skin and performing the reconstruction during the same surgery has become popular due to its many advantages. This technique completes most of the surgical treatment in one phase, sparing the need for additional operational stages. It eliminates the need for the patient to live with the deformity caused by the mastectomy, thereby reducing the emotional trauma and contributing to a more positive body image [3]. Furthermore, SSM has improved the cosmetic outcome of the reconstruction compared to delayed reconstruction in several ways, including preservation of the inframammary fold and native skin envelope, minimal manipulation of the breast pocket, and good symmetry with the contralateral breast [3].

Long-term studies showed that mastectomy with sparing of the skin and immediate reconstruction did not increase the risk of local or regional recurrence, nor did it delay adjuvant treatment in properly selected patients [4]. SSM and immediate reconstruction has become the standard in many centers, together with the establishment of multidisciplinary breast teams (Figs. 32.1, 32.2, and 32.3) [5]. A meticulous technique and gentle handling of the tissue in separating the breast tissue from the subcutaneous fat at the level of the superficial breast fascia have reduced the complication rates for skin necrosis and wound dehiscence [6].

In SSM, the nipple-areolar complex is removed, even though the nipple is a relatively

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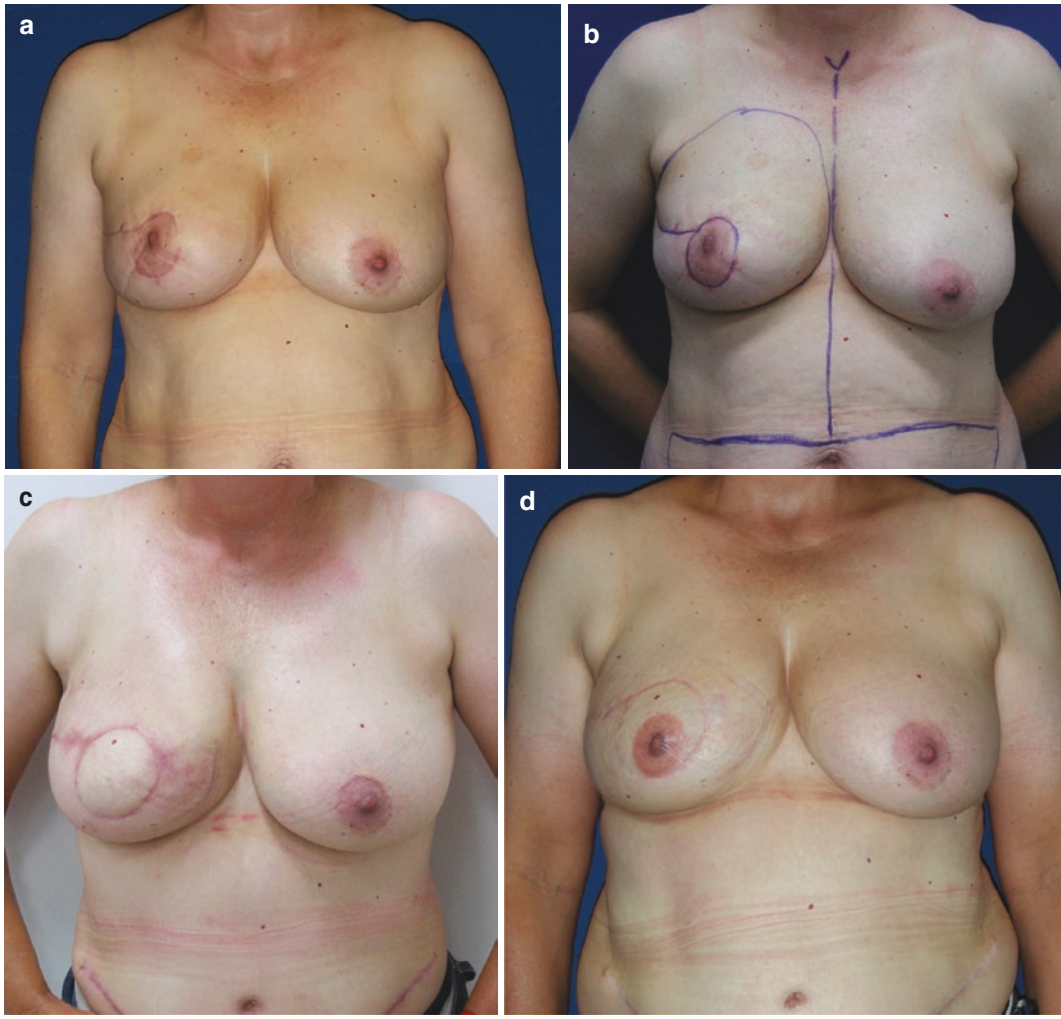

Fig. 32.1 A patient with right breast cancer that underwent right lumpectomy with positive margins (**a**). She underwent right skin-sparing mastectomy and immediate reconstruction with deep inferior epigastric perforator (DIEP) flap (**b**, **c**). The patient underwent right nipple-areolar reconstruction (**d**)

uncommon site for breast cancer to develop [7]. Publications on SSM with sparing of the NAC began to emerge in the early part of 2000. This technique is referred to as nipple-sparing mastectomy (NSM), and it includes a skin-sparing mastectomy with the preservation of the NAC. NSM was distinguished from the previously described subcutaneous mastectomy, for both appropriate indications and surgical techniques used [8]. The progression from SSM to NSM may be seen as the result of a paradigm shift in breast cancer, summarized by Umberto Veronesi's maxim "from maximum tolerable treatment to minimum effective treatment" [9].

Both SSM and NSM are associated with superior aesthetic outcomes and increased patient satisfaction compared to traditional mastectomy [3]. Nevertheless, patients generally report higher satisfaction with a spared nipple rather than a reconstructed one [3], and psychosocial wellbeing and sexual well-being scores are higher for NSM compared to SSM [3]. With ever-increasing expectations of improved cosmetic results from breast reconstruction, it would seem only natural

Fig. 32.2 A patient with BRCA mutation for bilateral risk-reducing mastectomy (**a**, **b**). She underwent bilateral skin-sparing mastectomy and immediate reconstruction with shaped implants and biologic mesh (**c**, **d**). The patient underwent bilateral nipple-areolar reconstruction (**e**, **f**)

Fig. 32.3 A patient with left breast multifocal carcinoma (**a**). She underwent left skin-sparing Wise-pattern mastectomy and immediate reconstruction with a shaped implant and right breast reduction (**b**, **c**). The patient underwent left nipple reconstruction (**d**)

that NSM would have gained popularity among both patients and surgeons (Figs. 32.4 and 32.5).

Sparing of the nipple has, however, raised a number of concerns, both oncologic and reconstructive [10]. Oncologic considerations include involved margins in tumors that are close to the NAC, and breast tissue that is left around the NAC area as well as other areas that are distant from the incision line. The most common incision in the NSM approach is in the inframammary fold, creating a long axis to the upper pole of the breast and limited access to the tail of Spence. Reconstructive considerations include nipple position and breast ptosis. Low-set nipples pose a challenging concern in NSM, leaving limited options for future nipple repositioning, and with the final position of the nipple often being unpredictable [11].

32.2 Mastectomy and Immediate Reconstruction

The introduction of the acellular dermal matrix (ADM) and the growing use of autologous fat grafting to the breast has even more greatly improved the cosmetic outcome of NSM and SSM with immediate reconstruction. It has broadened the applicability of these approaches by now including cases of post-mastectomy

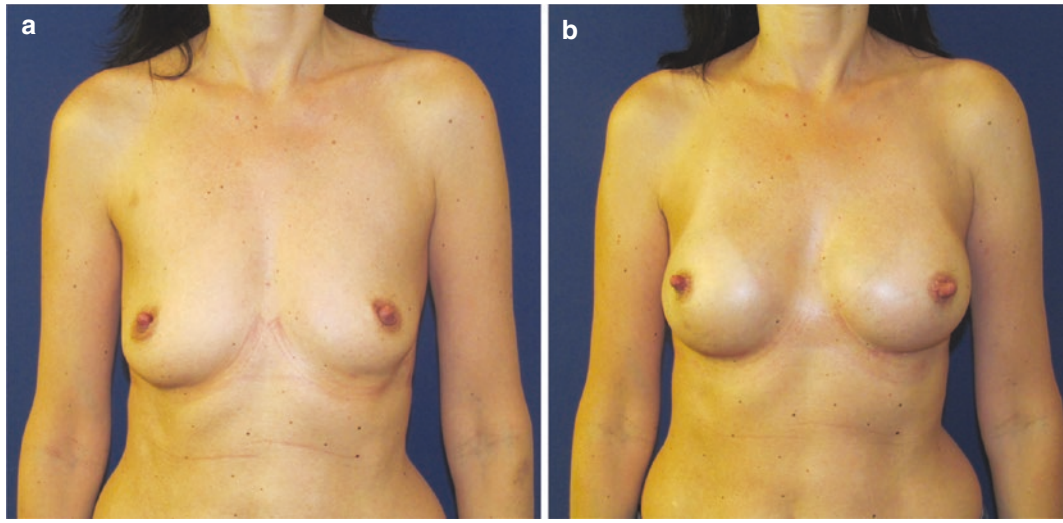

Fig. 32.4 A patient with BRCA mutation for bilateral risk-reducing mastectomy (**a**). She underwent bilateral nipple-sparing mastectomy with infra-mammary fold incision and immediate reconstruction with shaped implants and biologic mesh (**b**)

radiation therapy [12]. The ADM has revolutionized implant-based reconstruction, adding support to the implant and allowing placement of the permanent implant in the immediate setting [12]. The use of ADM in women who have undergone radiotherapy was reported to significantly reduce the rates of capsular contracture and inflammatory process associated with foreign body reaction [13]. The implant is traditionally covered by the pectoralis muscle in the upper pole and by the ADM in the lower pole in a dual-plane fashion. There is currently a trend toward shifting the implant from a dual-plane position to a prepectoral position to cover the entire anterior or total surface of the implant with ADM or synthetic mesh [14]. This technique requires very careful patient selection and meticulous surgical technique.

There are two major indications for mastectomy: one is to reduce the risk (risk-reducing mastectomy, RRM) in high-risk patients (BRCA gene carriers), and the other is intended for patients with breast cancer that is usually multifocal or in a diffused area, patients for whom there is any contraindication for radiation therapy, and patients who choose it. Immediate breast reconstruction with implants or with body tissue, which includes sparing the skin with or without the NAC, is feasible in both settings.

32.3 Risk-Reducing Mastectomy

SSM has been the workhorse for cases of RRM and immediate reconstruction [15]. Advantages of the technique include good exposure during the surgery, simple skin adjustment over the implant/flap, and a relatively short learning curve. Nevertheless, NSM has been steadily gaining favor since the seminal report by Hartmann et al. that was published in the New England Journal of Medicine in 1999 [16]. The data from that series of 639 women demonstrated that RRM (originally termed "prophylactic") did indeed have a protective benefit, reducing the risk of breast cancer in both high-risk and moderate-risk groups by 81–94%. Ninety percent of the mastectomies in that series were NSM. Breast cancer developed in seven women after RRM, six of which were confined to the chest wall at diagnosis and were explicitly not in the area of the NAC. One patient in the high-risk group presented with bone marrow metastases from adenocarcinoma with no evidence of breast disease. Lanitis et al. observed

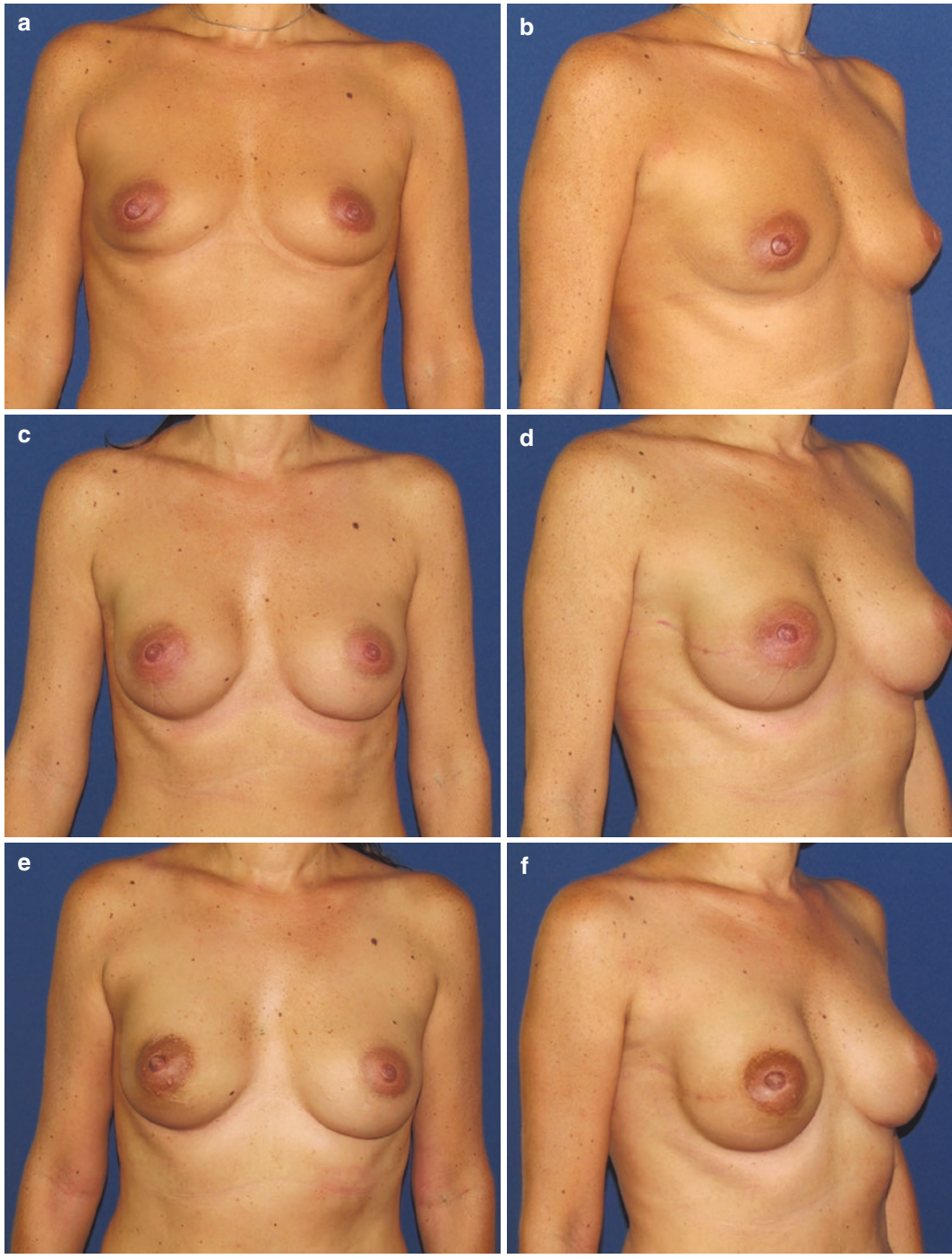

Fig. 32.5 A patient with right breast carcinoma (**a**, **b**). She received neoadjuvant chemotherapy and underwent right nipple-sparing mastectomy with a lateral incision and immediate reconstruction with a shaped implant and biologic mesh and left breast augmentation (**c**, **d**). She received post-mastectomy radiation therapy to the right breast. The patient 1 year after the completion of radiation therapy (**e**, **f**)

that there was no significant difference in the cancer-preventing benefit whether the nipple was removed or retained [17].

A study by Yao et al. [18] assessed related cancers, complications, and loco-regional recurrences in 201 BRCA1/2 mutation carriers who underwent NSM for risk reduction or cancer treatment. Most patients underwent bilateral mastectomies. There was no NAC cancer or recurrence after a median follow-up of 32.6 months. That study also reviewed the literature on NSMs for BRCA patients and found that NSM was associated with low rates of complications and loco-regional recurrence, similar to those found in non-BRCA carriers. However, the authors acknowledged that a longer follow-up was needed. Manning et al. [19] retrospectively assessed 728 NSMs performed on 413 patients between 2000 and 2013: 269 NSMs were carried out for breast cancer, 459 for risk reduction, and 177 (24.3%) were performed on patients known to have a BRCA1/2 mutation or a genetic variant of uncertain significance. No breast cancers were diagnosed over a median follow-up of 2.15 years [19]. Those authors concluded that NSM was an acceptable choice for patients with BRCA mutations since there was no evidence of oncological compromise in the short-term. Moreover, complication rates were acceptable, and subsequent revision of the NAC was rarely required.

32.4 Mastectomy for Breast Cancer

In SSM, the skin is spared but the NAC is removed, regardless of the tumor location. The reason for this is that the nipple is the terminal end-point of the breast ducts, and the latter are the origin of most breast tumors ("ductal carcinoma"). Many studies have demonstrated the long-term oncologic safety of SSM compared to the traditional mastectomy. Lanitis et al. published a meta-analysis of nine studies that included 3739 patients, and showed that the rates of local recurrence in SSM did not differ significantly from those in non-SSM, while the SSM group had a lower proportion of distant relapses compared to the non-SSM group [17]. A 2015 meta-analysis of 20 studies involving 5594 carefully selected women with early-stage breast cancer investigated overall survival, disease-free survival, and local recurrence in those who underwent SSM compared to those who underwent traditional mastectomy without reconstruction. No differences in oncologic outcomes between the two groups were detected.

Following the establishment of oncologic safety of NSM for RRM, a concern was raised with regard to sparing the NAC in breast cancer cases. Primary carcinoma of the nipple is rare [7]. The most often observed neoplasia of the nipple is Paget's disease of the breast ("intraepidermal tumor cells of the nipple"), which remains an uncommon presentation of breast malignancy, accounting for 1–3% of all breast tumors [20]. Nipple involvement may also occur in association with ductal carcinoma in situ (DCIS) or with invasive breast cancer in the breast parenchyma. Following the publication of more studies on the oncological outcomes of NSM in breast cancer patients, the US National Comprehensive Cancer Network (NCCN) issued suggested criteria for NSM in 2016 [21]. Those criteria included early-stage breast cancer (no skin or muscle involvement), biologically favorable, invasive breast cancer or DCIS at least 2 cm from the nipple, tumor size smaller than 3 cm, imaging findings indicating no nipple involvement, nipple margin assessed and found to be clear, no nipple discharge, and no Paget's disease [21]. The availability of more data on the long-term safety of NSM in breast cancer patients led to the search for wider indications for that approach. Santoro et al. described NSM for cases in which the tumor is less than 2 cm from the NAC [22]. Frey et al. described NSM in selected patients after neoadjuvant chemotherapy, with tumors initially larger than 3 cm [23]. Although the follow-up was short and complications were more frequent, the overall results were promising [23].

32.5 Operative Technique

The key component for a good outcome after SSM/NSM and immediate reconstruction is the mastectomy. Glandular breast tissue must be expertly removed, while protecting the vascularity of the skin. The proper plane of dissection is at the level of Cooper's ligaments, identified within the superficial fascia between the gland and the subcutaneous fat. This dissection plane is generally avascular, and excessive bleeding might indicate dissection in the wrong surgical plane. Preserving the subcutaneous fat is vital for skin vascularity and aesthetic outcome. Flap thickness may vary greatly, depending upon the patient's age, breast anatomy, and general adiposity. Flap thickness can be defined preoperatively by means of digital mammography [24], and it can assist in identifying the appropriate plane of dissection. In addition to flap thickness, trauma to the skin during the mastectomy, including electrocautery heat damage, skin stretching, and crush injury from the surgical retractors, may cause vascular compromise to the skin, mainly around the wound edges and in the breast pole opposite to the incision line. In NSM, the retroareolar tissue should be removed with caution and, in cases of breast tumor adjacent to the NAC, a sample from the remaining underside of the areola should be sent for pathologic assessment, and removal of the NAC should be considered if that tissue is tumor-positive.

The skin incision of a mastectomy depends upon the type of mastectomy, breast size and shape, tumor location, nipple position, and surgeon preference. SSM has four types of skin resection, starting from NAC alone (type 1) (Fig. 32.1) to reduction pattern skin resection (type 4) (Fig. 32.3). Types 2 and 3 include resection of a previous scar or skin over a superficial tumor, separate from the NAC (type 2) or in continuity with the NAC (type 3) [25]. NSM also has various possible incisions, some near and some far from the NAC (Figs. 32.4 and 32.5) [8]. NSM had initially been performed in small non-ptotic breasts. With growing experience in the technique, larger and ptotic breasts were considered with the aim of sparing of the nipple. Recent publications have reported on shared experiences in NSM and ptotic and large breasts in one or multiple stages, including reduction of the skin envelope in selected cases [8].

Preoperative drawings include the midline, the footprint of the breast, and the incision line (i.e., whether sparing or excising the NAC). For a skin-reducing mastectomy in a vertical or Wise pattern, the drawing of the skin excision is conservative and less than in a mastopexy or breast reduction. Moreover, the new position of the NAC is planned relatively low in order to minimize the pedicle length.

There are various techniques to safely perform a mastectomy with sparing of the skin and nipple. The authors' technique involves injecting a tumescent solution of 1 L of saline with 1 mg adrenaline and 400 mg lidocaine. Around 100 cc of the tumescent solution is injected superficially between the skin and the gland. After waiting 10–15 min, the mastectomy is performed by dissecting the skin from the gland using facelift scissors and subsequently dissecting the gland from the pectoralis muscle. Care is taken to minimize the retraction on the skin using skin hooks and retraction with the fingers. After completing the mastectomy, the skin flaps and NAC are assessed for viability. This can be done clinically or by using indocyanine green technology [26].

32.6 Complications

Complications of SSM and NSM with immediate reconstruction include wound dehiscence, infection, implant loss, asymmetry, and capsular contracture, as seen in non-traditional mastectomies [27, 28]. Potential complications unique to NSM are partial or complete nipple loss, nipple malposition on the breast, as well as involvement of the nipple with cancer. Flap necrosis in NSM is reportedly higher compared to SSM [11]. This can be attributed to the limited access to the incision line during mastectomy. Headon et al. [10] conducted a pooled analysis of 12,358 NSM cases to assess complications, including onco-

logical safety. The overall complication rate was 22.3%, and the nipple necrosis rate was 5.9%. Importantly, they found that the rates of complications, including nipple necrosis, decreased over time, which they attributed to improving surgeon expertise. Factors predisposing to nipple necrosis were found to be large breast volume, ptotic breast, smoking, prior radiotherapy, and periareolar incision. A study from the European Institute of Oncology [29] found that comorbidities, smoking, type of incision, flap thickness, and the type of reconstruction all influenced the NAC necrosis rate in NSM. Despite variability in the aesthetic outcomes, patient satisfaction tends to be very high when retaining the nipple. Careful preoperative planning of mastectomy incisions as well as gentle intraoperative manipulation of the flaps may prevent these potentially serious sequelae.

32.7 Conclusion

Skin- and nipple-sparing mastectomies with immediate reconstruction not only preserve breast appearance but also provide an opportunity for breast restoration that may enhance the woman's appearance. The technique has a learning curve, and the levels of complication rates are acceptable when performed by experienced surgeons. Carful patient selection and a meticulous surgical technique can provide a safe oncologic procedure, with good aesthetic outcome and low complication rates. As more favorable long-term data on NSM become available, wider indications will be established, and more patients will become eligible to undergo this procedure, for risk reduction as well as treatment for breast cancer.

Tips and Tricks

- Aggressive retraction on the skin flaps during skin or nipple-sparing mastectomy can considerably increase the rate of skin necrosis and wound dehiscence in immediate breast reconstruction.

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