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5.1 Introduction

In the last century, breast-cancer surgery underwent a dramatic development, starting from the initial approaches of radical surgery to the more recent codification of a series of conservative treatments that do not invalidate oncologic radicality. In 1894, Halsted [1] delineated radical mastectomy, which remained the standard treatment for breast cancer for many years. This operation, involving the removal of all the breast tissue (en bloc removal of the breast and overlying skin, both the pectoralis major and minor muscles and the axillary lymph nodes from Berg level I to III) was a fundamental shift in the surgical treatment of this disease (local disease control), but it was also a symbol of destruction, of a large wound, not only in surgical terms, suffered by the patient. In 1948, Patey and Dyson [2] of Middlesex Hospital, London, proposed an alternative approach to reduce the morbidity of Halsted's operation (with the preservation of the pectoralis major muscle and the removal of the pectoralis minor muscle, the axillary lymph nodes could equally be removed). This was perhaps the first shift toward a more local conservative surgery. Later on, Madden [3] reinforced this course with a modified radical mastectomy that preserved both the pectoralis major and minor muscle. The conservative surgical approach found its assertion in quadrantectomy and radiotherapy, as described by Veronesi [4], where oncologic radicality is combined with research into the cosmetic outcome, with the utmost respect for the patient's physical and mental integrity. Even though quadrantectomy, together with radiotherapy, is the standard treatment for breast cancer, it is known that not all breast cancer cases can be handled safely with this type of operation (multifocal tumors, multicentric tumors, recurrence after conservative surgery, inability to manage radiotherapy, BRCA1-BRCA2 patients). About 20–25%

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of the cases will still need to undergo mastectomy. How can one still be conservative when the whole gland is being destroyed? How can oncologic radicality be ensured without neglecting the cosmetic and functional aspects? These are the considerations on which the course of oncoplastic surgery, a term coined by Audretsch [5], were based and which best match the collaborative surgical aspects of breast-cancer surgery and reconstructive plastic surgery. In 1962, Freeman [6] described his results with subcutaneous mastectomy. In a study, published in 1984 by Hinton [7], which compared modified radical mastectomy with subcutaneous mastectomy and immediate reconstruction with a prosthesis, no differences in survival were found. The skin-sparing mastectomy (SSM) was first delineated in 1991 by Toth and Lappert [8]; this type of mastectomy involves a periareolar incision, with the removal of the nipple-areolar complex (NAC) and the skin overlying superficial tumors, an effort to maximize skin preservation and to facilitate immediate reconstruction. Simultaneously, Kroll [9] discovered one recurrence in 100 patients during a 2-year follow-up. Since then, the technique has been given great attention and has been subject to many studies that have shown substantial oncologic equivalence with other destructive methods. The cosmetic outcome was excellent, thanks to the preservation of the skin and the inframammary fold, and due to a simpler immediate reconstruction, which usually does not need contralateral symmetrization. The interest in, and the success of this surgical approach, together with the results of the clinical studies on the oncologic safety of the SSM, have increased interest in this type of operation. On the other hand, the cosmetic and emotional impact, still partly negative and linked to the loss of the entire NAC, and the results obtained from the various techniques used for the reconstruction of the nipple, which are not always excellent, led to the proposal of new surgical operations: the NAC-sparing mastectomy (NSM) [10], and the skin-reducing mastectomy (SRM). These three techniques belong to the new chapter of conservative mastectomies.

5.2 Nipple-sparing Mastectomy

The NSM involves the removal of all the breast tissue while preserving the skin of the breast, the NAC and the inframammary fold (*breast-conserving* mastectomy). It might seem like another name for subcutaneous mastectomy or subcutaneous adenomammectomy. However, the NSM is a real demolitive operation that ensures oncologic radicality but differs for the careful preparation of skin flaps, global removal of glandula and preservation of only 3–5 mm of the NAC.

The description given is that of the procedure that is usually carried out. However, there is a variant of this operation that involves the preservation of a subareolar glandular tissue pad, which is irradiated during the operation using the IORT technique [11].

5.2.1 Surgical Anatomy of the Breast

The mammary gland is located in the splitting of the superficial fascia: the anterior

lamina (premammary), which is not present in the areola and nipple, and the posterior lamina (retromammary). External to the anterior lamina, there is a celluloadipose layer, which varies in thickness from person to person. Below the lamina there are large axial vessels from where vertical branches branch off toward the subdermal plexus. Fibrous projections (Cooper's ligaments) pass from the anterior surface of the mammary gland to the superficial lamina, and the retinacula are stretched between the former and the dermis. Between the posterior lamina and the pectoral muscle fascia there is a retromammary adipose layer, through which fibrous projections pass (suspensory ligament of the breast) keeping the mammary gland joined to the chest wall. Anatomical studies have defined borders of the mammary gland: large infraclavicular muscle bundles, midsternal lines, the front edge of the latissimus dorsi and the lower edge of the pectoralis major muscle on the sixth rib. The latter border is of great importance for the presence of the inframammary fold, an area where the superficial fascia joins to the deep pectoralis fascia.

5.2.2 The Arterial Vascularization of the Breast and Nipple-areolar Complex

The arterial vascularization of the NAC is supplied by the internal and external mammary artery. In the NAC, these branches anastomose to form two plexus, a massive and diffused one around the areola, and a thin and superficial one around the nipple. Recurrent perforating arteries (inner mammary artery perforators, the outer mammary artery perforators, anterior-medial intercostal perforators and anterior-lateral intercostal perforators) flow from this circle and reach the mammary ducts where they anastomose with the subareolar subdermal plexus. The venous outflow from the NAC is supplied by the tributary branches of the perforating veins of the internal mammary, the intercostal veins and the axillary veins (Fig. 5.1).

5.2.3 The Innervation of the Breast and Nipple-areolar Complex

The innervation of the NAC is mainly supplied by the anterior-medial and anterior-lateral branches of the intercostal nerve IV. The intercostal nerves III and V, together with the supraclavicular nerves, contribute to sensitivity. The intercostal nerve IV enters laterally through the IV space and runs medially along the deep fascia and upwards to reach the NAC through the parenchyma. In the light of the fact that various nerves contribute to the innervation of this area, the surgical sectioning of some of these branches should not result in the anesthesia of the NAC. Also true is the fact that it is practically impossible to choose preferential incisional surgical options to conserve the nervous fiber section; such impossibility seems to be valid also for vascularization (Fig. 5.2).

Most authors reported that the sensitivity of the nipple after NSM reduces significantly and the same is valid for its erectile function [12], with a possibility of recovery, after about 6 months, in 28% of cases.

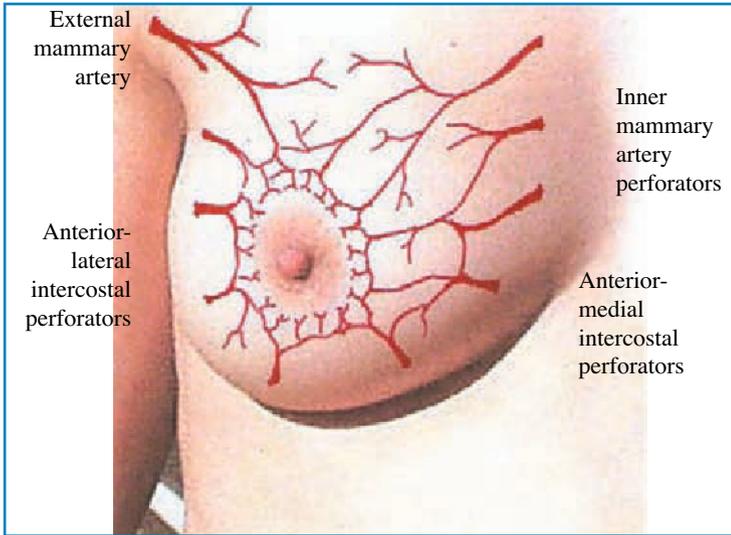


Fig. 5.1 Vascularization of the breast and nipple-areola complex

5.2.4 Planning the Surgery

1. Evaluation of the surgical indications.
2. Getting consent for the surgery. It is important to explain clearly some fundamental points: any oncologic risks, even if small, linked to the persistence of the NAC, as well as the surgical approach chosen and the expected cosmetic outcome, any possible complications (discoloration/ischemia/ necrosis of the NAC, the reduction-loss of nipple sensitivity and its erectile function, prosthesis infection) and problems linked to axillary lymph nodes.
3. Choosing the surgical approach: which incision to be carried out taking into consideration any existing scars; which approach allows an easy and radical removal of all the gland tissue; which one allows the perfect identification and skeletonization of the retroareolar tissue and safeguards the vascular system of the NAC.
4. Study of the axillary sentinel lymph node or the axillary lymph node dissection.
5. Planning breast reconstruction (prosthesis, type and sizes, flaps, other).

5.2.5 Indications and Contraindications

The indications and the contraindications for NSM must be carefully evaluated before proposing and carrying out the operation. The follow-up of this new surgical approach is still too young to drive absolute criteria and the literature always presents new elements for reflection [12–15].

The criteria to select this surgery include both clinical and instrumental criteria

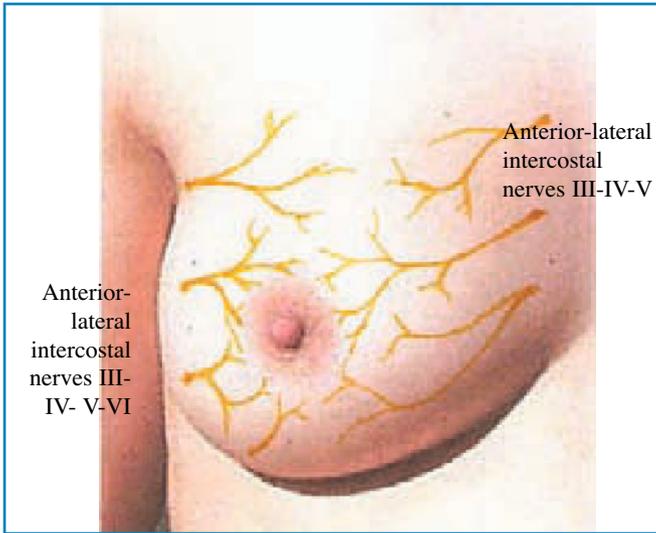


Fig. 5.2 Innervation of the breast and nipple-areola complex

(tumor size ≤ 3 cm, tumor distance from the NAC > 2 cm, the possibility of an MRI of the NAC, clinically negative axillary lymph nodes, absence of Paget's disease and the absence of an inflammatory component), and also anatomical criteria (not big breast size, no high-grade ptosis). Oncologic and prophylactic indications are listed in Table 5.1 together with absolute contraindications.

Literature on these indications is in sufficient agreement. Many studies have shown that the SSM, have the same results as the modified radical mastectomy in terms of local recurrences, both when treating infiltrating tumors and intraductal ones [16–18]. A very debated issue is the oncologic risk linked to the maintenance of the NAC. In a literature review published in 2001, Cense [19] claimed that the percentage of neoplastic involvement of the NAC in mastectomies varies from 5.6 to 58%, and has a significant correlation with the tumor size and its distance from the nipple [16, 20]. In fact, in tumors larger than 4 cm (T3), there are neoplastic cells within the NAC in more than 50% of the cases. The same applies if the mass is less than 2 cm away from the NAC. In 2001, a retrospective analysis of 217 cases by Simmons and Brennan [21] found the involvement of the NAC in 10.6% of the cases. This percentage drops to 6.7% of peripheral tumors, with a diameter of less than 2 cm and with less than two positive lymph nodes. Analyzing the involvement of the areola and the nipple separately, the authors sustain that the areola is implicated in only 0.9% of the cases of NAC involvement. In the rest of cases, the tumor is restricted to the nipple. This fact favors the maintenance of the areola (areola-sparing mastectomy), when the conservation of the nipple is not possible [22–28]. In fact, the lymphatic drainage of the breast is not, as Sappey [29] claimed, toward the nipple, but toward the deep lymphatic prepectoral lymphatic plexus [30]. In addition, Welligs [31] has shown that the anatomical area of the breast where tumors form, is the terminal duct lobular unit (TDLU), which is present only at the

base of the nipple and not at the tip. Therefore, only the outer surface (the skin) of the nipple remains when the core is removed together with all the glandular tissue [32–35]. The risk of the nipple involvement, therefore, seems to directly correlate to the tumor size and the distance of the tumor from the nipple. It is necessary to reconsider the importance of positive lymph nodes, the presence of lymphatic vascular invasion (LVI) as well as the extensive intraductal component (EIC). The risk factors linked to local recurrence seem to be different; in the case of infiltrating tumors one should consider the grading, the overexpression/amplification of the HER2/neu and the molecular characteristics of the tumor (luminal B). It seems that in situ tumors correlate with the patient's age (< 45 years), absence of estrogen receptors, grading, overexpression of HER2/neu and high value of Ki67. The pre-operative histological examination might represent the best solution to define the histological, hormonal and biological characteristics of the tumor so as to reduce local recurrence, selecting the patients who should undergo a NSM [36]. Intraductal mammary carcinoma and infiltrating ductal carcinoma with important in situ components, negative hormone receptors and high degree overexpression of HER2/neu, are all associated with a high risk of local recurrence that can manifest itself as Paget's disease of the nipple [37]. For this reason, it is absolutely necessary to inform the patient of the existing problems and to obtain a truly informed consent.

5.2.6 The Surgical Technique

The NSM, like other conservative mastectomy techniques, involves the removal of the entire mammary gland while sparing the cutaneous envelope. The element that characterizes the operation is the conservation of the NAC, after an intraoperative histological exam of the retroareolar tissue.

5.2.6.1 Skin Incisions

Several skin incisions (Fig. 5.3) have been proposed and they can be summarized as follows:

- Upper periareolar
- Upper periareolar with lateral extension
- Transareolar - transnipple
- Inframammary /inferior lateral
- Upper-outer radial
- Omega (mastopexy).

An upper-outer radial incision should be given preference, due to its various advantages: excellent scar outcome; easier access to the axilla, the nipple and the complete glandular demolition; the highest possibility of conserving the areolar vascularization, and the best reconstruction time, both in small and large breasts. All the periareolar incisions have the advantage of resulting in an almost invisible scar. Therefore, besides allowing excellent access to the retroareolar region, they also favor the subareolar resectioning timing; they are the preferred choice for small-sized breasts, due to the difficulties to reach the inframammary fold medially and the

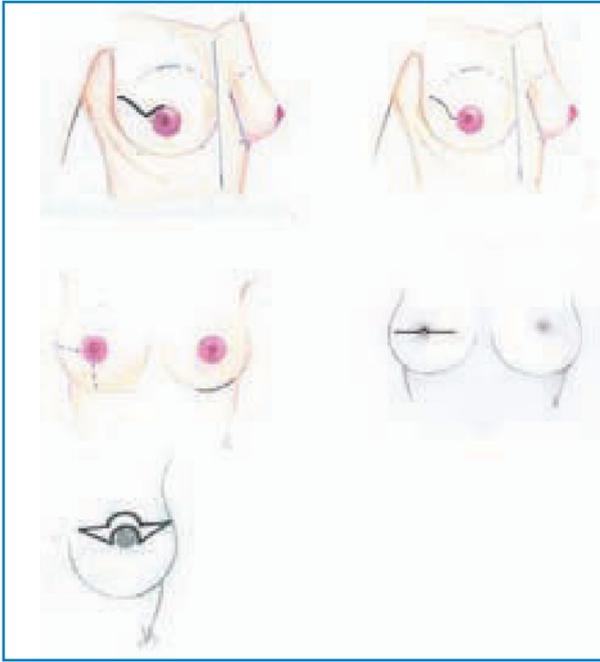


Fig. 5.3 Skin incisions

neurovascular elements of the axilla (if lymphadenectomy is mandatory).

The periareolar incision with lateral extension certainly ensures wider access to axilla; however, it often results in a deviation and lateralization of the NAC, requiring corrective action. The external inframammary incision has the advantage of a hidden scar but, on the other hand, it creates a few problems as far as the demolition of the upper or middle quadrants is concerned and in reaching the axilla, especially in large breasts.

The dissection occurs along the superficial fascia, taking care to respect the skin flap vascularization; most vessels flow deeply in the muscle band, but there might be perforated vessels to the skin that must be coagulated (Fig. 5.4). The thickness of the flaps must be kept constant throughout their extension. To reach this aim, the skin must be stretched upwards by the second surgeon and the gland in the opposite direction by the surgeon.

Both these maneuvers facilitate the identification of the correct dissection plane, which should be in the subcutaneous tissue, immediately at the surface of the fascia, which is above the mammary gland.

From time to time, during the dissection, the skin flap must be palpated to ensure a uniform and adequate thickness, not too thin and devascularized (necrosis!!), and not too thick as there would be a risk of glandular residue (local recurrence!!). In order to assess the vitality of the flaps and the NAC, studies have evaluated perfusion with the fluorescence emitted after an infusion with indocyanine green dye [38].

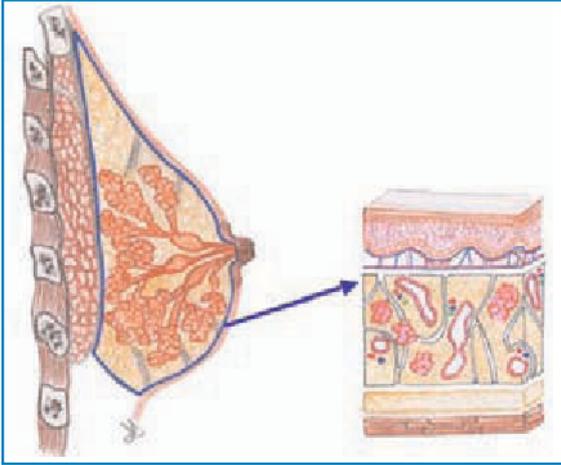


Fig. 5.4 Dissection of the glandular plane

The flap thickness may depend on the patient's characteristics; in slim patients, it may be only a few millimeters thick (2–3 mm) and transparent to light, while for obese patients, it can be up to 1 cm. In all cases, the removal of glandular tissue must be truly radical. The releasing of the gland from adipose tissue begins from the upper quadrants getting to the pectoralis muscle up to its infraclavicular bundles of the pectoral muscle. Medially, the muscle fascia is not well-defined and the dissection leads to the parasternal line, where the perforating vessels coming from the internal mammary artery are present; on the lower side, the muscle is followed up to the joint with the posterior membrane, where the skin adheres to the chest wall at the inframammary fold. The anterior axillary pillar, the margin of the pectoralis major and the lower anterior serratus can be reached laterally. The dissection must be carried out carefully with meticulous technique to prevent ischemia of the skin flap. Proceeding from the top toward the bottom, the gland is mobilized from the deep plane, incising and dissecting the pectoralis major muscle band.

5.2.6.2 Treatment of the Subareolar Tissue

The most characteristic element of this surgery is the conservation of the NAC. For this purpose, as mentioned above, it is mandatory to carry out an intraoperative histological study of the margin of a section of the subareolar tissue. During the glandular dissection, one should proceed with meticulous care when isolating the areolar conus, which is followed and sectioned until removal from within the nipple (avoiding the use of electrosurgery to avoid artifacts from electrocautery). This sectioning, which reaches the dermis plane, almost transforms the NAC into a sort of dermoepidermal graft, easily revascularized from the underlying muscle tissue. This timing is greatly facilitated by the hydrodissection technique, which consists of infiltrating the retroareolar tissue with an epinephrine and saline solution, to allow the identification of an anatomical and bloodless incision plane [39] (Fig. 5.5). This technical procedure makes the surgical procedure easier, quicker

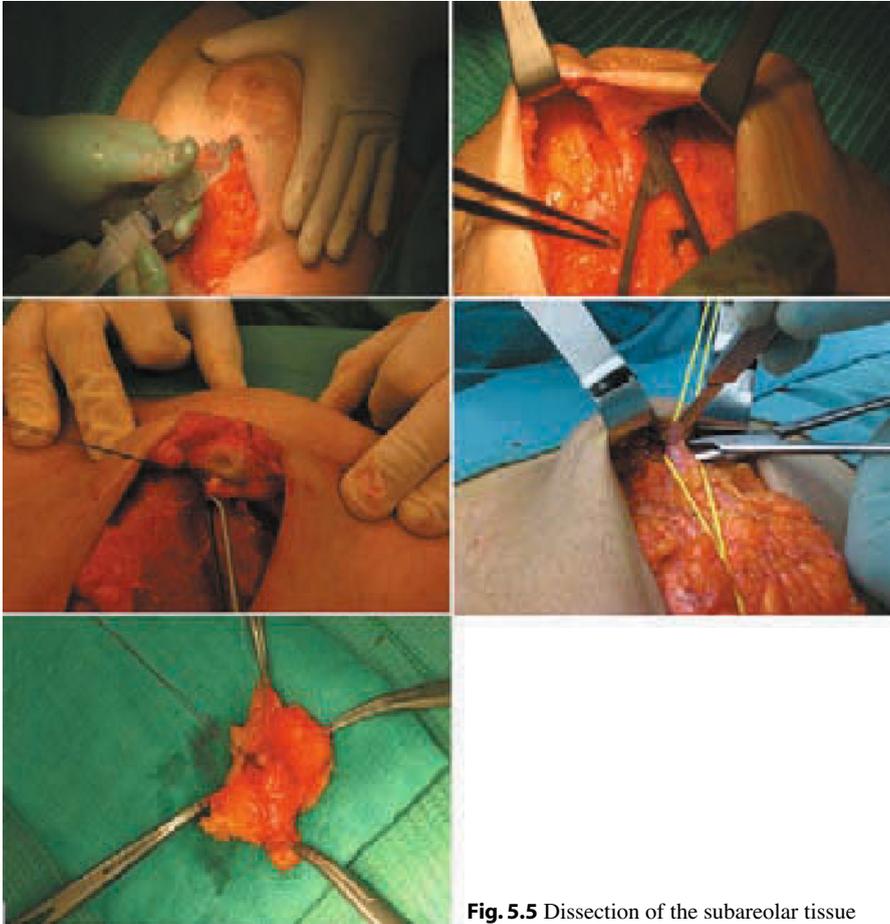


Fig. 5.5 Dissection of the subareolar tissue

and probably even safer from an oncologic point of view since a subdermal plane, which allows a better and complete removal of the retroareolar breast tissue, is obtained. The resected retroareolar tissue is then sent for intraoperative histological examination, subjected to the right orientation. The pathologist then prepares at least three frozen sections at 200–300 microns; a negative or positive result for tumor presence is given. When positive, he specifies the presence of infiltrating or in situ tumor, extension and distance from the edge of nipple (Fig. 5.6). At this point, our choices can be: conserve the nipple, removal of the NAC or, given the rarity of areolar accessory ducts, removal of the nipple alone; this latter variant of the technique (areola-sparing mastectomy), which is sometimes used, involves the closure of the circular areolar wound with a purse-string suture, creating a scar that is almost punctiform with projection and a fairly good esthetic result. The result of the definitive histological test must be considered with great attention, since the possibility of false negatives from the intraoperative histological test seems to be

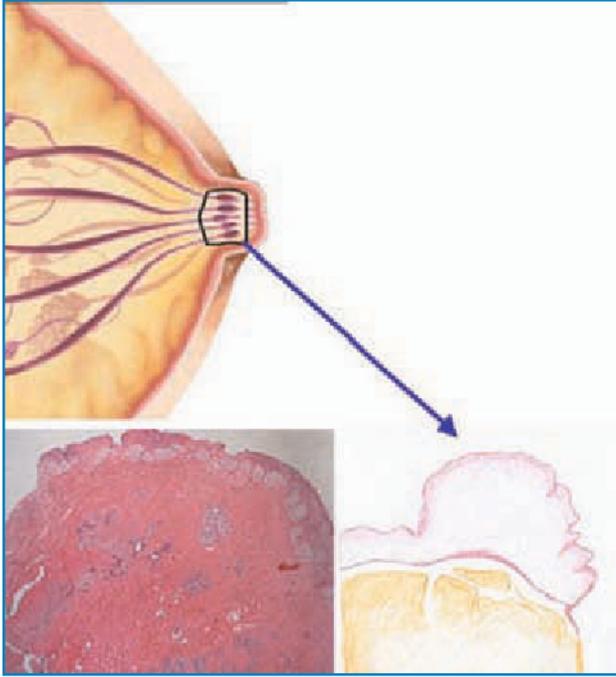


Fig. 5.6 Intraoperative study of the subareolar tissue

approximately 4.6% [40–45]. In all cases in which a nipple-sparing mastectomy is carried out for oncologic purposes, even for the treatment of noninfiltrating forms, it is advisable to check the state of the axilla (sentinel node biopsy/axillary dissection).

5.2.6.3 Reconstruction Time

The pocket under the pectoralis major muscle is then prepared for the prosthesis implant. It begins with the dissection of the lateral edge of the pectoralis major from the pectoralis minor and the costal plane: in the middle sternal tract, the muscular fibers are completely sectioned up to the subcutaneous fat and down to the inframammary fold. The muscular section, which compromises the contracture of the pectoral muscle, is necessary to achieve good skin expansion, good inframammary fold and also to ensure the best positioning of the prosthesis. The volumetric reintegration of the gland is obtained with the insertion of an implant made of prosthetic material. The reconstruction can be carried out in one session using an implant with a permanent prosthesis, or in two sessions, using an expander or a prosthesis-expander, with a biological or synthetic mesh, with a flap transposition, and with fat grafting (Fig 5.7) [46, 47].

(For further information about reconstruction, readers should refer to chapter 16).

The surgery ends with the positioning of a drain and the synthesis of the surgical wound. The complications of the operation are listed in Table 5.4.



Fig. 5.7 Nipple-sparing mastectomy right (upper periareolar approach)

5.3 Skin-sparing Mastectomy

SSM was first described by Toth and Lappert in 1991 and later, still in 1991, by Kroll, who is the father of conservative mastectomies [8, 9]. This surgery involves the exeresis of the entire mammary gland, saving the breast skin and the removal of the NAC and any skin overlying the tumor, including any area with previous surgical biopsy incisions. The advantages of this type of mastectomy resulting in welcoming by the surgical world are the possibilities of conserving the skin and the inframammary fold, ensuring a better cosmetic outcome in a more natural manner, facilitating the reconstruction time with less scars and less need for contralateral symmetrization. In 1997, Carlson [48] proposed an SSM classification with four types, depending on the surgical approach used and previous evaluating with the presence of biopsy scar: Type I, only nipple-areola removed; Type II, nipple-areola, skin overlying superficial tumors and previous biopsy incision removed in continuity with nipple-areola; Type III, nipple-areola removed, skin overlying superficial tumors and previous biopsy incision removed without intervening skin; Type IV, nipple-areola removed with an inverted or reduction pattern skin incision [18, 49–53]. Nowadays, the fundamental SSM indications are the clinical conditions themselves when an NSM cannot be carried out (refer to Tables 5.1, 5.2) (Fig. 5.8).

5.4 Skin-reducing Mastectomy

A SRM is in fact a skin-sparing mastectomy (Type IV), which involves the reduction of an excessive skin envelope. In fact, the operation is for patients with large-sized breasts (jugulum-nipple distance > 25 cm) and a severe degree of ptosis (areola to inframammary fold distance > 8 cm). The oncologic and prophylactic indications are the same as those of an SSM and NSM. The operation must be suitably planned, the degree of possible skin reduction must be carefully measured and, when oncologically safe, the NAC will be conserved. This operation is often carried out combined with a breast reduction or contralateral mastopexy. The conven-

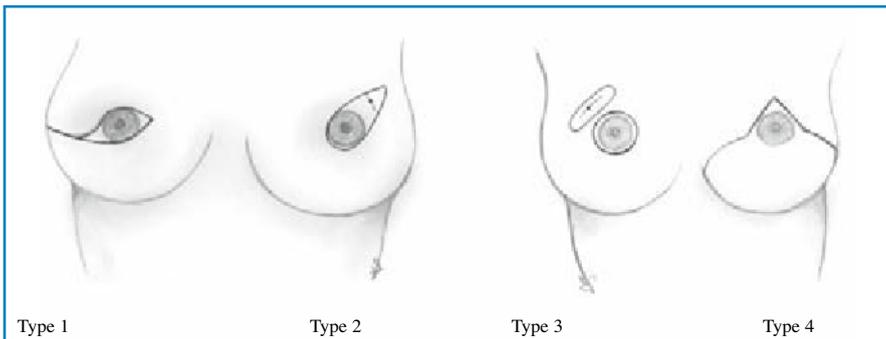
Table 5.1 Indications (oncologic and prophylactic) and contraindications of NSM

Oncologic
Multifocal DCIS
Multifocal and multicentric T1, T2
T1 with extensive intraductal component (EIC)
Margins involvement after conservative surgery
High tumor/breast ratio
Relapse post QUART
Patient refuses BCT
Patient's refusal or impossibility to radiotherapy
Difficulty for follow-up after conservative surgery
Prophylactic
BRCA1/BRCA2 (risk reduction 81–96%)
Opposite breast
LCIS
ADH?
Papillomatosis?
Phyllodes tumor?
Contraindications
Tumor distance < 2 from NAC in mammography or RM studies
Nipple retraction
Subareolar microcalcifications
Bleeding from the nipple
Skin involvement
T3, T4
Inflammatory disease
Paget's disease
N+ ?
Distance from the nipple to the inframammary fold > 8 cm
Large breast (> 400 cm ³)
Intraoperative histological involvement of retroareolar tissues

tional method of reducing the epidermal tissue involves the removal of an ellipse of skin around the NAC. This technique combines the skin incision used for reductive mammoplasty based on the lower pedicle with the conservation of a dermal flap, whose final role is to be part of the lower cover of the prosthetic implant. Mastectomy is then carried out. Reconstruction starts with the sectioning of the lower medial fibers of the pectoralis major muscle which are successively sutured to the upper edge of the lower skin flap. The implant is then inserted in the pocket, which will be closed laterally with the fascia of anterior serratus muscle. In some circumstances, it may be oncologically safe to conserve the nipple, which can be shifted towards the position of the new nipple conserving the epidermal bridge [54–56]. In addition, other authors have proposed interventional procedures with two to three stages, for large-sized breasts with ptosis [57, 58].

Table 5.2 NSM complications

Minor
Cyanosis/hypopigmentation of the NAC
Localized infection
Major
NAC ischemia (in 30%)
NAC necrosis
Flap necrosis (more frequent when risk factors such as diabetes and smoking are present (5–8%))
Seroma
Bleeding/hematoma
Necrosis of the skin
Implant infection (2.8–15%)
Late
Extended and retracted scar
Nipple or skin area retraction
Wrong positioning/displacement of the NAC
Changes in sensibility and erectile function of the nipple
Capsular retraction
Wrong positioning of the implant
Rotation of the implant
Evident breast asymmetry
Cancer recurrence (4–5%)

**Fig. 5.8** Skin-sparing mastectomy (Carlson classification)

5.5 Conclusions

Conservative mastectomies are a further step in the conserving treatment of breast cancer, especially the NSM, which is the most advanced surgical technique. From

an oncologic point of view, the outcomes are reassuring, while cosmetically, they are surely exhilarating. The conservation of the NAC definitely enhances the outcome of the reconstruction. Local recurrence compares to that of radical mastectomy or SSM. It is fundamental to carry out an intraoperative histological exam of the subareolar tissue. The procedure has various levels of difficulty, which can be overcome with an adequate period of training. It is of utmost importance to highlight the necessity of a good selection of cases to be treated and careful planning of the procedure [59, 60]. The literature will surely propose further elements for a better definition of indications and also the limits of the techniques, which are already described in part.

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