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GENERAL REVIEW

Skin-reducing oncoplasty: A new concept and classification in breast cancer surgery

Oncoplastie avec réduction de l'enveloppe cutanée : proposition d'une nouvelle classification pour la chirurgie du cancer du sein

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Summary

Background and objectives. — Breast-conserving surgery and skin-sparing mastectomy are nowadays widely accepted as the standard of care in selected patients with early breast cancer. After an accurate review of the literature, it appeared that no ordered list of the numerous techniques described for conservative breast surgery has been established so far. The aim of this study was to develop a simple classification of the different skin incision patterns that may be used in breast surgery.

Methods. — A systematic review of the English literature was conducted using the PubMed database to identify all the articles reporting breast-conserving surgery and skin-sparing mastectomy techniques up to the 31st of December 2016.

Results. — Among the 1426 titles identified, 230 were selected for review. Based on the reviewed papers, the skin-reducing oncoplasty incision pattern (SROIP) classification was elaborated.

Conclusions. — Breast cancer surgery should nowadays optimise aesthetic outcomes by improving the final breast shape, volume and scar location. This may be achieved using different procedures that we grouped together under the term skin-reducing oncoplasty (SRO). Depend-

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MOTS CLÉS

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ing on the breast cancer location, the SROIP classification helps in the choice of the best technique to be used.

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Résumé

Introduction. — La chirurgie mammaire conservatrice et la mastectomie avec conservation de l'étui cutané (*skin-sparing mastectomy*) sont aujourd'hui largement acceptées comme traitements de choix chez certaines patientes atteintes de cancer du sein au stade précoce. Après une étude précise de la littérature, il est apparu qu'aucune liste ordonnée des nombreuses techniques décrites pour la chirurgie mammaire conservatrice n'a été établie jusqu'à présent. L'objectif de cette étude était de développer une classification simple des différentes incisions cutanées qui peuvent être utilisées dans la chirurgie mammaire.

Méthodes. — Une revue systématique de la littérature anglaise a été réalisée grâce au moteur de recherche Pubmed permettant d'identifier tous les articles portant sur les différentes techniques de chirurgie mammaire conservatrice et *skin-sparing mastectomy* jusqu'au 31 décembre 2016.

Résultats. — Au total, sur les 1426 titres identifiés, 230 articles ont été sélectionnés pour notre étude. Sur la base des articles examinés, une nouvelle et simple classification des voies d'abord (*skin-reducing oncoplasty incision pattern* [SROIP]) pour la chirurgie mammaire conservatrice a été élaborée.

Conclusion. — La chirurgie du cancer du sein devrait aujourd'hui optimiser les résultats esthétiques en améliorant la forme finale du sein, le volume et l'emplacement de la cicatrice. Cela peut être réalisé en utilisant différentes procédures que nous avons regroupé sous le terme de *skin-reducing oncoplasty* (SRO). Selon la localisation du cancer du sein, la classification SROIP est une aide dans le choix de la technique optimale à utiliser.

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Abbreviations

BCS	breast-conserving surgery
SSM	skin-sparing mastectomy
IBR	immediate breast reconstruction
NSSM	non-skin-sparing mastectomy
SRO	skin-reducing oncoplasty
SROIP	skin-reducing oncoplasty incision pattern
SRM	skin-reducing mastectomy
NAC	nipple-areolar complex
NSM	nipple-sparing mastectomy

Introduction

In the past, breast carcinomas were classically treated with aggressive procedures while there is now a clear trend toward skin-sparing and/or nipple-sparing mastectomy, when they are indicated [1]. Breast-conserving surgery (BCS) and skin-sparing mastectomy (SSM) are currently widely accepted as a treatment of choice in selected patients with early breast cancer. Tumour size and location, breast dimensions, patient age and potential neo-adjuvant and adjuvant treatments are the most important factors to be considered in the choice of the best surgical treatment [2]. For the surgeon, two elements are critical when performing a conservative treatment: to ensure a complete oncologic resection, with negative margins; and to obtain a satisfying aesthetic result, preventing the occurrence of

sequelae. Sequelae can be a consequence of surgery itself, but it can also be worsened by postoperative adjuvant radiotherapy. As these sequelae are difficult to treat, we have to prevent them during surgery, as a one-stage procedure [3].

Small breasts are usually reconstructed using permanent implants or temporary expanders. In these cases, the breast may be removed using a periareolar approach. Large- or medium-sized breasts are usually ptotic and require a variable degree of skin reduction and a contralateral symmetrisation to achieve acceptable cosmetic and reconstructive outcomes.

Breast reshaping after BCS and immediate breast reconstruction (IBR) after SSM are consolidated techniques used in breast oncology. These techniques have been shown to significantly improve patient quality of life, even if sometimes the need for adjuvant radiotherapy may negatively influence the result of the reconstructed breasts [4].

The SSM technique preserving the skin envelope and the infra-mammary fold, enables to maintain as much as possible the original breast shape, resulting in a more symmetrical result. The overall aesthetic outcome after SSM and IBR has been shown to be superior to that achieved with non-skin-sparing mastectomy (NSSM) [5]. The aim of this review was to develop a simple classification of the different skin incision patterns that may be used in breast surgery to help surgeons in their decision-making. As this classification refers to all the procedures (lumpectomy, quadrantectomy and mastectomy) in which a skin amount may be preserved, the term "skin-reducing oncoplasty" (SRO) was used to better summarise all these approaches.

Materials and methods

A systematic review of the literature was conducted using the PubMed database to identify the relevant articles. A comprehensive search was performed using the following keywords: "oncoplasty", "immediate breast reconstruction", "skin-sparing mastectomy", "skin-reducing mastectomy", "skin-preserving mastectomy", "oncoplastic breast surgery". The search included all study designs and was limited to articles published in English up to the 31st of December 2016. The articles describing original techniques or a change in known procedures of breast-conserving surgery, skin-sparing mastectomy or skin-reducing mastectomy in women with breast cancer or for prophylactic surgery were included. The articles that did not describe the surgical technique were excluded. No other restrictions were applied on selection. The main author read all included articles to analyse the different BCS and SSM techniques described. A classification of the different skin incision patterns was developed.

Results

Titles of 1426 citations were identified from the PubMed search from which 851 non-English language or duplicate articles were excluded. After appraisal of the inclusion criteria, 230 articles describing relevant and original techniques were included and reviewed in detail to form the basis of the systematic review (Fig. 1).

The BCS and SSM techniques described so far may be performed using seven main incision patterns that were grouped into the skin-reducing oncoplasty incision pattern (SROIP) classification (Table 1).

Concept of skin-reducing oncoplasty (SRO) and SROIP classification

After a review of the current literature, it appeared that a clear schematisation of the various types of incision used in

BCS and SSM was missing [1–42]. Carlson's classification of SSM is now routinely used by breast surgeons and the type IV is the first example of techniques which were later defined as SRO [6]. The term "skin-reducing mastectomy" (SRM) has been introduced by Nava et al. in 2006: the technique presented was essentially similar to that described by Hammond in 2002 with a Wise pattern skin reduction and a dermo-muscular pocket to allow the inferior pole to adequately accommodate the volume of silicone implants [7–10].

Considering that the skin-reducing approaches may be applied to all the conservative breast cancer surgical procedures in which a variable skin amount needs to be resected, we decided to refer to all these procedures using the term SRO.

Different incision patterns may be used in conservative breast surgery. Some are commonly used in aesthetic breast procedures, while others have been originally described for oncoplastic breast-conserving surgery.

We classified the different incision patterns of SRO depending on the final scar aspect into the SROIP classification as follow (Fig. 2):

- type 1: exclusively upper hemiperiareolar scar (Crescentic pattern);
- type 2: exclusively circumareolar scar (Round Block pattern);
- type 3: upper hemiperiareolar scar with lateral extension (Hemi Omega pattern);
- type 4: upper (or lower) hemiperiareolar scar with extension on both the medial and lateral sides (Omega pattern);
- type 5: circumareolar and vertical scar (Lejour pattern/Malata);
- type 6: circumareolar and inverted T scar (Wise pattern) (Toth/Carlson);
- type 7: circumareolar and "T modified to S" scar (Santaneli).

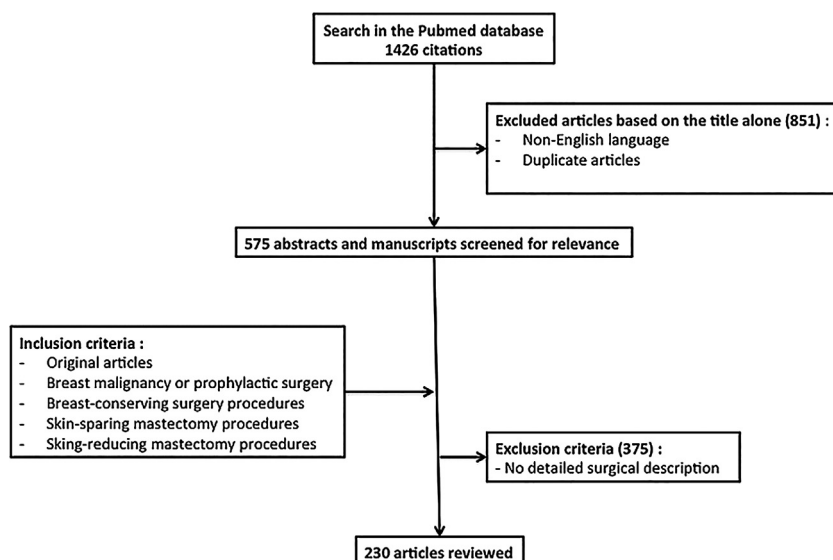


Figure 1 Flow chart.

Table 1 The SROIP classification.

	Indications	Advantages	Drawbacks
Type 1. Exclusively upper hemiperiareolar scar (Crescentic pattern)	Upper quadrant tumour/close to the skin/non-ptotic breast	Good vascular supply to the NAC	Limited exposure/possible NAC deformation/not for ptotic breasts
Type 2. Exclusively circumareolar scar (Round Block pattern)	Upper quadrant tumour/small to medium-sized breast/mild to moderate breast ptosis	Circumareolar scar avoiding visible scar on the breast	Not for severe breast ptosis
Type 3. Upper hemiperiareolar scar with lateral extension (hemi omega pattern)	Large outer quadrant tumour/with or without skin involvement/non-ptotic breast	Simple and reliable technique/direct surgical approach of the tumour/allowing for resection of the overlying skin when necessary	Not for ptotic breasts
Type 4. Upper (or lower) hemiperiareolar scar with extension on both the medial and lateral sides (Omega pattern)	Lesions located deep within or adjacent to the NAC (upper inner or upper outer quadrant)	Good vascular supply to the NAC/allowing skin resection when necessary	Visible scar/Not for severe breast ptosis
Type 5. Circumareolar and vertical scar (Lejour pattern/Malata)	Inferior quadrant tumour/large or ptotic breast	Reduce the resulting scars	The breast volume may be adapted with autologous tissue or implants covered by latissimus dorsi flap/implant alone is not securely covered/lower dermal flap is not possible
Type 6. Circumareolar and inverted T scar (wise pattern) (Toth/Carlson)	Can be applied for all quadrants/large tumour/large and ptotic breasts	Even for severe breast ptosis/NAC pedicle depends on tumour location	Contralateral breast symmetrization is needed/scars
Type 7. Circumareolar and "T modified to S" scar (Santanelli)	Quadrantectomy for lesions of the upper quadrants/moderate to severe breast hypertrophy	Large tumors can be resected	Contralateral breast symmetrization is needed/medial or lateral scar

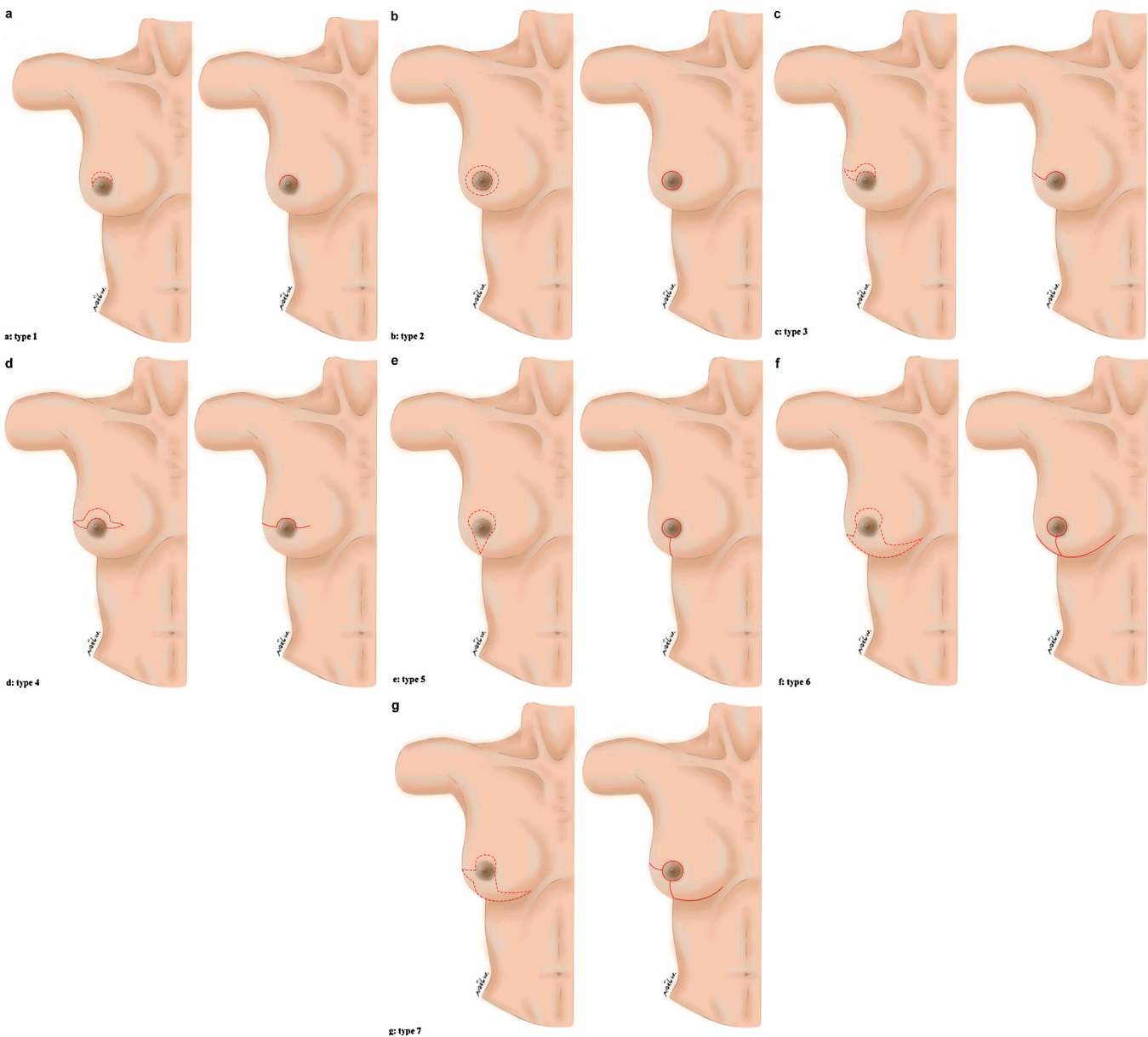


Figure 2 The SROIP classification and final scar aspect schema: a: exclusively upper hemiperiareolar scar (Crescentic pattern); b: exclusively circumareolar scar (Round Block pattern); c: upper hemiperiareolar scar with lateral extension (Hemi Omega pattern); d: upper (or lower) hemiperiareolar scar with extension on both the medial and lateral sides (Omega pattern); e: circumareolar and vertical scar (Lejour pattern/Malata); f: circumareolar and inverted T scar (Wise pattern) (Toth/Carlson); g: circumareolar and "T modified to S" scar (Santanelli).

Exclusively upper hemiperiareolar scar (Type 1: Crescentic pattern)

This approach is indicated for lesions close to the skin located in the upper hemisphere (12 o'clock position) [11].

The crescentic mastopexy incision allows an adequate view to perform the mastectomy, ensuring a good vascular supply to the nipple-areolar complex (NAC). The area cranial to the NAC from 9 o'clock to 3 o'clock is excised as a crescent which includes the tumour site. The NAC is lifted up as an inferiorly based flap [12].

Exclusively circumareolar scar (Type 2: Round Block pattern)

Benelli has initially presented the "round block" approach in 1990 as a mastopexy technique for mild to moderate breast ptosis. This technique may be used in numerous types of breast surgery: in cases of ptosis or hypertrophy, it allows the scar to be located around the periareolar circle, which is in itself generally well tolerated [13].

Numerous patients with breast cancer may be eligible for the round block technique. This simple technique may be used to avoid visible scars on the breast. The NAC may be lifted up, depending on the distance between the outer incision and the new areola incision. Patients with symmetric, small to medium-sized breasts and without major ptosis who may not require contralateral breast surgery for symmetrisation are best suited for this technique [14]. A representative case is shown in Fig. 3.

Upper hemiperiareolar scar with lateral extension (Type 3: Hemi Omega pattern)

Cordeiro's group has reported different skin approaches used in 435 consecutive patients who underwent total mastectomy and immediate reconstruction [15]. A hemiperiareolar incision with a lateral extension was used in some patients. This approach, called the hemi-batwing technique, combines a radial ellipse with a crescent excision. It is designed to elevate the NAC while excising a radial segment of the breast [16].

Upper (or lower) hemiperiareolar scar with extension on both sides (Type 4: Omega pattern)

One of the first descriptions of the "Omega" pattern for NSM, with or without an ellipsoid skin excision, appeared in a brief communication by Stanec et al in 2004 [17]. Although omega incisions are more visible than those used in the Wise pattern, the authors have reported that no full skin thickness necrosis or necrosis of the NAC occurred. Stanec's group repropose the "Omega" approach as a concept to be applied to various surgeries, from lumpectomy to quadrantectomy, and from nipple-sparing mastectomy (NSM) to SRM.

The main disadvantage of this technique is that it leaves a very visible scar.

Other authors refer to the same technique using the term "Batwing mastopexy" [18].

This surgical approach is indicated for lesions located deep within or adjacent to the NAC. Two similar close half-circle incisions with angled wings at each side of the areola are performed to close the subsequent defect.

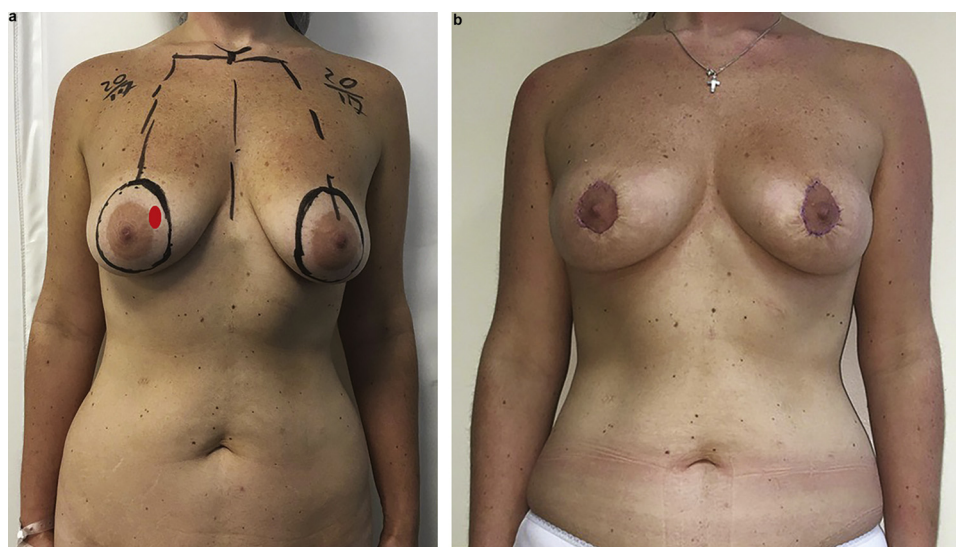


Figure 3 A representative case of exclusively circumareolar scar (Type 2: Round Block pattern). Preoperative aspect of a 43-year-old patient's breasts. Previous nodule biopsy found in situ ductal carcinoma. Red circle indicates the location of the breast lesion to be excised via this pattern. A contralateral symmetrisation was performed at the same time (a). Postoperative aspect at 6 months follow up (b).

A contralateral lift may be performed at the same time to achieve symmetry. The viability of the areola is usually good when the batwing technique is used.

Circumareolar and vertical scar, Type E (Lejour pattern) (Malata)

For SRM, Malata et al. have preferred to adopt a vertical scar pattern which corresponded to that used by Lejour for breast reduction, to reduce the resulting scars [19]. The Lejour pattern is indicated in patients whose cancer is located in the inferior part of the breast, with large or ptotic breasts willing to undergo reduction mastoplasty or mastopexy. The breast volume may be adapted with autologous tissue or implants covered by latissimus dorsi flap. The prosthetic material alone did not seem to be securely covered with this technique and the creation of a lower dermal flap was not possible.

Circumareolar inverted T scar Type F (Wise pattern) (Toth) (Carlson)

Brian Toth has been the first to highlight the importance of the plastic surgeon early involvement in this type of combined operation, which paved the way for the use of the term "oncoplastic surgery", subsequently used by other authors [5]. In his study, he has used different types of skin incisions to perform SSM, including a technique in which the residual post-mastectomy cutaneous scars resembled those formed after normal reduction mammoplasty or mastopexy. This technique was based on the classic Wise pattern (which resulted in "inverted T" scars), so widely used in breast plastic surgery, but it never gained popularity in SSM [20].

In 1997, Carlson et al. [6] have classified subcutaneous mastectomy into four types based on the type of incision used and the resected skin amount: the type IV is used in large, ptotic breasts whose tissue is excised according to an incision pattern similar to that used in reduction mastopexy.

Wise pattern approach can be used especially for lesions located in the inferior part of the breast (performing a superior or a supero-medial pedicle reduction mammoplasty; a representative case is shown in Fig. 4), or in case of SSM and immediate breast reconstruction that can be achieved through breast implants or a de-epidermized DIEP flap [4].

In these cases a Doppler probe can be used to mark the cutaneous location of the DIEP flap perforators (underlying the native mastectomy flaps) on the mastectomy skin flaps to assure postoperative flap monitoring [21].

"T modified to S" scar, Type G (Santanelli)

One development of the Wise pattern scheme in quadrantectomy for lesions of the upper quadrants has recently been presented by Santanelli et al. [22]. The NAC may be transferred based on a dermoglandular pedicle, either contralateral to the quadrantectomy side or ipsilateral on the top of the spared lower flap, depending on the shortest distance and avoiding any risk of distortion (Fig. 2c, d). Finally, the glandular-skin flaps are sutured to restore the new breast mound.

Discussion

The term "skin-sparing mastectomy" (SSM) has been introduced by Toth and Lappert in 1991 [5]. The careful preoperative planning of SSM incisions allows performing more easily an IBR.

Several types of incisions have been presented to spare the skin in breast cancer surgery. Carlson et al. have classified these approaches into four categories based on the type of incision used and skin amount removed. Type I, II and III of this classification involve mainly small breasts and take into account the location of previous biopsy scars. In all of these cases, mastectomy is carried out using a periareolar approach [6].

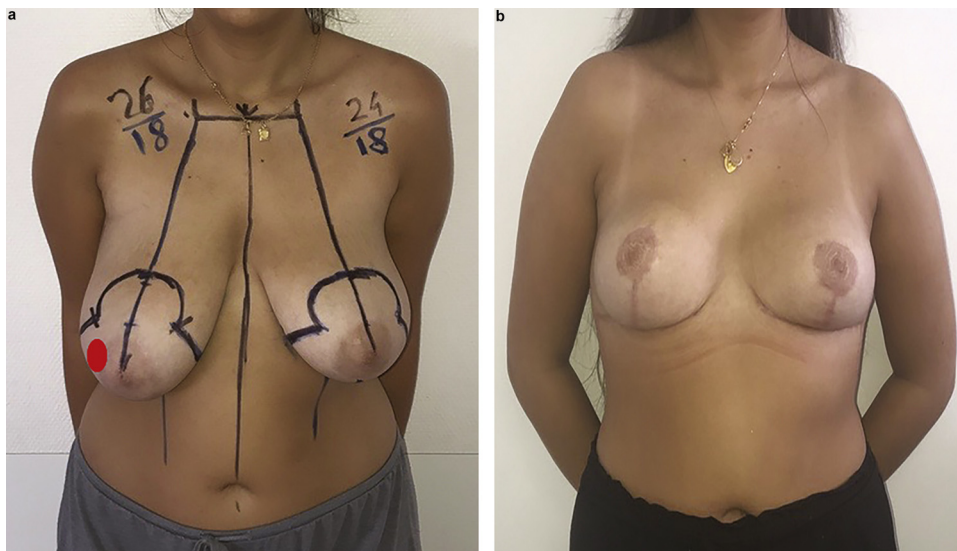


Figure 4 A representative case of Circumareolar inverted T scar Type F (Wise pattern) drawings in a 41-year-old patient with in situ breast ductal carcinoma. Red circle indicates the location of the breast lesion that was excised via this pattern; the supero-medial pedicle technique was used. Immediate contralateral symmetrization, as requested by the patient, was performed (a). Postoperative aspect at 6 months follow up (b).

In the early 1990s, Bostwick has proposed the use of a muscle-skin combined pocket for permanent implant allocation for prophylactic and cosmetic purposes [7].

Hammond et al. have then revisited this technique that may be defined as a variant of the Carlson type IV SSM [8]. The technique combines a SSM with the simultaneous reduction of the breast skin and the highlight of this approach was the use of a lower dermal flap to create a dermo-muscular pocket to reinforce the lower pole of the expander or implant, to avoid its potential exposure inferiorly if the skin incision breaks down.

The term SRM has been introduced by Nava et al. in 2006 [9]. This technique was especially indicated in women with large or ptotic breasts and it was also a good alternative to bilateral prophylactic mastectomy in women at higher risk of breast cancer. This term may be applied to a number of procedures grouped together in any skin reduction procedure combined with subcutaneous mastectomy.

Anyway, caution should be taken when using this approach because the deep blood flow to the skin is interrupted. The inverted T incision mostly interrupts the inferior skin flap blood supply that is only controlled by the dermal microvasculature which may lead to a risk of insufficient mastectomy flap vascularisation [23,24]. Thus we urge caution when performing wise pattern SRM when both autologous tissues and implants are used. On this basis, we recommend surgeons to avoid using the described technique in heavy smokers and if a microvascular disease (e.g., diabetes, postradiation therapy, and so on) is present. In our opinion, the complication rate may be lowered with an accurate patient selection. Immediate breast volume replacement may be performed after NSM thereby improving aesthetic results in patients who are candidates for total mastectomy. The neoplastic involvement of the NAC may be predicted before surgery and assessed intraoperatively [25–30]. When NSM is indicated in patients with moderate or large size or with ptotic breasts, nipple preservation needs to be associated with skin reduction to have a specific group of NSM/SSM. From a technical point of view, this will make more complex the whole procedure and enable the use of very different approaches. The intraoperative assessment of NAC viability is a key point of the surgical technique.

Based on a systematic review of the literature, we tried to establish an ordered list of the numerous techniques and plans described for subcutaneous mastectomies that may often generate confusion due to the various terms used (SSM, SRM, NSM), especially when these procedures are superimposed. Considering that the skin-reducing approaches may be applied to all the conservative breast cancer surgical procedures in which different skin amounts need to be resected, we referred to all these procedures using the term “skin-reducing oncoplasty” (SRO). The different incision patterns that may be used in conservative breast surgery have been listed with the aim to develop a preliminary and possibly universally accepted classification of the several approaches currently available in breast cancer surgery.

This review has limitations. The included studies evaluate a broad spectrum of oncoplastic techniques. We took into account both BCS, SSM, SRM and NSM techniques although there is a difference in blood supply, immediate breast reconstruction possibilities and potential adjuvant treatments. The use of observational data also introduces con-

founding factors, including patient demographics, genetic predisposition, tumour size, specimen weight, nodal status, hormonal status, and neo-adjuvant and/or adjuvant therapy that were not taken into account. Despite this, the aim of this review was not to assess oncologic outcomes but to classify the several approaches available.

Conclusions

Nowadays, the oncologic procedures used in breast cancer should integrate an accurate preoperative assessment to optimise cosmetic outcomes. Most of these procedures require a certain degree of skin envelope reduction. In eligible cases, this may be performed using a single-step operation that we called “skin-reducing oncoplasty”. Through this classification, all our patients who meet appropriate oncologic and reconstructive criteria will benefit from this kind of treatment.

Most women who need a quadrantectomy or a mastectomy are good candidates for SRO, and thanks to a single operation, we might be able to minimize unpleasant scarring and provide favourable cosmetic and psychological outcomes.

Disclosure of interest

The authors declare that they have no competing interest.

Acknowledgements

The authors declare that all contributors meet the criteria for authorship.

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