Aesth Plast Surg (2023) 47:546–556
https://doi.org/10.1007/s00266-022-03115-y

ORIGINAL ARTICLE BREAST SURGERY

"Hook Shape" Nipple-Sparing Mastectomy and Prepectoral Implant Reconstruction: Technique, Results and Outcomes from a Preliminary Case Series

Marco Marcasciano[1] · Federico Lo Torto[2] · Luca Codolini[2] · Juste Kaciulyte[2] · Gianluigi Luridiana[3] · Dario Cassetti[4] · Leonardo Barellini[5] · Alessandro Neri[4] · Diego Ribuffo[2] · Manfredi Greco[1] · Donato Casella[4]

Received: 30 May 2022 / Accepted: 11 September 2022 / Published online: 24 October 2022

Abstract

Introduction Nipple-sparing mastectomy (NSM) is a surgical procedure increasingly performed for breast cancer or risk reduction surgeries. The site of skin incision seems to affect not only cosmesis but also technical ease in operating and vascular viability of the nipple. We present a series of patients who underwent a modified vertical surgical approach for NSM, which resulted to be safe, reliable, and with good esthetic results.

Materials and Methods From December 2016 to February 2019, 27 "Hook Shape" incision NSMs were performed. All patients underwent an immediate subcutaneous muscle-sparing reconstruction with tissue expander covered by a titanium-coated polypropylene mesh, followed by a second surgical step with expander substitution and lipofilling on the definitive implant when indicated. Preoperative and postoperative BREAST-Q patient-reported outcomes measure was performed in all cases.

Results Postoperative morbidity was evaluated: One patient developed seroma and another presented a systemic infection that resolved with intravenous infusion of antibiotics. One patient experienced vertical wound dehiscence, recovered after conservative treatment and without implant exposure. No implant loss was observed. Nipple–areola complex necrosis or ischemia rate was 0%. The BREAST-Q outcomes reported significant increases in the overall satisfaction with breast ($p < 0.05$), psychosocial well-being ($p < 0.05$), and sexual well-being ($p < 0.05$) sections. Scores in the physical impact of surgery section appeared to decline from preoperative to postoperative evaluations, with no statistically significant results.

Conclusion The mastectomy incision pattern can burden the surgical challenge, impact vascular viability of the nipple and significantly affect the aesthetic outcomes in breast reconstruction. We report our experience with an alternative approach for NSM, which appears a safe, practical, and reproducible method for patients with small- to medium-sized breasts and little/medium ptosis (grade I or II).

Level of evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266

Keywords Breast reconstruction · Nipple-sparing mastectomy · Implant-based breast reconstruction · Prepectoral implant reconstruction · Synthetic mesh

✉ Marco Marcasciano
dott.marcomarcasciano@gmail.com

[1] Plastic and Reconstructive Surgery Unit, Magna Graecia University of Catanzaro, Catanzaro, Italy

[2] Unit of Plastic and Reconstructive Surgery, Department of Surgery, P. Valdoni Policlinico Umberto I, Sapienza University of Rome, Rome, Italy

[3] Unit of Oncologic and Breast Surgery, A.O. Brotzu, Businco Oncologic Hospital, Cagliari, Italy

[4] Department of Breast Cancer Surgery, UOC Chirurgia Oncologica Della Mammella, Azienda Ospedaliero-Universitaria Senese, University Hospital of Siena, Siena, Italy

[5] UOC Oncologia Chirurgica Ricostruttiva Della Mammella, Azienda USL Toscana Nord Ovest - Spedali Riuniti di Livorno, Livorno, Italy

Introduction

Nipple-sparing mastectomy (NSM) is a surgical procedure that combines skin-sparing mastectomy (SSM) with the preservation of the nipple–areola complex (NAC).

In general, NSM should be considered for a patient with T0 to T2 tumors smaller than 5 cm, localized more than 2 cm from the areolar edge, and not involving skin envelope or NAC clinically [1, 2].

Preservation of the NAC offers an improved aesthetic outcome and higher quality of life for women with breast cancer, and for these reasons, it is increasingly considered also for risk reduction mastectomies in BRCA 1/2 mutation carriers [3–6].

The overall complication rate of NSM ranges from 0 to 48 percent [3]. Nipple and skin necrosis are the most threatening adverse events and the most common [7–12].

Several investigations have been conducted to assess factors that impact the development of complications that can occur after NSM [3, 13–16]. Age, smoking habit, body mass index (BMI), co-morbidities, breast size, as well as previous surgeries and radiation therapy, are considered patient-related risk factors [2, 17–23].

Instead, technical factors that may play a role in complication rates following NSM have not been exhaustively investigated with no consensus on a standardized surgical approach [24].

The selection of the incision, in particular, appears to affect not only cosmesis but also technical ease of the procedure and vascular viability of the nipple. For this reason, the optimal location of the skin incision for NSM is still a subject of debate. Various techniques have been reported in the literature, and they are associated with different NAC ischemia/necrosis risk and varied patient satisfaction [13, 25–28].

We present an alternative approach for NSM, which resulted to be safe, reliable, and with good esthetic results. A lateral hemi-periareolar incision with an inferior extension to the inframammary fold ("Hook Shape" incision) is drawn to perform a NSM, followed by immediate subcutaneous muscle-sparing breast reconstruction with tissue expander and titanium-coated polypropylene mesh. Technique details, patients satisfaction, and clinical, oncological and aesthetic outcomes are reported.

Materials and Methods

From December 2016 to February 2019, a total of 27 NSM with a "Hook Shape" incision technique were performed. In this retrospective study, all reconstructions were carried out using a subcutaneous tissue expander wrapped in a titanium-coated polypropylene mesh (TCPM) either in the format of a single-layer TiLOOP® Bra (TiLOOP® Bra, pfm medical, Cologne, Germany) or a pre-shaped pocket TiLOOP® Bra (TiLOOP® Bra, pfm medical, Cologne, Germany) [29]. TCPM pockets are available in two sizes, medium or large. The proper device was chosen to each patient according to disposability and to the expander and breast size.

In case of patients with larger breasts, when available, we opted for one medium or large TPCM pocket. In case of "single-layer" mesh and volumes greater than 300cc, two meshes were sutured and tailored around the expander to create an appropriate pocket. Breast expanders were selected taking into account preoperative and intraoperative parameters: Breast size and volume were evaluated at the moment of first consultation. However, after completing the mastectomy, base and height of the new subcutaneous pocket were always assessed intraoperatively and measured, in order to guide surgeons in the selection of the appropriate device.

All expanders were deflated to one-third before the implantation and then placed in a totally subcutaneous prepectoral position. A second reconstructive step was scheduled 6 months after the final expansion, in which the tissue expander was substituted with a definitive silicone-based implant. Patients with small- to medium-sized breasts and little/medium with ptosis (ranging from grade I to grade II) were included. Patients with long distances between NAC and inframammary fold in large sized and high ptotic breasts (grade IV) were not considered good candidates due to the high risk of NAC necrosis and low cosmetic results. Furthermore, exclusion criteria for this series were: previous radiotherapy, previous breast surgeries, inflammatory or metastatic breast cancer, and malignant nipple discharge. Patients with comorbidities like diabetes, renal failure, heart failure, cardiovascular diseases, pulmonary diseases, hepatic diseases, metabolic diseases, and active smokers were also excluded from this study. Follow-up visits were scheduled one month, three months, six months, and one year after final surgery. Data collected included patients' characteristics, short- and long-term complications, and patient satisfaction using the BREAST-Q questionnaire. Postoperative results were evaluated by reporting early and late complications such as NAC necrosis, infection, wound dehiscence, hematoma, seroma, implant failure, and local recurrence.

Surgical Technique

Preoperative markings provide a lateral emiareolar line extended vertically to the inframammary fold with an elliptical shape (Fig. 1a-b). This vertical mark may be designed in an elliptical shape in prevision of a de-epithelialization in order to reduce the width of the skin envelope if necessary.

A lateral emiareolar incision with an extension either from the 12 o'clock to 6 o'clock or from the 6 o'clock up to the 7-9 o'clock depending on the size of the areola/breast and location of the lesion, is followed by a vertical skin incision. This incision extends from just below the base of

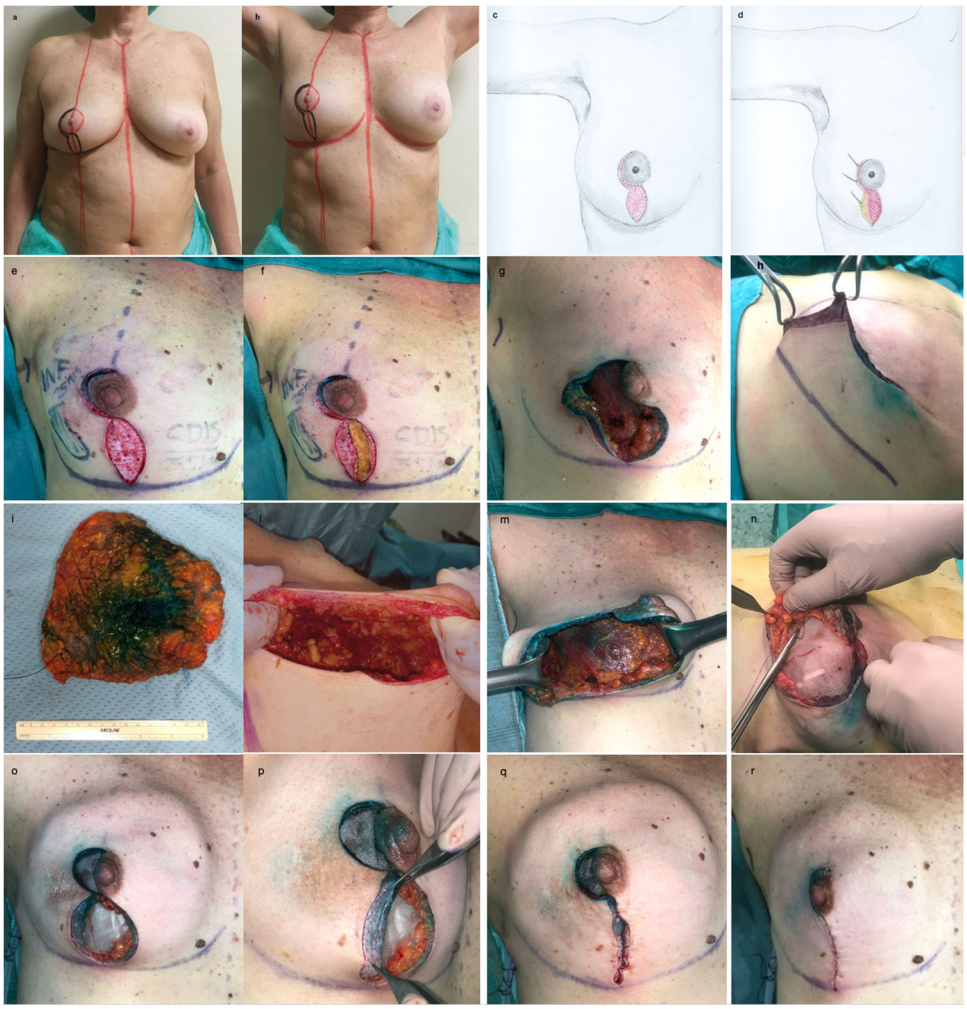

Fig. 1 The collage represents the main steps of the surgical procedure focusing on preoperative markings and intraoperative details. **a** Preoperative markings with arms along the sides; **b** preoperative markings with raised arms; **c** the illustration shows the lateral emiareolar site of incision followed by a vertical extension from the 12 o'clock to approximately 1 cm above the inframammary fold. De-epithelialized area of the breast is highlighted. **d** The illustration shows the lateral based inferior dermal flap elevated in continuity with the later mastectomy flap. Prepectoral pocket with pectoralis major muscular plane is highlighted in red on background; **e** the area included in the incisions is de-epithelialized to prepare the inferior dermal flap; **f** a full-thickness access performed on the medial margin of the de-epithelialized inferior dermal flap follows the de-epithelialization; **g** preservation of a lateral based inferior dermal flap and viable skin flaps after glandular tissue is shaved off the pectoralis major; **h** intraoperative view of the lateral flap of mastectomy in continuity with a vertical dermal flap; **i** intraoperative image of mastectomy breast tissue; **l** skin flaps undergo intraoperative viability check before proceeding with reconstruction: active bleeding at the fresh cut edges along with reasonable thickness to the skin and subcutaneous fat are considered essential to perform a safe prepectoral reconstruction; **m** intraoperative view. "Hook shape" incision allows for a direct view of the surgical field and easy access to all breast quadrants; **n** synthetic mesh-assisted two-stage prepectoral tissue expander reconstruction is performed; **n** cranial, medial and lateral borders of the mesh are secured to the pectoral fascia with absorbable 2-0 interrupted stitches; **o** tissue expander inflated at one-third of its volume, wrapped in a titanium-coated polypropylene mesh and placed in a prepectoral fashion; **p** the lateral based inferior dermal flap is advanced, placed under the margin of the contralateral mastectomy flap; **q** a "double breasted fashion" overlapped multi-layer closure is performed to protect the skin incision and increase vertical implant coverage; **r** final skin closure. Immediate intraoperative result.

the areola to approximately 1 cm above the inframammary fold. The vertical elliptical incision is de-epithelialized to prepare the inferior dermal flap (Fig. 1c).

A full thickness access follows the de-epithelialization. The side of the vertical extension of the incision is chosen according to tumor location, tissue quality and breast characteristics. It can be safely performed either on the medial or lateral margin of the de-epithelialized inferior dermal flap (Fig. 1f).

Skin flaps are raised using scissors dissection that is carried out through the avascular plane between the subcutaneous tissue and the fascia, resecting Cooper's ligaments. Dissection of the sub-nipple area and the nearby mastectomy flaps performed from this incision is usually fast and reliable, sped up by the chance of direct view of the surgical field and comfortable access to all quadrants (Fig. 1g). After completing the dissection of even cutaneous flaps, glandular tissue is shaved off the pectoralis major using electrocautery (Fig. 1h-i).

Mastectomy flap viability has been assessed clinically in the intraoperative setting: skin flaps undergo intraoperative viability check before proceeding with reconstruction: Parameters such as skin color, capillary refill time and active dermal bleeding from the fresh cut skin edges along with reasonable thickness to the skin and subcutaneous fat are considered essential to guide resection of non-viable tissue and to allow a prepectoral reconstruction (Fig. 1l). After hemostasis, a single suction drain is placed in the subcutaneous plane, except for cases in which an axillary dissection is performed, which necessarily requires a supplementary drainage (Fig. 1m). Two-stage prepectoral breast reconstruction using subcutaneous tissue expanders wrapped in a titanium-coated polypropylene mesh (TCPM) was performed as described in our precedent studies [29–34] (Video 1).

The expander is inflated at one-third of its volume and placed over the pectoralis major muscle, covered by a titanium-coated polypropylene mesh. Cranial, medial and lateral borders of the mesh were secured to the pectoral fascia with absorbable 2-0 interrupted stiches (Fig. 1m-n).

The inferior dermal flap resulting from the vertical de-epithelialization, is meant to offer protection to the skin suture and prevent implant exposure by performing a "double breasted fashion" multilayer closure (Video 2).

It is advanced and placed under the margin of the contralateral mastectomy flap (Fig. 1p). It can be simply overlapped over the synthetic mesh or loosely anchored to it with resorbable stiches to prevent its mobilization. Then, its medial portion is sutured to the preserved dermal edge of contralateral mastectomy flap in order to increase vertical implant coverage (Fig. 1q-r). For each procedure, the surgical prophylaxis includes intravenous broad-spectrum antibiotics 30 minutes before incision. After surgery, all patients are maintained on broad-spectrum antibiotics for at least 5 days or until drainage removal. Outpatient expansions are administered every week or every 2 weeks beginning from the second week after surgery, until reaching the desired volume. Breast reconstruction is completed with the second stage procedure approximately 6 months after the end of the expansion (Fig. 2). Tissue expander is removed and replaced with a definitive implant either through the same incision or a new inframammary approach, depending on patients' features and desire (Fig. 3).

Usually a small, hidden inframammary approach is elected in order to avoid vertical scar impairment, and a full-thickness incision performed to access the prepectoral pocket. At this time, the titanium-coated polypropylene mesh that covers the expander is completely integrated with the mastectomy flaps, playing as a framework to support a sort of "neofascia" with good capsular consistence and low incidence of contractures, shrinkage and inflammation. The capsule continuity is surgically restored, the wound is resutured by layers, and inferior sulcus definition is carried out, when required (Fig. 4).

At the same time, homolateral lipofilling [35, 36] and/or contralateral mastopexy, implant augmentation, or reduction mammaplasty may be performed, when necessary.

Outcomes and Measures

The BREAST-Q questionnaire is routinely submitted to the patients one month before surgery and 1 year after the completion of breast reconstruction. Written informed consent for the use of clinical records was obtained from each participant. The BREAST-Q was designed to meet high standards of medical outcomes evaluation in patients undergoing breast surgery [37–39]. It has been extensively validated for research in breast reconstruction, and it is routinely used at our institutions [30]. All aspects of the BREAST-Q reconstructive module (Satisfaction with Breasts, Satisfaction with Outcome, Psychosocial Well-Being, Physical Well-Being, and Sexual Well-Being) were analyzed.

Statistical Analysis

SPSS software (IBM Corp., Armonk, NY) was used for simple descriptive statistics, accounting for patient sociodemographic, clinical characteristics, complications, and satisfaction grade. Using the Q-Score Scoring Software, BREAST-Q scores for each matrix were converted from survey raw scores (1 through 4 or 5) to a continuous range from 0 to 100, with a higher score representing greater satisfaction or better HRQOL. Absolute scores and their changes with time were studied. The Shapiro–Wilk

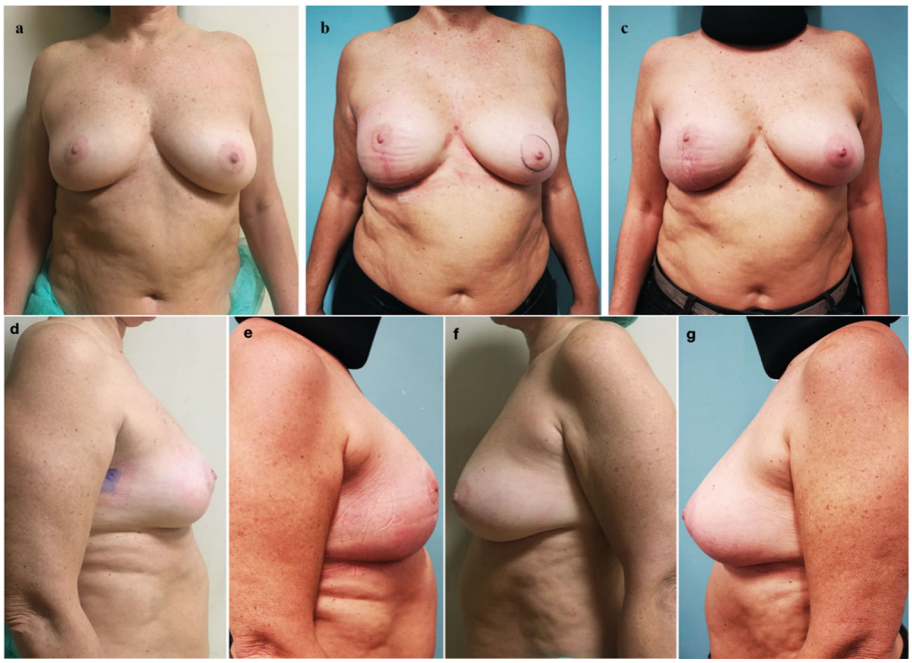

Fig. 2 "Hook Shape" two-stage NSM in a 62-year-old patient, with an invasive carcinoma NST (pT1bN0) on the right breast. Contralateral symmetrization was not performed according to the will of the patient. **a** Preoperative view; **b** postoperative view with prepectoral tissue expander; **c** postoperative view with definitive implant; **d** preoperative lateral view of the right breast; **e** postoperative lateral view of the right breast with definitive implant; **f** preoperative lateral view of the left breast; **g** postoperative lateral view of the contralateral left breast.

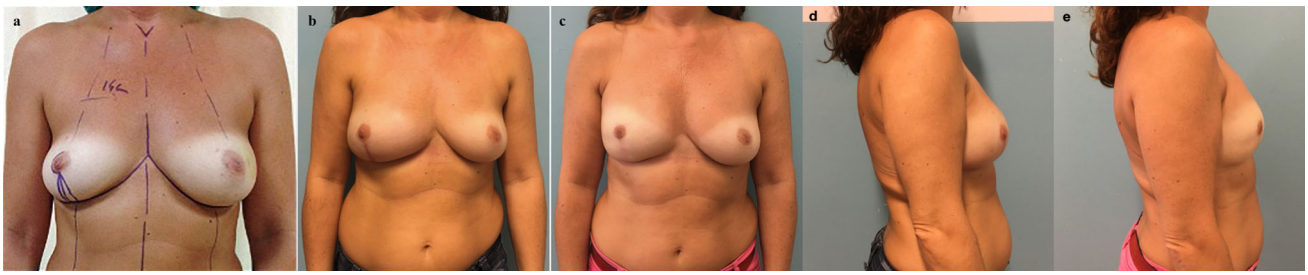

Fig. 3 Monolateral "Hook Shape" NSM in a 54-year-old patient, with an invasive carcinoma NST (pT1cN0) in her right breast. **a** Preoperative view; **b** postoperative view with prepectoral tissue expander; **c** postoperative view with definitive implant; **d** postoperative lateral view of the right breast with prepectoral tissue expander; **e** postoperative lateral view of the right breast with definitive implant.

test was used to verify the normal distribution of continuous variables. Consequently, BREAST-Q scores and panel scores were analyzed as continuous variables using Student's *t*-test. *P* values less than 0.05 were considered statistically significant.

Results

A total of 27 NSMs with "Hook Shape" incision and immediate reconstruction with subcutaneous tissue expander covered by a titanium-coated polypropylene mesh were performed in 25 female patients with breast cancer (23 monolateral and 2 bilateral mastectomies). Patients' characteristics and surgical procedures are listed in Table 1. Mean age was 47 years (range: 29-55 years). Mean BMI was 24.3 (range: 20-35). Most of the 25 patients were medium breast preoperatively (17 medium–8 small). Breast expanders with low or moderate height and intermediate projections were preferred in this series (volumes ranging between 275 and 600 cc).

Mean size of the tumors encountered was 2.5 cm ± 0.8 cm. Lymph node metastasis was found during 2 procedures (8%). All 27 mastectomies received intraoperative subnipple biopsy, all of which showed lack of invasion by malignancy. All final surgical margins were clear of residual disease. Postoperative complications are shown in Table 2. The overall complication rate was 11% (3 out of 27 procedures). There were no major or life-threatening complications. No hematoma was found in the postoperative period. One patient developed a seroma, which resolved after repeated aspiration in conjunction with expansion as previously described by the authors [31]. Another patient developed a serious infection that resolved with intravenous infusion of antibiotics and prompt substitution with the definitive implant. One patient experienced vertical wound dehiscence, recovered after conservative treatment and without implant exposure. No

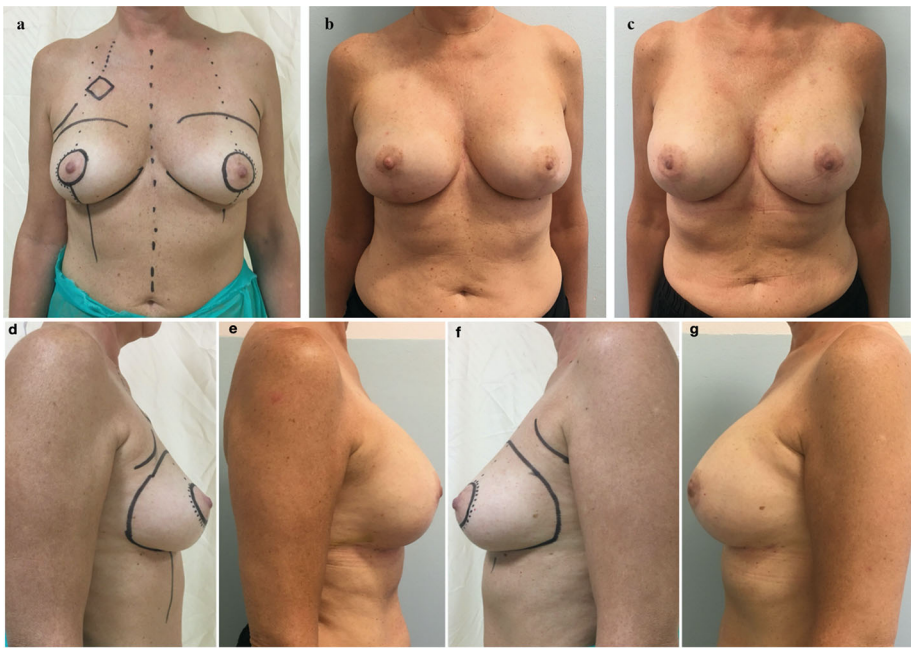

Fig. 4 Bilateral "Hook Shape" NSM in a 49-year-old patient, **a** preoperative view; **b** postoperative view with prepectoral tissue expander; **c** postoperative view with definitive implant; **d** preoperative lateral view of the right breast; **e** postoperative lateral view of the right breast with definitive implant; **f** preoperative lateral view of the left breast; **g** postoperative lateral view of the left breast with definitive implant.

Table 1 Patients characteristics

Nipple-sparing mastectomy	27
Pre-pectoral expander reconstruction	27
Breast size	Small to medium
Breast ptosis	Grade I-II
Age	47 (range 29-55)
BMI	24.3 (range 20-35)

Table 2 Post-operative complications

Hematoma	0 (0%)
Seroma	1 (4%)
Infection	1 (4%)
Wound dehiscence	1 (4%)
Implant Loss	0 (0%)
Nipple–areola complex necrosis	0 (0%)
Overall complications	3 (11%)

implant loss was observed. NAC necrosis or ischemia rate was 0%. Postoperative adjuvant hormone therapy, chemotherapy, and radiotherapy were given to patients according to current breast cancer guidelines. No locoregional recurrence, distant metastasis, and mortality were registered. All patients adequately answered the five domains of BREAST-Q questionnaire administered before and after surgery. As shown in Table 3, significant increases were reported in the overall satisfaction with breast ($p < 0.05$), psychosocial well-being ($p < 0.05$), and sexual well-being ($p < 0.05$) sections. Scores in the physical impact of surgery section appeared to decline from preoperative to postoperative evaluations, with no statistically significant results.

Discussion

Nowadays, the combination of NSM and immediate breast reconstruction is considered the surgical strategy of choice in selected patients [40–42]. The NAC preservation leads to superior cosmetic outcomes, avoiding feelings of loss arising from mutilation [43].

NAC necrosis due to poor blood supply is the most common complication following NSM, and it occurs in 0-48% of cases, with most series reporting 10–15% [3, 10, 13, 44–47].

According to Colwell et al. [3], preoperative radiotherapy, implant's volume, and periareolar incision may increase the risk of NAC necrosis. Recently, Frey et al. [48] analyzed the issue of incision choices in NSM and presented the effects of different incision sites on complications incidence after breast reconstruction: Vertical radial, lateral radial and inframammary fold incisions were associated with low complication rates. To date, there is no standardized surgical approach for NSM and following breast reconstruction to prevent postoperative complications. Various surgical techniques have been described, and surgeon's comfort level with a particular procedure appears to be an important factor in choosing the incision type. Frey et al. [48] reported lower rates of complications with

Table 3 BREST-Q scores recorded postoperatively and one year postoperatively expressed as mean ± standard deviation. Changes in scores are expressed as delta (postoperative score minus preoperative score). $P < 0.05$

Domain	Preoperative mean (+/− SD)	Postoperative mean (+/− SD)	Delta mean	*p*-value
Satisfaction-breasts	58,7 (±10,2)	67,7 (±12)	9	0.0065
Psychosocial wellness	62,2 (±10,4)	71,9 (±13)	9,7	0.0053
Sexual well-being	52,2 (±7,6)	57,8 (±8,9)	5,6	0.0199
Physical impact (chest)	68,6 (±9,9)	67,1 (±10,1)	− 1,5	0.5945
Overall satisfaction with outcome	–	73,8 (±12)	–	–

vertical radial incision, if compared to other approaches, except for inframammary fold incision. In a recent paper, Adi Maisel Lotan et al. aimed to assess the influence of mastectomy scars on breast reconstruction aesthetics and provide a treatment algorithm for mastectomy incision selection. This interesting study confirms that patients with non-ptotic breasts who are likely to benefit from a nipple-sparing mastectomy are ideally treated with a hidden inframammary fold incision or a vertical incision, depending on the breast surgeon's preference. Nevertheless, we believe it is not always feasible, especially in case of larger and "higher" breasts, and eventually may cause technical issues during the oncological step of the procedure.

Moreover, the authors focus on the aesthetic outcomes related to the different incisional patterns, with no mention on complications incidence and oncological outcomes [49].

In our series, we reported no NAC ischemia or necrosis using a lateral emiareolar and vertical incision technique, followed by subcutaneous expander placement. Our results differ from part of the literature concerning periareolar incisions that have been discouraged facing results with high rates of NAC and skin flap necrosis [45, 46].

Indeed, main NAC blood supply comes from four different arterial sources: branches from the lateral thoracic artery, the internal mammary artery, the anterior perforators of the intercostal arteries, and branches from the highest thoracic arteries [50]. All these sources come from lateral and medial areas surrounding the NAC, making the inferior vertical incision less hazardous. Even the periareolar incision was limited as possible, less of half of the areolar diameter, from the 6 o'clock to the 7-9 o'clock when feasible. Moreover, mastectomy flaps viability not only depends on incision localization. A periareolar incision with a vertical prolongation guarantees a comfortable approach to the dissection both of gland and subnipple area. With an excellent tissue exposure and the possibility to perform all surgical steps of the dissection under direct visualization, a viable and adequate flap is easier to carve. In particular, it is easier to preserve the medial intercostal perforator arteries, thus preventing NAC vascular impairment [51, 52].

In fact, mastectomy flaps' viability represents a key factor in the success of immediate breast reconstruction. Flap necrosis can lead to infection, implant extrusion, reoperation, and reconstructive failure. Viable flaps may be traditionally assessed by clinical judgment, but a more objective and reliable evaluation can be provided using innovative intraoperative imaging technologies, such as indocyanine green angiography for the intraoperative assessment of the perfusion and ischemic stress resistance [53, 54].

Moreover, an even distribution and adequate fixation of the synthetic mesh to the pectoralis fascia as well as skin flaps viability may be eased by the use of deflated expanders that favors gentler manipulation of the devices, reduce tension and minimizes immediate tissues expansion.

Indeed, the subcutaneous expander is inflated to one-third of its volume when inserted, and it is filled postoperatively. The prepectoral pocket is shaped progressively, with less tension on skin capillaries, leading to better and safer outcomes [55].

On the other hand, the titanium-coated polypropylene mesh that covers the expanders helps to achieve a good cell growth and low incidence of capsule contracture, shrinkage and inflammation [29].

The area under major tension is the vertical incision and is considered at risk for wound dehiscence. We believe that it is essential to strengthen this area and reduce tension, in order to reduce implant-related complications. For this, we preserve a vertical dermal flap that adds coverage on the lower half of the implant. In our experience, this maneuver can prevent implant's exposure and reconstruction failure, if superficial skin dehiscence occurs [56]. Keeping in mind that contralateral breast adjustment is carried out frequently [57] especially in terms of mastopexy, the presence of a vertical scar in the mastectomy side reveals to be aesthetically favorable, as breasts show symmetrical scar disposition with the possibility of performing a slight reduction of the width of the mammary base and its skin envelope when required. Another concern about NSM regards

oncological safety. Sceptics base their doubts on local recurrence possibility for residual disease in the skin envelope or occult nipple involvement. However, it has been demonstrated that NSM does not compromise oncological safety in well-selected patients and recent studies seem to extend the inclusion criteria to NSM, confirming its use in any circumstance calling for total mastectomy if intraoperative frozen sections of sub-nipple–areola complex tissue are tumor-free [2, 3, 41, 58].

In this series, all surgeries were performed by breast unit surgical teams, composed by general and plastic surgeons [59]. In such patients, the challenge lies in complete removal of all breast tissue to ensure oncological safety, while leaving sufficient skin flap thickness to maintain skin viability (Fig. 3). No surgical margin involvement was observed on the final pathologist checkup confirming oncological safety of the vertical access. With a "hook shape" approach, we can comfortably perform superior, inferior, medial, and lateral dissection without excessive retraction damage that may contribute to the impairment of flaps viability, especially when a prepectoral reconstruction is planned. In our opinion, this represents an enormous advantage ensuring minimum stretching to the flaps and oncological safety, especially for the dissection of inner quadrants and multicentric tumors. Moreover, a complete exposure of the field through the "hook shape" incision, allows for direct sentinel node biopsy and eventually oncological skin removal at the inferior quadrants, with no need for additional incisions and surgical scars. Ideally, either one-stage or two-stage, retro muscular or prepectoral reconstruction can be safely performed through this approach leading to good results [60, 61].

Direct-to-implant (DTI) breast reconstruction has proved to be a reliable one-stage alternative for selected patients undergoing conservative mastectomies with reliable mastectomy skin envelopes. As reported by Salzberg et al., ideal candidates for DTI are patients with medium to small breast size, grade 1 to 2 breast ptosis, and good skin quality [62].

As an alternative, Barnea et al. presented their experience with the anatomical Becker expandable implant in a large series of patients who underwent either IBR or a salvage procedure for IBR with anatomically shaped permanent expandable implants [63]. Favorable indications include contralateral breast augmentation and patients with major comorbidities, with the possibility to adjust the size of the implant postoperatively to enable gradual stretching of the skin flaps and to enhance breast symmetry in a single-stage procedure.

However, not all patients are suitable for these approaches and choosing the best procedure requires a thorough understanding of the benefits and drawbacks of every technique, to offer every single candidate the best tailored reconstructive option. Subpectoral implant placement offers some advantages: minimal implant visibility, reduced rippling and minimal palpability of implant edges at the upper pole. However, pectoralis major detachment leads to morbidity, animation deformity and postoperative pain [61, 64]. Prepectoral breast reconstruction is experiencing an important revival, and proper patient selection is absolutely critical to achieve surgical success [29]. Surgical risks should be assessed with a precise and personalized method, highlighting patient's comorbidities (smoking habit, diabetes, previous surgeries/radiotherapy, BMI, etc.), to eventually safely outline the surgical indication toward a prepectoral or submuscular breast reconstruction [33].

A general health consideration including a full history and general clinical examination as well as the screening of relevant patient-related preoperative and intraoperative risk factors is mandatory in decision-making and timing of reconstruction.

While demonstrating the safety and reliability of the "hook shape" technique, our data reported patients satisfaction, outcomes and quality of life through the analysis of BREAST-Q scores (Video 3).

The postoperative data were evaluated both in absolute terms and in relation to preoperative results, because changes in scores were considered more reliable.

Data about BREAST-Q outcomes for quality of life after 1 year confirmed what we recently reported about patient satisfaction after NSM and implant-based immediate prepectoral breast reconstruction with titanium-coated polypropylene mesh [44].

The two-stage reconstruction was carried out with the aim to achieve the advantages of the prepectoral approach, even in hazardous cases with thinner skin flaps. While lower tension was applied to the skin, the second reconstructive step was used to condense further essential surgeries: Fat grafts were injected to improve implant coverage [65] and contralateral breast adjustment, as mastopexy, allowed to reach better symmetry and improve postural balance [66].

Conclusion

The mastectomy incision pattern impact on vascular viability of the nipple significantly affects the aesthetic outcomes in breast reconstruction. We report our experience with an alternative incision for NSM which resulted to be safe and reproducible, with low complication and high satisfaction rates, in patients with small- to medium-sized breasts and little/medium ptosis.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00266-022-03115-y.

Acknowledgement We here acknowledge Miss Ottavia Cecchi, for her explanatory drawings of the technique.

Declarations

Conflict of interest Author Donato Casella has received a speaker honorarium from Pfm Medical, TiLOOP® Bra manufacturing company and is a member of Arista Breast Advisory Board for Becton Dickinson Italia S.p.a.. Author Dario Cassetti is a member of Arista Breast Advisory Board for Becton Dickinson Italia S.p.a.. The other authors declare that they have no conflicts of interest.

Human and Animal Rights This article does not contain any studies with human participant or animals performed by any of the authors.

Informed consent For this type of study informed consent is not required.

References

1. Fortunato L, Loreti A, Andrich R et al (2013) When mastectomy is needed: is the nipple-sparing procedure a new standard with very few contraindications? J Surg Oncol 108:207–212. https://doi.org/10.1002/jso.23390
2. Petit JY, Veronesi U, Orecchia R et al (2009) Nipple sparing mastectomy with nipple areola intraoperative radiotherapy: one thousand and one cases of a five years experience at the European institute of oncology of Milan (EIO). Breast Cancer Res Treat 117:333–338. https://doi.org/10.1007/s10549-008-0304-y
3. Colwell AS, Tessler O, Lin AM et al (2014) Breast reconstruction following nipple-sparing mastectomy: Predictors of complications, reconstruction outcomes, and 5-year trends. Plast Reconstr Surg 133:496–506. https://doi.org/10.1097/01.prs.0000438056.67375.75
4. Frederick MJ, Lin AM, Neuman R et al (2015) Nipple-sparing mastectomy in patients with previous breast surgery: comparative analysis of 775 immediate breast reconstructions. Plast Reconstr Surg 135:954e–962e. https://doi.org/10.1097/PRS.0000000000001283
5. Reish RG, Lin A, Phillips NA et al (2015) Breast reconstruction outcomes after nipple-sparing mastectomy and radiation therapy. Plast Reconstr Surg 135:959–966. https://doi.org/10.1097/PRS.0000000000001129
6. Zarba Meli E, Cattin F, Curcio A et al (2019) Surgical delay may extend the indications for nipple-sparing mastectomy: a multicentric study. Eur J Surg Oncol J Eur Soc Surg Oncol Br Assoc Surg Oncol 45:1373–1377. https://doi.org/10.1016/j.ejso.2019.02.014
7. Caruso F, Ferrara M, Castiglione G et al (2006) Nipple sparing subcutaneous mastectomy: Sixty-six months follow-up. Eur J Surg Oncol 32:937–940. https://doi.org/10.1016/j.ejso.2006.05.013
8. Petit JY, Veronesi U, Orecchia R et al (2006) Nipple-sparing mastectomy in association with intra operative radiotherapy (ELIOT): A new type of mastectomy for breast cancer treatment. Breast Cancer Res Treat 96:47–51. https://doi.org/10.1007/s10549-005-9033-7
9. Psaila A, Pozzi M, Barone Adesi L et al (2006) Nipple sparing mastectomy with immediate breast reconstruction: a short term analysis of our experience. J Exp Clin Cancer Res 25:309–312
10. Komorowski AL, Zanini V, Regolo L et al (2006) Necrotic complications after nipple- and areola-sparing mastectomy. World J Surg 30:1410–1413. https://doi.org/10.1007/s00268-005-0650-4
11. Rusby JE, Smith BL, Gui GPH (2010) Nipple-sparing mastectomy. Br J Surg 97:305–316. https://doi.org/10.1002/bjs.6970
12. Petit JY, Veronesi U, Rey P et al (2009) Nipple-sparing mastectomy: risk of nipple-areolar recurrences in a series of 579 cases. Breast Cancer Res Treat 114:97–101. https://doi.org/10.1007/s10549-008-9968-6
13. Davies K, Allan L, Roblin P et al (2011) Factors affecting postoperative complications following skin sparing mastectomy with immediate breast reconstruction. Breast 20:21–25. https://doi.org/10.1016/j.breast.2010.06.006
14. Gould DJ, Hunt KK, Liu J, Kuerer HM, Crosby MA, Babiera G, Kronowitz SJ (2013) Impact of surgical techniques, biomaterials, and patient variables on rate of nipple necrosis after nipple-sparing mastectomy. Plast Reconstr Surg 132(3):330e–338e. https://doi.org/10.1097/PRS.0b013e31829ace49
15. Dent BL, Small K, Swistel A, Talmor M (2014) Nipple-areolar complex ischemia after nipple-sparing mastectomy with immediate implant-based reconstruction: risk factors and the success of conservative treatment. Aesthetic Surg J 34:560–570. https://doi.org/10.1177/1090820X14528352
16. Losco L, Cigna E (2018) Aesthetic refinements in C-V Flap: raising a perfect cylinder. Aesthetic Surg J 38:NP26–NP28. https://doi.org/10.1093/ASJ/SJX195
17. Tang R, Coopey SB, Colwell AS et al (2015) Nipple-sparing mastectomy in irradiated breasts: selecting patients to minimize complications. Ann Surg Oncol 22:3331–3337. https://doi.org/10.1245/s10434-015-4669-y
18. Ribuffo D, Berna G, De Vita R et al (2021) Dual-plane retropectoral versus pre-pectoral DTI Breast Reconstruction: an Italian multicenter experience. Aesthetic Plast Surg 45:51–60. https://doi.org/10.1007/s00266-020-01892-y
19. Marcasciano M, Kaciulyte J, Di Giuli R et al (2021) Just pulse it Introduction of a conservative implant salvage protocol to manage infection in pre-pectoral breast reconstruction: case series and literature review. J Plast Reconstr Aesthet Surg. https://doi.org/10.1016/j.bjps.2021.09.060
20. Lo Torto F, Vaia N, Casella D et al (2018) Delaying implant-based mammary reconstruction after radiotherapy does not decrease capsular contracture: An in vitro study. J Plast Reconstr Aesthetic Surg 71:28–29
21. Lo Torto F, Cigna E, Kaciulyte J et al (2017) National breast reconstruction utilization in the setting of postmastectomy radiotherapy: two-stage implant-based breast reconstruction. J Reconstr Microsurg 33:E3
22. Lo Torto F, Vaia N, Ribuffo D (2017) Postmastectomy radiation therapy and two-stage implant-based breast reconstruction: is there a better time to irradiate? Plast Reconstr Surg 139:1364e–1365e
23. Marcasciano M, Conversi A, Kaciulyte J, Dessy LA (2017) RE: prosthetic breast implant rupture: imaging-pictorial essay : full cooperation between surgeon and radiologist: “the best of both worlds.” Aesthetic Plast Surg 41:1478–1480
24. Marcasciano M, Kaciulyte J, Mori FLR et al (2020) Breast surgeons updating on the thresholds of COVID-19 era: results of a multicenter collaborative study evaluating the role of online videos and multimedia sources on breast surgeons education and training. Eur Rev Med Pharmacol Sci 24:7845–7854. https://doi.org/10.26355/EURREV_202007_22289
25. Carlson GW, Chu CK, Moyer HR et al (2014) Predictors of nipple ischemia after nipple sparing mastectomy. Breast J 20:69–73. https://doi.org/10.1111/tbj.12208

26. Endara M, Chen D, Verma K et al (2013) Breast reconstruction following nipple-sparing mastectomy: a systematic review of the literature with pooled analysis. Plast Reconstr Surg 132:1043–1054. https://doi.org/10.1097/PRS.0b013e3182a48b8a
27. Lai HW, Chen ST, Chen DR, Chen SL, Chang TW, Kuo SJ, Kuo YL, Hung CS (2016) Current trends in and indications for endoscopy-assisted breast surgery for breast cancer: results from a six-year study conducted by the Taiwan endoscopic breast surgery cooperative group. PLoS One 11(3):e0150310. https://doi.org/10.1371/journal.pone.0150310
28. Chirappapha P, Petit J-Y, Rietjens M et al (2014) Nipple sparing mastectomy: does breast morphological factor related to necrotic complications? Plast Reconstr surgery Glob open 2:e99. https://doi.org/10.1097/GOX.0000000000000038
29. Torto FLO, Marcasciano M, Kaciulyte J et al (2020) Prepectoral breast reconstruction with TiLoop® Bra Pocket: a single center prospective study. Eur Rev Med Pharmacol Sci 24:991–999. https://doi.org/10.26355/EURREV_202002_20149
30. Casella D, Di Taranto G, Marcasciano M et al (2018) Nipple-sparing bilateral prophylactic mastectomy and immediate reconstruction with TiLoop® Bra mesh in BRCA1/2 mutation carriers: a prospective study of long-term and patient reported outcomes using the BREAST-Q. Breast 39:8–13. https://doi.org/10.1016/j.breast.2018.02.001
31. Marcasciano M, Kaciulyte J, Marcasciano F et al (2019) "No drain, no gain": simultaneous seroma drainage and tissue expansion in pre-pectoral tissue expander-based breast reconstruction. Aesthetic Plast Surg 43:1118–1119. https://doi.org/10.1007/s00266-018-1192-0
32. Casella D, Bernini M, Bencini L et al (2014) TiLoop® Bra mesh used for immediate breast reconstruction: comparison of retropectoral and subcutaneous implant placement in a prospective single-institution series. Eur J Plast Surg 37:599–604. https://doi.org/10.1007/s00238-014-1001-1
33. Casella D, Kaciulyte J, Lo Torto F et al (2021) "To pre or not to pre": introduction of a prepectoral breast reconstruction assessment score to help surgeons solving the decision-making dilemma. retrospective results of a multicenter experience. Plast Reconstr Surg 147:1278–1286. https://doi.org/10.1097/PRS.0000000000008120
34. Casella D, Calabrese C, Bianchi S et al (2015) Subcutaneous tissue expander placement with synthetic titanium-coated mesh in breast reconstruction: long-term results. Plast. Reconstr. surgery. Glob. open 3:e577
35. Calabrese C, Kothari A, Badylak S et al (2018) Oncological safety of stromal vascular fraction enriched fat grafting in two-stage breast reconstruction after nipple sparing mastectomy: long-term results of a prospective study. Eur Rev Med Pharmacol Sci 22:4768–4777. https://doi.org/10.26355/eurrev_201808_15610
36. Dessy LA, Marcasciano M, Rossi A, Mazzocchi M (2015) Response to comments on a simple device for syringe-to-syringe transfer during lipofilling. Aesthetic Surg J 35:NP242–NP243
37. Pusic AL, Klassen AF, Scott AM et al (2009) Development of a new patient-reported outcome measure for breast surgery: the BREAST-Q. Plast Reconstr Surg 124:345–353. https://doi.org/10.1097/PRS.0b013e3181aee807
38. Wei CH, Scott AM, Price AN et al (2016) Psychosocial and sexual well-being following nipple-sparing mastectomy and reconstruction. Breast J 22:10–17. https://doi.org/10.1111/tbj.12542
39. Casella D, Di Taranto G, Marcasciano M et al (2019) Evaluation of prepectoral implant placement and complete coverage with Tiloop bra mesh for breast reconstruction: a prospective study on long-term and patient-reported breast-q outcomes. Plast Reconstr Surg 143:1E-9E. https://doi.org/10.1097/PRS.0000000000005078
40. Marcasciano M, Frattaroli J, Mori FLR et al (2019) The new trend of pre-pectoral breast reconstruction: an objective evaluation of the quality of online information for patients undergoing breast reconstruction. Aesthetic Plast Surg 43:593–599. https://doi.org/10.1007/s00266-019-01311-x
41. Mallon P, Feron J-G, Couturaud B et al (2013) The role of nipple-sparing mastectomy in breast cancer: a comprehensive review of the literature. Plast Reconstr Surg 131:969–984. https://doi.org/10.1097/PRS.0b013e3182865a3c
42. Shi A, Wu D, Li X et al (2012) Subcutaneous nipple-sparing mastectomy and immediate breast reconstruction. Breast Care 7:131–136. https://doi.org/10.1159/000337640
43. Spear SL, Willey SC, Feldman ED et al (2011) Nipple-sparing mastectomy for prophylactic and therapeutic indications. Plast Reconstr Surg 128:1005–1014. https://doi.org/10.1097/PRS.0b013e31822b6456
44. Crowe JP, Patrick RJ, Yetman RJ, Djohan R (2008) Nipple-sparing mastectomy update: one hundred forty-nine procedures and clinical outcomes. Arch Surg 143(11):1106–1110. https://doi.org/10.1001/archsurg.143.11.1106
45. de Alcantara FP, Capko D, Barry JM et al (2011) Nipple-sparing mastectomy for breast cancer and risk-reducing surgery: the memorial sloan-kettering cancer center experience. Ann Surg Oncol 18:3117–3122. https://doi.org/10.1245/s10434-011-1974-y
46. De Vita R, Zoccali G, Buccheri EM et al (2017) Outcome evaluation after 2023 nipple-sparing mastectomies: our experience. Plast Reconstr Surg 139:335e–347e. https://doi.org/10.1097/PRS.0000000000003027
47. Algaithy ZK, Petit JY, Lohsiriwat V et al (2012) Nipple sparing mastectomy: can we predict the factors predisposing to necrosis? Eur J Surg Oncol J Eur Soc Surg Oncol Br Assoc Surg Oncol 38:125–129. https://doi.org/10.1016/j.ejso.2011.10.007
48. Frey JD, Salibian AA, Levine JP et al (2018) Incision choices in nipple-sparing mastectomy: a comparative analysis of outcomes and evolution of a clinical algorithm. Plast Reconstr Surg 142:826e–835e. https://doi.org/10.1097/PRS.0000000000004969
49. Lotan AM, Tongson KC, Police AM, Dec W (2020) Mastectomy incision design to optimize aesthetic outcomes in breast reconstruction. Plast Reconstr surgery Glob open 8:e3086. https://doi.org/10.1097/GOX.0000000000003086
50. O'Dey DM, Prescher A, Pallua N (2007) Vascular reliability of nipple-areola complex-bearing pedicles: an anatomical microdissection study. Plast Reconstr Surg 119:1167–1177. https://doi.org/10.1097/01.prs.0000254360.98241.dc
51. van Deventer PV (2004) The blood supply to the nipple-areola complex of the human mammary gland. Aesthetic Plast Surg 28:393–398. https://doi.org/10.1007/s00266-003-7113-9
52. Palmer JH, Taylor GI (1986) The vascular territories of the anterior chest wall. Br J Plast Surg 39:287–299. https://doi.org/10.1016/0007-1226(86)90037-8
53. Jeon FHK, Varghese J, Griffin M et al (2018) Systematic review of methodologies used to assess mastectomy flap viability. BJS open 2:175–184. https://doi.org/10.1002/bjs5.61
54. Mundy LR, Sergesketter AR, Phillips BT (2020) optimizing intraoperative evaluation of mastectomy skin flap viability. Plast Reconstr surgery Glob open 8:e2935. https://doi.org/10.1097/GOX.0000000000002935
55. Munhoz AM, Aldrighi CM, Montag E et al (2013) Clinical outcomes following nipple-areola-sparing mastectomy with immediate implant-based breast reconstruction: a 12-year experience with an analysis of patient and breast-related factors for complications. Breast Cancer Res Treat 140:545–555. https://doi.org/10.1007/s10549-013-2634-7
56. Marcasciano MdM, Kaciulyte J, Gentilucci M et al (2018) Skin-reduction breast reconstructions with prepectoral implant covered

by a combined dermal flap and titanium-coated polypropylene mesh. J Plast Reconstr Aesthet Surg 71:1123–1128
57. Razdan SN, Panchal H, Albornoz CR et al (2019) Impact of contralateral symmetry procedures on long-term patient-reported outcomes following unilateral prosthetic breast reconstruction. J Reconstr Microsurg 35:124–128. https://doi.org/10.1055/s-0038-1667365
58. Voltura AM, Tsangaris TN, Rosson GD et al (2008) Nipple-sparing mastectomy: critical assessment of 51 procedures and implications for selection criteria. Ann Surg Oncol 15:3396–3401. https://doi.org/10.1245/s10434-008-0102-0
59. Marcasciano M, Kaciulyte J, Mori FLR et al (2021) Plastic surgery in the time of Coronavirus in Italy. Maybe we should say: "Thanks Darwin we are Plastic Surgeons!" J Plast Reconstr Aesthet Surg 74:1633–1701
60. Casella D, Lo Torto F, Marcasciano M et al (2021) Breast Animation Deformity: A Retrospective Study on Long-Term and Patient-Reported Breast-Q Outcomes. Ann Plast Surg 86:512–516. https://doi.org/10.1097/SAP.0000000000002522
61. Redi U, Marcasciano M, Lo Torto F et al (2021) Invited response on: dual-plane retro-pectoral versus pre-pectoral DTI breast reconstruction: an Italian multicenter experience. Aesthetic Plast Surg 45:1348–1349
62. Bellaire CP, Sayegh F, Janssen P et al (2021) Major complications after textured versus non-textured breast implants in direct-to-implant breast reconstruction: a propensity score analysis. Aesthetic Plast Surg 45:2077–2085. https://doi.org/10.1007/s00266-021-02377-2
63. Kedar D, Inbal A, Arad E et al (2019) Immediate breast reconstruction in high-risk cases using an anatomically shaped permanent expandable implant. J Plast Reconstr Aesthet Surg 72:401–409. https://doi.org/10.1016/j.bjps.2018.10.030
64. Casella D, Kaciulyte J, Resca L et al (2022) Looking beyond the prepectoral breast reconstruction experience: a systematic literature review on associated oncological safety and cancer recurrence incidence. Eur J Plast Surg 45:223–231. https://doi.org/10.1007/s00238-021-01868-4
65. Vaia N, Lo Torto F, Marcasciano M et al (2018) From the "Fat Capsule" to the "Fat Belt": Limiting Protective Lipofilling on Irradiated Expanders for Breast Reconstruction to Selective Key Areas. Aesthetic Plast Surg 42:986–994. https://doi.org/10.1007/S00266-018-1120-3
66. Mangone M, Bernetti A, Agostini F et al (2019) Changes in Spine Alignment and Postural Balance After Breast Cancer Surgery: A Rehabilitative Point of View. Biores Open Access 8:121–128. https://doi.org/10.1089/biores.2018.0045