

Nipple Reconstruction: A Novel Triple Flap Design

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Background: Restoring the nipple–areola complex completes the breast reconstructive process. Local flaps are often used for the nipple reconstruction; however, the number of techniques indicates the lack of a superior design. The aims of this study were to test the feasibility of a new triple flap design for nipple reconstruction and to evaluate complication rate and nipple projection.

Methods: From November 2015 to November 2018, we performed the triple flap nipple reconstruction guided by a template for preoperative mark-up. Patients were followed up postoperatively to evaluate healing and signs of complications including wound dehiscence, infection, and flap necrosis, and nipple projection. The areola was tattooed 3 months postoperatively.

Results: Twenty-six nipple reconstructions were successfully performed in 22 women. Four nipple reconstructions (15%) were performed in irradiated tissue. One reconstruction had a superficial infection, while there were no cases of wound dehiscence or flap necrosis. Three nipple reconstructions (12%) experienced prolonged healing that did not require intervention. None of these reconstructions had received radiation therapy. The nipple projection was 7.3 mm (range 6–9 mm) at the time of surgery and 3.1 mm (range 0–6 mm), 2.5 mm (range 2–3 mm), and 1.6 mm (range 0–3 mm) at follow-up of 3, 6, and 12 months, respectively.

Conclusions: We present the new triple flap design for nipple reconstruction guided by a template for mark-up. The preliminary results indicate a low complication rate in both irradiated and nonirradiated patients while sustaining the projection over time remains to be a challenge. (*Plast Reconstr Surg Glob Open* 2019;7:e2262; doi: 10.1097/GOX.0000000000002262; Published online 21 May 2019.)

BACKGROUND

The nipple–areola complex (NAC) is the landmark of the breast,¹ and restoration transform the mound into a naturally appearing breast which completes the breast reconstructive process.² This is not only of esthetical significance but creates a sense of completeness,^{3–5} restores body image,^{4,6} and improves the psychosocial well-being in women treated for breast cancer.⁵

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Numerous techniques for NAC reconstructions have been described, using nipple sharing, skin grafts, and local flaps with or without augmenting material.⁷ Local flaps are most often used for the nipple reconstructive part, to avoid those donor site complications sometimes seen when using various types of grafts.^{8,9} Complication rates vary with flap design,¹⁰ increasing with previous radiation therapy,^{10–14} whereas nipple projection tends to decrease over time regardless of the surgical design,^{7,15,16} suggesting that there is still room for improvement in this surgical procedure.

We present a novel technique for nipple reconstruction using a triple dermal-fat flap design. The surgical technique is described and illustrated along with a presentation of the preliminary results regarding complication rate and long-term nipple projection.

METHODS

From November 2015 to November 2018, we performed the triple flap nipple reconstructions at the Department of

Disclosure: Dr. Rose has developed the triple flap design for nipple reconstruction and invented the template used for this. None of the remaining authors have a financial interest in any of the products, devices, or drugs mentioned in this article.

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Surgery, Section of Plastic Surgery and Section of Breast Surgery at the public *Hospital of Southwest Jutland, Esbjerg, Denmark* and *Hospital of Southern Jutland, Aabenraa, Denmark* and the private *Aleris-Hamlet Hospitals, Copenhagen, Denmark*. Women who requested NAC reconstruction were presented to the most commonly used techniques and the triple flap design and were included in the study when choosing the latter. Smokers were excluded from the study. Two surgeons performed all procedures as a part of the standard breast reconstructive process.

We recorded data on patient age, comorbidity, previous breast surgery, type of breast reconstruction, and oncological treatment. Patients were seen at a 2-week, 3-, 6-, and 12-month follow-up to evaluate healing and signs of complications including wound dehiscence, infection, and flap necrosis and the nipple projection.

Design of the Nipple Reconstruction

The nipple was reconstructed using the triple-based flap design developed from simple geometrical principles (Fig. 1). Two dotted circles are shown: the inner with the neo-nipple diameter, and the outer with twice the diameter (Fig. 1). An equilateral triangle forms 3 triangles in each corner of the design that touch base on the outer circle (Fig. 1).

The length of each base of the triangles and the base of each flap constitute one-sixth of the circumference of the outer circle. The bases of the flaps are thus separated with one-sixth of the circumference of the outer circle. As a consequence of the geometry, the ratio between the width and the length of each flap is 1:1.45 (Fig. 1). Pulling the bases of the triangles together will constrict the circumference of the outer circle to the inner circle, with half the circumference and diameter, constituting the footprint of the nipple. As a result, the three flaps positioned with their bases on the outer circle (Fig. 1) will be pushed upward and forward giving rise to a cylinder-like shape with a rounded top: the neo-nipple (Fig. 1).

Templates for preoperative markings of the design were made in different sizes for neo-nipple diameters of 8, 10, 12, or 14mm. This ensured the proper size of the neo-nipple to fit the individual patient, and the accuracy of the design.

Surgical Technique

(See video, **Supplemental Digital Content 1**, which demonstrates the triple flap technique. This video is available in the “related videos” section of the full-text article on PRSGlobalOpen.com or available at <http://links.lww.com/PRSGO/B95>)

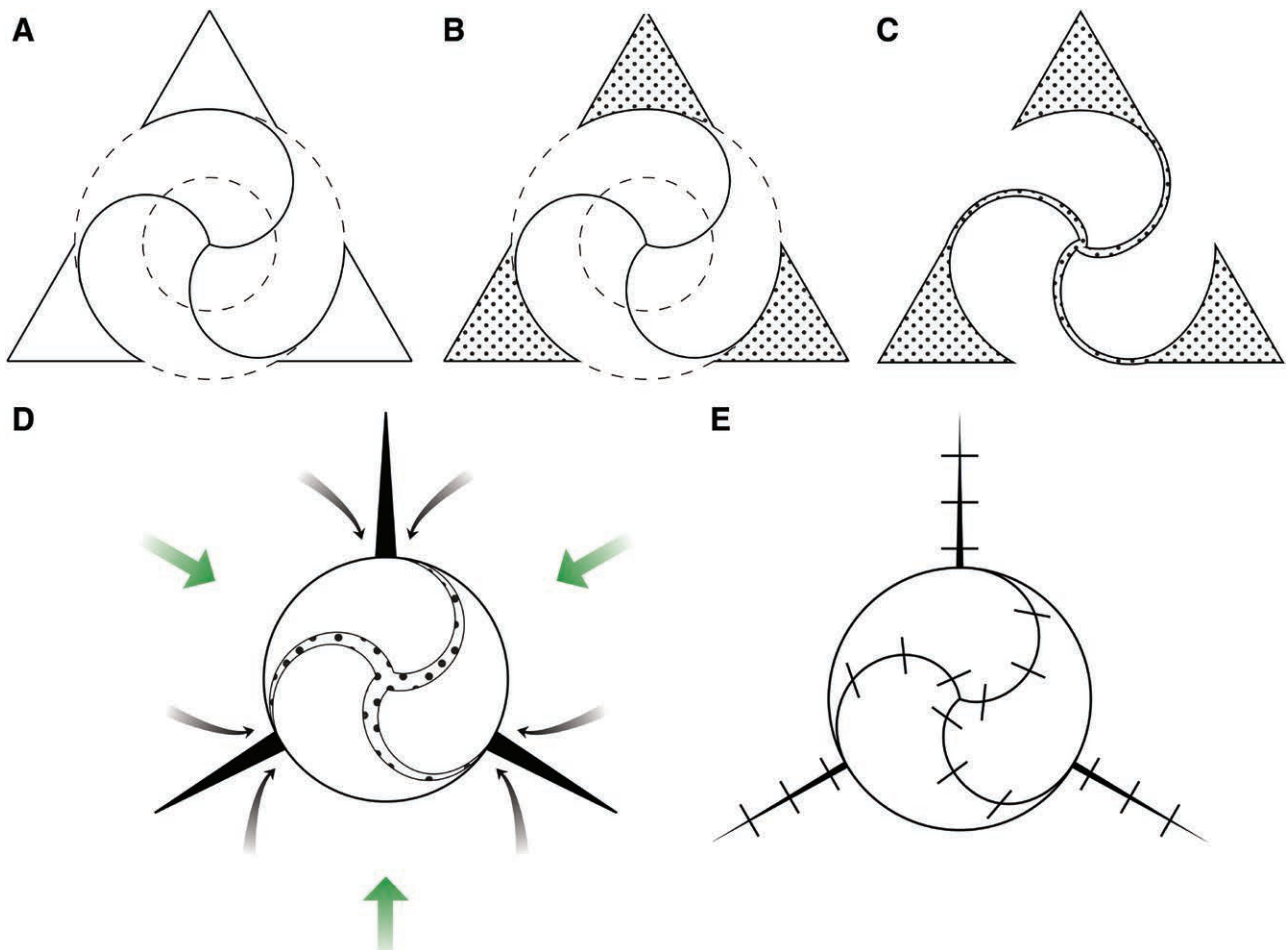


Fig. 1. Geometrical design. A, Geometrical principle of the design. B, The 3 triangles with de-epithelized skin. C, The 3 dermal-fat flaps. D, Joining of the 3 dermal-fat flaps. E, The neo-nipple.

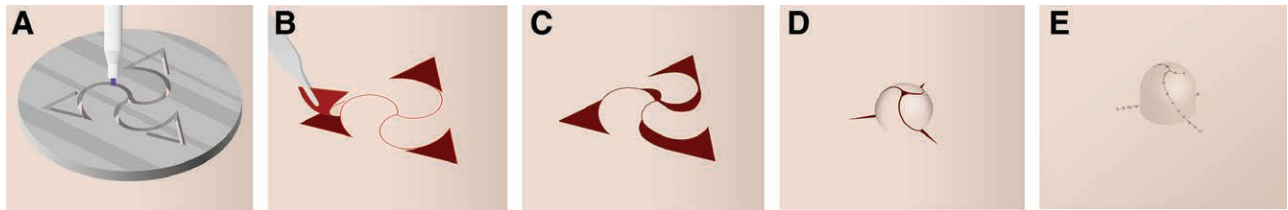


Fig. 2. Illustration of the surgical procedure. A, Preoperative markings using the template. B, De-epithelization of the skin. C, Incision and elevation of the 3 dermal-fat flaps. D, Jointing of the 3 dermal-fat flaps. E, The neo-nipple.

The position of the neo-nipple was decided between patient and surgeon. The incision lines were marked pre-operatively on the breast skin using the template (Figs. 2 and 3). The 3 triangles in the corners of the design were

de-epithelized (Figs. 2 and 3) and 3 dermal-fat flaps raised with a thickness of 3–7 mm (Figs. 2 and 3). The base “corners” of the 3 de-epithelized triangles were pulled together with a single 3-0 PDS dermal suture, resulting in

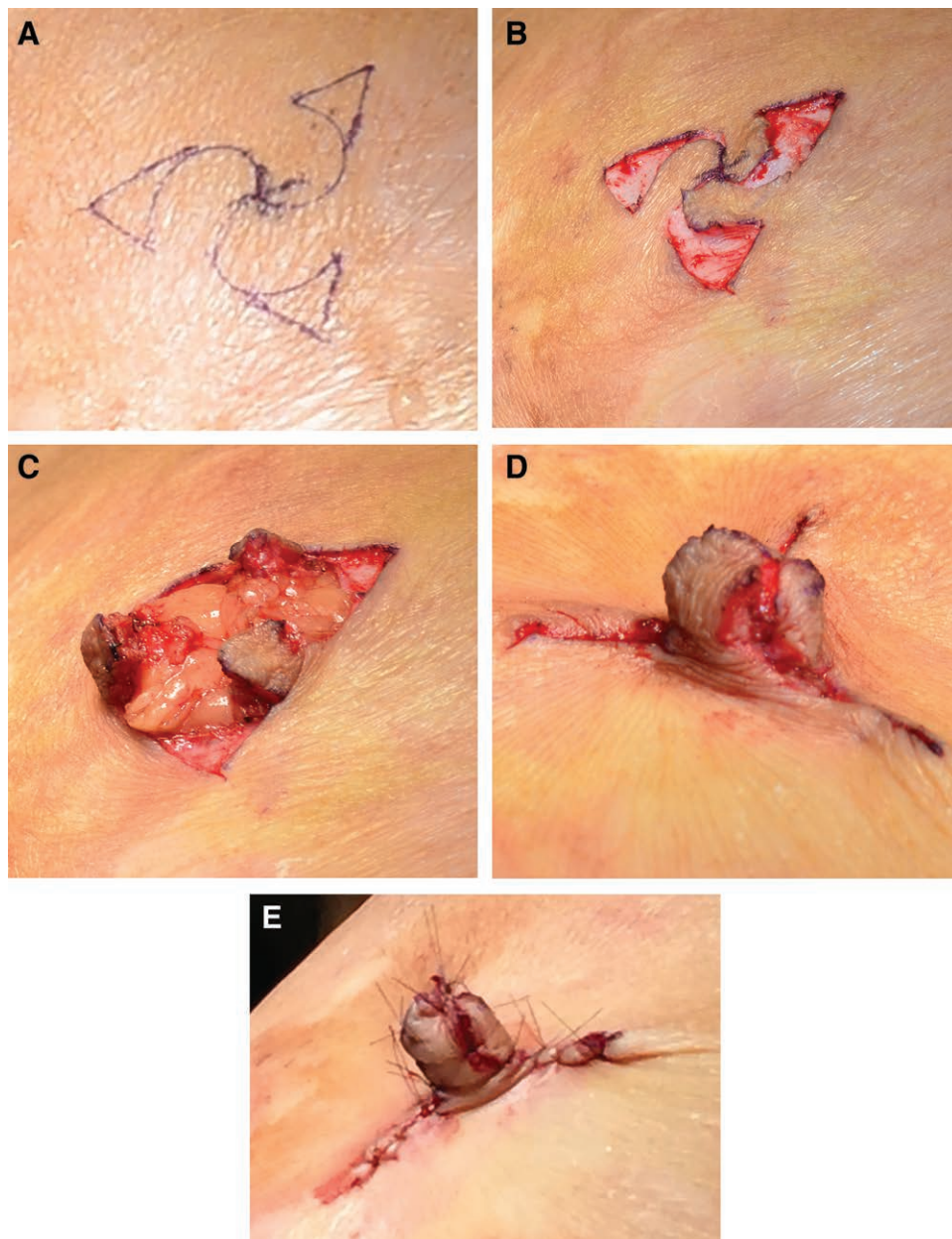


Fig. 3. Perioperative photographs. A, Preoperative markings using the template. B, De-epithelization of the skin. C, Incision and elevation of the 3 dermal-fat flaps. D, Jointing of the 3 dermal-fat flaps. E, The neo-nipple.

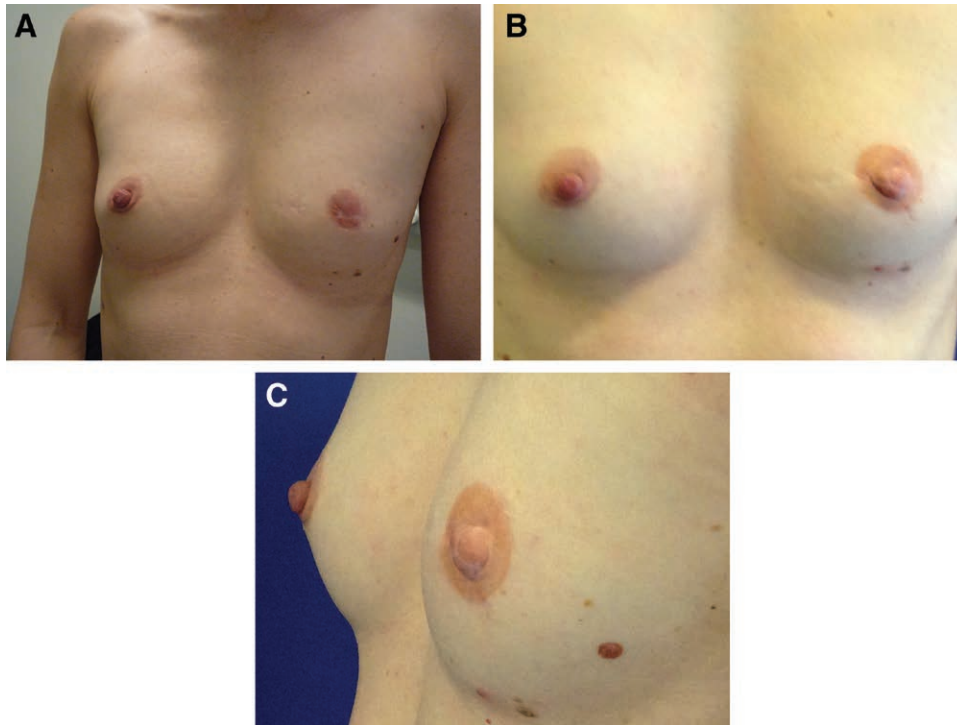


Fig. 4. Pre and postoperative photographs. A, Preoperative photograph. B, 3 months postoperative photograph, front. C, 3 months postoperative photograph, side.

Table 1. Surgery Before Reconstructive Breast Surgery

Surgery	No. (%)
Curative mastectomy	19 (73)
Curative lumpectomy including NAC	3 (11)
Curative lumpectomy + prophylactic mastectomy*	1 (4)
Prophylactic mastectomy	1 (4)
Diagnostic lumpectomy with nipple necrosis†	1 (4)
Burn sequelae	1 (4)
Total breasts	26 (100)

*One patient had unilateral curative lumpectomy but was later found BRCA positive and had bilateral prophylactic mastectomy. BRCA positive, mutation in either BRCA1 or BRCA2 tumor suppressor genes.

†One patient underwent a diagnostic nipple sparing lumpectomy (pathology showed intraductal papilloma). Postoperatively the nipple turned necrotic.

the reduction of the circumference, approximation, and elevation of the flaps and a projected neo-nipple as described above (Figs. 2 and 3). The nipple flaps and donor sites were sutured using interrupted absorbable 5-0 vicryl sutures in the dermis and 5-0 nylon sutures in the skin, a running suture at the donor site and interrupted sutures at the flap site (Figs. 2 and 3).

The reconstruction was dressed with a foam “chimney” bandage encircling the nipple and covered with adhesive film for protection. Patients were instructed not to wear bra for 2 months. The bandage and sutures were removed 10–12 days postoperatively. Tattooing of the nipple and areola was performed approximately 3 months after surgery, with the scars within the tattooed areola (Fig. 4).

The procedures were mainly performed in local anesthesia in the outpatient clinic, except from 2 patients, who

Table 2. Reconstructive Breast Surgery Before Nipple Reconstruction

Surgery	No. (%)
Total breast reconstruction with implant	10 (38)
Total breast reconstruction with MSLD+ implant	9 (34)
Total breast reconstruction with DIEP-flap	2 (8)
Partial oncoplastic reconstruction (thoracodorsal flap)	1 (4)
Partial breast reconstruction with autologous fat transplantation	2 (8)
No breast reconstruction*	2 (8)
Total breasts	26 (100)

*One patient had sequelae after previously surgery (same patient as

† in Table 1) and one patient had burn sequelae. MSLD, muscle sparing latissimus dorsi.

required general anesthesia due to additional surgery, such as lipofilling. No prophylactic antibiotics were given.

Ethics

The study was approved by the Danish Data Protection Agency (no. 2017-41-5143) and presented to The Regional Committee on Health Research Ethics for Southern Denmark. Written informed consent was obtained from each patient.

RESULTS

We performed 26 nipple reconstructions in 22 non-smoking women 51 years of age (range 15–66) who had previously undergone breast reconstruction following curative or prophylactic breast surgery except for 1 patient who had lost her nipple due to burns (Tables 1 and 2). Eighteen patients (82%) had a unilateral nipple reconstruction and

4 patients (18%) bilateral. In most cases, the nipple was reconstructed using breast or chest wall skin (54%). The remainders of the nipples were reconstructed from skin originating from the back, *m. latissimus dorsi* or TAP-flap back skin (38%) or abdomen, DIEP-flap (8%). Four nipple reconstructions were performed in irradiated tissue (15%). Nineteen breast (73%) were reconstructed with implants only (38%) or implants in combination with flaps (35%). Four women (18%) had comorbidities, 1 patient had hypertension, 2 diabetes, and 1 a rheumatic condition.

Following nipple reconstruction, 1 patient had a superficial infection. Three reconstructions (12%) in 3 patients experienced prolonged healing for more than 2 weeks, one due to the infection, but none required revision surgery. Neither of the patients had received radiation therapy. There were no cases of wound dehiscence or necrosis. We did measure the nipple projection, however, the measurements were not comprehensive. At the time of surgery, we have measurements from 10 reconstructions and a median nipple projection of 7.3 mm (range 6–9 mm), at 3-month follow-up we have data from 15 reconstructions and a median projection of 3.1 mm (range 0–6 mm), after 6-month follow-up we have data from 4 reconstructions and a median projection of 2.5 mm (range 2–3 mm) and the median projection was 1.6 mm (range 0–3 mm) in the 10 reconstructions measured at follow-up 12 months post-surgery.

DISCUSSION

We have successfully used the novel triple flap design for 26 nipple reconstructions. The technique is safe and simple to perform when using the template for mark-up. No complications such as wound dehiscence or flap necrosis were recorded, but one reconstruction got a superficial infection and 3 reconstructions (12%) in 3 patients experienced prolonged healing, that did not require intervention. Neither of these breasts had received radiation therapy.

NAC reconstruction finalizes the breast reconstructive process and is reported of importance to the majority of previous breast cancer patients,³ who experience higher satisfaction with their breast reconstruction, compared with those who have not undergone NAC reconstruction.^{6,17} The procedure should be simple to perform and with minimal risk, to safely finish the reconstructive process. Various techniques for nipple reconstruction have been described,⁷ the mere fact that there are so many, could indicate the lack of an optimal technique, when it comes to optimizing the esthetic result with the least possible complications.

The preliminary results using the triple flap nipple reconstruction are promising as most of the reconstructions were successful with only one infection and no necrosis. This may be due to the design. Based on the geometry, the triple-pedicle design offers a better width-to-length ratio than bipediced or unipediced flap designs and should hypothetically enable better perfusion.^{7,15,18,19} However, this hypothesis needs to be tested in a future study comparing perfusion of flaps. In each of the 3 flaps, the width-to-length ratio is approximately 1:1.5. The thickness of each flap, that is, the thickness of the skin and subcutaneous fat, is usually 3–7 mm depending on the size of the used

template and the size wanted for the reconstructed nipple. If it preoperatively is expected that it not will be possible to have a sufficient thickness of the flaps, for example, with underlying prosthesis, this design should not be the one of choice. Just as the bipediced flap has been proposed as an alternative to the single-pedicle flap due to a more preserved vascularization,¹⁹ we now suggest the triple-based flap as an even better vascularized alternative to both the single- and bipediced flaps, possibly improving the healing process and reducing the risk of complications.

Reports on total complication rates in NAC reconstructions are poor and has been reported to range between 4% and 13%; however, higher for some studies only presenting individual complications, such as partial necrosis/flap loss (1%–29%) and infection (0.9%–16%).¹⁰ Most complications are minor and can be managed with conservative treatment,^{3,20} although previous radiation therapy has been associated with more and sometimes severe complications.¹⁴ Twenty-five percent of irradiated patients have been reported to experience a complication following nipple reconstruction,¹³ and 50% of infections in flap-based nipple reconstructions on irradiated implant-based breast reconstructions required surgical intervention.¹² Radiation causes damage to the vessels inducing morphological changes with tissue fibrosis compromising perfusion,²¹ which could be one of the pathophysiological mechanisms behind the high complication frequency in irradiated breasts.

In irradiated patients, a strictly dermal flap has been proposed to be a more safe alternative to the dermal-fat flap in nipple reconstruction,²² with an overall complication rate of 6.1%, including infection (2.0%) and partial flap loss (4.1%). Irradiated skin is subject to a decreased vascularization,²¹ and it is likely that this single-pedicle design may be more susceptible to impaired healing compared with the possibly more perfused bi or tripediced design. We were not able to compare the results of the nipple reconstructions in the irradiated and the nonirradiated breast as the sample size was too small, and there were only 4 irradiated breasts in 26 nipple reconstructions (15%). However, no patients with irradiated skin experienced complications, which may be due to the design with a good vascularization and healing potential.

Our study is limited by the few data regarding nipple projection due to missing registration at the time of surgery at the start of the study and later due to missing follow-up visits. However, the results indicate a decrease in projection over time. The tendency was that the nipple projection diminished over time from 7.3 mm at the time of surgery to 1.6 mm at 12-month follow-up. This is known to be an issue to all techniques regardless of the design used^{7,15,16} and has been estimated to vary from 45% to 75% in a recent review article by Sisti et al.⁷ The progressive decrease is partly caused by tension in the skin of the breast from which the reconstruction is raised. The skin tension tends to retract the neo-nipple back in line with the skin covering the breast. With a high tension in the skin, the loss of nipple projection is expected to be more pronounced than in the cases where the tension is low. In implant-based reconstructions, the tension is often considerable higher than in autologous reconstructions, that is, deep inferior epigastric perforator (DIEP)-flaps, *latissimus dorsi* (LD)-flaps, and

inter-costal artery perforator (ICAP)-flaps in partial reconstructions. The best possible scenario, with regard to low tension in the skin, would be an immediate partial breast reconstruction using a flap where a skin paddle can be designed to replace the NAC after immediate nipple reconstruction.²³ This would result in a nipple reconstruction with nearly no tension at all. Scar contraction can also be a reason for loss of projection. This underlines the importance of careful adaptation of the skin suturing the nipple. In this study, 19 breast reconstructions (73%) had implant-based reconstructions, which we believe in part explains the decreasing nipple projection. In the aim of improving the long-term projection with the triple flap technique, we now apply a dermal “triangle suture” through the 3 points where the bases of the flaps are sutured, that is, the base corners of the de-epithelized triangles. This suture forms a triangle at the base of the flaps and is not tightened but only supporting the base of the reconstructed nipple and do not compromise perfusion of the flaps. The use of a skin graft in the areola area or acellular dermal matrices in the neo-nipple as supporting means could also be a method to improve the long-term nipple projection.^{1,24}

The obvious perspectives of this novel technique is to evaluate the triple flap design including a “triangle suture” in a larger sample size, comparing different types of breast reconstructions and irradiated to nonirradiated breasts, to examine if the triple flap design is superior to the other techniques regarding complication rate, projection, and patient-reported outcome.

CONCLUSIONS

We present a novel and safe technique for nipple reconstruction with a triple flap design using a template. The reconstructions were successful in both irradiated and nonirradiated patients with no necrosis and only one infectious complication. Sustaining the nipple projection over time remains to be a challenge.

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REFERENCES

- Nimboriboonporn A, Chuthapisith S. Nipple-areola complex reconstruction. *Gland Surg.* 2014;3:35–42.
- Losken A, Duggal CS, Desai KA, et al. Time to completion of nipple reconstruction: what factors are involved? *Ann Plast Surg.* 2013;70:530–532.
- Goh SC, Martin NA, Pandya AN, et al. Patient satisfaction following nipple-areolar complex reconstruction and tattooing. *J Plast Reconstr Aesthet Surg.* 2011;64:360–363.
- Jabor MA, Shayani P, Collins DR Jr, et al. Nipple-areola reconstruction: satisfaction and clinical determinants. *Plast Reconstr Surg.* 2002;110:457–663; discussion 464.
- Bykowski MR, Emelife PI, Emelife NN, et al. Nipple-areola complex reconstruction improves psychosocial and sexual well-being in women treated for breast cancer. *J Plast Reconstr Aesthet Surg.* 2017;70:209–214.
- Wellisch DK, Schain WS, Noone RB, et al. The psychological contribution of nipple addition in breast reconstruction. *Plast Reconstr Surg.* 1987;80:699–704.
- Sisti A, Grimaldi L, Tassinari J, et al. Nipple-areola complex reconstruction techniques: a literature review. *Eur J Surg Oncol.* 2016;42:441–465.
- Spear SL, Schaffner AD, Jespersen MR, et al. Donor-site morbidity and patient satisfaction using a composite nipple graft for unilateral nipple reconstruction in the radiated and nonradiated breast. *Plast Reconstr Surg.* 2011;127:1437–1446.
- Zenn MR, Garofalo JA. Unilateral nipple reconstruction with nipple sharing: time for a second look. *Plast Reconstr Surg.* 2009;123:1648–1653.
- Kristoffersen CM, Seland H, Hansson E. A systematic review of risks and benefits with nipple-areola-reconstruction. *J Plast Surg Hand Surg.* 2017;51:287–295.
- Momeni A, Ghaly M, Gupta D, et al. Nipple reconstruction after implant-based breast reconstruction: a “matched-pair” outcome analysis focusing on the effects of radiotherapy. *J Plast Reconstr Aesthet Surg.* 2013;66:1202–1205.
- Momeni A, Ghaly M, Gupta D, et al. Nipple reconstruction: risk factors and complications after 189 procedures. *Eur J Plast Surg.* 2013;36:633–638.
- Draper LB, Bui DT, Chiu ES, et al. Nipple-areola reconstruction following chest-wall irradiation for breast cancer: is it safe? *Ann Plast Surg.* 2005;55:12–15; discussion 15.
- Satteson ES, Reynolds MF, Bond AM, et al. An analysis of complication risk factors in 641 nipple reconstructions. *Breast J.* 2016;22:379–383.
- Losken A, Mackay CJ, Bostwick J III. Nipple reconstruction using the C-V flap technique: a long-term evaluation. *Plast Reconstr Surg.* 2001;108:361–369.
- Shestak KC, Gabriel A, Landecker A, et al. Assessment of long-term nipple projection: a comparison of three techniques. *Plast Reconstr Surg.* 2002;110:780–786.
- Momoh AO, Colakoglu S, de Blacam C, et al. The impact of nipple reconstruction on patient satisfaction in breast reconstruction. *Ann Plast Surg.* 2012;69:389–393.
- Butz DR, Kim EK, Song DH. C-Y trilobed flap for improved nipple-areola complex reconstruction. *Plast Reconstr Surg.* 2015;136:234–237.
- Turgut G, Sacak B, Görgülü T, et al. Nipple reconstruction with bipedicle dermal flap: a new and easy technique. *Aesthetic Plast Surg.* 2009;33:770–773.
- Otterburn DM, Sikora KE, Losken A. An outcome evaluation following postmastectomy nipple reconstruction using the C-V flap technique. *Ann Plast Surg.* 2010;64:574–578.
- Yarnold J, Brotons MC. Pathogenetic mechanisms in radiation fibrosis. *Radiother Oncol.* 2010;97:149–161.
- Rem K, Al Hindi A, Sorin T, et al. Nipple reconstruction after implant-based breast reconstruction in radiated patients: a new safe dermal flap. *J Plast Reconstr Aesthet Surg.* 2016;69:617–622.
- Carstensen L, Biggaard J. Management of central breast tumours with immediate reconstruction of the nipple-areola complex: a suggested guide. *Breast.* 2015;24:38–45.
- Nahabedian MY. Secondary nipple reconstruction using local flaps and AlloDerm. *Plast Reconstr Surg.* 2005;115:2056–2061.