

# Prophylactic Bilateral Nipple-sparing Mastectomy and a Staged Breast Reconstruction Technique: Preliminary Results

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**ABSTRACT:** More high-risk women with breast cancer are identified using genetic testing at a younger age. These young women often opt for prophylactic surgery. Most patients are reluctant for extra donor-site scars besides infections and necrosis. In order to reduce these risks, a two-stage breast reconstruction technique is used for high-risk women with large or ptotic breasts. We presume that this procedure will reduce the risk of skin envelope and nipple–areola complex (NAC) necrosis to less than 1%. In the first stage, an inferior pedicle reduction is performed to obtain large volume reduction with maximal safety for the NAC. The ptosis, skin excess, and malpositioning of the NAC are corrected safely at this stage. In the second stage, the skin-sparing mastectomy is performed with or without nipple sparing. During this procedure, the areola is never removed. A bilateral breast reconstruction is then performed with an immediate subpectoral prosthesis or delayed with the use of a subpectoral tissue expander. In this way, we aim to meet the patient's wish to undergo bilateral risk reducing mastectomy in breasts that need ptosis correction without donor-site scarring. This article describes the procedure and reports the preliminary data.

**KEYWORDS:** high risk, BRCA, prophylactic, reconstruction, mastectomy, necrosis, infection, nipple sparing

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## Introduction

Breast cancer is becoming endemic in the industrialized world. The major reason for this is not known. We do know that approximately 5%–7% of breast cancer cases are due to a genetic defect. Women with mutations have a significant lifetime risk of developing breast cancer. Due to the increasing awareness, more women undergo genetic testing. If tested “positive”, women can opt for intense screening, preventive medication, or prophylactic surgery in order to reduce the risk of developing breast cancer. Evans et al<sup>1</sup> note an increase in enquiries for risk reducing mastectomy in the UK due to the Angelina Jolie effect. Prophylactic surgery may include bilateral mastectomy or a skin-sparing mastectomy. In a recently performed study among seven countries, 69.5% of 1635 BRCA-1 and -2 mutation-positive women were elected for breast reconstruction after prophylactic mastectomy. Young women (77.6% of women were younger than 35 years) and those without a previous diagnosis of breast cancer are more likely to have breast reconstruction than older women.<sup>2</sup>

Most patients are, however, afraid for extra donor-site scars besides infections and necrosis. In order to reduce these risks, a two-stage breast reconstruction technique was developed. This article describes the procedure and reports the preliminary data.

## Patients and Methods

The study population included five high-risk patients who underwent a staged procedure of bilateral breast reduction followed by nipple-sparing mastectomy (NSM) and bilateral prosthesis reconstruction. Two patients had a strong positive family history for breast cancer, two patients were BRCA-1 mutation carriers, and one patient was BRCA-2 mutation carrier. Their age varied between 26 and 47 years.

The ethics committee of the University of Antwerp deemed this research exempt from the requirement of ethics committee approval, as it comprises an accepted procedure, but here performed in two stages instead of one. Patients gave their written, informed consent to participate in the research, and for publication of images. The research complied with the principles of the Declaration of Helsinki.

All included patients had large or ptotic breasts and refused other surgical reconstructive procedures that created extra scars besides those needed on the breasts. Patient's age, weight, height, breast circumference, cup size, body mass index (BMI), smoking history, and associated comorbidities (diabetes mellitus, hypertension, and dyslipidemia) were recorded as patient factors. Specimen weight, degree of ptosis (Table 1), and sternal notch to nipple (SNI) index were recorded as breast morphological factors (Table 2).

**Table 1.** Degree of ptosis.

| DEGREE OF PTOSIS | DEFINITION   |
|------------------|--|
| First degree     | Nipple at the level of inframammary fold (IMF)   |
| Second degree    | Nipple below the level of IMF but still higher than the majority of the breast contour               |
| Third degree     | Nipple below the level of IMF and sitting at the most dependent, inferior part of the breast contour |
| Pseudoptosis     | A loose breast that looks ptotic from a distance, but the nipple remains above the level of the IMF  |

Surgical factors are the type of breast reduction and the type of reconstruction. The plastic surgery team performed breast reduction. The oncological breast surgery team performed NSM, and the plastic surgery team performed the immediate or delayed prosthesis breast reconstruction.

**Technique.** The bilateral breast reconstruction is performed in two or three stages depending on the residual volume after reduction in the first stage and the possibility to cover the implant completely in the second stage (Table 3).

In the first stage, an inferior pedicle breast reduction with classic anchor scar pattern was performed. The nipple-areola complex (NAC) is vascularized by the perforators from the internal mammary and intercostal branches that supply the remaining glandular tissue in the inferior pedicle. We aim for a maximal glandular volume reduction and size reduction of the skin envelope. The NAC is repositioned with the position of the nipple corresponding with the onset of the medial inframammary fold.

In the second stage, the NSM is carried out by the vertical part of the anchor pattern. The incision can be prolonged either medially or laterally of the NAC on the already existing periareolar scar. We specifically avoid reusing the inframammary incision: the distance for the dermal vascularization to reach the skin just above the inframammary incision is much longer than when using the vertical component. The skin-sparing mastectomy is scheduled at least four months after the first stage. The healing period of a few months for the NAC is acceptable for most women because of the prophylactic nature of the procedure.

If the patient wishes to have her nipples removed, the vertical scar can be prolonged superiorly with circumcision of the nipple. The nipple will be removed en bloc with the underlying glandular tissue without resection of the areola.

The immediate breast reconstruction is then performed by subpectoral positioning of anatomical breast prosthesis. We prefer a tall height, medium-to-high profile prosthesis. The tall height prosthesis will avoid lack of volume in the upper breast pole. The wide prosthesis base is necessary to fill the medial pole with cleavage creation. The medium-to-high profile is used to reshape the projection of the breast mound and to support the position of the NAC.

If not enough laxity of the musculus pectoralis major can be obtained after creation of the subpectoral pocket, an anatomical tissue expander is implanted instead of a definite prosthesis.

In the third stage, the expander will be replaced by a definite anatomical implant. The incision is made through the lateral horizontal part of the anchor pattern allowing the use of the complete length of the capsula. The muscle will adhere to the overlying skin, and the capsula around the expander can then be used to give complete coverage of the prosthesis. The definite implant will always be larger than the expanded volume to avoid wrinkles and to give extra tension of the skin envelope. In case of nipple resection in the second stage, a nipple reconstruction can also be performed in the third stage with the remaining areolar skin.

## Results

In the first stage, bilateral inferior pedicle breast reduction was performed with an average reduction weight of 306.3 g. Cup sizes varied from C to E cup with a breast circumference of 75–85 cm. SNI index varied from 26 to 30 cm. All patients had a third-degree breast ptosis. BMI varies from 18.73 to 26.61 with an average of 22.87. In two BRCA-1 patients, an abnormal tissue result was found. One patient had lobular carcinoma in situ (LCIS) in both her breasts and one patient had ductal carcinoma in situ (DCIS) in one breast. The tumor-free margin in both cases was more than 2 cm.

In the second stage, NSM was performed in four patients and bilateral areola-sparing mastectomy in one patient who had bilateral LCIS in the breast reduction stage. The average time between the first and second stages was eight months. In two

**Table 2.** Patient characteristics and results.

| AGE (Y) AT FIRST SURGERY | BREAST SIZE | SNI (INDEX IN cm) | PTOSIS (GRADE 1–3) | BMI    | NAC NECROSIS  | INFECTION | LATE COMPLICATIONS (12 MONTHS) | SNI (12 MONTHS) |
|--------------------------|-------------|-------------------|--------------------|--------|---------------|-----------|--------------------------------|-----------------|
| 26                       | 75E         | 26                | 3                  | 25, 12 | –             | –         | –                              | 22              |
| 31                       | 75D         | 26                | 3                  | 18, 73 | Epidermolysis | Skin      | –                              | 24              |
| 47                       | 85C         | 30                | 3                  | 24, 06 | –             | –         | –                              | 23              |
| 45                       | 85D         | 28                | 3                  | 26, 61 | –             | –         | –                              | 24              |
| 40                       | 85C         | 26                | 3                  | 20, 54 | –             | –         | –                              | 22              |

**Table 3.** Timing and steps followed in the staged approach protocol.

|                             | TIMING                  | PROCEDURE                                  | INCISION                                      | IMPLANT   |
|-----------------------------|-------------------------|--|---|---|
| Stage 1                     | –                       | Inferior pedicle breast reduction          | Inverted T anchorpattern                      | None  |
| Stage 2 (2 stage procedure) | ≥4 months after stage 1 | Nipple sparing mastectomy                  | Vertical component of anchorpattern           | Definite prosthesis if pectoral muscle allows sufficient prosthesis coverage    |
| Stage 2 (3 stage procedure) | ≥4 months after stage 1 | Nipple sparing mastectomy                  | Vertical component of anchorpattern           | Tissue expander if pectoral muscle doesn't allow sufficient prosthesis coverage |
| Stage 3 (3 stage procedure) | Expansion time needed   | Secondary prosthesis breast reconstruction | Lateral horizontal component of anchorpattern | Definite prosthesis   |

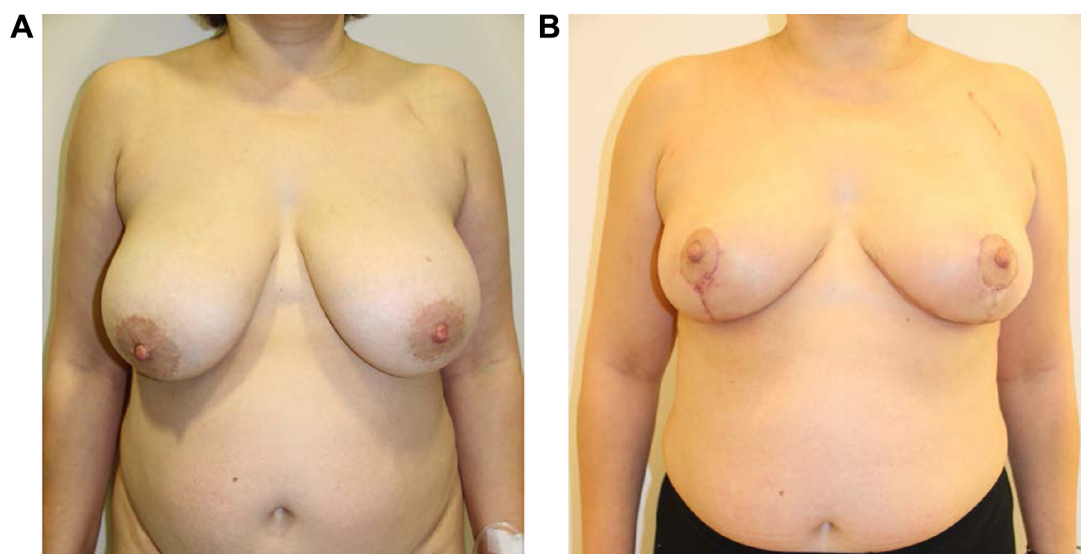
patients, the incision was made in the vertical component of the anchor scar with medial periareolar prolongation in order to create a larger access. In the patient with bilateral LCIS in the reduction specimen, the nipple was removed together with the gland through a superior prolongation of the vertical scar and circumcision of the nipple. The average weight of the glandular mastectomy specimen was 175.75 g. The average weight of the glandular tissue removed per breast in total was 485.38 g. Final pathology results showed benign glandular tissue except for one breast in which there was still a small focus of LCIS. All retroareolar sections showed benign glandular tissue.

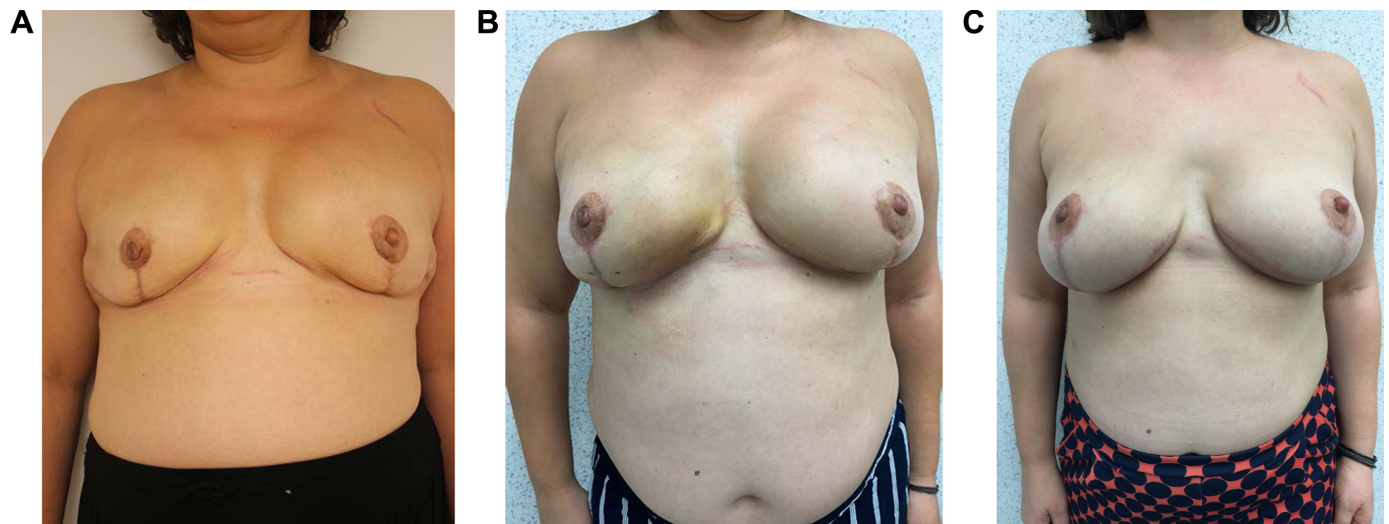
Four patients underwent an immediate bilateral subpectoral prosthesis reconstruction. The patient with remaining LCIS underwent a staged reconstruction with a subpectorally placed tissue expander and a definitive prosthesis reconstruction five months later. In 3 patients an anatomical prosthesis of tall height was used with moderate profile projection. In 1 patient an anatomical prosthesis of tall height was used with high profile projection and in the last patient a high profile round prosthesis was used on patients demand regarding the final breast shape. The prosthesis volumes varied from 375 to 515 cm<sup>3</sup>.

SNI at 1-year follow-up varied from 22 to 24 cm. The cup sizes after final reconstruction varied from C to D cup.

Postoperative complications consisted of one epidermolysis of a NAC with spontaneous recuperation under conservative therapy and one superficial skin infection immediately lateral from the NAC, which resolved under the six weeks of antibiotic therapy. Both complications occurred in the same patient but in different breasts. This patient was the only one who smoked. She had stopped smoking four months prior to the breast reduction procedure. The follow-up time of this specific patient was 18 months after the complications occurred. At the last check-up, all complications were resolved without any residual abnormalities. The follow-up time varies from 18 months to five years. Figure 1 shows the pre- and postoperative views of a bilateral reduction mammoplasty. Figure 2 shows a bilateral subcutaneous mastectomy with tissue expansion and the definite views with bilateral prosthesis three and 18 months later.

No late complications, such as capsular contraction, lack of upper pole filling, and high riding prosthesis, with double bubble phenomenon occurred.


**Figure 1.** (A) Preoperative view: SNI 30 cm right breast, SNI 29 cm left breast, and 85 cup E. (B) Bilateral reduction mammoplasty SNI 24 cm bilaterally and 85 cup C (four months postoperative).



**Figure 2.** (A) Bilateral subcutaneous mastectomy with tissue expansion 450 cm<sup>3</sup>. (B) Definite bilateral prosthesis breast reconstruction—anatomical tall height moderate projection 515 cm<sup>3</sup> (three months postoperative). (C) Definite bilateral prosthesis breast reconstruction—anatomical tall height moderate projection 515 cm<sup>3</sup> (18 months postoperative).

## Discussion

The anatomy and the risks of breast skin flap perfusion and NAC perfusion are related to each other. The unreliability of the vascularization of the skin envelope and the NAC in large and ptotic breasts is based on the distance the dermal microvascularization has to cross to supply the most remote skin of the mastectomy flap (the length of the skin flap).<sup>3,4</sup> This is mainly why we can expect more skin necrosis in NSM and skin-sparing mastectomy in large and ptotic breasts.<sup>5</sup> This probably also explains why Chirappapha et al<sup>6</sup> found a significance between the removed glandular volume and the increasing appearance of NAC necrosis in their series of 124 nipple-sparing mastectomies. Moreover, there is no single specific universal thickness for mastectomy skin flaps since the thickness of the subcutaneous layer varies individually.<sup>7</sup> Other procedure-related risks exist of the extra skin incisions necessary to reposition the NAC,<sup>8,9</sup> the necessity of the anchor incision to remove the skin excess, the traction on the skin flaps to restore the breast mound, and the thickness of the skin flaps.<sup>10,11</sup> Other known risk factors are age, diabetes, smoking, prior irradiation, and BMI.<sup>6,8</sup> These variables are also risk factors for vascular insufficiency and flap necrosis.<sup>12</sup> The only patient reported with superficial epidermolysis of the NAC and with skin infection had a smoking history. It is wise to reconsider performing a skin-sparing mastectomy in smoking patients.<sup>13</sup> As in elective microsurgery where smoking is generally considered to be a contraindication, the elimination of significant risk factors will reduce important postoperative complications, such as skin necrosis and infection.<sup>14</sup> We ask patients to stop smoking at least four to six months prior to surgery.

One-stage NSM with immediate reconstruction is used in our center for smaller breasts (cup size A and B) without ptosis (grade 0 and 1 in correspondence to SNI). The lower

border of the NAC is positioned higher or equal to the medial onset of the inframammary fold in these cases. In an NSM, we vary the NAC incision, depending on the access needed, from infraareolar to transareolar with possible medial or lateral horizontal extension. We avoid an inframammary incision because of a higher risk of skin flap necrosis.<sup>15</sup> In our cases, none of the patients developed a necrosis of the NAC which needed an excision. Previous studies also showed that if the volume of NSM is increased, then the risk of necrosis and infections drops from 3.5% to 0.6%.<sup>16,17</sup>

Small ptotic characteristics can be corrected by using an anatomically shaped high-profile prosthesis with a larger volume than the volume of the resected gland. When NAC resection is indicated, then a horizontal elliptical excision of the NAC also corrects a minor degree of ptosis. Although reported with acceptable results in one surgeon's experience,<sup>18</sup> we found rather poor results in performing immediate mastopexy after NSM. Skin necrosis and prosthesis exposure were the most common complications. Rather good results are seen in moderately ptotic breasts,<sup>18</sup> the immediate periareolar mastopexy brings the SNI only 2.2 cm higher on average.

We suggest the described staged technique for young, high breast cancer risk patients with large or ptotic breasts who are reluctant to have an autologous reconstruction because of the extra scars, besides those on the breast, or because of the length of the surgery. Furthermore, these patients lack the anatomical criteria for one-stage NSM with immediate reconstruction because of NAC position or skin excess.<sup>19</sup> Immediate reconstruction after Wise pattern skin-sparing mastectomy is found to have a high incidence of epidermolysis and full thickness necrosis.<sup>20</sup>

NAC involvement in local recurrence is not common.<sup>21–23</sup> In Benediktsson's series, almost all cases of local recurrence



in the NAC occur with tumors located within 2.5 cm on the areola.<sup>24</sup> In a reported series of prophylactic mastectomies, there were no positive NAC margins.<sup>25</sup> There was, however, a loss of the NAC in seven breasts (1.8%).<sup>25</sup> By creating the ideal anatomical criteria in the first stage, the NAC is delayed.<sup>26</sup> This allows neovascularization through the periareolar scar, which in the reported cases seems to be enough to avoid NAC vascularization problems in the second stage. Nevertheless, the other risk factors like smoking should not be neglected.

Although all mastectomies were scheduled as prophylactic, foci of LCIS in both breasts and DCIS in one breast were found in the two BRCA-1 patients. For this reason, the nipples were removed together with the gland in the LCIS patient. In this patient, residual LCIS was found in the final skin-sparing mastectomy specimen on one side. Ischemic problems in the remaining areolar skin were not seen. Follow-up of the patient with LCIS is 18 months, and follow-up of the patient with DCIS is five years. No recurrences were noted until now.

The early results of this limited group of patients are good. Esthetic outcome is pleasing without extra donor-site scars as in an autologous reconstruction. Looking at the weight and BMI of the reported patients, the use of a bilateral autologous reconstruction alone would not be sufficient to recreate a cup size that corresponds with their former body image. Nevertheless, even after this staged procedure, no contraindications are created for any type of autologous reconstruction in the future.

## Conclusion

The preliminary results of a prophylactic bilateral NSM and a staged breast reconstruction technique are promising. The risk-reducing surgery is performed with a safe remodeling of large and ptotic breasts and a maximum safety of the NAC. By this approach, there is a maximal glandular reduction without donor-site scars or other morbidities. The described procedure is oncologically safe and has a pleasing esthetic result with a contained body image of the patient. Larger series are needed to confirm these results.

## Author Contributions

Conceived and designed the experiments: TT, FT, WT. Analyzed the data: TT, FT, WT. Wrote the first draft of the manuscript: TT, FT, WT. Contributed to the writing of the manuscript: TT, FT, WT. Agree with manuscript results and conclusions: TT, FT, WT. Jointly developed the structure and arguments for the paper: TT, FT, WT. Made critical revisions and approved final version: TT, FT, WT. All authors reviewed and approved of the final manuscript.

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