

## Original Article



# Immediate Reconstruction of Large Ptotic Breasts following Vertical Reduction Pattern Nipple-Sparing Mastectomy

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### Conflict of Interest

All authors have completed the ICMJE uniform disclosure form. The authors declare that they have no competing interests.

## ABSTRACT

**Purpose:** Women with large and/or ptotic breasts are generally not considered candidates for nipple-sparing mastectomy because of concerns regarding the high incidence of postoperative complications including ischemic complications. Therefore, we adopted a vertical skin resection technique for nipple-sparing mastectomy, and obtained satisfactory results following immediate autologous breast reconstruction. In this study, we aimed to describe our operative technique and review its outcomes.

**Methods:** Between January 2010 and March 2017, immediate autologous breast reconstructions were performed in 28 patients with moderate or large ptotic breasts after nipple-sparing mastectomy using the vertical reduction pattern. Grade II ptosis was observed in 12 patients, and 16 patients were classified as having grade III ptosis.

**Results:** Of the 28 patients, 21 received abdominal free flap reconstruction. In the remaining 7 patients, extended latissimus dorsi flaps were used in conjunction with anatomic implants. The mean weight of the excised breast tissue in the 2 groups was 575 g and 482 g, respectively. Satisfactory esthetic outcomes without major complications were achieved in all patients. Similar vertical reductions or mastopexies in the contralateral breast allowed better postoperative adjustment for symmetry. There was only 1 case of complete nipple necrosis; however, the problem was solved with “skin banking.” No local recurrences or distant metastases were detected at follow-up (mean 18 months, range 4 months to 6 years).

**Conclusion:** To enhance cosmetic outcomes in patients with large and/or ptotic breasts, the vertical skin resection pattern for nipple-sparing mastectomy can be used to achieve better breast shape while preserving the nipple-areola complex. Moreover, it can improve the esthetic outcome without compromising oncologic safety.

**Keywords:** Breast neoplasm; Mastectomy; Reconstructive surgical procedures

## INTRODUCTION

Recent trends in breast cancer surgery lean toward skin-sparing mastectomy (SSM) and nipple-sparing mastectomy (NSM) rather than the more classic radical mastectomy. Since SSM or NSM preserve the inframammary fold and native skin, it can enhance symmetry,

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Chung JH, Hwang YJ; Investigation: Yoon ES;  
Methodology: Chung JH; Supervision: Jung  
SP, Park SH, Yoon ES; Validation: Yoon ES;  
Visualization: Chung JH, Yoon ES; Writing -  
original draft: Chung JH; Writing - review &  
editing: Chung JH, Jung SP, Park SH, Yoon ES.

leading to better esthetic results. NSM, that preserves the nipple-areola complex (NAC), is considered to offer the best esthetic outcome [1]. Besides, immediate breast reconstruction following NSM also has a positive psychological effect on patients, and consequently improves their quality of life [2,3].

However, NSM is not usually accepted in disadvantageous conditions, including large breasts (> 500 g) and substantial breast ptosis, because of the potential risk of NAC necrosis [4]. NSM separates the NAC from its underlying blood supply, which increases the risk of NAC and skin flap necrosis. Some authors have demonstrated that a large volume and high-grade ptosis may further contribute to the development of this complication [5,6]. In addition, NSM in conjunction with breast reconstruction using autologous flaps, such as free transverse rectus abdominis musculocutaneous (TRAM), deep inferior epigastric perforator (DIEP), and latissimus dorsi (LD) flaps in patients with large, ptotic breasts is quite challenging, because the esthetic outcome can be compromised by a mismatch between the retained skin envelope of the breast and the donor tissue volume [7].

In cases of large and/or ptotic breasts with an excessive skin envelope, the problem can be solved using the vertical skin resection pattern [8]. Herein, we report 28 cases of immediate autologous breast reconstruction after NSM using the vertical reduction pattern.

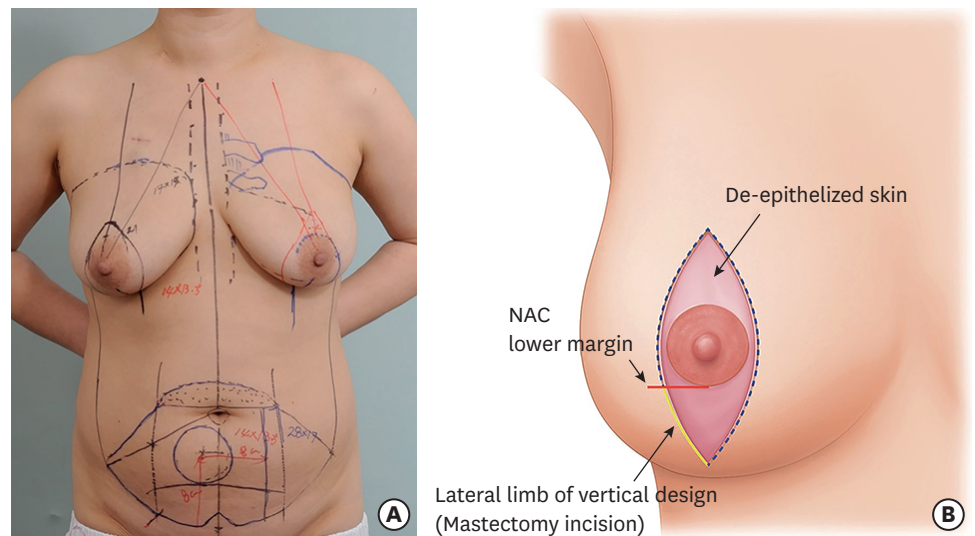
**METHODS**

Between January 2010 and March 2017, immediate autologous breast reconstructions following NSM using the vertical skin resection pattern were performed in 28 patients with moderate or large ptotic breasts diagnosed with early breast cancer (stage I or II of the *AJCC Cancer Staging Manual, 8th Edition*) [9]. The criteria for selecting patients for this technique were as follows: 1) patients diagnosed with early breast cancer (stage I or II) at least 2 cm away from the nipple, and 2) patients who had very long or large, pendulous breasts classified as grade II or III ptosis according to Regnault's classification of breast ptosis. Patients with inflammatory breast cancer, advanced breast cancer (stage III or IV) and skin invasion in the upper poles of the breast were excluded. All breast reconstructions were performed by the senior author. We reviewed a retrospectively built, Institutional Review Board-approved database (protocol number: K2019AN0037). Medical records including detailed operation notes, follow-up records, and photographs were collected and analyzed.

**Operative technique**

Preoperative marking for NSM with the vertical reduction pattern was performed jointly by the oncologic and plastic surgeons (**Figure 1**). A circumferential areolar incision line was designed at least 5 mm away from the NAC and a vertical extension was marked 2–3 cm above the inframammary fold. The new location of the superior border of the areola was set to the level of the anterior projection of the inframammary crease on the breast, as in the general mosque dome pattern.

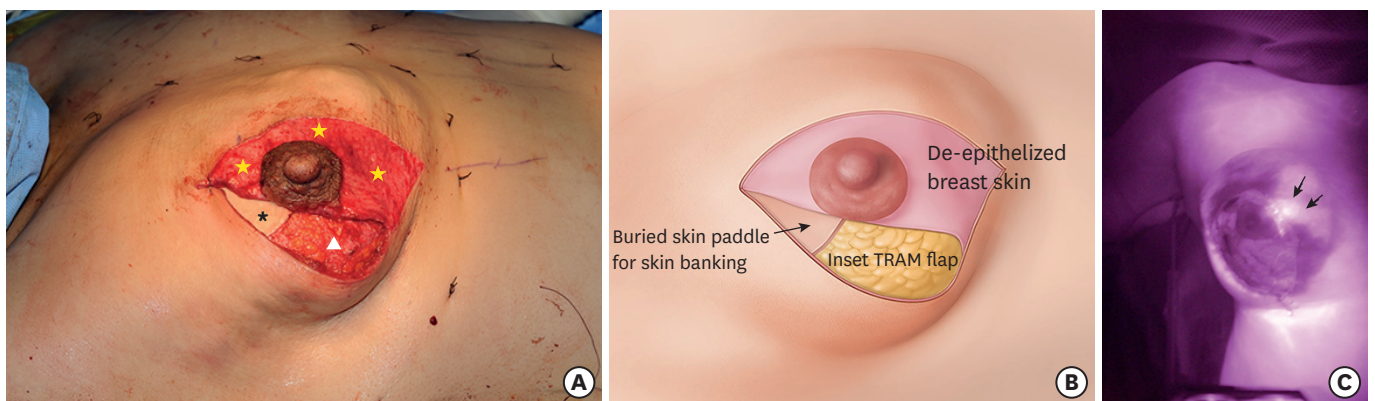
Initially, only the lateral limb of this preoperative design below the lower border of the NAC was incised; resection of the tumor and sentinel lymph node extirpation were performed only through this lateral limb incision to preserve the medial perforators and superolateral cutaneous blood flow. In addition, the oncologic surgeons made efforts to preserve as many branches of the internal mammary and lateral thoracic arteries as possible during



**Figure 1.** Schematic illustration of preoperative marking. (A) A circumferential areolar incision line 5 mm away from the NAC has been designed with a vertical extension 2 to 3 cm above the inframammary fold. (B) Only the lateral limb of vertical design below the lower border of NAC has been incised for oncologic resection to preserve the superolateral cutaneous blood flow. NAC = nipple-areola complex.

mastectomy. If a full axillary lymph node dissection was required, an axillary incision was performed separately. After mastectomy was performed by the oncologic surgeons, the inferior, superior, and medial pedicle was de-epithelized using a scalpel, with care taken to preserve the maximum amount of the dermal plexus (**Figure 2**). Access for axillary clearance, and, if indicated, dissection of the thoracodorsal or internal mammary vessels for free tissue transfer was obtained via the same incision.

Then a reconstructive flap (a free muscle-sparing TRAM, DIEP or extended LD flap) was harvested according to standardized procedures and placed into the mastectomy defect, and the skin envelope was closed in the NAC. In abdominal-flap-based reconstruction, we preferred to inset the flap vertically, with the internal mammary or thoracodorsal vessels



**Figure 2.** Representative image of flap inseting. (A) Note the de-epithelized breast skin (★) with a preserved superomedial pedicle over the inset TRAM flap (▲). (B) Schematic illustration of Intraoperative photo. (C) The circulation in the mastectomy flap after oncologic resection is visualized using indocyanine green angiography with a near-infrared camera (Moment K; IANC&S, Seoul, Korea). TRAM = transverse rectus abdominis musculocutaneous. \*indicates the buried skin paddle for skin banking.

used as recipients. Additional suturing to the anterior chest wall helped to maintain medial support for the flap. In LD flap reconstruction, the edges of the flap were sutured to the anterior chest wall to make a pocket for the implant, and an anatomic implant was placed beneath the flap.

If the circulation of the NAC considered to be compromised in the indocyanine green (ICG) angiography, we buried the skin paddle of the reconstructive flap under the breast tissue for revision. We also performed simultaneous vertical reductions or mastopexies in the contralateral breast for better breast symmetry.

### Esthetic assessment

To assess the esthetic outcomes, 2 independent plastic surgeons who were not involved in the surgeries subjectively assessed the outcome with clinical photographs. The photographs showed both preoperative and final postoperative appearances from 5 different angles: an anterior view, from each lateral side of the trunk, and at an angle of 45° between frontal and lateral views on each side. The photographs included the region from above the suprasternal notch to the pubic symphysis. For scoring, the photographs were arranged in a random order to decrease the information bias. The reviewers were blinded and asked to assess the esthetic outcomes of each item on a 5-point Likert scale (1 = very poor, 2 = poor, 3 = fair, 4 = good, and 5 = excellent). The following 5 individual aspects were scored: 1) volume, 2) shape, 3) symmetry, 4) scarring, and 5) NAC, which are the components of the Aesthetic Items Scale described by Dikmans et al. [10]. In addition, reviewers also graded the overall outcome on a 5-point Likert scale as a 6th item.

### Statistical analyses

All statistical analyses were performed using SPSS software, version 24.0 (IBM Corp., Redmond, USA). All intraclass correlation coefficients (ICCs) were interpreted using the Rosner interpretation (0–0.40, poor agreement; 0.40–0.75, good agreement; 0.75–1.00, excellent agreement) [11]. The higher the ICC, the greater the agreement and stronger the correlation. Further, for statistical analysis, we produced a mean score of each item to compare outcome by donor tissue. For all analyses, a value of  $p < 0.05$  was considered statistically significant.

### Ethical statement

The study was approved by the Institutional Review Board of Korea University Anam Hospital (protocol number K2019AN0037). Individual consent for this retrospective analysis was waived.

## RESULTS

### Patient demographics

A total of 28 patients who underwent autologous breast reconstruction after NSM using the vertical pattern were identified. Of the 28 patients, 21 received abdominal free flap reconstruction. In the remaining 7 patients, an extended LD flap was used in conjunction with an anatomic implant. **Table 1** summarizes the demographic characteristics of the patients.

### Operative result

Twenty-one patients underwent reconstruction with abdominal flaps. (13 muscle-sparing TRAMs, 8 DIEPs) The mean age of the patients was 47.0 years (range, 32–61 years) and

**Table 1.** Patient demographics

Patient characteristics	Abdominal flap (%)	Implant enhanced LD (%)
No. of patient	21	7
Mean age (yr)	47.0 ± 10.1	45.3 ± 8.2
Mean BMI (kg/m <sup>2</sup> )	27.6 ± 4.2	22.9 ± 3.5
Operative indications		
DCIS	10 (47.6)	0
IDC	11 (52.4)	7 (100)
Cancer stage		
Stage I	3 (14.3)	3 (42.9)
Stage II	18 (85.7)	4 (57.1)
Degree of ptosis (Regnault grade)		
Grade II	7 (33.3)	5 (71.4)
Grade III	14 (66.7)	2 (28.6)
Smoking history	2 (9.5)	0
Diabetes mellitus	1 (4.8)	0
Mean mastectomy volume (g)	575.3 ± 152.1	482.1 ± 132.8
Mean inset flap volume (g)	551.3 ± 114.6	176.5 ± 22.4
Type of reconstruction		
DIEP flap	8 (38.1)	N/A
MS-II TRAM	13 (61.9)	N/A
Recipient vessel		
Internal mammary vessel	18 (85.7)	N/A
Thoracodorsal vessel	3 (14.3)	N/A
Contralateral procedure		
Vertical reduction	12 (57.1)	2 (28.6)
Vertical mastopexy	9 (42.8)	5 (71.4)

LD = latissimus dorsi; BMI = body mass index; DCIS = ductal carcinoma in situ; IDC = intraductal carcinoma; DIEP = deep inferior epigastric perforator; TRAM = transverse rectus abdominis musculocutaneous.

the mean body mass index (BMI) was 27.6 kg/m<sup>2</sup> (range, 22.9–34.1 kg/m<sup>2</sup>). Seven patients had grade II ptosis, and 14 patients were classified as having grade III ptosis according to Regnault's classification. Of the 21 patients, 2 were current smokers, and 1 patient had well controlled diabetes mellitus. The mean excised breast tissue weighed 575 g (range, 300–712 g), and the mean inset flap weighed 551 g (range, 370–700 g). All patients underwent planned microsurgical reconstruction using the internal mammary (n = 18) or thoracodorsal vessels (n = 3) as recipients. If needed, we also performed similar vertical reductions (n = 12) or mastopexies (n = 9) in the contralateral breast for better symmetry.

The remaining 7 patients underwent reconstruction with extended LD flaps plus implants. The mean age of patients was 45.3 years (range, 40–50 years) and mean BMI was 22.9 kg/m<sup>2</sup> (range, 18.3–25.6 kg/m<sup>2</sup>). Five patients had grade II ptosis, and 2 patients were classified as having grade III ptosis. The mean excised breast tissue weighed 482 g (range, 316–650 g), and the mean inset flap weighed 176 g (range, 148–200 g). We also performed similar vertical reductions (n = 2) or mastopexies (n = 5) in the contralateral breast for better symmetry.

All flaps survived with satisfactory results. There was only 1 case of complete nipple necrosis, however, this problem was solved using the buried skin paddle of the TRAM flap, dubbed as the “skin banking procedure.” Minor complications included wound dehiscence, hematoma, seroma, and venous congestion of the skin envelope (**Table 2**). Wound dehiscence and hematoma did not recur after delayed repair and hematoma evacuation under local anesthesia. Donor site seroma occurred in 1 patient who underwent breast reconstruction using LD flap plus implant; however, it resolved with conservative management including serial aspirations. Venous congestion occurring in abdominal flaps resolved without further intervention.

**Table 2.** Postoperative complications

Complication	Abdominal flap (%)	Implant enhanced LD (%)
Major complication		
Total/Partial flap loss	0	0
Total NAC necrosis	1 (4.7)	0
Partial NAC necrosis	4 (19.0)	0
Minor complication		
Wound dehiscence	1 (4.7)	1 (14.3)
Wound infection	0	0
Hematoma	1 (4.7)	0
Seroma	0	1 (14.3)
Venous congestion	1 (4.7)	0
Total	8	2

LD = latissimus dorsi; NAC = nipple-areolar complex.

The mean follow-up was 18 months (range, 4 months to 6 years), and there were no local recurrences or distant metastases. All patients achieved satisfactory esthetic outcomes without major complications. Regarding additional surgery, 1 patient underwent liposuction to correct the bulging of the upper abdomen. In addition, 2 patients underwent liposuction and 6 patients underwent fat grafting to improve the contour of the breast.

### Esthetic outcome assessment by independent investigators

Before statistical analysis, the inter-rater reliability was assessed using ICCs. The ICC for each individual parameter (volume, shape, symmetry, scarring, NAC, and overall cosmesis) showed excellent agreement between the reviewers, and ranged from 0.76 to 0.85 (Table 3). In particular, overall cosmesis had the highest ICC for inter-rater reliability (ICC = 0.847).

The results of the esthetic outcome assessment are presented in Table 3. On all parameters, our vertical reduction pattern showed favorable esthetic outcomes ranging from good (4) to excellent (5), except on scarring and NAC symmetry. In our study, NAC asymmetry was present in a total of 4 patients, 3 of whom underwent surgery for revision.

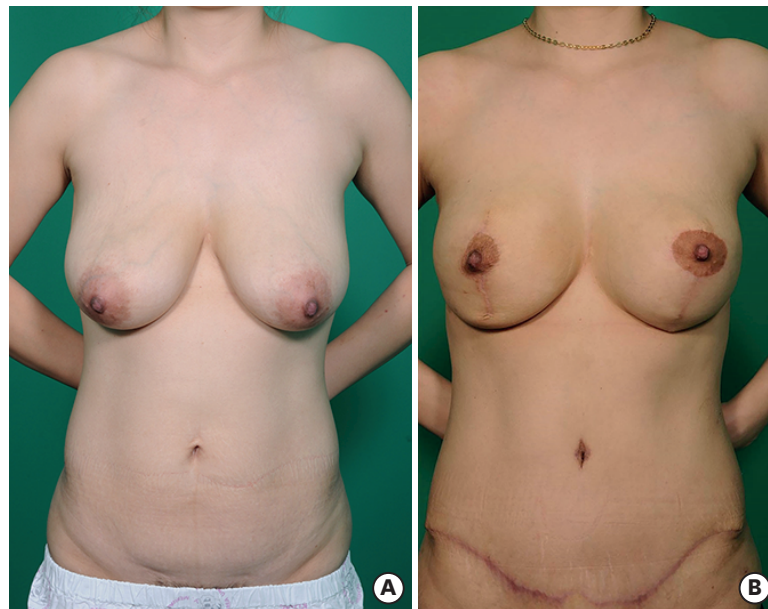
### Case 1

A 32-year-old woman, who was a current smoker, was diagnosed stage 2 ductal carcinoma in situ of the right breast. The patient had a BMI of 23.6 kg/m<sup>2</sup> and grade II ptosis (Figure 3A). The initial volume of the left breast was 460 mL. She underwent NSM using a vertical pattern reduction in combination with immediate free muscle-sparing TRAM flap reconstruction. The weight of the excised breast tissue was 430 g, and the final inset flap weighed 480 g. Contralateral vertical axis mastopexy was also performed for breast symmetry. On postoperative day 7, partial nipple necrosis was noted and repaired in the operating room under local anesthesia using a banked skin flap. Satisfactory result was achieved at 1 year after surgery (Figure 3B).

**Table 3.** Esthetic assessment results

Inter-rater reliability	Volume	Shape	Symmetry	Scarring	NAC	Total score
ICC	0.838	0.840	0.804	0.839	0.757	0.847
<i>p</i>	0.003	0.003	0.006	0.003	0.014	0.002
Aesthetic score						
Abdominal flap	4.50 ± 0.65	4.21 ± 0.70	4.07 ± 0.62	3.50 ± 1.02	3.29 ± 0.73	3.86 ± 0.86
Implant enhanced LD	4.10 ± 0.88	4.00 ± 0.67	4.00 ± 0.67	4.80 ± 0.42	3.50 ± 0.85	4.20 ± 0.63

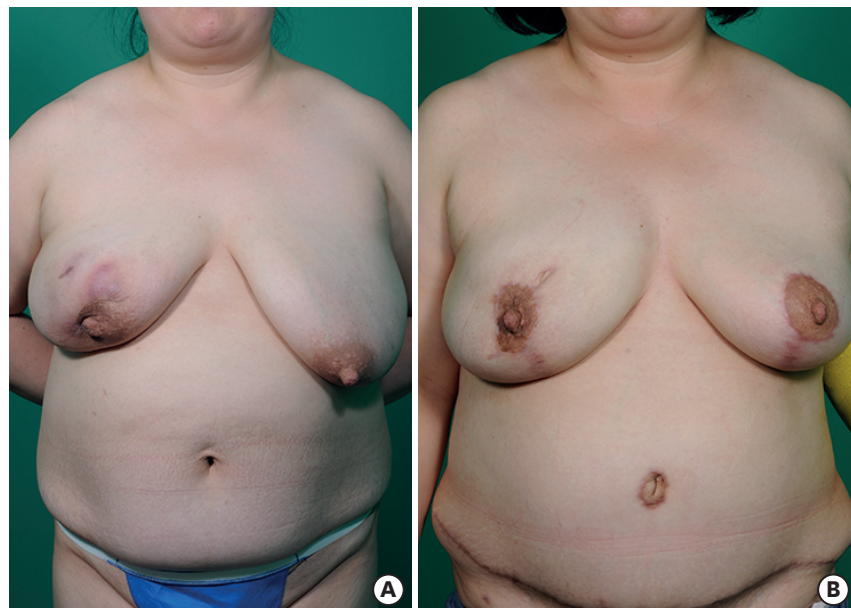
NAC = nipple-areolar complex, ICC = intraclass correlation coefficient; LD = latissimus dorsi.



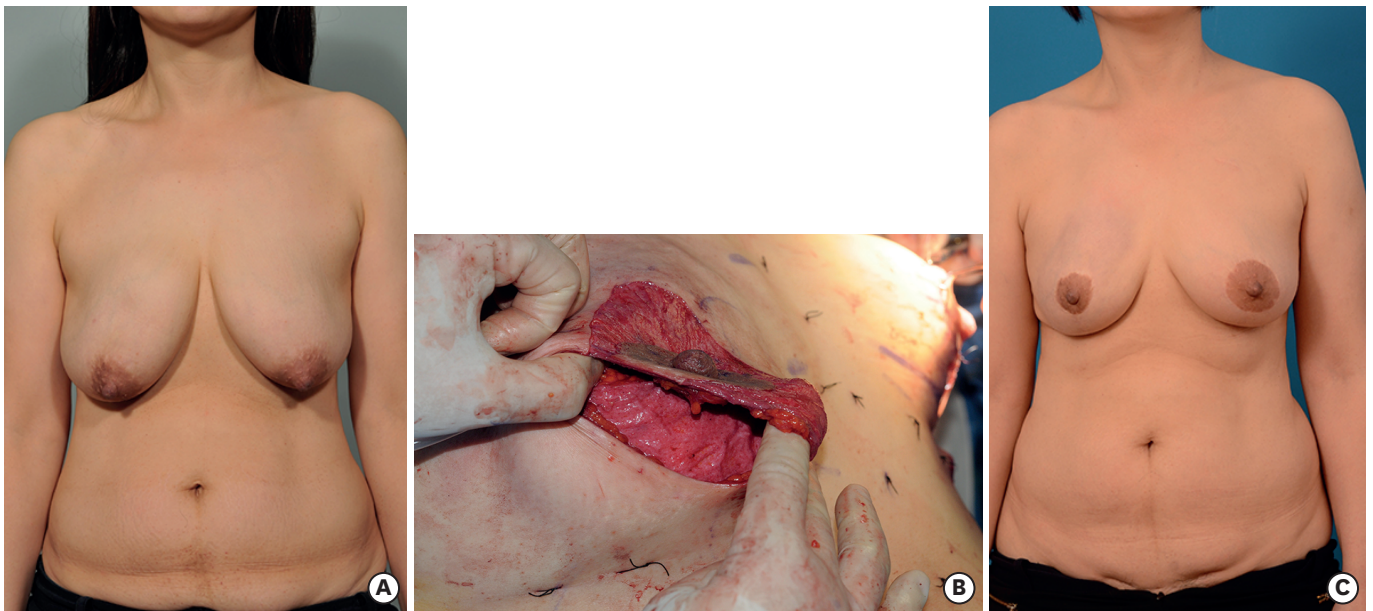
**Figure 3.** Pre- and postoperative clinical images of Case 1. (A) Nipple-sparing mastectomy using a vertical skin resection technique performed in combination with immediate free muscle-sparing transverse rectus abdominis musculocutaneous flap reconstruction. Contralateral reduction mammoplasty using vertical technique has been performed for breast symmetry. (B) Postoperative results 1 year after surgery.

### Case 2

A 41-year-old woman was diagnosed with stage 2 intraductal carcinoma of the right breast. The patient had a BMI of 34.1 kg/m<sup>2</sup> and grade II ptosis (**Figure 4A**). The initial volume of the left breast was 970 mL. We planned NSM using a vertical pattern reduction in combination



**Figure 4.** Pre- and postoperative clinical images of Case 2. (A) Nipple-sparing mastectomy using a vertical reduction technique in combination with immediate free muscle-sparing transverse rectus abdominis musculocutaneous flap reconstruction has been performed, together with reduction of the opposite breast. (B) Postoperative results 6 months after surgery.



**Figure 5.** Pre- and postoperative clinical images of Case 3.

(A) Nipple-sparing mastectomy using a vertical skin resection technique has been performed in combination with immediate pedicled extended latissimus dorsi flap reconstruction with textured anatomic implant (Mentor CPG 321, 280 cc). Contralateral reduction mammoplasty using vertical technique has been performed for breast symmetry. (B) To reduce necrosis of the mastectomy flap, oncologic surgeon has preserved the maximal possible amount of subcutaneous fat and medial perforators while performing tumor excision. (C) Postoperative results 5 years after surgery.

with immediate free muscle-sparing TRAM flap reconstruction. The weight of the excised breast tissue was 780 g, and the final inset flap weighed 600 g. For symmetry, vertical reduction of the contralateral breast was also performed. Satisfactory result was achieved at 6 months after surgery (**Figure 4B**).

### Case 3

A 50-year-old woman was diagnosed with stage 1 intraductal carcinoma of the left breast. The patient had a BMI of 24.9 kg/m<sup>2</sup> and grade III ptosis (**Figure 5A**). The initial volume of the left breast was 510 mL. We planned NSM using a vertical pattern reduction in combination with immediate pedicled extended LD flap reconstruction plus textured anatomic implant (Mentor CPG 321, 280 cc). To reduce mastectomy flap necrosis, the oncologic surgeon preserved the maximum possible amount of subcutaneous fat and medial perforators while performing tumor excision (**Figure 5B**). The weight of the excised breast tissue was 480 g. For symmetry, vertical reduction of the contralateral breast was also performed. Satisfactory result was achieved at 5 years after surgery (**Figure 5C**).

## DISCUSSION

From an oncologic surgeon's point of view, the tumor must be < 3 cm in diameter and at least 2 cm away from the nipple for therapeutic NSM. In addition, there should be no skin involvement or inflammatory disease, and clinically negative axillary nodes. From an anatomic perspective, it is generally not recommended for patients with excessively large or ptotic breasts given the potentially increased risk of NAC necrosis [12]. For these reasons, most surgeons are reluctant to perform NSM in patients with the above conditions.



Moreover, the esthetic outcome of NSM in immediate breast reconstruction with free TRAM or DIEP flaps can be compromised by a mismatch between the retained skin envelope and the donor tissue volume. This discrepancy can produce incongruity in breast volume, shape, projection, and areola position between the native and reconstructed breasts. In case of large and/or ptotic breasts, the excessive skin envelope makes it difficult for the surgeon to achieve better esthetic results.

However, Evans et al. [7] proposed that vertical reduction pattern combined with immediate breast reconstruction could be the remedy for solving this discordance. The vertical pattern preserves the natural skin envelope while sufficiently facilitating oncologic resection. It also provides a sufficiently wide field for microsurgical procedures, and enables the plastic surgeon to cone the reconstructed breast, similar to current mastopexy techniques. We believe that it is possible to expand this procedure to the realm of NSM as well as SSM.

There are several incision designs for the various reduction mammoplasty or mastopexy techniques. The Wise pattern (keyhole) incision, also known as the inverted-T or inferior pedicle technique described by Robbins in 1977, has been the preferred method of breast reduction globally, mainly because there is no defined upper limit concerning amount of volume reduction. It is applied in a wide range of procedures, from simple mastopexy to reduction of gigantomastia, but does have some distinct disadvantages [13,14], such as skin flap necrosis or other complications in wound healing due to compromised blood supply to the breast skin [7]. The excessive scar burden is also one of the reasons why many plastic surgeons are now unwilling to adopt this technique.

To overcome these disadvantages, vertical reduction mammoplasty introduced by Lassus, extended by Marchac and de Olarte, popularized by Lejour, and simplified by Hall-Findlay, has become a frequently used alternative to the Wise pattern reduction mammoplasty in the past decade. Key features of this procedure include skin excision in only one direction and central vertical glandular excision. The pattern of skin excision eliminates the inframammary scar, achieving good esthetic results. In addition, Ogunleye et al. [15] reported that there was no significant difference in complications between the vertical pattern technique using a superomedial pedicle and the Wise pattern using an inferior pedicle, suggesting that vertical pattern is a safe alternative to the Wise pattern, even in patients with macromastia requiring large volume reduction. Therefore, we believe that the vertical mammoplasty pattern is a viable alternative technique for NSM in selected patients, especially those undergoing autologous tissue reconstruction.

Several studies have reported the incidence of complications in breast reconstruction following NSM. Laporta et al. [16] reported that 19.2% patients undergoing DIEP flap reconstruction following NSM developed partial- or full-thickness mastectomy skin flap and NAC necrosis. Kim et al. [17] also showed that the incidence of complete necrosis of the NAC was 9.6% in patients with immediate TRAM flap reconstruction following NSM. In our study, complete necrosis of the NAC occurred in one breast (4.7%) and partial necrosis of the NAC was observed in 4 (19.0%) patients. These results are similar to those of previous studies.

The most frequent complication when performing breast reconstruction after oncologic resection is partial necrosis of the NAC. To achieve complete tumor excision, extensive undermining of the breast skin is required. This may compromise the blood supply to the NAC, leading to total or partial necrosis. This complication is usually not a serious problem,

and revision under local anesthesia can solve partial necrosis of the NAC in most cases. However, since the main rationale for performing NSM is to achieve esthetically superior results, all complications that negatively influence the esthetic outcome of the procedure can be of serious concern [18]. Therefore, to reduce the incidence of complication, there must be sufficient communication between the oncologic and reconstructive surgeons.

To prove the safety of this procedure, it is necessary to compare the incidence of NAC necrosis in this procedure with that in the conventional superolateral oblique incision approach. In a recent study of 53 patients who underwent NSM via the conventional superolateral radial incision, Park et al. [19] observed nipple necrosis in 9 (17.0%) patients. Further, Algaithy et al. [20] reported a 16.2% incidence of NAC necrosis among 37 patients who received NSM via a superolateral incision. Since these studies included patients with small and non-ptotic breasts, the incidence of complications is expected to be higher when patients with large and ptotic breasts are included. Although the number of patients in our cohort was insufficient, and the thickness of the mastectomy skin flap may vary depending on the breast surgeon, the incidence of complications was comparable with that with the conventional approach. Thus, it is expected that our approach can be performed safely.

To achieve a satisfactory result, surgeons must adhere to several key principles. First, the oncologic surgeon should perform mastectomy via the lateral limb incision below the lower border of the NAC. Although this limitation of access makes NSM more difficult, it can preserve the blood flow to the NAC by maintaining the superolateral cutaneous perfusion. In our institution, partial necrosis of the NAC often occurred initially because we extended the lateral incision beyond the upper border of the NAC. However, the refinement of the incision line minimized the incidence of NAC necrosis significantly. Even if partial necrosis of the NAC occurred, the esthetic result was superior to that of SSM, because the natural structure of the NAC is preserved as far as possible. Second, the maximum possible amount of subcutaneous fat and medial perforator should be preserved with minimal use of the electrocautery while performing tumor excision. Maintaining a sufficient thickness of the mastectomy flap is critical for minimizing compromise of the circulation. However, there is a need for consultation with the oncologic surgeon before surgery, because the primary goal of breast cancer surgery is the complete eradication of tumor.

In immediate breast reconstruction, the viability of the NAC can be very difficult to predict. Several tools to evaluate the perfusion of the mastectomy flap intraoperatively have been introduced, such as fluorescein, Doppler ultrasound, thermography, and laser-assisted ICG angiography [21]. However, these methods require additional expensive medical equipment, which was not easily available during the early days of NSM. Initially, we overcame this problem with the “skin banking procedure” [22]. When there was a risk of NAC necrosis, a skin paddle of the flap was spared and buried under the reconstructed breast. Approximately 10 days after the initial resection and reconstruction, the status of the vascular circulation of the NAC was assessed. If the NAC was deemed viable, the spared and buried skin paddle was re-approached and de-epithelized via the previous incision under local anesthesia. If partial or total necrosis was present, the spared skin paddle was used for revision surgery, as it was very useful in maintaining breast shape and symmetry. In recent years, however, the frequency of using skin banking procedure has significantly decreased, because ICG angiography is performed routinely for assessment of tissue perfusion. After subcutaneous injection of ICG (Dongindang Pharm, Sigheung, Korea), we can evaluate the viability of the

NAC in advance with a near-infrared camera (Moment K; IANC&S, Seoul, Korea). Compared to the past, it has become widely available and cost-effective.

Our study had several limitations. The results were limited due to the relatively small number of patients. Another limitation was the study design, a retrospective analysis in a single institute. Had the study included more patients, more meaningful results like risk factor analysis could have been generated. However, the vertical resection technique could enable surgeons to perform NSM and reconstructive flap surgery in patients with large and/or ptotic breasts resulting in esthetic outcomes without oncologic risk. Furthermore, clinical results regarding the implant-based breast reconstruction following NSM using vertical pattern will be reported in our future study.

This study demonstrated satisfactory breast reconstruction after NSM using the vertical pattern. This procedure can be used to achieve a better breast shape while preserving the NAC without compromising oncologic safety. Therefore, we suggest that it is possible to adopt this vertical resection technique in the realm of NSM.

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