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Review Article



# Aesthetic Scar-Less Mastectomy and Breast Reconstruction

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**Conflict of Interest**
The authors declare that they have no competing interests.

## ABSTRACT

Surgical approaches in breast cancer have been changing to ensure both oncologic safety and cosmetic results. Although the concept of "oncoplastic breast surgery" has been accepted for decades, breast and plastic surgeons have been striving to develop more advanced surgical skills that ensure non-inferior oncologic outcomes with better cosmetic outcomes. Endoscopic or robotic devices, which are currently available only for chest or abdominal surgeries, could be used for breast surgery to ensure better cosmetic outcomes. The authors refer to this surgical concept as "aesthetic scar-less breast surgery and reconstruction," a term that encompasses the consequential concepts rather than naming it with simple technical words such as endoscopy-assisted or robot-assisted surgery. The "scar-less" term simply means leaving less of a scar, and better results can be expected by designing incisions on invisible areas. Herein, we summarize our experiences with various techniques of "aesthetic scar-less" surgery and review the existing literature on this topic.

**Keywords:** Breast neoplasms; Esthetic; Mastectomy; Reconstructive surgical procedures

## INTRODUCTION

To achieve desirable aesthetic outcomes in patients with breast cancer, many surgeons have introduced various methods of oncoplastic surgery (OPS) with breast reconstruction after partial or total mastectomy [1-3]. Although OPS is a surgical technique that leads to oncologic safety and good cosmetic outcomes, a large visible scar often remains after the operation. Because the breast is an organ that symbolizes femininity, this large visible scar could be worrisome for female cancer survivors. Thus, the focus of breast cancer surgery has recently shifted to the patient's quality of life as well as better cosmetic outcomes with fewer operative scars. Breast surgeons endeavor to minimize operative scars by providing the so-called "aesthetic scar-less" surgery [4,5].

Journal of Breast Cancer JBC

**Author Contributions**

Conceptualization: Yang JD, Park HY; Investigation: Yang JD, Lee J, Lee JS, Park CS; Methodology: Yang JD, Park HY; Writing - original draft: Lee J, Lee JS, Kim EK; Writing - review & editing: Lee J, Lee JS, Kim EK.

## CONCEPT OF "AESTHETIC SCAR-LESS" SURGERY

The "aesthetic scar-less" breast surgery can be defined as an operation wherein incisions are secured out of sight and minimized within the range of oncologic safety. Thus, the incision for this surgery can be designed on the inframammary fold, axillary area, periareolar area, or mid-axillary line, which can be hidden by the arms. To hide an operative scar, the axillary, inframammary, and periareolar (semi- or whole-circumareolar) incisions are good options, and for a single incision, a lateral incision can be selected. Recent advances in technology, such as endoscopic surgical instruments and robotic surgery systems, have made these approaches possible.

## "AESTHETIC SCAR-LESS" BREAST-CONSERVING SURGERY

The surgical process of "aesthetic scar-less" breast-conserving surgery is similar to that of conventional breast-conserving surgery. However, the incisions are made in an area that can be easily hidden, including the axillary area, inframammary fold, or periareolar line (**Figures 1** and **2**). In contrast, in conventional breast-conserving surgery, a glandular flap

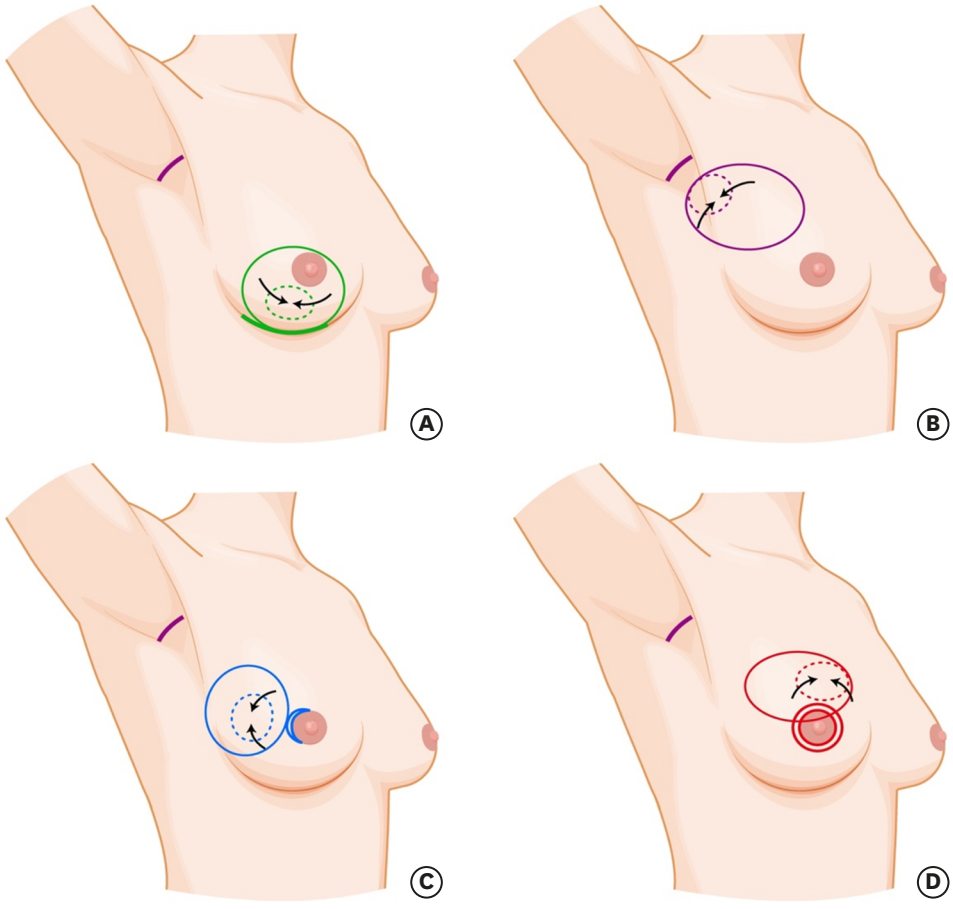


**Figure 1.** "Aesthetic scar-less" breast-conserving surgery (dotted color circles) and partial mastectomy (solid color circles). The incisions during "aesthetic scar-less" breast-conserving surgery or partial mastectomy are designed in an area that can be easily hidden, such as the inframammary fold (A), axillary area (B), or periareolar line (C, D). When primary closure is difficult, the glandular flap can be performed after partial mastectomy.


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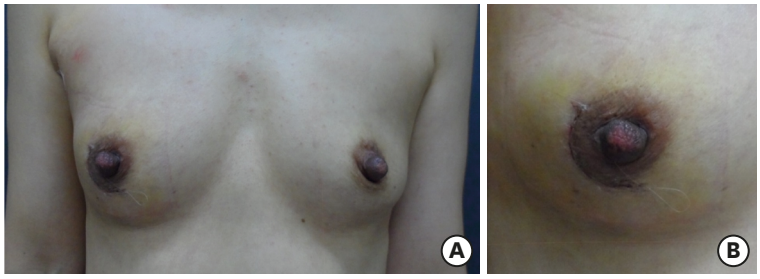


**Figure 2.** Postoperative view of "aesthetic scar-less" breast-conserving surgery. The symmetry and shape of the ipsilateral breast is well maintained, with a rarely visible scar in the periareolar line.

is occasionally required when the primary closure is difficult, and an absorbable filling material can be inserted to fill the defect instead of the glandular flap. This absorbable filling material is an oxidized regenerated cellulose (Interceed® or Fibrillar®; Ethicon, Inc., Johnson & Johnson Company, Somerville, USA) used alone or in combination with other biomaterials [6-8] (**Figure 3**). This surgical method is possible because the overlying skin of the surgical

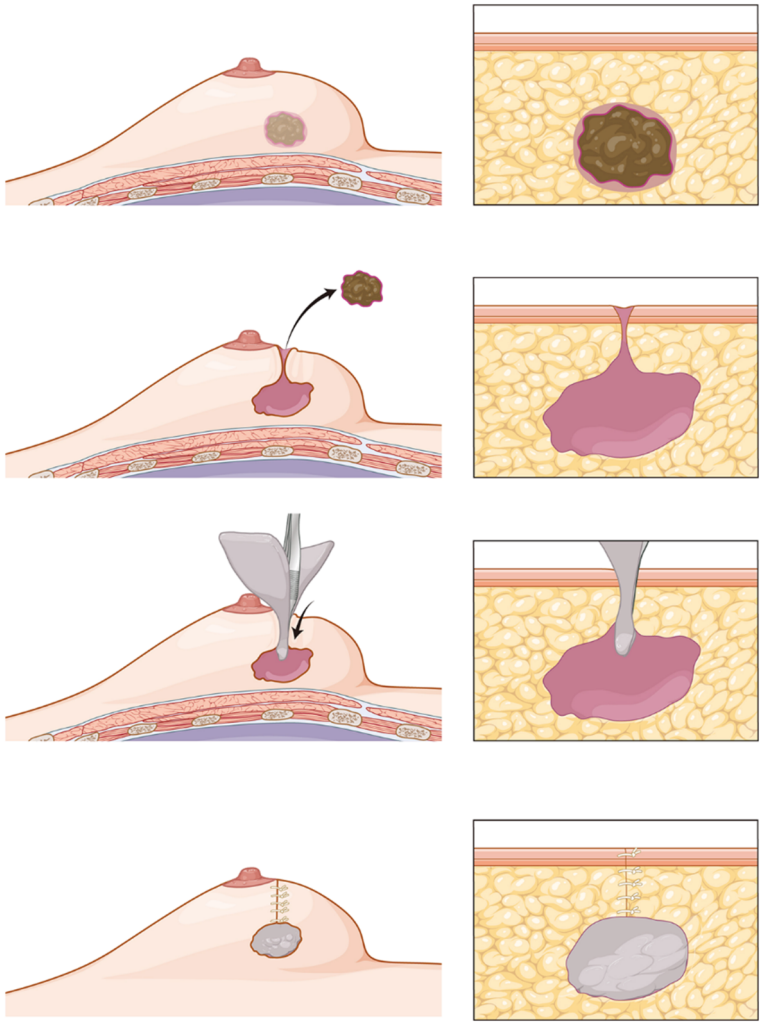

**Figure 3.** The surgical process of absorbable implant insertion using oxidized regenerated cellulose (Interceed® or Fibrillar®). After removal of the breast tumor, the absorbable implant was inserted to fill the defect, and subcutaneous fat and dermis were closed using a layer-by-layer technique.


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defect is intact. However, when the surgical defect becomes 20% larger after breast cancer removal with an oncologic safety margin, an additional breast reconstructive technique is required to obtain better cosmetic outcomes [9,10].

### Axillary approach

An axillary incision can be easily hidden, which makes it a good option for "aesthetic scar-less surgery" [11-13]. The greatest benefit of the axillary approach is that a single incision can be shared for both breast cancer removal and evaluation of the axillary lymph nodes. Sentinel lymph node biopsy or axillary lymph node dissection is a standard procedure used to evaluate the status of the axillary lymph node in invasive breast cancers. After breast tumor removal, the defect can usually be filled with a glandular flap.

### Inframammary approach

An inframammary incision for breast-conserving surgery is appropriate for cancers located in the lower inner to lower outer quadrant of the breast [14,15]. Although a small tumor (< 2 cm) can be closed using only a primary closure, a medium-to-large sized tumor in the lower part of the breast may result in a bird's beak-like breast shape if an appropriate glandular flap is not performed [16].

### Periareolar approach

The periareolar approach for breast-conserving surgery has excellent aesthetic outcomes because of the reduced visibility of the scar owing to the pigmentation of the nipple–areolar complex. Based on their length, periareolar incisions can be divided into semi- or whole-circumareolar incisions. In 1990, Benelli [17] first described a whole-circumareolar incision for mammoplasty, the so-called round block technique or Benelli mastopexy. The advantages of the periareolar incision include not only a less-visible scar but also wider exposure to the deepithelized skin and its usefulness in tumors located in any quadrant of the breast [18-20]. In addition, incision closure can usually be performed using the continuous cerclage suture technique.

## BREAST RECONSTRUCTION AFTER "AESTHETIC SCAR-LESS" BREAST-CONSERVING SURGERY

Efforts are underway to identify methods to reduce scarring after surgery by minimizing the incision in the breast mound. In case of a small defect with a size < 10%–15% of breast, the glandular reshaping technique is performed using the same incision as that for breast-conserving surgery, with the expectation of achieving a satisfactory aesthetic shape, even though the overall breast volume is decreased by the resection. However, in cases with a moderate to large defect that constitutes ≥ 20%–25% of the entire breast, autologous tissue transfer is essential. Therefore, various reconstruction options can be selected based on the characteristics of the defect location [21-23].

The regional flap (lateral thoracodorsal flap or rotation flap), a mini or muscle-sparing latissimus dorsi (LD) flap, is considered to be a useful reconstructive surgical method, as it can be applied to all breast defects and allows for faster recovery than an extended LD flap. To minimize the scarification of functional muscles, perforator flaps, such as the intercostal artery perforator flap or the thoracodorsal artery perforator (TDAP) flap, can also be applied. However, TDAP is a method that can be used selectively for a laterally located cancer in all areas, except the lower inner quadrant (LIQ) [24-26]. Compared with the classical


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preoperative design, all these surgical methods employ the concept of incision minimization, which incorporates the idea of scarless surgery. Based on this concept, powerful devices (i.e., endoscopy or robotic surgery) are used to make the mid-axillary incision smaller, more accurate, and more precise (**Figure 4**). Not only is the incision shortened but also designed to be covered by the bra line, in an effort to maximize patient satisfaction (**Figure 5**).

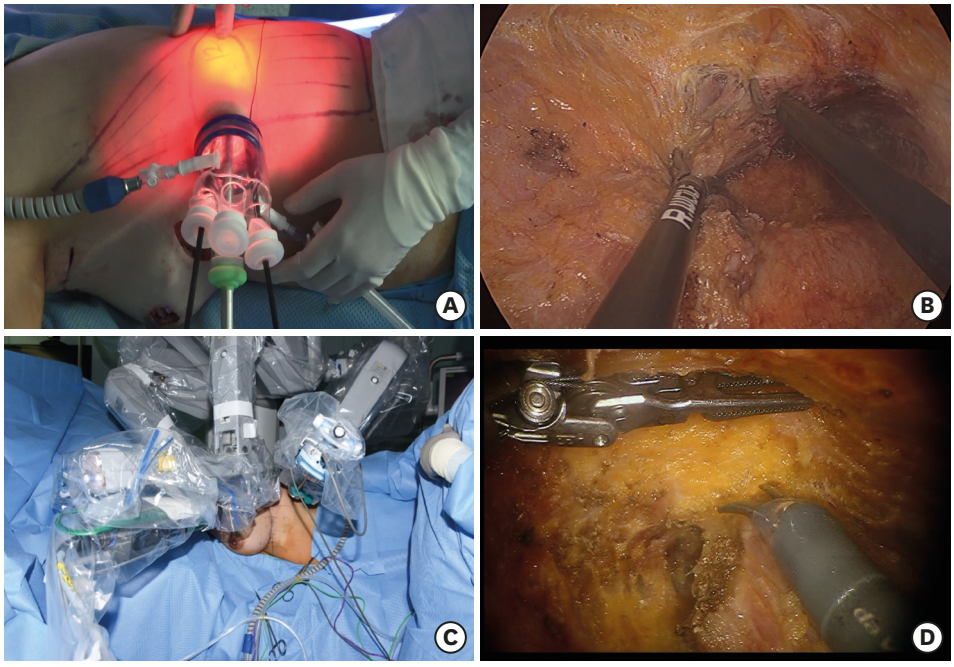


**Figure 4.** "Aesthetic scar-less" breast reconstruction using a mini LD flap after partial mastectomy. (A, B) Endoscopy-assisted breast reconstruction using a mini-LD flap after partial mastectomy. Operative view and intraoperative endoscopic view during dissection at the lateral border of the LD flap. (C, D) Robot-assisted breast reconstruction using a mini-LD flap after partial mastectomy. Operative view and intraoperative robotic scope view during dissection of the inferior border of the LD flap.
LD = latissimus dorsi.

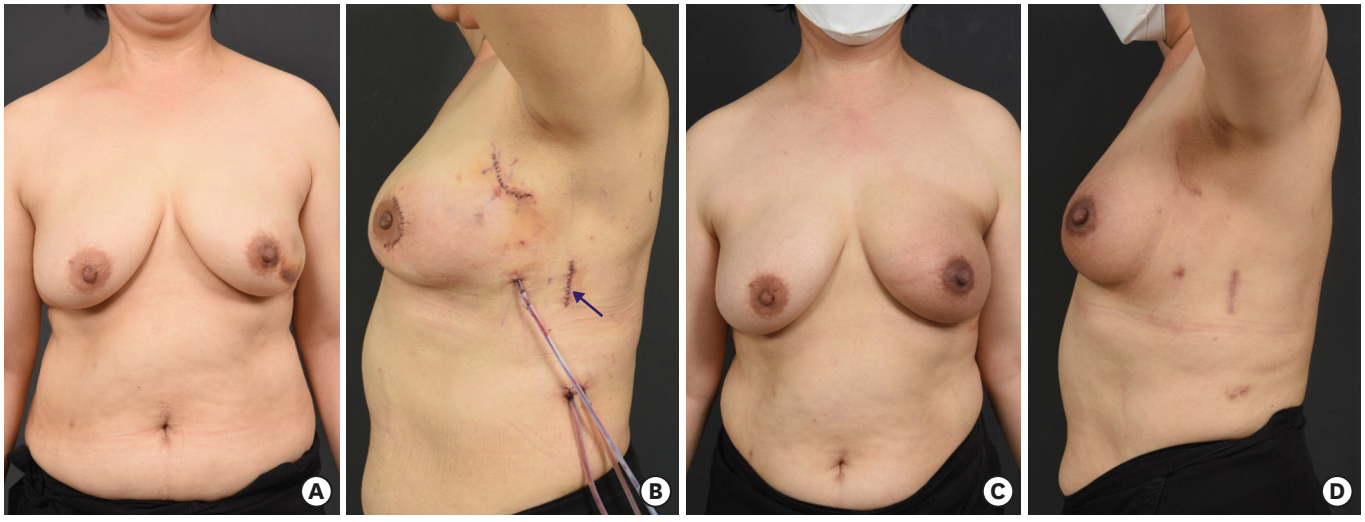


**Figure 5.** Cosmetic outcomes of endoscopy-assisted breast reconstruction using the mini LD flap after partial mastectomy. (A) Preoperative view. (B) Immediate postoperative lateral view 3 days after surgery. Only a small lateral incision (arrow) remains for harvesting the endoscopy-assisted mini-LD flap. (C, D) Five months postoperative view after radiotherapy (anteroposterior and lateral views).
LD = latissimus dorsi.


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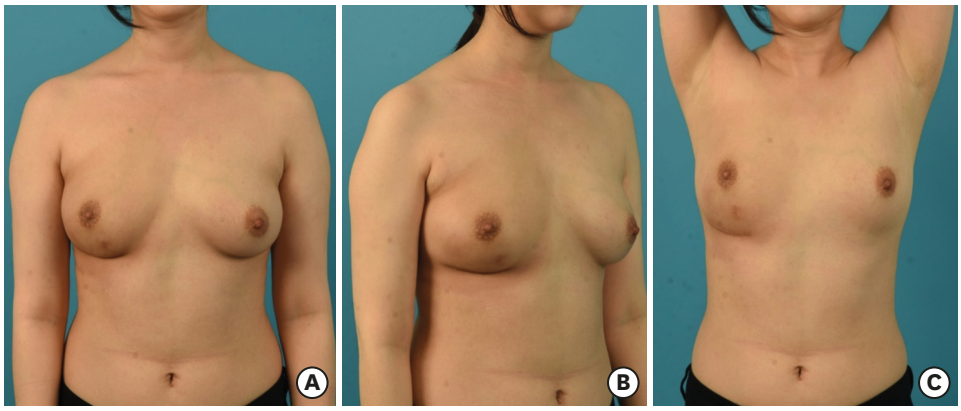


**Figure 6.** (A-C) 1-year postoperative views of immediate breast reconstruction using laparoscopically harvested omental flap.

The LIQ, which is the most difficult area to reconstruct, is considered to be useful in Asians with small-to-moderate breast volume and can be reconstructed using an omental flap or anterior intercostal artery perforator (AICAP) flap. In addition, for cases wherein breast-conserving surgery is performed for lower or LIQ lesions, especially where more than 30% of the breast tissue is expected to be removed, immediate reconstruction using a laparoscopically harvested omental flap can be a good choice. A wide local excision (WLE) of the lower or LIQ lesion without an overlying skin excision can be performed through the inframammary fold incision, and the laparoscopically harvested omental flap is transferred to and fills the WLE cavity through a subcutaneous tunnel (**Figure 6**). The significant advantage of this surgical method is that both WLE and reconstruction are possible using only the inframammary fold incision, which can hide the scar in its natural crease [27].

## "AESTHETIC SCAR-LESS" NIPPLE-SPARING MASTECTOMY

Aesthetic scar-less nipple-sparing mastectomy is a more general concept in breast cancer surgery. Although many surgical oncologists use a lateral or upper-lateral incision for conventional nipple-sparing mastectomy [28,29], the large, visible scar that remains in the front view of the breast is one of the disadvantages of this technique. To overcome this drawback, many surgical oncologists have attempted to prevent visible scars through inframammary or axillary incisions with or without a periareolar incision, which can be referred to as an "aesthetic scar-less" nipple-sparing mastectomy (**Figure 7**).

When nipple-sparing or skin-sparing mastectomy is performed via the inframammary or axillary incision, one of the biggest obstacles is approaching the upper inner quadrant and the medial aspect of the breast owing to the parenchyma. Endoscopic or robotic devices can be used to approach these areas more easily, a procedure that is referred to as endoscopy- or robot-assisted nipple-sparing mastectomy (**Figure 8**).

When gasless endoscopic or robot-assisted nipple-sparing mastectomy is performed, the retromammary space can be easily dissected using conventional surgical instruments such as Army or Richardson retractors. The subcutaneous skin flap can be dissected with surgical scissors after injection of tumescent fluid (Hunstadt's solution, 1,000 mL Ringer's lactate + 50 mL, 1% lidocaine + 1 mL, 1:1,000 epinephrine) [30]. The lateral and medial sides of the breast can then


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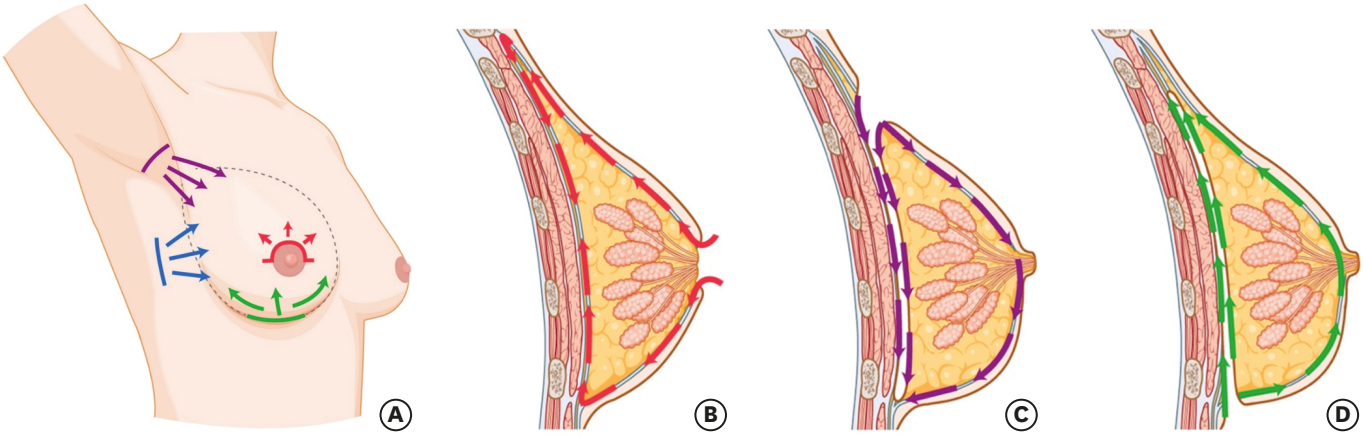


**Figure 7.** "Aesthetic scar-less" nipple-sparing mastectomy. (A) The incisions during "aesthetic scar-less" nipple-sparing mastectomy can be designed at the axillary crease (purple line), mid-axillary line (blue line), inframammary fold (green line), and periareolar line (red line), depending on the breast shape and ptosis. (B) Periareolar incision is performed for "aesthetic scar-less" nipple-sparing mastectomy. Typically, the mastectomy skin flap is dissected first from the incision, and the retromammary layer is dissected later. (C, D) The axillary incision (purple) and inframammary incision (green) can be used for "aesthetic scar-less" nipple-sparing mastectomy.

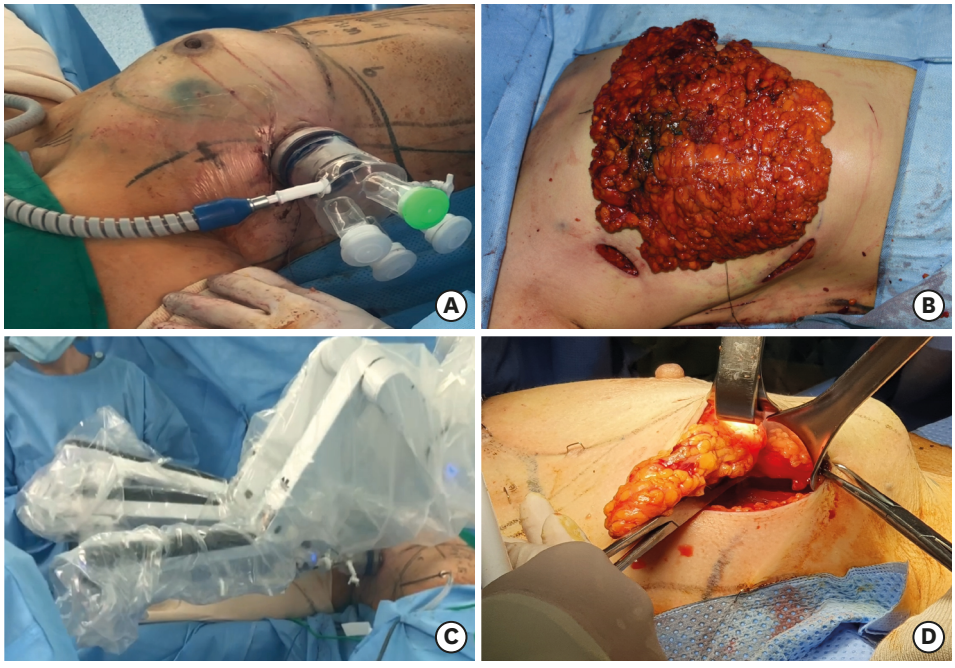


**Figure 8.** "Aesthetic scar-less" nipple-sparing mastectomy with breast reconstruction. (A, B) Endoscopy-assisted nipple-sparing mastectomy with breast reconstruction. Operative view and immediate postmastectomy view with specimen. (C, D) Robot-assisted nipple-sparing mastectomy with breast reconstruction. Operative view and immediate postmastectomy view with pulling of the breast specimen.

be transected using various energy devices, including electrocautery, the LigaSure™ device (Covidien, Mansfield, USA), the Harmonic™ scalpel (Ethicon Endo-Surgery, Inc., Cincinnati, USA), or the Thunderbeat™ (Olympus, New York, USA), under an endoscopic camera.

## Inframammary approach

The inframammary incision for nipple-sparing mastectomy is a favorable design that results in a less-visible incision that is hidden by the inframammary fold [31,32]. However, because


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the incidence of nipple ischemia increases in the ptotic large breast, this approach has been recommended only for small-sized breasts [33].

When the upper side of the breast is not easily dissected, the surgeon can use an additional axillary incision, which can also be used for sentinel lymph node biopsy. After nipple-sparing mastectomy, breast reconstruction can be performed with a prepectoral or subpectoral implant or with an autologous tissue flap [34].

### Axillary approach

Because the axillary incision for nipple-sparing mastectomy is hidden in the axillary area, this method results in the best cosmetic outcome. Moreover, the same incision can be used for the evaluation of axillary lymph nodes. The surgical process is very similar to the inframammary approach for nipple-sparing mastectomy [35]. However, when an implant is inserted into the subpectoral pocket, the anchoring of an acellular dermal matrix (ADM) becomes somewhat difficult. Therefore, this approach is more appropriate when the insertion of a prepectoral implant is planned for breast reconstruction.

### Periareolar approach

The periareolar incision for nipple-sparing mastectomy can also be easily hidden by pigmentations of the nipple–areolar complex. In general, the Ω (omega)-shaped circumareolar incision is designed for nipple-sparing mastectomy. A subcutaneous flap is made with tumescent fluid and is dissected using surgical scissors via the periareolar incision. The retroareolar space is then dissected using electrocautery or energy devices from the periareolar and axillary incisions, which were opened for axillary evaluation.

However, reports have indicated that the incidence of nipple ischemia is higher in a radial incision or during the combination of a radial and periareolar incision [33]. Therefore, a better choice for skin-sparing mastectomy might be the periareolar approach, which requires sacrificing a nipple or the nipple–areolar complex.

## BREAST RECONSTRUCTION AFTER "AESTHETIC SCAR-LESS" NIPPLE-SPARING MASTECTOMY

The reconstruction methods that can be applied after scar-less nipple-sparing mastectomy are classified into 2 types: autologous tissue and implant. The first method, an autologous tissue transfer, could be performed to apply the LD flap in Asian patients with a small-to-moderate breast volume. In all cases wherein a nipple-sparing mastectomy incision is used, total reconstruction can be performed by tunneling to the breast through the axillary incision. Although this method is designed to cover the surgical scar on the bra line at the back, the inevitable presence of long scars remains a disadvantage. To compensate for this drawback, a method of transferring and applying an LD muscle flap to the mid-axillary line has been developed [36,37]. Using the latest devices (endoscopy-assisted or robotic-assisted methods), total breast reconstruction is possible by transferring only the LD muscle flap through a smaller incision using the one-port incision method to approach the mid-axillary line (**Figure 9**). Currently, in the case of a small breast, reconstruction can be performed using only a flap. However, in patients with moderate to large breasts, if the flap volume is insufficient, a small implant can be placed under the flap to create symmetry with the breast on the other side, thereby compensating for this disadvantage. In addition, in patients with


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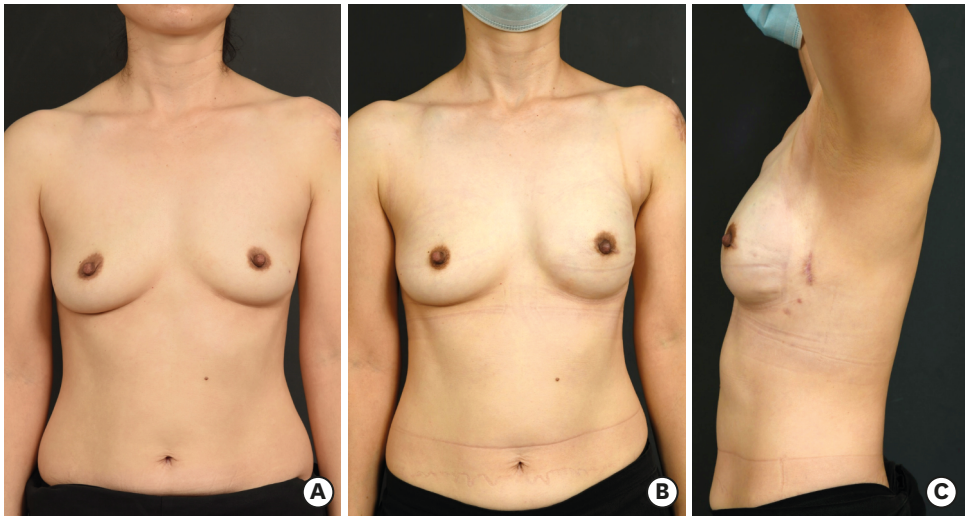


**Figure 9.** Robot-assisted breast reconstruction using an implant after nipple-sparing mastectomy (BellaGel BRSZ-L 175 mL, BellaCell HD 6 × 16 cm; subpectoral technique). (A) Preoperative view. (B, C) Ten-month postoperative findings after robot-assisted breast reconstruction using an implant (anteroposterior and lateral views). Only a small lateral incision (arrow) remains, not only for breast reconstruction but also for nipple-sparing mastectomy with sentinel lymph node biopsy.

large breasts or in patients who need delayed breast reconstruction that requires a sufficient skin envelope after total mastectomy, reconstruction can be performed using a transverse rectus abdominis muscle flap or deep inferior epigastric perforator flap, which are autologous tissues of the abdomen. Recently, there has been an increasing number of reports on efforts to reduce blood vessel damage by minimizing the destruction of abdominal walls using endoscopy or robot assistance and by performing sophisticated operations [38,39].

Finally, one reconstruction method uses a silicone implant. This method can be broadly divided into the subpectoral and prepectoral techniques. The latter is a new surgical concept associated with a good aesthetic outcome, and with the growing popularity of a powerful ADM material, a variety of prepectoral techniques (full wrapping or partial wrapping) is possible. This method facilitates implant-based breast reconstruction, even when mastectomy is performed using an axillary incision, in which case incorporating subpectoral techniques could be difficult [34,40].

In the inframammary fold approach, subpectoral implant-based breast reconstruction is the most convenient. However, in patients with small-to-moderate breast volume, it is difficult to completely hide the scar of the inframammary fold line. Therefore, this concept has been shifting to one in which scars are shortened using endoscopy or robots when nipple-sparing mastectomy is performed. Naturally, the decrease in scar length is directly proportional to the patient's satisfaction.

## CONCLUSION

“Aesthetic scar-less” breast surgery is not a novel concept in breast cancer treatment. Any breast cancer surgery that results in a minimized and invisible incision could be considered an “aesthetic scar-less” breast surgery. However, there appears to be a need for a concept that can integrate and encompass numerous surgical methods developed and reported by many surgical oncologists, and we hence used the terms “aesthetic scar-less” breast surgery and reconstruction.


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We hope that the concept of "aesthetic scar-less" breast surgery and reconstruction will allow more surgeons to apply conventional devices in different ways rather than rely only on existing methods.

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