Breast Surgery

Aesthetic and Technical Refinements in Latissimus Dorsi Implant Breast Reconstruction: A 15-Year Experience

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Abstract

Background: The latissimus dorsi myocutaneous flap and implant breast reconstruction procedure has undergone many refinements over its lifetime. In fact, the authors have made many aesthetic and technical refinements to their own approach to breast reconstruction.

Objectives: The authors review the historical progression of latissimus flap and breast reconstruction techniques and compare these to their own 15-year experience.

Methods: A retrospective chart review was conducted for all latissimus and implant breast reconstructions performed by the senior author (MAC) from July 1994 to June 2009, for a total of 52 procedures in 31 patients. Surgical and oncological data, complications, and outcomes data were recorded.

Results: The mean age of the patients at time of surgery was 47.6 years. Average mastectomy weight was 283 grams and average final implant volume was 364 cc. Average follow-up was three years, four months. Of the 52 total procedures, 34.6% were immediate breast reconstructions utilizing skin-sparing mastectomy (SSM); 13.5% of the reconstructed breasts also had preservation of the areola (areolar-sparing mastectomy [ASM]). The most common complication was donor site seroma (40.4%). Aesthetic and surgical refinements identified over the time period included the adoption of SSM and ASM techniques, immediate nipple reconstruction, the placement of an adjustable saline implant to allow for postoperative size adjustment, and implant placement in the prepectoral position. The overall latissimus dorsi implant reconstruction success rate was 94.2% (49/52).

Conclusions: The data demonstrated a successful outcome for latissimus dorsi and implant breast reconstruction for patients with a low or normal body mass index and a small (A to C cup) breast size. The aesthetic outcome of latissimus dorsi breast reconstruction has been improved over the past 15 years by the adoption of SSM and ASM techniques. Immediate nipple reconstruction and the placement of an adjustable saline implant potentially render this procedure a true single-stage reconstruction. Prepectoral implant position provides good aesthetics while preserving the subpectoral space for future management of capsular contracture if required.

Keywords

implants, breast surgery, breast reconstruction

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The latissimus dorsi myocutaneous flap remains a reliable choice in breast reconstruction. Although the procedure was originally described in 1906 by Tansini to cover mastectomy defects, it did not gain widespread popularity until the 1970s. Several authors have investigated the vascular anatomy of the muscle and advanced its use in breast reconstruction.1-3 Bostwick popularized the technique by incorporating a skin island over the muscle for immediate replacement of the skin defect following mastectomy. The latissimus flap became less popular following the

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introduction of the transverse rectus abdominus myocuta-
neous (TRAM) flap, as well as free tissue transfer. The transverse rectus abdominus myocutaneous (TRAM) flap, as well as free tissue transfer. Recent aesthetic advances have come about through the joint efforts of oncologic and reconstructive surgeons to improve the aesthetic outcome of latissimus dorsi and free tissue transfer. Recent aesthetic advances have come about through the joint efforts of oncologic and reconstructive surgeons to improve the aesthetic outcome of latissimus dorsi implant breast reconstruction. In these settings, the latissimus dorsi plays an important role in improving the aesthetic results after immediate breast reconstruction. In addition, the latissimus flap is also commonly utilized for salvage of the partial mastectomy defect and irradiated breast after lumpectomy.

At the start of the study period, traditional total (simple) mastectomy (TM) and modified radical mastectomy (MRM) were the standards in breast cancer treatment. Over the past 15 years, significant aesthetic improvements have been made by performing skin-sparing mastectomy (SSM), selective nipple-sparing mastectomy (NSM), or areola-sparing mastectomy (ASM) as appropriate. Adoption of these techniques has allowed retention of the native breast skin envelope, the inframammary fold (IMF), and, if appropriate, the native nipple and/or areola, which yields a more aesthetic postoperative breast appearance. The recent application of ASM and immediate breast reconstruction has also allowed a decrease in the size of the harvested skin island with the latissimus dorsi flap. In our practice, we have collaborated with general surgeons over the past three years to reduce scarring and improve the aesthetic outcomes of their patients. Since the advent of ASM in our practice, immediate nipple reconstruction has been performed on the in situ back skin island before elevation of the latissimus muscle, rather than after inset. Refinements have also been made to the selection of an implant or expander for reconstruction, along with operative changes regarding muscle coverage of the chosen implant. The pectoralis major muscle was initially raised and the expander or implant was placed subpectoraly, with the lower pole of the implant covered by the latissimus dorsi muscle flap. However, inset of the latissimus dorsi myocutaneous flap has evolved to now provide total muscle coverage over an anatomically shaped, adjustable implant in the prepectoral position.

METHODS

A retrospective chart review was conducted to identify all patients who underwent bilateral or unilateral latissimus dorsi breast reconstruction by the senior author (MAC) over a 15-year period from July 1994 to June 2009. An independent observer performed data retrieval and entered the patient information into a database, including basic demographic information and comorbidity risks. The oncologic data retrieved included initial tumor diagnosis, tumor size, type of mastectomy, axillary lymph node dissection, and administration of preoperative chemotherapy or radiation. Surgical data included timing of reconstruction (immediate or delayed), position of the implant and expander (subpectoral or prepectoral), type of adjustable implant/expander and permanent implant, initial fill volume, and final fill volume. Operative duration, hospital length of stay, and incidence of postoperative complications were also documented. Patients with Baker grades 1 or 2 capsules were considered to be capsular contracture (CC) free, whereas those with Baker grades 3 or 4 were classified as having CC.

Current Operative Technique

In our current approach, the latissimus dorsi flap is raised following the standard operative protocol. In brief, patients are marked with a horseshoe crescent overlying the midportion of the latissimus dorsi at the level of the patient’s bra strap, with the skin flap as small as possible (Figure 1). The skin island ranges in size from 4 × 6 cm (for immediate reconstruction in patients with ASM) to 8 × 21 cm (for patients with SSM or delayed breast reconstruction). A 3-cm axillary incision is also marked for division of the latissimus insertion and for axillary dissection if required. The thoracodorsal nerve is preserved to reduce the atrophy that may be associated with division of the motor nerve, but complete release of the origin and insertion is performed to minimize muscle contraction (Figure 2). The superior axillary tunnel to the mastectomy defect is designed high on the lateral chest wall to preserve the lateral mammary tissue for separation of the two pockets and to maintain lateral breast shape. After mastectomy, the patient is repositioned into the lateral decubitus position for flap harvest (occasionally, the patient is placed in a prone position for bilateral reconstruction). Nipple reconstruction is performed immediately. Closure of the donor site is performed with spray Thrombin (King Pharmaceuticals, Inc., Bristol, Tennessee). Vicryl (Ethicon, Inc., Bridgewater, New Jersey) 2-0 three-point fixation sutures are inserted at the incision. Two closed suction drains are placed into the donor site and mastectomy defect.

Figure 1. Markings demonstrating the skin island for latissimus muscle harvest.
Insetting of the latissimus flap is performed as routine in the supine position. Vicryl 4-0 sutures are placed to fix the latissimus muscle to the chest wall, including the anterior surface of the pectoralis muscle, 360 degrees around the base of the mastectomy defect. The prepectoral space is thereby completely covered by the latissimus muscle; the skin island and nipple reconstruction are positioned under the areola or skin-sparing defect. Insertion of the implant under the latissimus muscle is performed after all sutures have been placed, with the orientation of the valve so that the fill tube (if present) exits the implant in an inferior direction. The port is placed 2 to 3 cm below the inframammary fold on the lateral part of the costal margin. If a postoperatively adjustable saline implant is placed, there are two size dome ports provided; although the small dome is most common, the larger dome may be considered for patients with significant subcutaneous tissue. The metal port connector joins the fill tube to the fill port with 3-0 silk ties (Figure 3). An average of approximately 65% of the final anticipated volume is placed initially to expand the implant. (A video of this current technique is available online at www.aestheticsurgeryjournal.com.) This technique has also now been employed as a one-stage reconstruction incorporating immediate nipple reconstruction at the time of areola-preserving mastectomy (Figures 4A, B and 5).

Postoperatively, the closed suction drains are removed once drainage is less than 30 cc per day. When required, expansion is begun in the office two weeks after surgery and 50 cc is added per visit until the final volume is achieved. Following completion of inflation, when a self-sealing double-valve adjustable saline implant has been placed, a small incision is made in the inframammary fold to remove the fill port under local anesthesia in an office setting. As the fill tube is pulled, an internal plug seals the valve, which then folds closed. The fill tube breaks at a predetermined point.

Patients who have undergone SSM tend to have a slightly larger areolar island, which is reduced at the time of nipple areolar reconstruction with the purse-string method. When required, tattooing is performed on the flat surface of the skin island prior to nipple reconstruction to reduce trauma to the reconstructed nipple. Interestingly, none of the patients who have undergone immediate nipple reconstruction with ASM in this series required nipple tattooing, as the reconstructed nipple appeared to pigment spontaneously from the surrounding areolar tissue (Figure 6A). To assess this phenomenon, two biopsies of one such reconstructed nipple were performed to examine the tissue histologically for melanocytes (Figure 6B).

RESULTS

Patient Demographics

During the study period, 31 patients underwent latissimus dorsi and implant breast reconstruction. The mean age of the patients was 47.6 years (range, 14-73). The 14-year-old patient had Poland syndrome, whereas the remainder of the patients underwent breast reconstruction for acquired breast deformities following mastectomy or lumpectomy. Nine patients (29%) had a history of cigarette smoking. Full patient demographics are listed in Table 1.

Reconstructive Data

Reconstructive data were reviewed for all 31 patients. Of the 52 total latissimus breast reconstructions, 10 were unilateral (five left and five right) and 21 were bilateral. Of the 21 patients who underwent bilateral mastectomy, three had bilateral prophylactic mastectomies (six total breasts). One patient had bilateral pathology. The remaining 17 patients had pathology in one breast (nine left, eight right) and prophylactic mastectomy in the contralateral breast. This comprised a total of 23 breast reconstructions follow-
ing prophylactic mastectomy, 28 for breast pathology, and one for congenital deformity. Immediate reconstruction was performed in 69% of breasts; 31% were delayed reconstructions. Average follow-up was three years, four months (range, one month to 8.75 years).

Oncologic Data

Data showing the causes of breast deformity are listed in Table 2. Mastectomy weights were available for 13 breasts, which averaged 283 grams. Of the available pathology results, oncological diagnosis included 12 invasive ductal carcinoma, one invasive lobular carcinoma, six cases of ductal carcinoma in situ (DCIS), and three patients with lobular carcinoma in situ (LCIS). Two patients with pathology on biopsy demonstrated benign mastectomy pathology. Positive axillary lymph nodes were identified in seven patients. Preoperatively, 13 patients had adjuvant chemotherapy and seven had radiotherapy. Postoperatively, five additional patients required chemotherapy and one underwent radiotherapy.

Primary Reconstructive Surgery

Reconstructive surgery times were analyzed when recorded separately from mastectomy times. The average surgical time for a unilateral reconstruction was three hours and 36 minutes. The average surgical time for bilateral reconstruction was five hours and 34 minutes. At the beginning of the series, subpectoral implant placement was routinely performed. Therefore, 25% of reconstructed breasts had traditional placement of the implant in a partially subpectoral, partially sublatissimus flap position. With advances in surgical technique, total latissimus muscle coverage with the implant placed in the prepectoral position was performed in the remaining 75% of breast reconstructions. Adjustable saline implants were placed in 86.3% (n = 44) of reconstructions. Other implants placed in the primary surgery were three expandable double lumen silicone/saline implants (5.8%), one textured saline expander (1.9%), and three permanent gel implants (5.8%). The final fill volume of the initial expander or implant averaged 378 cc. The drains remained for nine days, on average, after surgery.

Complication data from primary surgeries are listed in Table 3. Twenty-eight reconstructed breasts (53.8%) had a postoperative complication. The most common complication in this series was dorsal seroma, which was defined as any fluid collection requiring aspiration after surgery. Seroma occurred in 40.4% (n = 21) of reconstructions. All seromas were managed with percutaneous drainage in the office. Nine of the seromas (42.9%) resolved with only one to two aspirations, whereas 12 (57.1%) required three

Figure 4. (A) Markings for areolar-sparing mastectomy. (B) The nipple is removed in continuity with the mastectomy specimen.

Figure 5. Areolar-sparing mastectomy and immediate nipple reconstruction are shown at the completion of the reconstruction.
or more aspirations. One patient required bilateral replacement of drains for persistent seroma. Other complications included infection in four reconstruction patients (7.7%), ranging from stitch abscess to implant infection; partial skin or flap necrosis in three patients (5.8%); and postoperative hematoma in two patients (3.8%).

Statistical analysis of the complications data was performed with a two-tailed *t*-test. The relationships between complications and smoking status, pre- or postoperative radiotherapy, and development of capsular contracture were assessed. Patients who underwent radiotherapy developed significantly more complications overall than patients who did not have radiotherapy (*P* = .028). Subgroup analysis did not show any statistically significant relationship with any specific complication, likely because of the small number of patients in the radiotherapy group. No significant relationship was observed between the development of complications and smoking (*P* = 1.000) or CC (*P* = .284).

### Secondary Surgery

Overall, 10 breast reconstructions in five patients (19.2%) were completed in a single stage, whereas 42 reconstructions (80.8%; 26 patients) required two or more stages.

The most common secondary procedures performed to complete the breast reconstruction were planned and staged operations, including replacement of the saline expander or implant with a permanent silicone gel implant, nipple reconstruction, and nipple/areolar tattooing.
Although the adjustable saline implant is a permanent implant, patient choice often dictated that this implant be changed to a silicone implant at the final stage. The average volume of all final implants was 364 cc. Nipple reconstruction was performed immediately (at the time of primary surgery) in 19.2% of breasts (n = 10). Traditional delayed nipple reconstruction was performed in 78.8% (n = 41), whereas one breast had not yet undergone nipple reconstruction at the completion of the study period.

Over the follow-up period, additional secondary or revisional procedures were performed on 30 breasts (57.7%). Common secondary procedures included capsulectomy for CC (n = 16), mastopexy (n = 10), and scar revision of the breast or donor site scar (n = 8). Bilateral deepithelialized TRAM flap reconstruction was performed in one patient for recurrent CC and infection with implant removal, whereas unilateral TRAM was performed on a second patient following debridement of the mastectomy flaps. Therefore, our overall latissimus dorsi implant reconstruction success rate was 94.2% (49/52).

### Nipple Histology

Biopsies were taken for analysis from the tip and base of the nipple of one patient who underwent ASM, in whom the reconstructed nipple spontaneously repigmented (Figure 6A). A representative histological slide from the biopsy is shown in Figure 6B. Histology of tissue samples taken from both the base and the tip showed uniform melanization of the epidermis in the reconstructed nipple. These melanocytes are presumed to have spontaneously migrated from the surrounding native areola.

### DISCUSSION

Evolution in mastectomy techniques has expanded the procedure far beyond the historical wide, elliptical excision surrounding the nipple areola complex to include skin-sparing, nipple-sparing, and areolar-sparing techniques. Latissimus dorsi and implant breast reconstruction is a suitable option for a particular subset of patients who have a low or normal body mass index and small to moderate (A to C cup) breast size, as shown in this data set, in which mastectomy specimen weights averaged 283 grams and final implant volume averaged 364 cc. Over the 15 years included in this study, surgical techniques have evolved from MRM to ASM, from subpectoral to prepectoral implant placement, from expanders that require removal to permanent one-stage implants, and from delayed to immediate nipple reconstruction. We feel that these refinements have improved the aesthetic outcome of latissimus dorsi and implant breast reconstruction.

### Areola-Sparing Mastectomy

The advent of SSM performed through a periareolar incision has significantly improved the aesthetic results of breast reconstruction, particularly when combined with a flap that provides a skin island (Figure 7A,B). In an attempt to further improve the aesthetic appearance of the reconstructed breast, NSM and ASM can be performed. Although they do improve aesthetic results, these techniques must be oncologically sound. Preservation of the nipple has received considerable recent evaluation and is thought to be a safe technique for small and remotely placed tumors, but ductal tissue inside the lumen of the nipple and immediately below the nipple represents the major oncological concern with NSM techniques. However, areola preservation virtually eliminates this risk. Simmons and colleagues analyzed more than 200 mastectomy specimens for involvement of the nipple-areolar complex. They found a rate of 10.6% malignant involvement of the nipple, but only 0.9% involvement of the areola. Histologically, the areola has been shown to contain pigmented skin with an abundance of melanocytes, but the accessory mammary
glands in the areola are not connected by ducts to the breast tissue. Therefore, when the areola is preserved during mastectomy, the oncologic risk is minimized and aesthetic outcome is maximized. This article illustrates a subset of patients in whom the areola was preserved as the natural evolution of the skin-sparing mastectomy (Figure 8A,B). Compared with the routine results achievable with SSM (Figure 5A,B), we feel that ASM produces a better aesthetic outcome for the reconstructed breast. This technique can provide optimal positioning of the nipple-areolar complex and obviate the need for areolar grafting or tattooing due to preservation of the pigmented skin.

Immediate Nipple Reconstruction

Immediate nipple reconstruction can be performed from the skin island of the latissimus dorsi flap. This can be performed either prior to transfer from the back or after inserting the flap in the mastectomy pocket. The senior author (MAC) has found that raising the nipple reconstruction is easier to perform when the skin is still under normal tension in situ on the back, prior to raising the flap. As the skin island is smaller in patients undergoing ASM, final nipple position is planned in advance and is not reliant on the final flap inset position. The newly reconstructed nipple can then be inset directly into the natural areola. This option

Figure 8. (A) This 43-year-old woman presented for breast reconstruction. (B) Nine months after bilateral areolar-sparing mastectomy and breast reconstruction with latissimus dorsi flap with adjustable saline implants. (C) Nine months postoperatively, the patient’s healed latissimus donor site is shown.
provides a uniquely natural-appearing single-stage nipple reconstruction. As such, we believe that immediate (rather than delayed) nipple reconstruction contributes to the aesthetic outcome of the breast and therefore the psychological well-being of the patient in the immediate postoperative period, as well as obviating the need for operation to complete the reconstruction in a staged fashion.

Immediate nipple reconstruction in the setting of ASM incidentally demonstrated repigmentation of the nipple in this study (Figure 6A,B). This natural phenomenon of melanocyte migration from surrounding areolar tissue into the reconstructed nipple (and the trigger for induction of this process) is intriguing. Melanocyte migration has been well documented over the past 15 years, predominantly through in vivo and in vitro studies with vitiligo populations. Mitogens, which trigger signal transduction pathways with subsequent mitotic activation, include basic fibroblast growth factor (bFGF), leukotriene C4, endothelin-1, and transforming growth factor–α (TGF-α). These mitogens have been implicated in the induction of melanocyte migration. This cellular activity may explain the phenomenon of repopulation of melanocytes in the reconstructed nipple, with melanocyte migration from hyperpigmented regions of the areolar skin into the less melanotic regions of the newly reconstructed nipple. In this study, seven breasts in four patients (13.5%) demonstrated native melanocyte migration into the reconstructed nipple. To the best of our knowledge, this phenomenon has not been previously described. This process not only is of biologic interest, but also provides some practical advantage for the patient—namely, the avoidance of the usual intradermal tattooing, with its potential for fading, hue mismatch, and the need for continuous touch-ups over the patient’s lifetime. In contrast, the spontaneously repigmented nipple has a natural appearance and color match, which we assume will be permanent.

**Implant Refinements**

Although many authors advocate utilizing latissimus myocutaneous flap alone for pure autologous reconstruction, the flap is often limited by lack of volume and projection in the inferior pole, particularly in patients with larger breast sizes. For this reason, an expander or implant is commonly placed under the muscle in order to shape the inferior pole. In the literature, the most common description of latissimus dorsi implant reconstruction includes elevation of the pectoralis major in order to place the tissue expander or implant into a partial subpectoral pocket while allowing the latissimus muscle to cover the inferior lateral portion of the implant. In this setting, the primary advantages of the latissimus reconstruction are twofold. First, autogenous tissue for soft tissue coverage over the implant permits ptosis that matches the contralateral ptotic breast. Second, the procedure allows for a skin island that can be utilized for nipple-areolar reconstruction with a skin-sparing mastectomy.

In some cases, the permanent implant can be placed immediately underneath the latissimus flap at the time of reconstruction. However, expander placement has often been considered a more appropriate treatment, particularly if postoperative radiotherapy is planned. Also, it can be challenging to match the contralateral breast accurately at the time of surgery, as the latissimus flap may be swollen initially and the muscle itself may atrophy over time. Traditional expanders with fill ports located intrinsic to the implant can also present a challenge. With these expanders, access to the fill port often must be placed through the latissimus flap and near the implant pocket, which can potentially damage muscular perforators and theoretically provide a direct route for bacterial translocation to the implant. The thickness of the latissimus flap could also potentially misdirect the magnet that localizes the internal port. This is undesirable as puncture at the periphery, side, or back of an injection port can result in leakage of the port.

Regardless of whether a saline expander is placed under the flap and serially expanded prior to staged expander/implant exchange at a second operation or the final implant is placed at the time of the reconstruction, these traditional techniques have their drawbacks. The former commits the patient to a second operation to complete her reconstruction. The latter relies on the surgeon’s ability to match the contralateral breast at the time of surgery, which may be compromised by any number of variables, including immediate flap swelling, subsequent latissimus dorsi muscle atrophy, or the requirement for postoperative radiotherapy, which cannot always be accurately predicted preoperatively. To combat these disadvantages, we have begun to place self-sealing, double-valved, postoperatively adjustable saline implants (Spectrum, Mentor Corp., Santa Barbara, California) (Figure 3) for reconstructions. This device is designed to be a long-term implant rather than an expander but has a fill tube and port that allows the size to be adjusted in the postoperative months prior to port and tube removal. Although the original expanders with removable ports were associated with a high rate of deflation, Levi et al have recently described a lower deflation rate with adjustable breast implants compared to the more common anterior valve implants. With placement of an adjustable saline implant, the patient is provided with the opportunity to participate in determining the final, permanent size implant in the postoperative period. Also, secondary surgery to exchange the expander for a permanent implant can potentially be avoided. This has the advantage of allowing a single-stage latissimus dorsi implant breast reconstruction that may be better able to match the contralateral breast. This technique has allowed single-stage reconstruction to be performed in 10 breasts (19.2% of reconstructions) in the senior author’s (MAC) clinical practice.

**Prefectoral Implant Placement**

We feel that prepectoral implant position produces a more aesthetic, natural-appearing, ptotic shape to the breast when compared to a potentially tight subpectoral position of the implant. Totally covering the implant with the latissimus dorsi muscle allows retention of the subpectoral space, which can then be relied upon as a “lifeboat” during

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**References**

1. Pacella et al

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**Figure 6A,B**

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any necessary site change for any future implant-related complications, such as CC. In this study, latissimus breast reconstruction was associated with a stable, long-term, low incidence of reoperation after the first year. The main disadvantage with this technique has been the high incidence of seroma, despite attempts to reduce the risk with thrombin. Many other authors report dorsal seroma as the most common donor site complication, occurring in anywhere from 12.5% to 79% of latissimus dorsi donor sites. The thrombin administered at the donor site in this series did not seem to result in a significantly lower rate of seroma formation. We suggest that traditional quilting sutures may be of benefit here; alternatively, fibrin glue or substitute tissue adherent may be more effective. Leaving the donor site drains in place for a longer period may also decrease the number of seroma aspirations required. However, this would be impractical in our hands, as we prefer complete muscle coverage of the implant with the flap; partial muscle harvest is therefore unlikely to fulfill our requirements. Despite this shortcoming, this technique has become our first choice for patients who are thin and do not have excess abdominal tissue for a donor site, as well as for patients who are at increased risk for abdominal donor site morbidity, such as overweight patients and smokers.

CONCLUSIONS

The latissimus dorsi flap coupled with an implant for breast reconstruction has been performed successfully for the past 15 years in the senior author’s (MAC) clinical practice, with good outcomes in patients with low to normal body mass index and small-to-moderate breast size. Technical refinements over the study period include SSM and ASM, immediate nipple reconstruction, less dissection in the subpectoralis plane with preservation of the pectoralis muscle for treatment of subsequent capsular contracture if required, and the option of a single-stage breast reconstruction with expandable permanent implants. The ability to render a natural-looking reconstructed breast, comparable in shape to the contralateral breast and adjustable in size throughout the postoperative period, may reduce the need for contralateral procedures to obtain breast symmetry. ASM also offers the advantages of less visible scarring and a more natural-looking nipple-areolar complex that may not require subsequent tattooing due to spontaneous repigmentation. These changes improve the aesthetic outcome and potentially decrease the surgical burden for the patient.

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