2 Augmentation Mammoplasty and Mastopexy

M. Bradley Calobrace and Chet Mays

Introduction

Achieving a successful outcome in aesthetic breast surgery requires an assessment of the patient's desired look in conjunction with the anatomic characteristics of the breast. Whereas many patients have simply underdeveloped breasts or congenitally mal-shaped breasts, other patients seek correction for undesirable changes that have occurred. The shape and size of the breasts may experience significant deleterious effects over time secondary to pregnancy, weight fluctuations, and aging. Breast augmentation can provide improvement in shape, size, and symmetry, and improved body proportion in patients with micromastia. Patients with more significant changes resulting in breast ptosis may require only a breast augmentation when it is mild, but will often need a mastopexy when more significant ptosis exists. In patients with more significant ptosis and volume loss, a successful breast procedure may include not only adding much needed volume and shape stability that is offered with a breast implant but also tightening of the ptotic skin envelope and repositioning of the low nipple-areolar complex through a mastopexy, either simultaneously or in a staged fashion. Fat grafting can also be utilized with or without the use of an implant to improve upper pole fullness and cleavage. Thoughtful consideration of the patient's desired aesthetic result in conjunction with the anatomic characteristics of her breast and chest wall provide insight into the optimal surgical approach to achieve a successful outcome.

Preoperative Planning

One of the most critical steps in achieving excellence in aesthetic breast surgery is the preoperative evaluation. The preoperative evaluation through a thorough assessment should identify not only the appropriate implant to achieve optimal results but also the location of the incision; the implant pocket; asymmetries of the breast, chest wall, and/or nipple-areolar complex; and the potential need to lower the inframammary fold. The preoperative markings create a road map for the planned procedure. This includes marking the inframammary fold, midline, and meridian of the breast. The base diameter,

M. B. Calobrace (✉)
Private Practice, CaloSpa and CaloAesthetics Plastic Surgery Center, Louisville, KY, USA

Gratis Faculty, Division of Plastic Surgery, University of Louisville, Louisville, KY, USA

Gratis Faculty, Division of Plastic Surgery, University of Kentucky, Lexington, KY, USA
e-mail: drbrad@calobrace.com

C. Mays
Private Practice, CaloSpa and CaloAesthetics Plastic Surgery Center, Louisville, KY, USA

Gratis Faculty, Division of Plastic Surgery, University of Louisville, Louisville, KY, USA

S. R. Thaller, Z. J. Panthaki (eds.), *Tips and Tricks in Plastic Surgery*,
https://doi.org/10.1007/978-3-030-78028-9_2

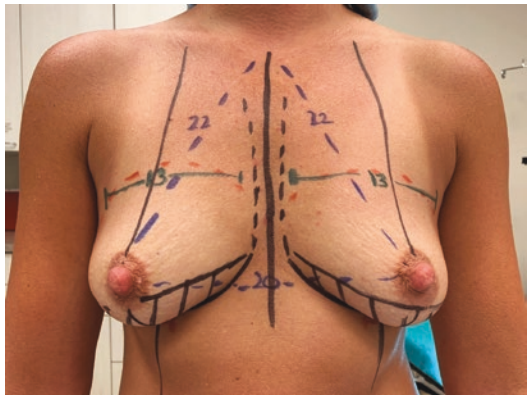


Fig. 2.1 Preoperative markings: inframammary fold, midline, and meridian of the breast. The breast width shown as 13 cm. The sternal notch-to-nipple distance shown as 22 cm. The vertical lines along the base of the breast represent the planned dual-plane level

intermammary line, and dual-plane planning can be also helpful in strategizing the surgical plan (Fig. 2.1).

Critical to success is determining the appropriate approach—breast augmentation, mastopexy, augmentation mastopexy, and/or fat grafting. Evaluation of the soft tissue coverage, including quality of skin and breast tissue, amount of breast parenchyma, the footprint of the breast, and the level of ptosis, is essential to determining the optimal approach:

Breast Assessment of the Soft Tissue
- Quality of the skin and breast tissue
- Amount of breast parenchyma
- Footprint of the breast
- Level of breast ptosis

When using an implant, precise pocket creation and appropriate implant choice are the best safeguards against postoperative implant malposition issues. Likewise, the most common reason for revisional surgery after a breast surgery with implants is capsular contracture [1, 2]. There is strong evidence that biofilm development from bacterial contamination is a significant causative component in the development of capsular contracture [3–6], Part of the operative planning, therefore, should include efforts to minimize this risk when possible. The list below summarizes some of the implant and surgical technique options that have been associated with lower capsular contractures [7–23].

Options Associated with Reduced Capsular Contracture Incidence
- No-touch technique [7–9]
- Nipple shields [8]
- Pocket irrigation with triple antibiotics [10]
- Insertion sleeve [9]
- Submuscular implant pocket [11–13]
- Textured implants [11, 13–18]
- Inframammary incision [13–19]
- Cohesive-shaped implants [20–23]

Breast Augmentation

Achieving a successful outcome in breast augmentation requires excellent preoperative and intraoperative decision-making and expert surgical execution. Thoughtful consideration of the patient's desired aesthetic result in conjunction with the anatomic characteristics of her breast and chest wall provides insight into the optimal surgical approach to achieve a successful outcome. There are many incisional approaches to breast augmentation, including inframammary, periareolar, transaxillary, and transumbilical. The inframammary approach has increasingly become the preferred incisional approach, and is the most commonly performed today.

Implant Selection

The selection of the appropriate implant is determined not only by the objective findings during the examination but also by the patient's expectations and desired final outcome. Today's implants can be saline or silicone, textured or smooth, and come in a variety of projections. The base diameter of the chest is considered one of the most important determinants in sizing of the implant. Classically, the final base diameter of the breast will be the diameter of the implant plus the width increase provided by the soft tissue contributions.

Thus, the final desired breast width minus the soft tissue contributions should provide guidance to the implant base diameter. (Implant Base Diameter = Desired breast width − (½ Medial pinch + ½ Lateral pinch.)

Patient Positioning

Patients are placed on the operating room table in the supine position. The arms are secured to the arm board with soft gauze wraps at 45 degrees to stabilize the patient in the upright position (Fig. 2.2). This relaxes the pectoralis muscle, providing a more accurate assessment of the implant position and the redraping of the overlying breast tissue. Alternatively, some surgeons prefer placing the arms alongside the patient on the operative table, but an arm board at 90 degrees should be avoided, as it does not allow accurate assessment of the breast when the patient is placed in the upright position.

Fig. 2.2 Patient positioning on the operating room table

Infiltration of Local

Prior to surgical preparation, 50 ml of a local field block is injected of 1/4% lidocaine, 1/8% bupivicaine, and 1:400,000 epinephrine (Table 2.1). The injection is placed in the dermis along the planned incision line, and as a field block with injections along the inframammary fold, the medial pectoral border, the anterior axillary line, and finally, deep to the breast parenchyma in a fanning fashion throughout the area of planned pocket creation (Fig. 2.3).

These injections provide assistance not only in operative hemostasis but also in the management of postoperative pain.

Table 2.1 Breast local anesthetic formula

1/2% Lidocaine plain	25 ml
1/2% Lidocaine/1:200,000 epinephrine	25 ml
1/2% Bupivacaine/1:200,000 epinephrine	25 ml
Injectable saline	25 ml
1/4% Lidocaine, 1/8% bupivacaine, and 1:400,000 epinephrine	100 ml

Fig. 2.3 Breast local infiltration preoperatively prior to surgical prep

Surgical Preparation and Sterile Draping

After local infiltration, nipple shields (created by placing a small piece of Tegaderm over each nipple-areolar complex) provide a barrier against potential bacterial contamination [8] (Fig. 2.4). The patient is prepped with chlorhexidine and draped to provide a sterile field, with the entire chest and bilateral breasts visible for assessment during the procedure. The sterile dressings must be secured to prevent disruption in the sterile field while placing the patient in the upright position.

Fig. 2.4 Tegaderm nipple shields

Inframammary Incision

The inframammary fold has become the preferred incision location for most surgeons today. There are many advantages, and some disadvantages, which must be considered to ensure the appropriateness of the IMF approach:

Advantages

- Well-hidden scar in the fold of the breast.
- Incisional length is unlimited and thus can accommodate any and all implant choices.
- Excellent visualization for dissection of the implant pocket.
- The ability to control the IMF position during incision closure.
- Can be used for any complication revision.
- Lower capsular contracture rates.
- Minimal issue of a scar contracture creating deformity.
- Potentially less nipple-sensation changes.

Disadvantages

- The scar is located on the breast.
- Scar may be more visible if breast fold is absent or if the scar becomes pigmented.
- Must determine final IMF position preaugmentation and place scar precisely in planned new fold.
- Scar position is more vulnerable to irritation from the bra.

The size of the incision depends on the location but, in general, should be as small as possible and yet large enough to safely dissect the pocket and place the implant without distortion or injury to the device. In general, the incision length increases with increases in implant size, gel cohesiveness, optimal fills, and texturization of the implant. Additionally, the quality of the scar is often better if a slightly larger scar is utilized, reducing the stretch and retraction injury placed on the scar. Incision length ranges include: 3–4.5 cm for saline implants, 4–6 cm for silicone round implants, and 4.5–7 cm for shaped cohesive silicone implants.

Inframammary Fold Positioning

Predicting the final position of the inframammary fold is critical to determining the placement of all breast incisions, but especially the inframammary incision. This can be a challenging task, as so many variables contribute to the final position of the fold. The inframammary fold is formed by the fusion of the anterior and posterior leaves of the superficial fascia, which is intimately associated with the dermis at the lowest aspect of the inferior pole of the breast [24]. During preoperative markings, the native inframammary fold is identified and marked in the sitting position. The true IMF position is determined by performing an IMF expansion test. The breast is grasped and autorotated inferiorly to identify the inferior extent of the attachments of the inframammary fold (Fig. 2.5). This is the best predictor of where the fold will naturally sit after breast augmentation. The amount of lower pole skin required and the ultimate position of the fold is a function of many factors, including the type of implant (saline vs. silicone and round vs. shaped), size of implant, pocket location, and the strength and stability of the soft tissue of the lower pole. The distance measured from the nipple to true fold under maximal stretch assesses the amount of lower pole skin available to accommodate the selected implant. An acceptable standard that has been used is an

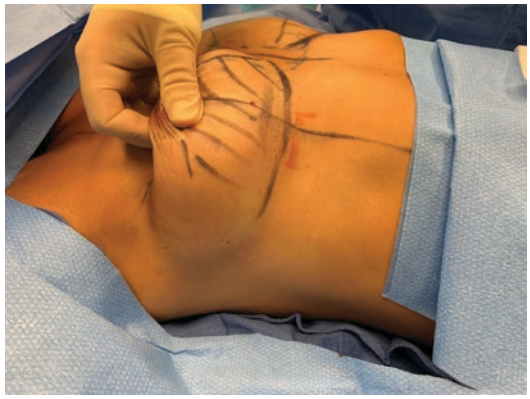


Fig. 2.5 Determining the true IMF position by autorotating the breast

Table 2.2 Techniques for determining lower pole skin requirements nipple to inframammory fold

Optimal N-IMF distance on maximal stretch = ½ implant projection + ½ implant height *Optimal N-IMF distance on maximal stretch* =		
N-IMF distance	*Base diameter*	*Fill volume*
7 cm	11 cm	200 cc
8 cm	12 cm	300 cc
9 cm	13 cm	400 cc

implant with a base diameter of 11 cm requiring 7 cm, a base diameter of 12 cm requiring 8 cm, and a base diameter of 13 cm requiring a 9 cm nipple to fold distance [25]. A more comprehensive evaluation has been described using tissue-based planning principles [26]. In the High Five System analysis, variables are analyzed including implant volume, patient's base width, implant base width, anterior pulled skin stretch, and nipple-to-fold distance under maximal stretch. Based on the selected implant, a reference chart provides the desired nipple-to-fold distance on maximal stretch, which if longer than the measured distance, will require IMF lowering.

In determining fold position, our team has found three alternative methods extremely useful by using the implant dimensions and fill volume (Table 2.2).

If the desired N-IMF distance is equal or less than the measured N-IMF distance, then the fold does not require lowering. The distance can be adjusted based upon expectation for lower pole stretch postoperatively. It is important to recognize that inframammary fold lowering is less often required when placing a larger smooth saline or silicone implant, especially if higher profile, secondary to lower pole stretch over time [27, 28]. However, when implant choice or soft tissue characteristics predict less lower pole stretching, inframammary fold lowering may be required [13, 29]. Likewise, shaped implants are not only textured but also have a greater volume of a more cohesive gel present in the lower pole of the implant, thus requiring more lower pole skin to accommodate the implant [20–23, 30, 31]. The list below identifies some implant and soft tissue characteristics that may be associated with a greater need to lower the inframammary fold due to less postoperative stretching of the lower pole [13, 20–23, 26–31, 39].

Characteristics Associated with Less Stretching of the Lower Pole

- Textured implants
- Cohesive implants
- Shaped implants
- Silicone compared to saline implants
- Lower profile implants
- Smaller implants
- Tight, firm breast skin

Incision

The inframammary incision provides direct access and visualization of the pocket with the least injury to surrounding structures. After determining the inframammary fold position (either the native true fold position or the planned lowered position), a paramedian line is drawn through the center of the breast and bisects the newly drawn inframammary fold. The incision's medial extent begins 1 cm medial to the paramedian line and extends laterally for the appropriate distance as previously described (Fig. 2.6). The initial incision is made with a 15-blade and dis-

section is then carried out with electrocautery through the skin and subcutaneous tissue, beveling upward while rotating the breast off of the chest wall. The dissection proceeds subcutaneous for approximately 1 cm and then deep through the superficial fascia and toward the lateral pectoral border deep on the chest wall. This technique preserves a small cuff of superficial fascia at the incision, which helps to protect the IMF and will prove useful during closure (Fig. 2.7).

Implant Pocket

There continues to be divergent thought with regard to the optimal pocket for breast implants.

Fig. 2.6 IMF incision extending 1 cm medial to paramedian line and laterally. The length of incision is based on the implant choice

Fig. 2.7 IMF incision preserving a small cuff of the superficial (or Scarpa's) fascia

The subglandular/subfascial pocket is the most natural for the implant, with avoidance of animation deformities seen with submuscular implants, enhanced correction of constricted breast or ptotic breasts, ease of dissection, and less postoperative discomfort for the patient [32–35]. The submuscular pocket advantages have included lower capsular contracture rates, enhanced coverage of the implant to minimize issues of wrinkling, provides a more natural upper pole, and provides enhanced support for the breast implant [11–13, 32–34, 36]. Undoubtedly, the issues of wrinkling and need for enhanced coverage with saline implants provided the impetus for submuscular pockets becoming the preferred pocket by US surgeons [29, 37, 38]. It has been widely accepted that an upper pole pinch test of 2 cm is required to place an implant in the subglandular/subfascial pocket to reduce the risk of upper pole implant visibility or wrinkling. With the availability of silicone implants, both round and shaped, optimally filled with increased cohesiveness and simultaneous fat grafting, optimal pocket choice may be even more elusive.

No matter which pocket is selected, it is helpful during the marking process to identify as accurately as possible the pocket size necessary to accommodate the selected implant. This will provide a pocket that maintains the implant in a control position and minimizes the risk of postoperative implant malposition. In breast augmentation with round implants, the accurate placement of the inframammary fold and control of the medial and lateral extent of the pockets provide ideal implant positioning to achieve the desired cleavage and minimize lateral migration of the implant [29]. When using a shaped implant, a controlled pocket including the superior extent is even more essential to minimize the risk of implant rotation postoperatively [23, 30, 31].

Dual-Plane Submuscular Pocket

The importance of optimizing soft tissue coverage in breast augmentation cannot be overstated. Inadequate coverage, often combined with oversized implants, can lead to parenchymal atrophy

and skin stretching, resulting in wrinkling and palpability of the implants and other associated breast deformities [27, 28]. The dual plane, initially described by Tebbetts, maximizes coverage and support of the breast implant while minimizing the disadvantages of submuscular placement, including animation deformities and pseudoptosis of the breast tissue overlying the submuscular implant (i.e., waterfall deformity) [36].

When performing a dual-plane pocket, the lateral pectoral border is identified, and fascia incised to expose the underlying muscle. Upward retraction of the breast tissue will usually elevate the lateral border, allowing further dissection and placement of the retractor beneath the overlying pectoralis muscle (Fig. 2.8). A very helpful "rule" is to never cut through the muscle that cannot be elevated. The inability to tent the muscle up off the chest wall may indicate that the muscle fascia is extremely adherent, but more likely that the identified muscle is actually not the pectoralis, but rather the serratus, rectus, or an intercostal muscle. Continuing the dissection through an intercostal could inadvertently penetrate the pleural space, resulting in a pneumothorax. Once the edge of the pectoralis is safely elevated and the subpectoral space is identified, dissection is carried upward centrally to the superior extent of the pocket. Dissection is then carried laterally to identify the pectoralis minor, and then carried directly over the fascia until the lateral border of the pocket is reached. Dissection is then continued along the lateral border of the pocket, identifying and staying superficial to the serratus muscle until the inferior extent of the pocket at the inframammary fold is reached. The muscle is then released along the planned inframammary fold, staying 1 cm superior to the fold to account for postoperative caudal muscle descent (Fig. 2.9). Dissection directly at the fold will often lead to a fold that is lower than planned as the muscle retracts inferiorly. As you carry your dissection medially along the IMF, it is critically important to stop the dissection at the most medial extent along the sternum. Preservation of the most caudal attachment of the pectoralis muscle at the transition point (TP) along the sternum is critical to minimize the chance of window shading of the pectoralis with subsequent medial implant exposure and animation deformities. A transition zone (TZ) of tapered muscle release connects the transition point to the main body of medial pectoral muscle along the sternum (Fig. 2.10).

The extent of the pocket is completed by defining the medial pectoral border by dividing the accessory slips of pectoralis muscle that insert along the ribs, preserving the main body of the muscle as it inserts along the sternum. Dividing these muscles with electrocautery rather than blunt dissection improves postoperative cleavage and maintains prospective hemostasis.

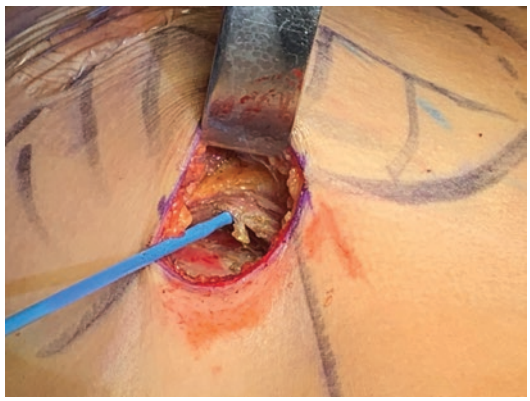


Fig. 2.8 Upward retraction of the breast tissue allows exposure of the lateral border of the pectoralis major muscle

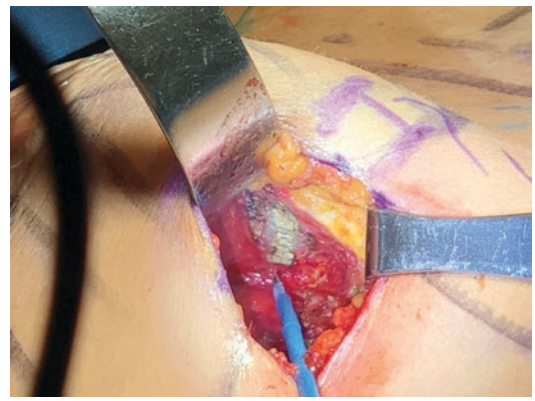


Fig. 2.9 Release of the pectoralis major muscle along the IMF, being careful to stay 1 cm superior to the inframammary fold

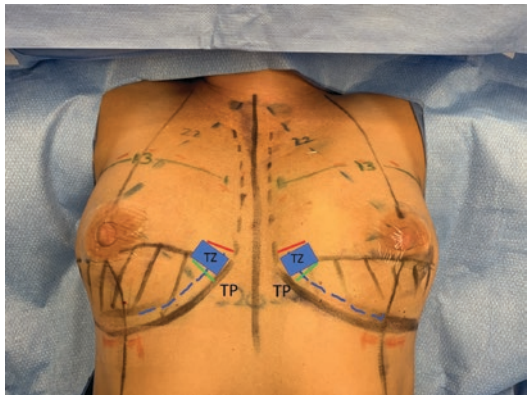


Fig. 2.10 Transition Zone (TZ) and Transition Point (TP). Dashed line (blue) reveals the location of the pectoralis muscle release 1 cm superior to the IMF (dark solid line), medially up to the TP (vertical green line). The TZ (blue shaded region) is a tapering of pectoralis, major up to the sternal attachment (red vertical line)

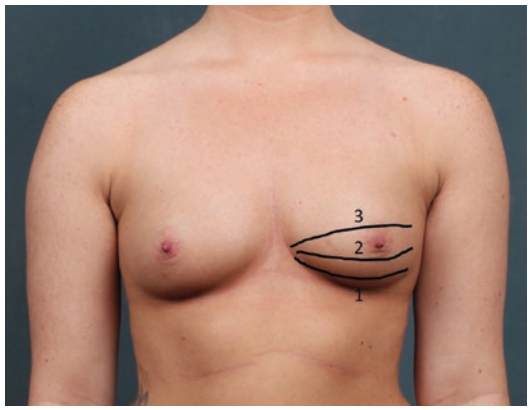


Fig. 2.11 Dual-plane levels. Dual plane 1 is a complete division of the pectoralis major muscle (PMM) along the IMF. Dual-plane 2 is release of the breast tissue off the PMM up to the lower areola. Dual plane 3 is release of the breast tissue off the PMM up to the upper border of the areola

The dual-plane approach ultimately creates a subglandular pocket in the inferior breast pocket. The levels of dual plane represent the amount of muscle released from the inferior breast tissue and resultant inferior subglandular pocket (Fig. 2.11). Division of the inferior pectoralis muscle just above the inframammary fold during initial pocket dissection created a dual-plane level 1. The level of dual plane required varies, and each surgery can be tailored to provide the optimal level based on soft tissue requirements and implant selection. In general, creating a subglandular pocket inferiorly is required to either redrape the skin and breast tissue more accurately over the implant, or for expansion and exposure of the lower pole, such as in a tuberous or constricted breast. The release of the caudal edge of the muscle is performed incrementally, creating the least amount of release that will adequately address the lower pole (Fig. 2.12). Placement of a retractor into the breast pocket and elevating superiorly while rocking the breast tissue over the retractor will assist in assessing the effects of the implant on the overlying skin and breast tissue once placed in the pocket. When a dual plane is created for expansion and exposure in a tight envelope, the level will depend on the need to access the parenchyma for scoring and expansion. This usually requires at least a level 2 and often a level 3 to expose the retroareolar tissue.

Fig. 2.12 Release of the pectoralis major muscle caudal edge off of the overlying breast tissue

Subglandular/Subfascial Pocket

The subglandular or subfascial pocket can be easily developed through the inframammary incision, and this dissection is performed without the need for muscle division or dual-plane creation. Once the incision is made and the lateral pectoral border has been identified, the dissection is carried out either above (subglandular) or deep to (subfascial) the pectoralis fascia. This is important, as inadvertent

overdissection can lead to implant medialization, visibility, and potentially symmastia. The subfascial plane can be a more challenging dissection as there is no natural plane present for this dissection. The subfascial pocket is often preferred over a subglandular pocket when shaped implants are used, as it potentially provides a more precise and stable pocket in the upper pole to avoid implant rotation.

Implant Placement

Once the pocket has been created, it is irrigated with triple antibiotic betadine solution (50 ml of povidone-iodine, 1 g of cefazolin sodium, and 80 mg of gentamycin mixed in 500 ml of normal saline) or 50% povidine-iodine saline solution and hemostasis is assessed [10]. It is the goal during the operation to achieve prospective hemostasis with minimal blood staining; however, a final assessment is mandatory prior to implant placement. The implants are soaked in the irrigation solution prior to insertion. Gloves are changed and rinsed with the irrigation solution to remove any lint or powder.

The implant is then placed either manually or with the assistance of an insertion sleeve such as the Keller funnel [9] (Fig. 2.13). The funnel provides a *minimal* to "no touch" technique, which has been associated with lower capsular contracture rates [7]. The funnel allows for easier implant placement with potentially smaller incision requirements, compared to manual placement. Repeated removal and insertions of the implant should be avoided to minimize implant or incision damage, potential contamination, and pocket overdissection.

Closure

Prior to incision closure, the patient should be placed in the upright position to assess implant position, fold position, symmetry, and the adequacy of the dual plane (Fig. 2.14). Any additional adjustments of the dual plane can be accomplished after the patient is placed back in the recumbent position by simply retracting the breast tissue superiorly off the implant, identifying the caudal edge of the muscle, and releasing it incrementally off the overlying breast tissue to the desired level.

A significant advantage of the inframammary approach is the ability to accurately and effectively control the fold position during closure of the incision. The cuff of superficial fascia that was preserved during the initial incision is utilized to secure the fold during closure. Although in our practice all inframammary folds are "locked-down" during incisional closure, it could be argued that a well-developed stable IMF that has not been violated or lowered during the procedure is potentially stable, and may only require a more superficial closure. However,

Fig. 2.13 "No touch" technique with Keller funnel insertion

Fig. 2.14 Patient sitting upright on operating room table to confirm final result

Fig. 2.15 Closure of breast pocket and locking the IMF. Running 2-0 Vicryl securing superficial fascia to the deep fascia

when the fold is unstable due to either inherent weakness in the fold structure or from disrupting it with fold lowering, closure should include stabilization of the fold structure. This is accomplished by securing caudal edge of the scarpa's fascia present on the lower incisional edge to the underlying deep fascial structures with an absorbable suture such as 2-0 vicryl (Fig. 2.15). This is usually done by simply incorporating the superficial and deep fascia together during a running closure. It may also be performed by first placing three to four interrupted sutures on the lower flap, securing scarpa's fascia to the underlying deep fascia, followed by closure of the incision. The incision is closed in three layers: scarpa's fascia superiorly to scarpa's fascia, and deep fascia inferiorly, deep dermis, and subcuticular.

Case Examples (Figs. 2.16 and 2.17)

Management of Breast Ptosis

Introduction

Breast ptosis is one of the most common issues seen for evaluation in a plastic surgeon's office. It can be developmental or more commonly acquired, secondary to weight loss, hormonal changes, pregnancy, and aging. Mild breast ptosis can often be corrected with a breast augmentation, but when more significant ptosis is present, a breast augmentation will not provide the correction of ptosis present and a mastopexy is required, with or without an implant. When evaluating the ptotic breast, the volume status of the breasts should be a part of the initial assessment, as this will determine whether a mastopexy is adequate and whether augmentation with an implant or fat is indicated.

Mastopexy

A mastopexy alone is reserved for a patient in whom the major concern is breast ptosis and not an issue of breast volume or upper pole fullness, as the procedure repositions the breast with only limited removal or transposition of breast tissue. There are many types of mastopexy techniques described to address the ptotic breast. The techniques are often described in reference to the final scar placement, such as the circumareolar technique [40], circumvertical technique [41, 42], and inverted-T scar technique [43, 44]. However, there is much more variation in the techniques, including the vascular pedicle orientation, management of the parenchyma, and additional ancillary procedures, to enhance the results. Long-term success of any mastopexy procedure is partially influenced not only by the scar technique but also, and maybe more importantly, by the pedicle selection and management of the parenchyma [42]. Thus, in general, the mastopexy can be performed with an inferior/central pedicle technique or a superior or superomedial technique, which describes the pedicle blood supply and the surgical approach. Secondarily, the skin excision pattern is determined and variable based on the surgeon's preference with excising excess skin along the inframammary fold, or maintaining a purely vertical approach and limiting the scar to only a periareolar vertical, with the excess skin reestablished on the abdominal skin below the fold if indicated.

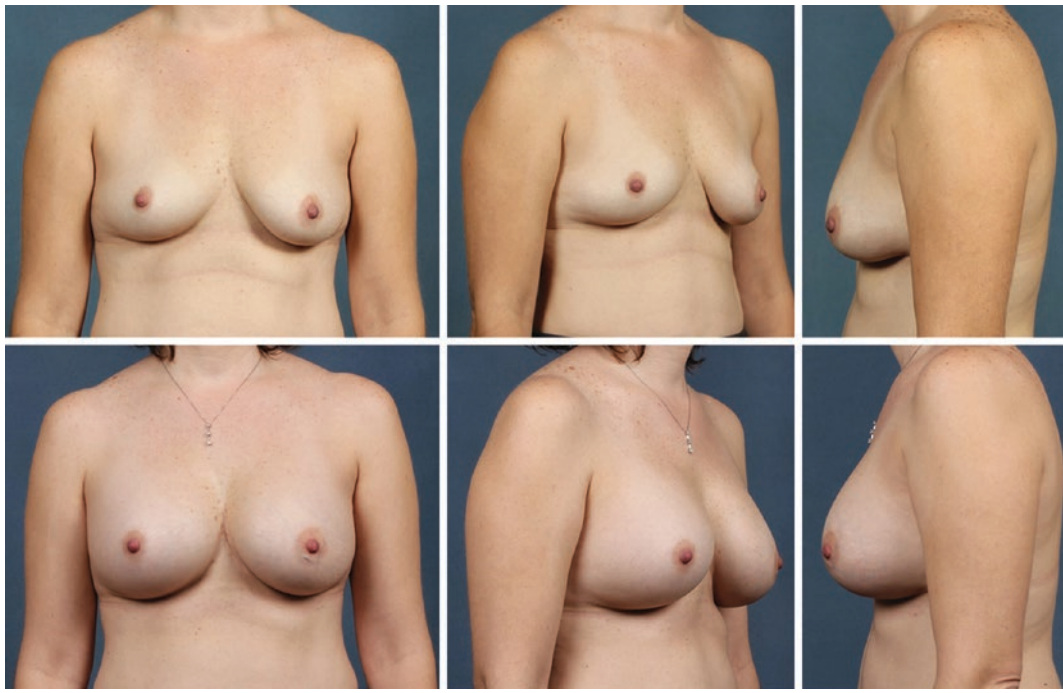


Fig. 2.16 Thirty-five-year-old female with grade I ptosis on the right and grade II ptosis on the left underwent bilateral submuscular augmentation mammoplasty with a dual plane 3 on the left using a 375cc moderate plus smooth round silicone implant. On the right she underwent a dual plane 2 with a 425cc high profile smooth round silicone implant

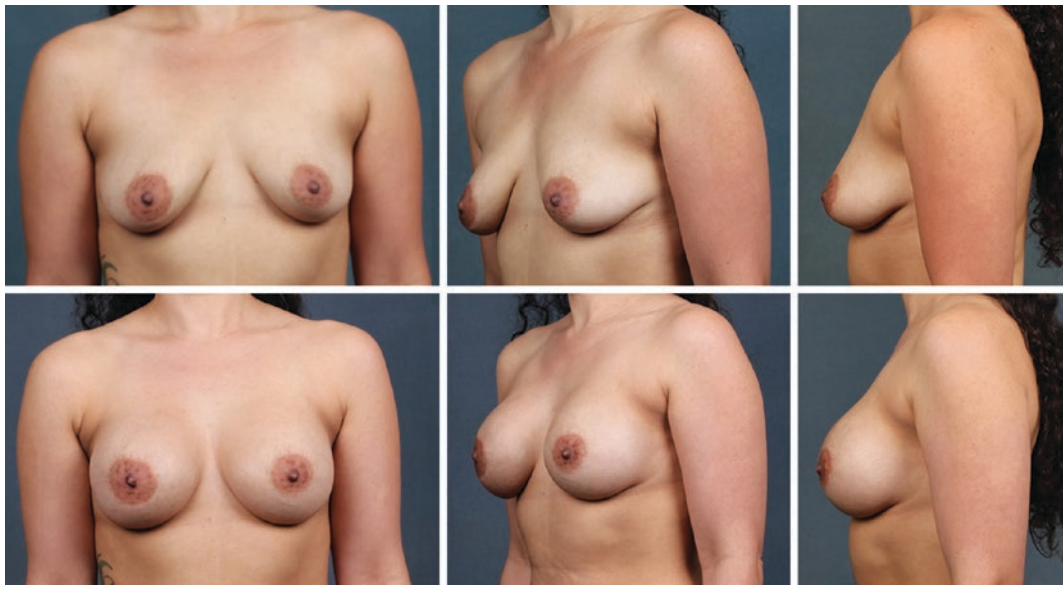


Fig. 2.17 Thirty-one-year-old female with grade II ptosis on the right and grade I ptosis on the left underwent bilateral subglandular augmentation mammoplasty with 355cc moderate plus textured round silicone implants

Preoperative Evaluation

The amount of ptosis present should also be assessed. Ptosis has classically been described, as per Regnault, based on the relationship of the NAC with the inframammary fold, but this falls short of adequately identifying and characterizing the breast ptosis [45]. A more complete assessment of ptosis is summarized in Table 2.3.

Patients with different grades of ptosis may have completely different breast compositions, including the quality of breast tissue and skin, the quantity of breast tissue present, and the vertical excess present. Assessment should also include evaluation of the skin thickness and elasticity, the quantity and distribution of subcutaneous fat, the composition and firmness of the breast parenchyma, the integrity of the Cooper's ligaments, the nature and position of the underlying musculature, and the shape and slope of the underlying chest wall. All these aspects of the breast composition influence the shape of the breast and, ultimately, the outcome after the augmentation mastopexy.

The preoperative evaluation is used to determine the mastopexy technique that will achieve an optimal outcome that meets the patient's desired results. For patients with less ptosis and minimal vertical excess, a circumareolar or circumvertical mastopexy can be performed without the need for skin removal along the fold. In our experience, if the distance from the new nipple position to the fold is less than 10–12 cm, most likely only a vertical or a vertical with small horizontal wedge or j-extension will be adequate for correction, usually employing a superior pedicle. To avoid the inframammary scar with a circumvertical mastopexy, the tissue at the base of the breast is resected internally, causing elevation of the fold with the excess vertical length tucked under the new breast fold, eliminating the need for the horizontal scar. However, we often choose to remove excess skin along the fold if necessary, no matter whether the flap is inferiorly or superiorly based. Not removing the skin at the fold increases the risk of fold malposition, scar irregularities or dog ears, or elongation of the lower pole with bottoming out over time.

The decision on whether to utilize a superior pedicle or inferior pedicle must be determined. That decision is based mostly on the amount of ptosis, the quality of the breast tissue, and the position of the nipple-areolar complex. For patients with good-quality breast tissue and the amount of nipple-areolar complex (NAC) elevation is less than 5–6 cm, a superior pedicle is utilized and a circumvertical mastopexy with inverted-T scar (Fig. 2.18). The superior pedicle also allows for the use of the lower pole tissue for autoaugmentation. The NAC can be elevated to a greater extent through the use of a superomedial or medial pedicle as well, and this is based on the surgeon's preferred approach and the likelihood of success with

Table 2.3 Assessment of breast ptosis

Relationship of the NAC to the IMF (Regnault's degree of ptosis) (*a*) *Grade 1*: Nipple at the level of the inframammary fold above the lower contour of the gland (*b*) *Grade 2:* Nipple below the level of the inframammary fold above the lower contour of the gland (*c*) *Grade 3:* Nipple below the level of the inframammary fold at the lower contour of the gland
Amount of breast tissue overhanging the fold
Location of the NAC on the breast mound
Amount of vertical excess and horizontal excess
Footprint of the breast on the chest wall —low, medium, and high
Quality and quantity of breast parenchyma and skin

Fig. 2.18 Example of a good candidate for a circumvertical mastopexy

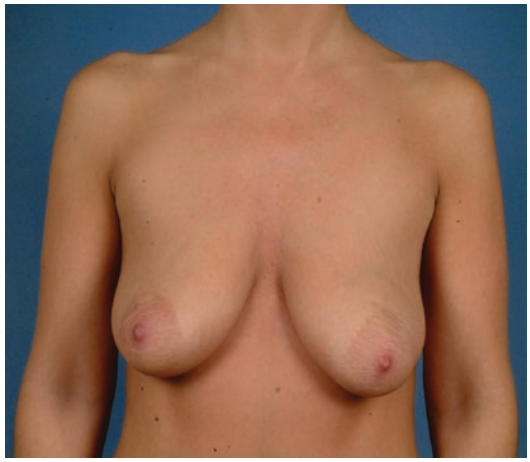


Fig. 2.19 Example of a good candidate for an inverted-T mastopexy or full wise mastopexy based on the amount of breast ptosis

the approach. In breasts with poor-quality tissue with associated laxity, and breasts requiring significant volume reductions and ptosis where NAC elevation is greater than 6 cm, an inferior pedicle inverted-T mastopexy is our preferred technique (Fig. 2.19). Often, a mesh reinforcement is secured across the inferior pedicle to limit the lower pole stretch due to the extra volume of the pedicle being retained in the lower pole.

Relevant Surgical Anatomy

When performing a mastopexy, an understanding and assessment of the vascular anatomy is critical to performing the procedure safely. The breast has a rich blood supply from multiple sources, including the internal mammary artery perforators, the lateral thoracic arteries, the thoracoacromial, and the anterolateral and anteromedial intercostal perforators. The superior pedicle is supplied by the second branch of the internal mammary artery (IMA) that emerges deep from the second interspace and courses superficial across the medial upper breast to enter the NAC slightly medial to the midline and approximately 1 cm deep. The medial pedicle is supplied by the third branch of the IMA that emerges from the third interspace and similarly courses superficially across the breast parenchyma to the medial aspect of the NAC. The inferior pedicle and central pedicle are supplied by the fourth branch of the IMA that courses deeply across the medial breast to enter through Wuringer's septum approximately 1–2 cm above the IMF and just medial to the breast paramedian line. The inferior pedicle also has additional blood supply through contribution from intercostal perforators along the IMF [46] (Fig. 2.20).

Preoperative Markings

Appropriate preoperative markings provide a road map and are essential to planning and performing mastopexy surgery. The markings guide the surgeon in providing symmetrical NAC placement and mastopexy design. The patient is sitting upright during the markings. A line is initially drawn along the midline of the breasts and bilaterally down the meridians. The meridian lines bisect the breast equally and may not intersect through the nipple if there is NAC malposition. The inframammary folds are then drawn, noting any asymmetries to be addressed at surgery. The position of the IMF is

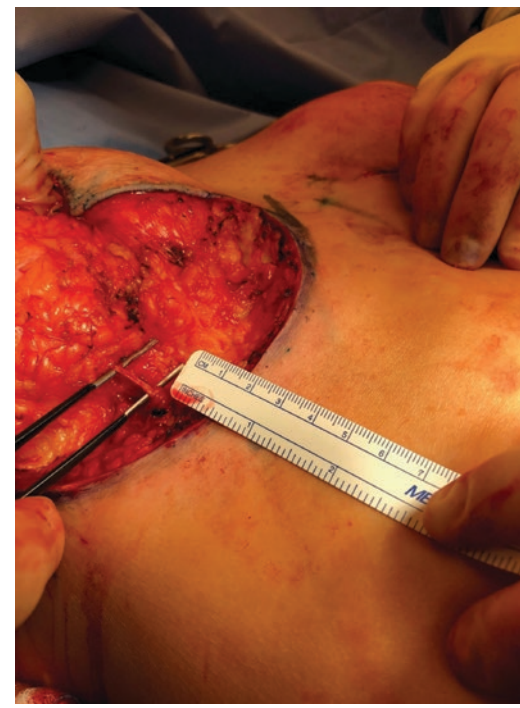


Fig. 2.20 The fourth branch of the internal mammary artery coursing through Wuringer's septum (1–2 cm above the IMF)

then drawn on the anterior breast through the meridian incision. The breasts are then rotated medially and laterally to mark the location of the vertical incisions. Placement of the areola is then marked, starting approximately 2 cm above the nipple position and extending the curved drawing down to meet the medial and lateral vertical markings. This areolar opening marking should produce an areolar opening of approximately 42 mm. Approximately 7 cm below the bottom of the keyhole opening, a line is drawn marking the inferior extent of the vertical incision. Curved transverse lines are then drawn from these medial and lateral points extending down to the IMF. When performing a superior pedicle, approximately 2–3 cm above the fold a U-shaped line connects the medial and lateral vertical markings to define the extent of skin resection (Fig. 2.21). With inferior pedicles, the entire lower segment between the two medial and lateral vertical lines is deepithelialized, making this line unnecessary (Fig. 2.22).

Intraoperative Markings

Once the patient is under anesthesia and has been prepped for the operative procedure, all markings are confirmed and retraced as necessary. The symmetry of the drawings is also confirmed. If any questions exist as to the accuracy of the markings, tailor tacking can be performed in many cases to reconfirm the markings. Tailor tacking is performed with a stapler and the patient is placed in an upright position to confirm design, symmetry, and NAC positioning. In the supine position, the staples are removed, and the selected pedicle is designed and then marked out. For the superior pedicle, the pedicle is positioned in the superior keyhole from the 8 o'clock to 4 o'clock position. If utilizing an inferior pedicle, the markings include at least a 1-cm cuff around the areola, and is designed between the vertical and lateral pillars extending down to the IMF. The pedicle is designed with a width of approximately 6–8 cm based on the length of the pedicle, ensuring that the length-to-width ratio does not exceed 3:1.

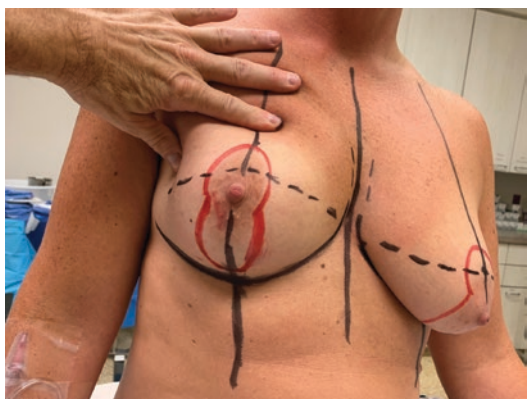


Fig. 2.21 Preoperative markings. The black dotted line represents the transposed IMF. The red vertical markings represent the circumvertical markings of the NAC and medial and lateral planned skin resections

Fig. 2.22 Preoperative markings of an inverted-T mastopexy with vertical and horizontal resection markings. The red markings represent the anticipated inferior pedicle for deepithelialization

Inferior Pedicle Inverted-T Mastopexy with or Without Mesh Reinforcement

The patient is positioned as has been described and preinjected. Each breast is placed under maximal stretch, and the areolas are marked with a 42-mm cookie cutter (range 38–45 mm depending on desired aesthetics) and superficially incised with a 15-blade scalpel (Fig. 2.23). Incisions are then made along the planned skin resection for the inverted-T mastopexy. The inferior pedicle is then deepithelialized from the inframammary fold up to the NAC, ensuring to include at least a 1-cm cuff of dermis around the NAC (Fig. 2.24). Care is taken to preserve the subdermal plexus during the

Fig. 2.23 NAC incision made of the NAC with a 15-blade scalpel

Fig. 2.24 Deepithelialized inferior pedicle

deepithelialization. Dissection is then carried out around the entire deepithelized inferior pedicle, ensuring not to narrow the base of the pedicle at its attachments to the chest wall perforators by beveling outward to maintain its integrity and bulk (Fig. 2.25). The medial and lateral dermoglandular segments are then resected. The upper breast skin flaps are then undermined to the pectoral fascia, excising fat and glandular tissue as necessary for shaping. In an inverted-T inferior pedicle mastopexy, volume reduction is not generally the goal, so the amount of tissue resected is limited to the skin resection and additional breast tissue and fat, as required, to create the desired size and contour of the final breasts.

Fig. 2.25 Dissection of the inferior pedicle. Be sure to keep a wide base to maintain integrity of the blood supply

In our experience, success in any mastopexy or reduction procedure is more likely long term if the new breast shape is created by parenchymal resection and shaping, as opposed to skin envelope reduction. Additionally, reduction in long-term bottoming out or pseudoptosis postoperatively is best assured through unloading the lower pole of the breast, usually accomplished with tissue resection or rearrangement as with a superior pedicle technique.

With the inferior pedicle technique, the pedicle is located in the lower pole, and thus, resection or tissue rearrangement is not possible. To help address this, we have found stabilizing the inferior pedicle can be valuable in planning final shape and potentially reducing the lower pole stretch postoperatively. The inferior pedicle is rather unstable after resection of surrounding tis-

sue and will generally fall laterally into the dissected space. The inferior pedicle is positioned centrally in the pocket and 2-0 vicryl sutures are placed from the pedicle to pectoralis fascia to stabilize its position (Fig. 2.26). It is helpful, if possible, to secure the pedicle from the dermis to the fascia for the best suture purchase, but this is not always feasible. The inferior pedicle has to be stabilized in a position that allows the NAC to be brought through the keyhole once the position of the NAC is confirmed and the opening created. Although these pectoralis-to-pedicle sutures can be used to provide some stabilization, long-term stability is not always reliable.

To ensure stability, we now placed a piece of poly-4-hyroxybutyrate mesh (GalaFLEX; Galatea Corp., Lexington, Mass.) reinforcement across the inferior pedicle, stabilized with 2-0 vicryl sutures on the medial and lateral pectoralis fascia [47] (Fig. 2.27). The size of the mesh is variable but, in general, a piece 5 × 15 cm per side has been adequate to create stability of the pedicle. This mesh resorbs in 12–18 months, but with retention of wound strength often four to five times the strength of the native tissue. The mesh should be placed snug enough to stabilize the pedicle, but without compressing or compromising the circulation through the inferior pedicle.

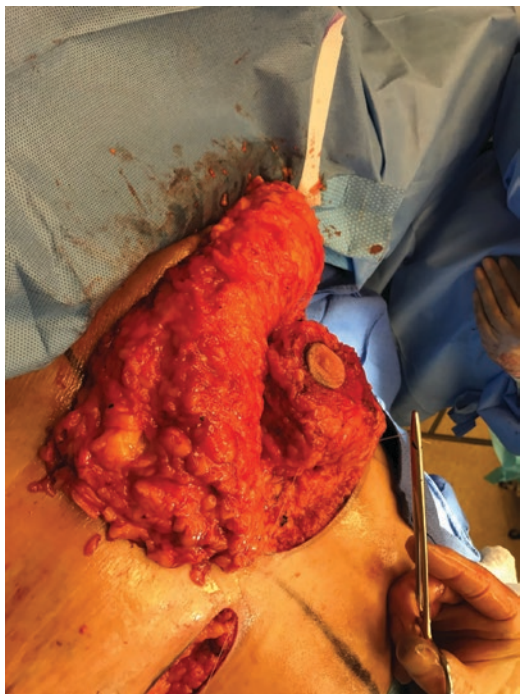


Fig. 2.26 2-0 Vicryl suture used to suture the pedicle to the underlying fascia for position stabilization

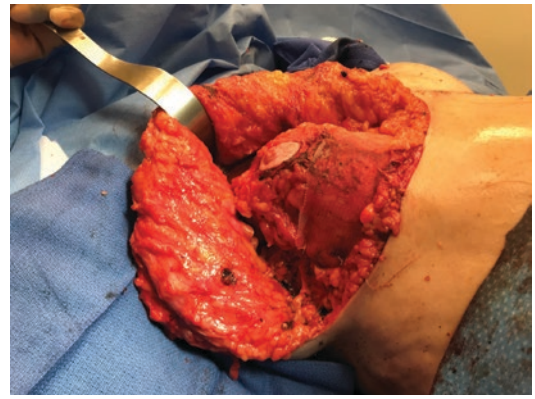


Fig. 2.27 The use of poly-4-hyroxybutyrate mesh across the inferior pedicle for soft tissue support. The mesh is sutured medially and laterally to the pectoralis fascia

The wounds are irrigated, and hemostasis is established with electrocautery. The nipple-areolar complex circulation is assessed for arterial and venous bleeding from the cut edges. The skin is then temporarily brought together with staples to confirm the final shape. The patient is then placed in the upright position to assess the volume, contour, and symmetry of the breast (Fig. 2.28). Tailor tacking to make some final adjustments in the shape of the breast is almost always performed to create the optimal postoperative outcome.

In contrast to the a superior pedicle technique described in the following section, one of the advantages in the inferior pedicle technique is that the keyhole is planned but not excised until nearly the end of the procedure to allow for adjustments in the NAC position during final tailor tacking. Therefore, while the patient is upright, the position of the nipple-areolar complex can be selected. A cookie cutter is placed at the apex of the vertical incision and positioned in an aesthetically pleasing location. The inferior areola to inframammary fold position is generally 5–7 cm based on the final breast size. Symmetry is confirmed by measuring the distance from the midline to medial areola, and by placing a suture at the sternal notch and checking that equal distance is achieved to the top of each areola (see Fig. 2.49 in the "Augmentation Mastopexy" section). With the patient supine, the

staples are removed, and the keyhole and any additional tissue marked during tailor tacking are excised. The pockets are irrigated with bacitracin saline solution and hemostasis is ensured. Deep parenchymal sutures of 2-0 vicryl are then placed along the vertical incision, bringing the medial and lateral pillars together at the midline. The incisions are then closed with interrupted 3-0 PDS dermal sutures. The vertical and horizontal scars are closed with a 4-0 monocryl running subcuticular suture. The areolas are then closed with a simple running 5-0 nylon suture. Steri-strips are placed over the incision. Contour tape is then placed along the lateral breast border and inframammary fold. The breasts are wrapped with a kerlix and ace wrap to provide gentle compression and support (Fig. 2.29).

Fig. 2.28 Tailor tacking of the breast to assess for shape and contour

Superior Pedicle Circumvertical Mastopexy with Inverted-T Scar

Each breast is placed under maximal stretch, and the areolas are marked with a 42-mm cookie cutter (range 38–45 mm depending on desired aesthetics) and incised with a 15-blade scalpel. Utilizing a 10-blade, the entire area within the marks is then deepithelized and cauterized for hemostasis (Fig. 2.30).

The lateral and medial flaps are dissected straight down toward the chest wall. The lateral and medial pillars are then developed, keeping them at least 2 cm thick (Fig. 2.31). If there is additional breast tissue deep to the developed pillars, this is either resected if it is not needed, or mobilized from lateral to medial and sutured to the main pedicle with 2-0 vicryl suture to maintain volume.

Option 1—Standard Approach

This central main pedicle located in the lower pole is then dissected off the pectoralis fascia, starting inferiorly and progressing superiorly under the central pedicle to the upper portion of the breast. This allows the entire breast to be effectively mobilized superiorly. With retractors under the breast, approximately four 2-0 vicryl Marchac sutures are placed between the deep breast parenchyma and the pectoralis fascia [44]. This central pedicle in the lower pole is then sutured in an ele-

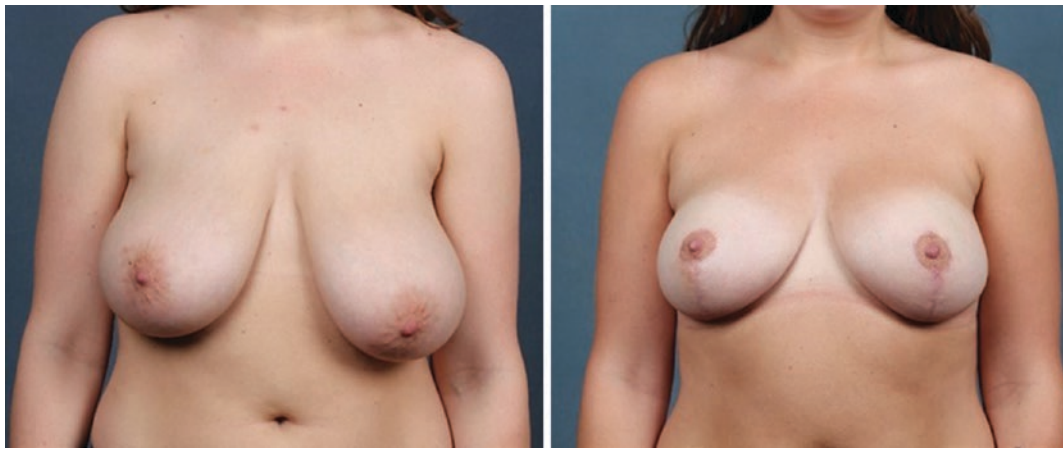


Fig. 2.29 Twenty-eight-year-old female before and after bilateral mastopexy reduction with an inverted-T mastopexy/reduction with an inferior pedicle using Galaflex soft tissue support

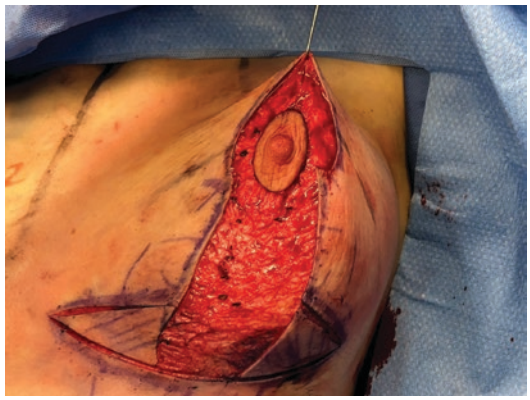


Fig. 2.30 Area of deepithelialization for the superior pedicle circumvertical mastopexy with a short horizontal incision

Fig. 2.31 Dissection of the medial and lateral breast pillars

vated position approximately 1–2 cm above the IMF. This stabilizes the tissue in a higher position during the healing process and elevates the inframammary fold. Care must be taken not to elevate too much or aggressively evacuate the lower pole, as this can lead to a flattening in the lower pole or retraction of the IMF, superiorly creating a contour defect along the fold (Fig. 2.32).

Option 2—Lower Island Flap Autoaugmentation

An alternative to the above-described approach is to use the central pedicle in the lower pole as a flap to transposition into the upper pole, as originally described by Ribiero and more recently by Hammond [48, 49]. Instead of elevating this central lower island flap off of the fascia, a flap is created that is based off the central pedicle just above the IMF (Fig. 2.33). This flap is dissected circumferentially, and then incrementally dissected to free its attachment to create a mobile flap still attached to the deep fourth branch of the IMA that courses through Wuringer's septum. Once the flap has been dissected and released for mobilization, the remainder of the breast above the flap is elevated off of the pectoralis fascia (Fig. 2.34). The

Fig. 2.32 Case example of patient who underwent mastopexy with a superomedial pedicle circumvertical (periareolar vertical) with a short horizontal on the right and a circumvertical mastopexy on the left

lower island flap is then transposed into the upper pole and sutured into place with approximately four 2-0 vicryl sutures (Fig. 2.35).

Once the parenchyma is positioned and stabilized, tailor tacking is performed to confirm the shape of the breast. Tailor tacking begins at the inferior areola (6 o'clock position) and proceeds inferiorly toward the IMF. The ideal inferior areola-to-fold distance varies based on the size of the breast, but is usually 6–7 cm. Adjustments are made with the tailor tacking to create the desired breast shape. Markings for the horizontal wedge excisions are then extended medially and laterally to create the inverted-T scar (Fig. 2.36). Once confirmed, all staples are removed, and the horizontal wedge is excised. The pockets are irrigated with bacitracin saline solution and hemostasis is ensured. Deep parenchymal sutures of 2-0 vicryl are then placed along the vertical incision, bringing the medial and lateral pillars together at the midline (Fig. 2.37). The incisions are then closed with interrupted 3-0 PDS dermal sutures. The vertical and horizontal scar are closed with a 4-0

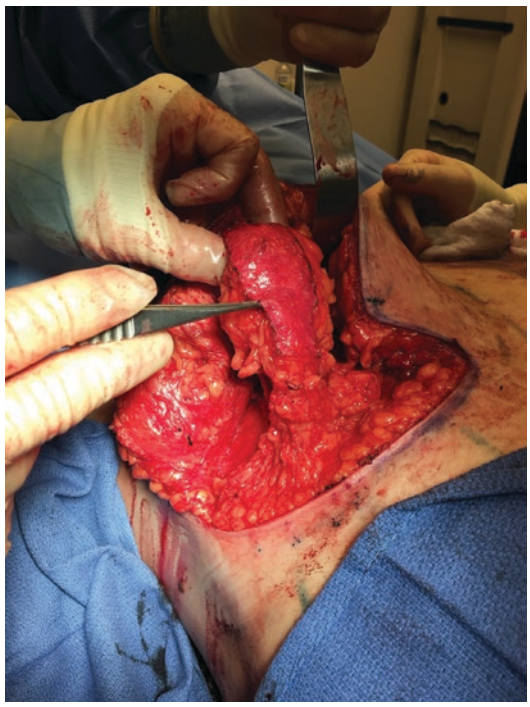


Fig. 2.33 Ribiero flap designed off of the central pedicle just above the IMF

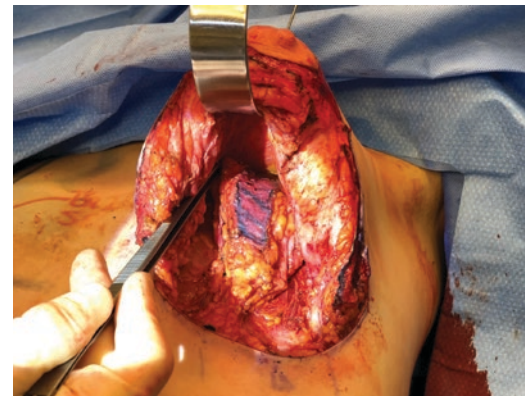


Fig. 2.34 Elevation of the breast tissue off of the pectoralis fascia to allow for flap transposition

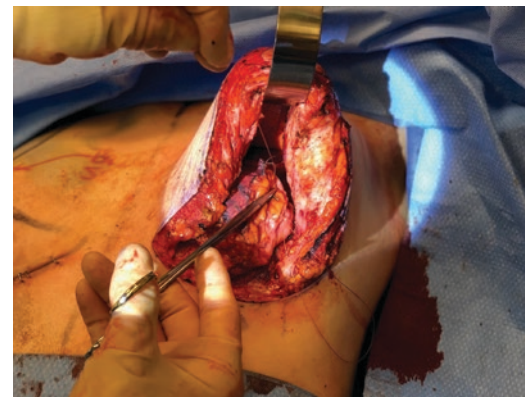


Fig. 2.35 Flap elevation superiorly then sutured to the fascia with 2-0 Vicryl sutures for stability

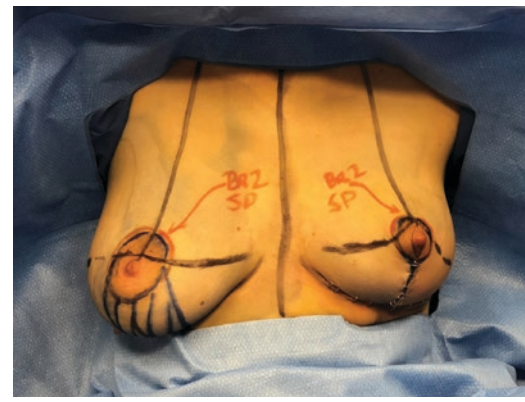


Fig. 2.36 Tailor tacking of the breast to confirm breast shape and size

Fig. 2.37 Medial and Lateral vertical breast pillars sutured with interrupted 2-0 Vicryl

monocryl running subcuticular suture. The areolas are then closed with a simple running 5-0 nylon suture. Steri-strips are placed over the incision. Contour tape is then placed along the lateral breast border and inframammary fold. If a drain is used, a biopatch is placed at the base of the drain as it exits the skin, and the drain is secured with a 2-0 nylon. The breasts are wrapped with a Kerlix and ace wrap.

Postoperative Care and Expected Outcomes

The patients are instructed to leave all dressings on for 24 hours. The wraps are then removed, and a sports bra is worn for the following 4 weeks. Dressing changes with antibiotic ointment and gauze are used over incisions for 1 week. Patients can shower after 48 hours. The contour tape is removed at day 4 through 7. Nylons around the areolas are removed 6–8 days postoperatively. The subcuticular monocryls are clipped on the ends as they exit the skin at 2 weeks. Scar management with silicone gel or silicone sheeting is initiated on all patients at 2 weeks. Patients are allowed to resume activities of daily living almost immediately. Exercise is usually allowed at 4 weeks, with heavy lifting at 6 weeks.

Patients are counseled that they can expect swelling and firmness to develop as their breasts heal. The breasts will continue to soften over time, and the breast will relax over the first few months. The results are stable after 6 months, but scars can continue to improve over the first year, and some additional relaxation of the breast with loss of upper pole volume can continue for even longer. Whereas inferior pedicle shape looks relatively normal shortly after the procedure, superior pedicle technique may take longer to obtain its natural shape.

Case Examples

Case 1 Sixty-four-year-old female with asymmetric grade 3 ptosis with a SN-N distance of 34 cm on the right and 32 cm on the left (Fig. 2.38). Due to the amount of ptosis requiring significant NAC elevation of greater than 6 cm, an inferior pedicle inverted-T mastopexy reduction was performed. The inferior pedicle was supported with a soft tissue scaffolding (Galaflex). She has uplifted, stable, symmetric breasts with no bottoming out as demonstrated in her 4-month postoperative results.

Case 2 Twenty-nine-year-old female with 34 DD cup breasts desiring a smaller, more uplifted appearance (Fig. 2.39). Her SN-N distance was 26 cm with grade 2 ptosis; thus, only requiring a few cm of NAC elevation. A superior pedicle inverted-T mastopexy was performed with a lower island flap autoaugmentation. Her postoperative photographs at 2 months demonstrate an uplifted C cup with good upper pole volume thus far.

Case 3 Thirty-five-year-old wearing a 32 DD cup complained of saggy, heavy breasts (Fig. 2.40). She presented with grade 3 ptosis on the right and grade 2 ptosis on the left. She desired an uplifted, full C cup appearance. She underwent a superior pedicle inverted-T mastopexy with removal of 152 g from the right and 86 g from the left breast. Her 3-month results reveal good uplifted volume with improved symmetry.

Fig. 2.38 Case 1: Sixty-four-year-old female with asymmetric grade 3 ptosis

Fig. 2.39 Case 2: A 29-year-old female with 34 DD cup breasts desiring a smaller, more uplifted appearance

Case 4 Thirty-four-year-old female with breast asymmetry presenting with grade 3 ptosis on the left and grade 2 ptosis on the right (Fig. 2.41). She underwent a bilateral inferior pedicle inverted-T mastopexy. For symmetry, 37 g was removed from the right and 176 g from left. Six months' postoperative result reveals symmetric lifted breasts.

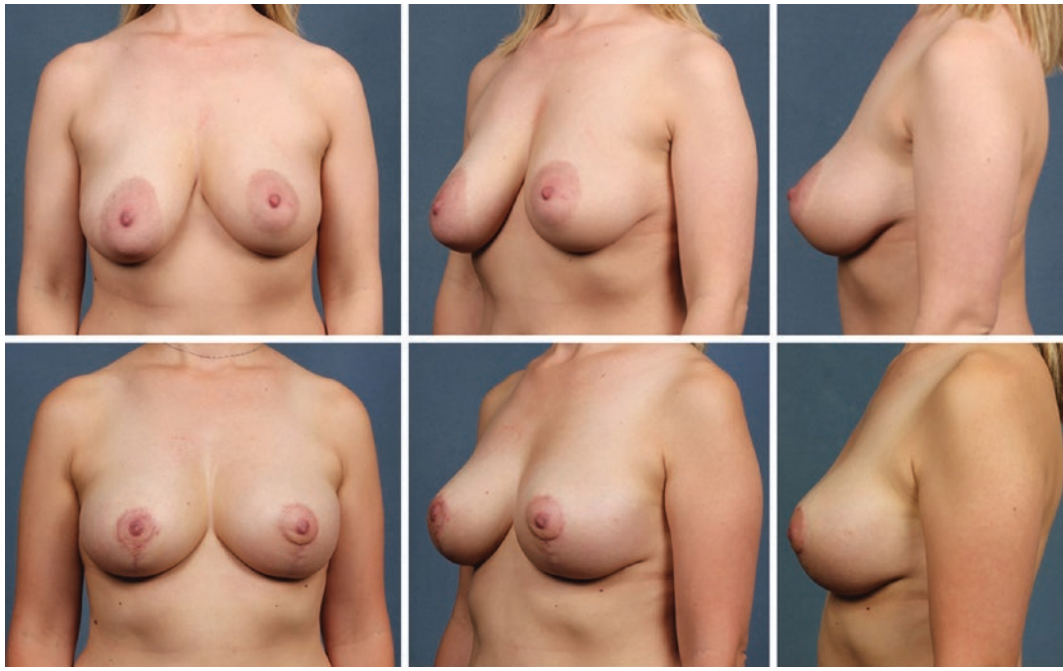


Fig. 2.40 Case 3: A 35-year-old wearing a 32 DD cup complained of saggy, heavy breasts

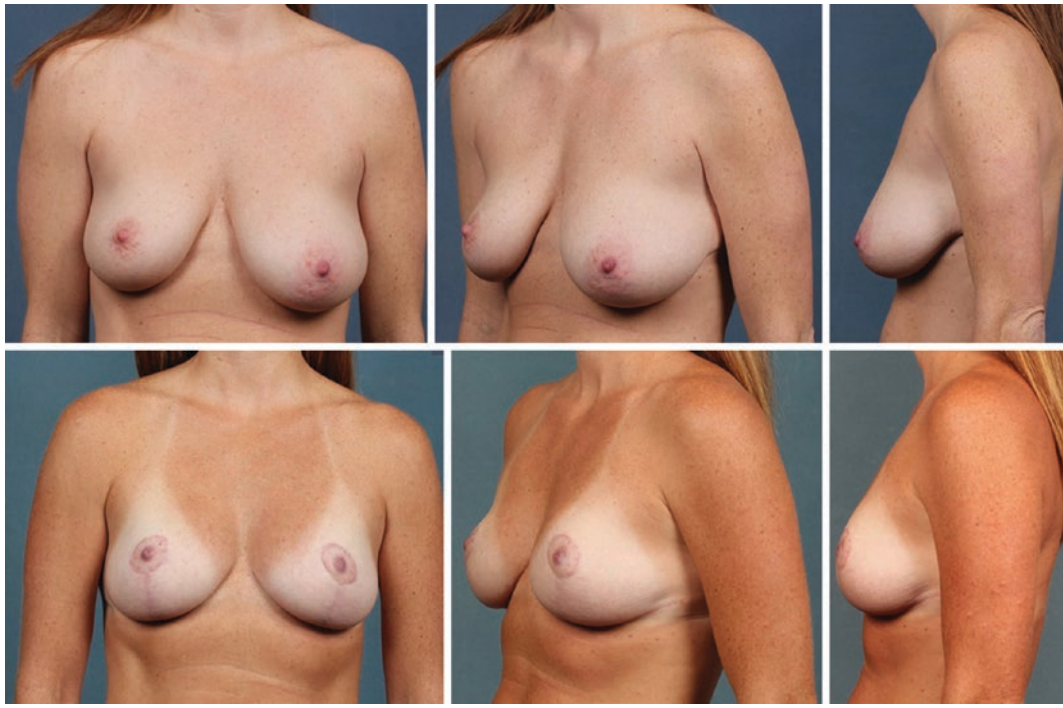


Fig. 2.41 Case 4: A 34-year-old female with breast asymmetry presenting with grade 3 ptosis on the left and grade 2 ptosis on the right

Augmentation Mastopexy

Patients with ptosis and volume deficiencies, or those desiring significant upper pole volume, require placement of an implant with the mastopexy to achieve their desired shape. The success of the augmentation mastopexy is multifactorial, but implementing the optimal surgical technique based on patient factors can significantly contribute to the long-term success of the procedure. The details, decisions, and experience-based pearls involved in this operation can provide guidance to perform this operation with expert precision.

To achieve these objectives, the breast augmentation and the mastopexy can be performed either simultaneously or as a staged procedure. Much controversy has existed over the years as to the safety of doing this procedure as one stage [50–52]. Detractors believe a two-stage procedure produces superior aesthetic results and is a much safer approach compared to a one-stage procedure. However, significant data and reports have emerged over the past few years demonstrating the safety and efficacy of these procedures being performed simultaneously [53–57]. However, there are patients for whom a staged procedure may be more appropriate, as listed below:

Relative Indications for a Staged Augmentation Mastopexy

- Obesity: BMI >30
- Large, pendulous breasts—need volume reduction
- Significant breast ptosis—NAC elevation >5–6 cm
- Vertical excess >8–10 cm (or possibly >6 cm)
- Unrealistic expectations (patient would not accept reoperation rate > 20%)
- Smoker refusing to quit >4 weeks
- Previous surgery impacting blood supply

Additional Considerations for a Staged Augmentation Mastopexy

- Significant breast asymmetry
- Borderline case—may be acceptable for mastopexy or augmentation alone
- Previous breast radiation
- Large implant volume or "augmented" look desired
- Massive weight loss patient
- Immunocompromised patient
- History of hypertrophic scarring
- Multiple medical comorbidities
- Surgeon uncomfortable performing a single-stage procedure based on the breast anatomy of the patient or surgeon inexperience

Blood Supply

To ensure the most reliable blood supply to the NAC and skin flaps in an augmentation mastopexy, the superior pedicle and occasionally the superomedial pedicles are utilized. The superficial position of these vessels in the upper pole allows the implant placement and mastopexy without interfering with the blood supply. However, these vessels take origin along the sternal border in the medial aspect of the implant pocket, and can be inadvertently sacrificed when aggressive medial pectoral muscle division is performed.

The inferior pedicle is not utilized in an augmentation mastopexy, as its blood supply through the deep fourth branch of the IMA is sacrificed with development of the implant pocket, and its secondary blood supply along the inframammary fold is divided with the mastopexy. Thus, an augmentation mastopexy with an inferior pedicle design is not truly supplied by pedicle blood supply in most cases, and the best one can hope for is random blood supply. If the remainder of the mastopexy is performed dividing deep into the flaps with an assumption that the inferior pedicle will provide circulation, the division of much needed superficial perforators both medially and laterally can lead to devastating consequences, including loss of NAC or breast flap viability, and resultant necrosis. Thus, the preferred pedicles enter the breast superiorly and superficially, providing a more reliable and robust blood supply (Figs. 2.42 and 2.43).

Additionally, implant and pocket selection affect the blood supply to the overlying breast.

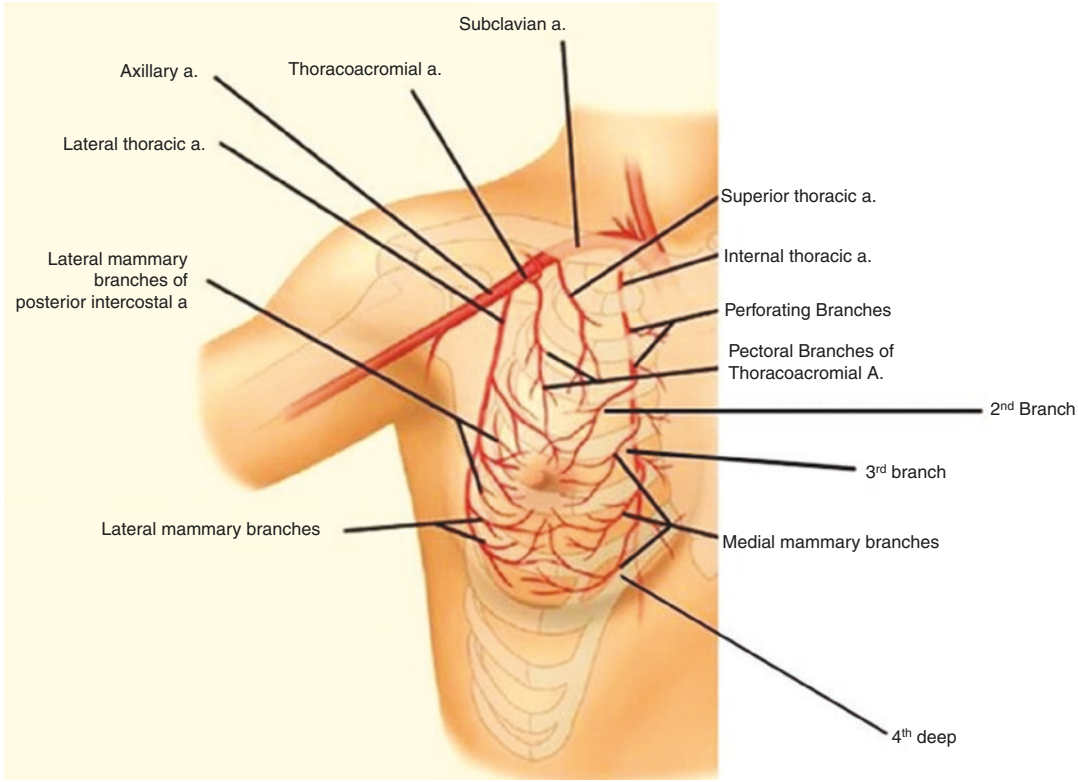


Fig. 2.42 Breast blood supply: the second branch of the internal mammary artery (IMA) supplying the superior pedicle; the third branch of the IMA supplying the medial pedicle; and the fourth branch of the IMA supplying the inferior pedicle

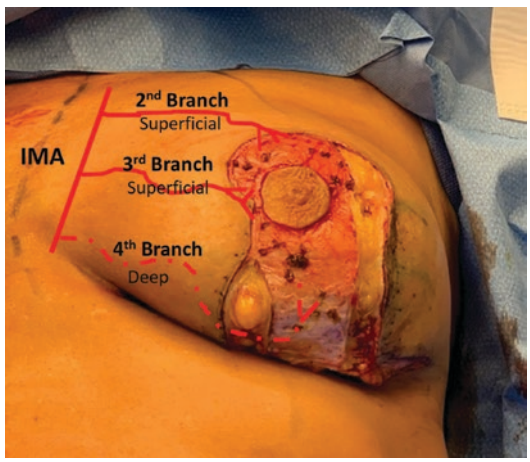


Fig. 2.43 Blood supply to the nipple-areola complex. Second branch of the internal mammary artery (IMA) running superficial supplies the superior pedicle. Third branch of the IMA coursing superiorly supplies the medial pedicle. The fourth branch of the IMA running in the deeper plane of the inferior breast is shown with the dotted lines and is cut during an augmentation mastopexy

The subpectoral pocket maintains the musculocutaneous perforators (unless an extensive dual plane is performed) and is less likely to interfere with the blood supply compared to a subglandular/subfascial pocket. Likewise, larger implants placed in any pocket, but especially the subglandular/subfascial pocket, may result in undue tension on the mastopexy closure that can also create vascular compromise to the NAC or overlying skin flaps, resulting in skin or NAC necrosis.

Implant Selection

In augmentation mastopexy, implant selection can significantly impact the final outcome in an augmentation mastopexy case. The implant selection in a one-stage augmentation mastopexy is of greater significance, as the augmentation is performed in the face of a mastopexy with soft

tissue envelopes that are more lax, stretched, thinned with stria, and less tolerant to the effects of the underlying implant.

Implant Profile and Size

Tissue-based planning proves very beneficial in augmentation mastopexy, just as it does in augmentation alone [56]. The base width of the breast provides a general guide as to the appropriate sizing of the implant for the breast. In considering implant width, critical to that calculation is determining how much the native breast itself will contribute to the final width of the breast. Optimal implant width is calculated by determining the desired final breast width (usually anterior axillary line to 1 cm from the midline of the chest) and subtracting the soft tissue contribution from the native breast using the medial and lateral pinch.

In a patient with ptosis but with a thin skin brassiere and minimal breast volume, the implant determination will be identical to a straightforward breast augmentation. In breasts with more significant volume, and heavier breasts, this calculation might lead to a smaller implant compared to a breast augmentation alone. When trying to achieve a desired volume with limited base width, a higher profile implant may be deemed as appropriate in these patients. However, the skin envelope laxity with the planned mastopexy must be taken into consideration. The effect of a high-profile implant on the skin envelope immediately on the skin flaps, and over time with potential for stretch deformity, must be balanced against the patient's desire for more volume [28]. In the heavier breasted patient requiring an augmentation and mastopexy, an implant is often selected with a lower profile and with greater height and width of the implant to add volume to the upper pole, but to minimize the impact on the overlying breast. Oversized implants not only create long-term effects, the undue tension created when mastopexy flaps are closed around a larger implant can impact circulation to the NAC and overlying breast skin flaps, leading to ischemia and necrosis. The pocket selection with these implants can also impact circulation. Because of stretch and weight of the implant on the overlying breast tissue, the authors prefer silicone implants over saline implants, as saline leads to greater lower pole stretch, palpability, visibility, and higher revision rates.

Smooth Versus Textured Implants

Smooth implants have several advantages, including a natural mobility and an extremely low risk of wrinkling or palpability. The implants tend to settle at the bottom of the breast pocket, and continue to descend with the overlying breast tissue naturally. When performing a mastopexy with the augmentation, the smooth implants can be translocated superiorly, taking the tension off the closure, and will naturally descend over time back into the newly lifted skin envelope. Due to the laxity of the skin envelopes, surgeons often cite the mobility of the implants as an advantage when there is instability in the overlying breast envelope.

In light of the issues related to textured implants, there has been a diminished use of textured devices, and if texture is selected, microtexture or nanotexture is utilized. Patients with sloping chest walls are also ideal for textured devices, as the texture stabilizes the implant and minimizes migration, especially lateral slip of the implant into the axilla. Textured implants also allow not only for placement of round implants but also the possibility of using an anatomic-shaped implant. The stability of texture, especially more aggressively textured implants, seems to create less lower pole stretch deformity over time. The less aggressively textured devices available today do not provide the level of stability and reduction in lower pole stretch, and may not prove advantageous in the augmentation mastopexy patient.

Shaped Implants

Shaped implants can provide advantages in certain types of patients and may be appropriate in an augmentation mastopexy. Shaped implants are uniquely beneficial when performing an augmentation mastopexy on patients with constricted breast or tuberous breast deformities. These augmentations are often performed in conjunction with a circumareolar mastopexy to optimize

results. The shaped implant provides a point of maximal projection lower than a round implant, allowing improved expansion and nipple positioning with the augmentation. The increased cohesiveness of the gel and the texturization of the implant provides stability that tends to improve the expansion of the lower pole. These qualities allow the implant to "shape" the tight, constricted tissue rather than the tight tissue restricting and "shaping" the implant.

Pocket Selection

Pocket selection for the augmentation mastopexy is often one of the most overlooked aspects, and may have the greatest impact on the final results. The pocket choices include the submuscular, subfascial, and subglandular. The very lax, loose breasts, such as those of the weight-loss patient, will need a greater level of dual plane to allow the lower pole to be subglandular, thus allowing greater expansion for correction. Whereas one might think this is not necessarily due to the overlying mastopexy that is capable of tightening the tissue over the implant, the very lax breast, even after a mastopexy, will often fall off of the underexpanded lower pole and implant, leading to a waterfall deformity. The ability of the implant to have some influence over the overlying breast tissue is an important, and yet often misunderstood, concept for achieving long-term success in augmentation mastopexy.

A subfascial/subglandular pocket is possible if the upper pole pinch is 2 cm or greater. Implants placed above the muscle have less coverage in the upper pole compared to submuscular implants. Thus, when above the muscle, implants with greater cohesiveness, optimal fills, and possible texture provide a more optimal implant for limiting lower pole stretch over time and maintaining upper pole volume.

Augmentation Mastopexy

When determined that a one-stage augmentation mastopexy is deemed appropriate, the approach to the mastopexy is based on the preoperative evaluation. The assessment of the level of ptosis guides the surgeon in assessing the need for NAC elevation, as well as skin envelope reduction and possibly parenchymal excision.

Circumareolar

Although performed less often, patients with borderline ptosis, grade 1 ptosis, or pseudoptosis (N-IMF under maximal stretch 10 cm), low NAC (such as constricted breast deformity), or tuberous breast deformity may benefit from a circumareolar mastopexy. This can elevate the NAC modestly (2 cm or less) and can reduce the areolar diameter. There should be minimal overhang of breast over the fold, and limited horizontal laxity. The circumareolar mastopexy should be used very selectively, as it can create widening and flattening of the breast, which may prove beneficial in a tuberous breast deformity but undesirable in a deflated, flattened breast. This approach mostly corrects the NAC and improves the shape of the NAC and breast, but with little ability to actually "lift" the breast.

Circumvertical

Patients with moderate ptosis, grade 1 or 2, requiring NAC elevation of usually less than 4 cm, with modest amounts of breast overhanging the fold, can be addressed with a circumvertical mastopexy with or without removal of a small amount of skin along the fold (horizontal wedge). These patients tend to have more horizontal laxity, requiring breast narrowing with only a modest amount of reduction in the vertical component.

Circumvertical with Inverted-T Skin Excision

For patients with more severe ptosis, grade 2 or 3, with significant vertical excess and overhang over the fold, a circumvertical with inverted-T skin excision is more appropriate to achieve opti-

mal results. The greater the vertical excess and laxity, the greater the horizontal wedge and the longer the incision becomes along the inframammary fold.

When planning the type of mastopexy, it is important to distinguish between the pedicle design and the skin excision design of the mastopexy [42]. In augmentation mastopexy, the design of the more ptotic breast is always a circumvertical approach, with the superior, or occasionally the superomedial, pedicle as the pedicle blood supply. The only difference in the approach is whether skin needs to be excised along the fold. Thus, even in the more ptotic breasts with significant laxity requiring an inverted-T skin pattern excision, the parenchymal and pedicle design is still a circumvertical approach with a superior pedicle. In these patients, if the breasts are heavy with excessive ptotic parenchyma, a lower pole parenchymal resection along with the skin excision is optimal to reduce the likelihood of recurrent ptosis postoperatively [27].

Lower Pole Mastopexy

There is an occasional patient, especially in secondary cases, in which the NAC is in satisfactory position, but a significant amount of glandular ptosis or pseudoptosis is present. These patients may benefit from simply an inframammary fold resection (smile mastopexy) or vertical-horizontal resection (sailboat mastopexy) without transposing the NAC [58]. This can address both vertical and horizontal laxity without jeopardizing NAC circulation and placing an unnecessary scar around the areola.

Operative Technique

Preoperative Markings

The augmentation mastopexy is based on a superior pedicle blood supply and is not dependent on the final skin excision pattern. Decision on nipple placement is performed based on the location of the fold and expectation on the location of the new lifted breasts with an underlying implant. This can be approximated by simulating the mastopexy and identifying the probable location of the NAC. The nipple position is marked along the breast meridian at or within 2–4 cm of the reflected inframammary fold.

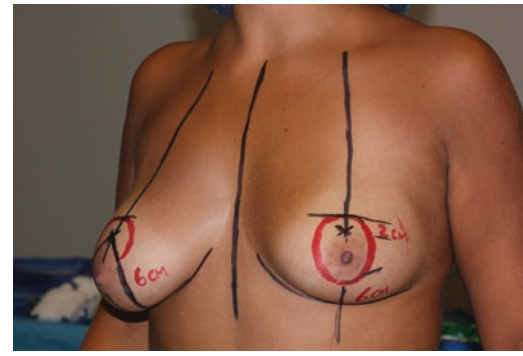


Fig. 2.44 Preop markings in an asymmetry case showing location of the new nipple position (black X), which is within 2 cm of the reflected inframammary fold. The red circles represent the proposed new NAC location. The left breast will be a periareolar mastopexy and the right breast will be a periareolar vertical with possible short horizontal along the IMF. Be sure to keep the distance from the IMF to new NAC 6–8 cm

In the circumareolar approach, the proposed location of the new areolar opening is marked, starting approximately 2 cm above the nipple position and 6–8 cm above the inframammary fold, based on implant size. An oval line is then drawn from the two points extending around the areola to create the desired shape and skin excision (Fig. 2.44).

Vertical Mastopexy

When a vertical or inverted-T mastopexy is planned, the areola is drawn from the planned superior areola opening, extending around the areola to produce an areolar opening of approximately 42 mm. The breasts are then rotated medially and laterally to mark the location of the vertical incisions, recognizing that the placement of the implant will add volume, thus requiring less skin excision than would be required with mastopexy designed without an implant (Fig. 2.45a, b).

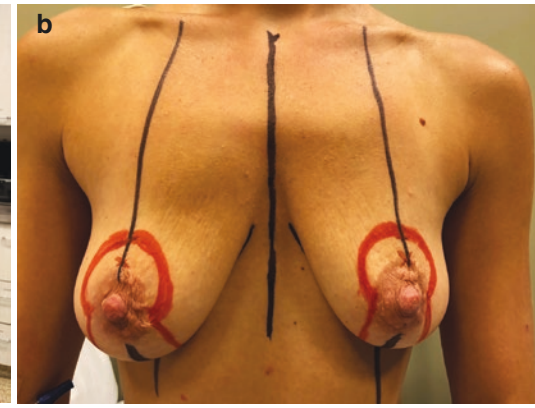


Fig. 2.45 (**a**) Medial rotation of the breast to mark the lateral vertical incision of the mastopexy. (**b**) Preoperative markings of a periareolar vertical mastopexy. The red X represents the new nipple position. Note the larger skin excision design of the patient's right breast based on the greater volume and ptosis of the breast compared to the left

If the vertical limbs are deemed excessively long, the design can be modified to include additional skin excision around the areola (circumvertical mastopexy) or along the inframammary fold (circumvertical with horizontal wedge excision).

Patients with greater ptosis will often require more significant excision of skin and elevation of the NAC. This can range from a long wise-pattern excision down to a very short horizontal wedge based on the amount of skin excess. These markings are made along the inframammary fold and intersect with a line drawn from the vertical limbs extending in a curved fashion down to the fold markings. When planning an augmentation mastopexy, these drawings should be conservative, allowing for adjustments once the implant has been placed. All the markings made preoperatively are made as a guideline for the operation, but the final NAC placement and skin excision required will be determined in surgery after the breast implant has been placed.

Surgical Technique

Each breast is placed under maximal stretch, and the areolas are marked with a 42-mm cookie cutter (range 38–45 mm depending on desired aesthetics) and incised with a 15-blade scalpel.

Once the areolas are incised, access to the breast pocket is determined. For circumareolar mastopexies, the access is either through the inferior areola in the area of planned deepithelization or through a counterincision in the IMF. The preferred access currently is with an IMF incision. This provides improved exposure and visualization of the pocket, which is associated with lower capsular contracture rates, and allows for IMF control sutures to be placed to stabilize the new fold position.

When a vertical or inverted-T skin incision is planned, access to the breast pocket can be made via the periareolar, vertical, or the inframammary approach. However, a vertical access approach (most typical) or the IMF is utilized in the majority of cases. The breast is divided down the midline extending from the inferior areola to at least 2 cm above the inframammary fold to gain access to the desired pocket (Fig. 2.46).

It is extremely important to not carry this incision all the way down to the fold, as this lower area of the breast, the "no-go zone," will provide a protective cuff of tissue during closure (Fig. 2.47).

Once through the breast tissue, the pocket is created based on preoperative decision-making, as described in the breast augmentation section. The level of dual plane required varies, and each surgery can be tailored to provide the optimal level based on soft tissue requirements and implant selection. In augmentation mastopexy, the breast-implant relationship is improved with

Fig. 2.46 Vertical incision made just inferior to the NAC, extending down to at least 2 cm above the IMF

Fig. 2.47 The "no-go zone" is an area along the IMF that provides a protective cuff between the implant and the outside world. Stopping your vertical incision 2 cm above the IMF will preserve this area

the overlying mastopexy. However, even with a mastopexy, failure to optimize the breast-implant interface during surgery can lead to a waterfall deformity, with the breast sliding off of the implant. If the subglandular or subfascial pocket is used, the implant-breast interface is not affected by the interposing muscle, and pocket development is simply developed to accommodate the implant.

Implant Placement

The implant is then placed into the pocket with the assistance of an insertion sleeve such as the Keller funnel. The use of the insertion sleeve is even more beneficial in an augmentation mastopexy surgery, as the implant is passed through either the circumareolar or vertical incision in the vast majority of patients. These access incisions require the implant to pass through the bacteria-laden breast tissue. The insertion sleeve provides a "minimal touch" technique that is associated with lower capsular contracture rates [9].

Tailor Tacking

Once the implant is in the pocket and oriented appropriately, the final planning of the mastopexy is carried out. Tailor tacking is a critical step in designing the optimal breast shape. With the circumareolar approach, the areola is stapled to the outer circle and adjusted to create the desired shape prior to deepithelialization. In the vertical or inverted-T approach, starting usually at what will be the new inferior areola location (6 o'clock position), the medial and lateral vertical limbs are brought together and stapled in a descending fashion, adjusted by tightening a little more or a little less to create the desired lower pole breast shape. If a vertical approach only, the planned excision tapers down to the fold. The length of the lower pole skin (distance from the inferior areola to IMF) varies based on the size of implant and amount of breast parenchyma that is present. For most augmentation mastopexies, this length is generally 6–8 cm. If this distance is excessive when tailor tacking, two options exist: expand the circumareolar opening to encompass more of the vertical length (circumvertical approach), or remove a horizontal wedge of skin at the fold to shorten the vertical limb. This often is a small wedge of skin, leaving a short horizontal scar (has been referred to as owl's feet) or extended laterally as J-type mastopexy. If the vertical excess is significant, the horizontal wedge excision will create an inverted-T pattern. With the patient in the upright position and the arms extended at 45 degrees, breast shape and symmetry are confirmed. Adjustments are made if necessary, until the results are optimal (Fig. 2.48).

It is important to mention that once the tacking is complete, a final decision on placement of the NAC must be made. There is flexibility, as no

Fig. 2.48 Tailor tacking of the breast after placement of the implant. The IMF to the inferior border of the areola is marked at 6–8 cm

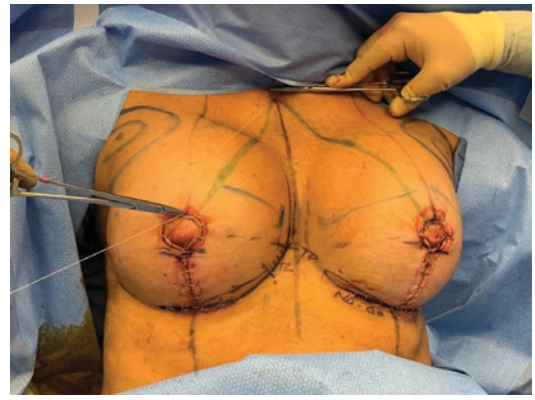


Fig. 2.49 Confirming the NAC placement is symmetrical using the "top-down" approach from the sternal notch to the top of the areola. Two needle drivers are used along with a suture tail to measure the symmetrical distance between the two sides

Fig. 2.50 Confirming the NAC is symmetric using the "bottom up" approach. Note the "bottom-up" distance of 6 cm from the IMF to the inferior edge of the NAC is confirmed bilaterally

skin has been excised at this time. The areola can be positioned higher or lower to optimize breast shape, placing the NAC centrally along the median of the breast at the point of maximal projection. When considering NAC placement, confirmation can be performed from bottom up, top down, or both. "Top down" refers to the distance from the sternal notch to the top of the areola (or nipple) and "bottom up" refers to the distance from the IMF to the inferior areola (or nipple). During tailor tacking, it is helpful to confirm NAC position and symmetry using both of these techniques (Figs. 2.49 and 2.50).

Once confirmed, the patient is placed supine and the tailor tacking is marked with methylene blue or permanent marker, identifying the planned incision lines.

Breast Flap and Pedicle Dissection

In the circumareolar approach, the area between the areola and outer circle is deepithelialized. Although an IMF counterincision is the preferred access for the augmentation, if the periareolar access was used, then the deep breast tissue must first be closed with an absorbable 2-0 Vicryl. The dermis is then cauterized for maximal shrinkage (Fig. 2.51). A purse string suture of 3-0 Gortex is placed in a wagon wheel pattern (Fig. 2.52).

In the vertical augmentation mastopexy technique, the superior pedicle is preferred. The incisions are outlined with a scalpel, ensuring not to cut deeply into the dermis. The periareolar region is deepithelialized. The incisions are then made full thickness through the dermis, along all of the scored skin. However, in the superior areola, the dermis is left intact (from 8 o'clock to 4 o'clock) as the superior dermal pedicle (Fig. 2.53a, b).

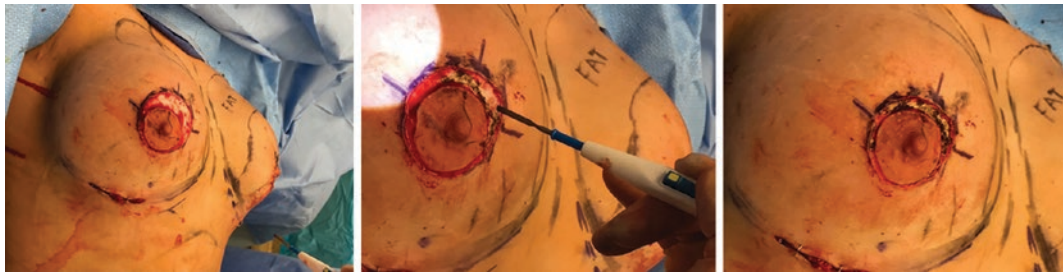
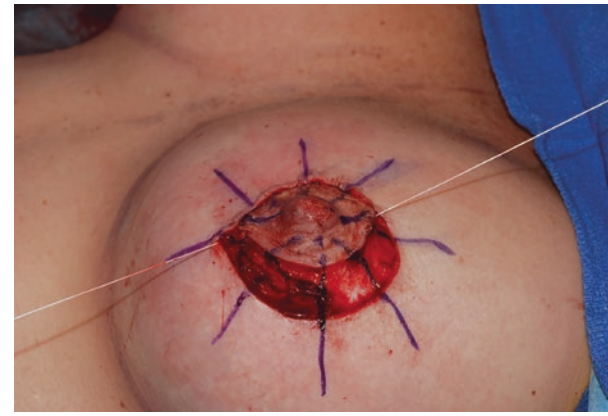


Fig. 2.51 The dermis around the areola is cauterized to shrink the tissue and facilitate a tension-free closure

Fig. 2.52 Wagon wheel closure of the NAC with a 3-0 Gortex



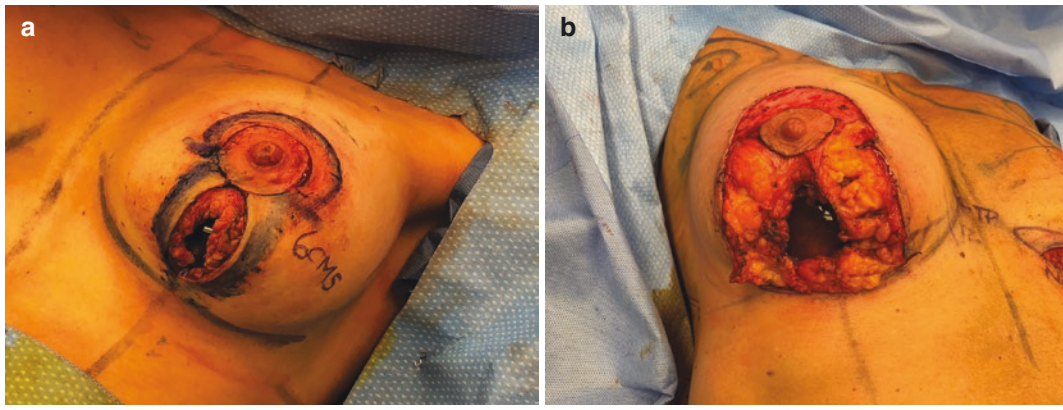


Fig. 2.53 (**a**) Once symmetry confirmed with the patient sitting upright, they are laid back supine, tailor-tacked staples removed, the incisions are demarcated with marking pen around the NAC and vertical limb. Note the distance from the IMF to NAC is 6 cm. (**b**) Periareolar and vertical limb are deepithelialized. Note that the superior dermis around the NAC is left intact from 8 to 4 o'clock to maintain NAC perfusion

Lower Pole Debulking

If the patient is extremely thin, such as in a revision surgery or a patient with paper-thin skin, the vertical skin +/- the horizontal skin is deepithelialized and maintained for additional coverage and support with the mastopexy. However, most patients with ptotic breasts have significant amounts of excess skin and breast tissue in the lower pole. In these patients, debulking of

the lower pole is probably the single most important step in the procedure to reduce the likelihood of recurrent ptosis. Breast flaps along the medial and lateral vertical incisions are initially created, staying approximately 2 cm or greater in thickness. Located centrally is the lower pole segment of breast tissue —located from the areola to the IMF within the vertical incisions. This tissue is aggressively debulked to reduce lower pole stretch over time with recurrent ptosis. It also reduces the tension on the lower pole mastopexy flap closure. When debulking the lower pole, the anterior tissue is removed, preserving a posterior lamellae of breast tissue and posterior breast fascia. It is especially important to maintain the "no-go zone" cuff of breast tissue located above the IMF, as this creates the floor for the implant and provides protection for the implant if skin breakdown occurs at the level of the IMF (Fig. 2.54).

Deep Fascial Sling

Once the pedicle has been developed and appropriate skin and breast tissue removed, closure of the breast pocket is performed. This step is extremely important to creating a lamellar closure over the implant and developing the shape of the lower pole. As in all mastopexy techniques, controlling the lower pole of the breast through parenchymal shaping—and not skin tightening—provides increased stability of the results over time. Starting inferiorly, which is just above the "no-go" cuff of breast tissue, the lateral and medial pillars are brought together at the most posterior aspect of the breast, just superficial to the implant, with a running 2-0 Vicryl suture (Fig. 2.55a, b).

This 2-0 Vicryl running suture carries the closure superiorly toward the NAC, continually tightening the lateral pillar and the medial pillar to create the desired lower pole shape. Therefore, this step is not just closing over the implant, it is parenchymal shaping in a vertical fashion to control overall breast shape and vertical projection. This closure additionally adds another layer of closure, protecting the underlying implant.

Fig. 2.54 "No-go zone" just above IMF shown in the tips of the forceps

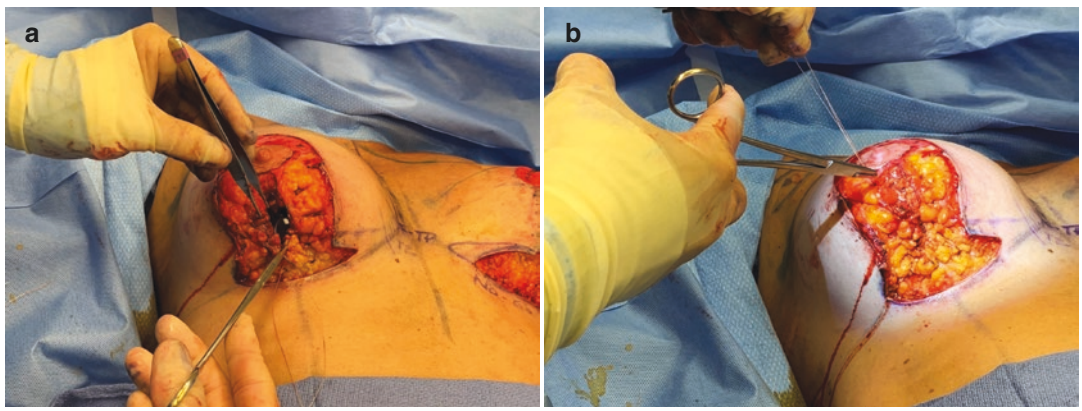


Fig. 2.55 (**a**, **b**) Closure of the posterior lamellae of the implant pocket with a running 2-0 Vicryl suture to provide an additional layer of closure

Closure

Deep parenchymal sutures of 2-0 Vicryl are then placed along the vertical incision, bringing the medial and lateral pillars together at the midline (Fig. 2.56). All incisions are then closed with interrupted 3-0 PDS dermal sutures. The vertical and horizontal scars are closed with a 4-0 monocryl running subcuticular suture. The areolas are then closed with 3-0 PDS interrupted dermal suture and a simple running 5-0 nylon suture (Fig. 2.57). Steri-strips are placed over the incisions. Contour tape is then placed along the lateral breast border and inframammary fold. The breasts are wrapped with a xeroform gauze, Kerlix, and ace wrap.

Fig. 2.56 Closure of medial and lateral breast pillars with a 2-0 Vicryl to provide final shape and support of lower breast pole

Fig. 2.57 Final closure of the breast with the patient sitting upright on the operating room table

Postoperative Management

Breast Augmentation

Patients are wrapped in an ace wrap for the first 24 hours, followed by a sports bra to be worn 23 hours a day for the next 4 weeks. Early range of motion beginning in the recovery room is initiated for all patients, which includes shoulder rolls in both directions as well as elevation of the arms outward to the sides and over the head. The contour tape is removed at days 4–7. With smooth devices, implant massage begins postoperative days 4–6 and includes displacing the implant upward and downward in the pocket, crossing the arms and pulling the implants inward to create cleavage, and downward pressure on the implants to stretch the lower pole. Implant massage is contraindicated with textured surface devices, as it can irritate the pocket and potentially create serous fluid around the implant. It is also advisable to limit strenuous exercise for 6–12 weeks with textured implants to avoid early seroma formation. Patients are allowed to resume wearing regular bras after 4 weeks, but should continue with sports bra during bedtime for an additional 2–4 weeks to limit lateral implant migration while recumbent. Normal activity resumes within a few days after surgery, but exercise and high-impact activity should be delayed for 4–6 weeks.

Mastopexy and Augmentation Mastopexy

The patients are instructed to leave all dressing on for 48 hours. The wraps are then removed, and a sports bra is worn for the following 4 weeks. Dressing changes with antibiotic ointment and gauze are used over incisions for 1 week. Patients are allowed to shower after 48 hours. Nylons around the areolas are removed 6–8 days postoperatively. The subcuticular monocryls are clipped on the ends as they exit the skin at 2 weeks. Scar management with silicone gel or silicone sheeting is initiated on all patients at 2 weeks. Patients are allowed to resume activities of daily living almost immediately. Exercise is usually allowed

at 4 weeks, with heavy lifting at 6 weeks. If implants are present, massage protocol is initiated once all incisions are well healed.

Management of Complications

Breast Augmentation

Hematoma The incidence of hematoma after a primary breast augmentation has ranged from 0.5% to 2.0%. The best prevention is achieving meticulous hemostasis intraoperatively. Blind or blunt pocket dissection without surgery for hemostasis after should be avoided, to limit the incidence of hematoma. Patients should likewise be counseled to avoid medications that increase bleeding or interfere with platelet function for at least 2 weeks prior to surgery. A hematoma is easily recognizable with a breast that is swollen, bruised, and exquisitely painful to palpation, or often arm movement. Treatment includes reoperation with evacuation of the hematoma, hemostasis, pocket washout, and drainage. Implant exchange is usually not necessary. A hematoma left untreated is discouraged, as it can lead to prolonged healing, wound problems, delayed healing, infection, possible long-term issues of asymmetry, and possible capsular contracture [59].

Infection Infection rates for primary breast augmentation can approach 2% [2, 60, 61]. It is well known that the breast parenchyma and associated breast ducts harbor bacteria that can be introduced into the operative field or breast pocket [8, 62]. Prevention is key, and many operative maneuvers can assist in minimizing this possibility. Current recommendations are for skin preparation with chlorohexidine, which covers most organisms including methicillin-resistant *Staphylococcus aureus* (MRSA). Likewise, perioperative antibiotics and pocket irrigation with 50% betadine reduce implant contamination and possible infection. The standard treatment includes operative exploration, irrigation, and debridement of the pocket with drainage. In most incidences, the implant is removed and reaugmented 6 months later. There is the possibility of implant salvage with prolonged antibiotic therapy if the patient is clinically stable and the infection is limited, but failure of a salvage procedure would mandate implant removal [63–65].

Sensation changes Alterations in nipple sensitivity can manifest as either hypoesthesia or hyperesthesia, and are often the result of traction injury, bruising, inflammation, or possibly even injury to the lateral intercostal cutaneous nerve that enters the breast laterally on the deep surface just above the pectoral fascia. Although the major innervation is the fourth, there is some overlap from the anterior and lateral branches of the third and fifth intercostal nerves. There is evidence that nipple sensitivity changes are no more likely with a periareolar incision when compared to an inframammary incision [66, 67]. The most common cause is aggressive pocket dissection laterally, especially with sharp dissection, with injury to the intercostal nerves.

Deflation and implant rupture It is important to inform breast augmentation patients that breast implants do not last a lifetime. Implant rupture and failure of the shell are dependent on implant style. Any disruption of the outer shell of a saline implant leads to complete failure of the implant, with the saline leaking out into surrounding tissue, and is harmless. Saline implant failure can be associated trauma or a spontaneous leak that involves either fold fatigue on the shell of the implant or valve incompetence. Silicone implant rupture rates have been quite variable between devices, and failures increase with the age of the implant. The fifth-generation silicone gel implants have more cohesive gels, and the silicone is less likely to egress from the implant shell, leading to a much lower rupture rate than earlier fourth-generation devices [1, 2, 20]. MRI imaging is currently the diagnostic technique of choice to discern a silicone implant rupture, although high-definition ultrasound has shown excellent utility in discerning ruptures, and will most likely play a role in identifying occult ruptures.

Capsular contracture Capsular contracture remains the number 1 complications of breast

augmentation, with incidence ranging as high as 15–30%, with the development of palpable and/or visible deformation of the periprosthetic capsule around the implant [1, 2, 68, 69]. The development of a capsule around an implant is always present due to the unique foreign body reaction by the surrounding breast tissue. A periprosthetic capsular contracture that is clinically significant is characterized by excessive scar formation with shrinkage and often thickening of the capsule, leading to firmness, distortion, and displacement of the breast implant. Baker proposed a clinical classification system for capsular contractures that is still widely used today [70]. While there are many factors identified that seem to contribute to the incidence of capsular contracture, the exact etiology is not known. The infection theory has been studied and appears currently to be the most cited explanation for capsular contracture development [3–8]. This theory entails a chronic subclinical infectious process located adjacent the implant shell within a microscopic biofilm that is protective of the infectious process and inaccessible to cellular and humoral immune function to combat the inflammatory process. Staphylococcus epidermidis, propionibacterium, enterobacter, bacillus, and other organisms have been implicated in this process.

There have been many techniques proposed to reduce the incidence of capsular contracture. Maneuvers to minimize tissue trauma, blood staining, and seroma formation during pocket dissection have been employed, as these may all contribute to capsular contracture formation. Periprosthetic fluid pockets generally resorb within the first week, and the use of topical antibiotic irrigation has been shown to decrease this rate [71]. Additionally, the use of an insertion sleeve (e.g., Keller funnel) for implant placement and placement of Tegaderm (nipple shield) over the nipple-areolar complex have been employed to reduce bacterial contamination of the implant and potentially biofilm formation [8]. Pocket irrigation with antibiotic solutions has proven beneficial in reducing the incidence of capsular contracture. Our current recommendation is the betadine-containing Adams' formula or 50% betadine alone. Leukotriene receptor antagonists which are used to treat asthma, such as zafirlukast (Accolate) and montelukast (Singulair), have shown some benefit in reversing the clinical signs of capsular contracture, but should be used with caution due to potential side effects [72, 73]. Treatment includes capsulotomies or capsulectomies (partial or total), with implant exchange and pocket exchange if possible. Recurrent capsular contractures can be more problematic to treat, but the use of an acellular dermal matrix, such as Alloderm or Strattice, has reduced the recurrence rate to 1–4% [74, 75].

Implant malposition/rotation Implant malposition is the second most common complication in most studies, and is rather a broad category, encompassing a wide range of complications. Most malpositions are preventable. Medial and lateral malposition are most often the result of overdissection of the lateral pocket or overrelease of the pectoralis sternal attachments, respectively. Inferior malposition is often due to mismanagement of the inframammary fold during lowering, or use of implants larger than the lower pole can tolerate, leading to stretch deformities. Superior malposition is usually due to underdissection of the lower pole, inadequate dual plane if submuscular, inadequate lowering of the inframammary fold, or the development of a capsular contracture. Implant rotation is a complication only applicable to shaped devices, and refers to the implant orientation becoming altered in the breast pocket. Because of this possibility, all shaped devices are textured to help maintain spatial orientation in the pocket. Creation of a controlled implant pocket that fits the implant accurately (hand-in-glove) is critical to minimizing this risk. Treatment includes correcting the implant malposition, either through manipulation of the capsule with capsulorrhaphy or capsular flaps, or creation of a new pocket, such as the neosubpectoral pocket. The use of acellular dermal matrices or mesh (such as Galaflex, Galatea Corporation) has been very useful in reducing the incidence of recurrence of the malposition.

Wrinkling/rippling Adequate soft tissue coverage takes priority in determining implant pocket

location and minimizing the risk of wrinkling, rippling, visibility, and/or palpability of the implant. Placement of the implant in the submuscular or dual-plane pocket provides the greatest coverage. Placement of an implant above the muscle requires at least a 2 cm upper pole pinch thickness. Even with adequate coverage, soft tissue atrophy and lower pole thinning and stretching are possible. Wrinkling is more likely with inadequate or thin soft tissue coverage, saline implants, textured implants, and underfilled gel devices. Treatment of wrinkling may include implant exchange to the retropectoral position, implant exchange to appropriate device with less wrinkling (e.g., saline to silicone and texture surface to smooth surface), fat grafting, and/or placement of a soft tissue matrix.

Animation deformity Implant distortion on muscular contracture is a phenomenon unique to implants placed in the submuscular position. It can be very noticeable, and especially bothersome for patients who exercise or lift weights frequently. In one study, although mostly mild, 15% of patient were noted to have moderate or severe distortion on animation [76]. Placement of the implant in the subglandular or subpectoral pocket is preventative, and may be a preferable pocket for those patients at risk, but must be weighed against the benefits of subpectoral placement. If a severe animation deformity is present, correction may include conversion to preferably a subglandular/subfascial pocket or to a dual plane with or without acellular dermal matrix in patients who are not candidates for subglandular placement.

Breast implant associated-anaplastic large cell lymphoma Over the past few years, there have been increasing awareness and questions raised concerning reported cases of BIA-ALCL in women with breast implants. Initial presentation has included the development of a late periprosthetic fluid collection, a mass attached to the capsule, tumor erosion through the skin, lymph node involvement, or discovered during a revisional procedure. These have been associated with saline and silicone implants. In the cases of ALCL where the patient's full implant history is known, most, if not all, are associated with having at least one textured implant in place as part of their history, the majority of these being of the "salt-loss" type of texturing. The Biocell textured implants (Allergan, Irvine, CA) were recalled globally in 2019. Whereas smooth implants have generally not been associated with BIA-ALCL, there is some early evidence that texture may be merely a passive potentiator and the real culprit may be a chronic immune response to a certain variety of bacteria [51]

In any patient presenting with a late seroma 1 year or greater after implant surgery, evaluation should include image-guided fluid aspiration and appropriate fluid evaluation for culture, cell count, and cytology [77]. All late seromas or capsular contractures associated with a mass should be evaluated, and BIA-ALCL should be considered and ruled out. Even if idiopathic, and not associated with infection or neoplastic process, surgical intervention is usually indicated and includes total capsulectomy with or without implant exchange. Appropriate staging is mandatory and dictates adjuvant treatment, including possibly chemotherapy and/or radiation therapy.

Mastopexy

Early complications Early complications are infrequent with mastopexy procedures. The most concerning complication is ischemia to the nipple-areolar complex or skin flaps. Ischemia may be due to the dissection of the pedicle, but often is secondary to excessive tension on the skin closure and underlying volume under the skin flaps. If recognized during surgery, all sutures should be removed to look for improved circulation, improved color, capillary refill, and pinprick bleeding. It is important to assure that the pedicle is free of tension and not twisted or compromised. Topical nitroglycerin or DMSO can be used to improve venous outflow. If the closure is too tight due to volume present under the flaps, consideration should be made to resect more volume in an attempt to reduce the closure tension. If any doubt exists, the NAC can be left

unattached and closed the following day in the clinic. Although conversion to a free nipple graft could be done if inadequate pedicle flow through all of the above-mentioned efforts, this is by far more common in a breast reduction, and should be extremely rare in a mastopexy procedure.

An occasional patient may develop a hematoma, usually within the first 24 hours, but a late hematoma at days 10–14 is also occasionally encountered, as activity level increases and the clots present on the ends of the cauterized vessels begin to dissolve. A very small hematoma can be allowed to resolve on its own, but any substantial hematoma should be explored, evacuated of blood, and drained. Small amounts of blood within the pocket in a mastopexy without a breast implant are generally less concerning, as there is not potential for capsular contracture. Seromas are generally managed conservatively with serial aspiration until resolved.

Delayed aesthetic issues Late sequalae include poor scarring, recurrent ptosis, bottoming out, asymmetry, contour deformities, fat necrosis, and loss of upper pole volume. These may require revisional procedures to improve the final aesthetic outcome. Most procedures are delayed at least 6 months or longer to allow for soft tissue remodeling and stabilization of the results. Scars are often the product of excessive tension on the closure and postoperative swelling, and can often be improved with scar revisions when the environment for scar maturation is more optimal. Lower pole stretch deformities and recurrent ptosis are managed with a revision of the mastopexy, with or without the addition of some additional support from a mesh or acellular dermal matrix. Fat necrosis is often simply monitored if it is small and not deforming the shape of the breast. If the area of fat necrosis impairs the shape or softness of the breast, or is interfering with cancer surveillance, excision of the involved area is appropriate.

Loss of upper pole volume is the most common late finding after a mastopexy, whether inferior pedicle or superior pedicle. Loss of the upper pole can be secondary to relaxation and loss of lower pole support, or simply due to the lack of stable, firm volume in the breast envelope. A breast augmentation is the most reliable procedure to provide stable upper pole volume and cleavage. Surgeons often will stage their procedure, performing a mastopexy as the initial procedure, followed by a breast augmentation 6 months or more postoperatively. Fat grafting can also be performed to improve volume in the upper pole and cleavage, but does little to improve breast projection and is less reliable than a breast implant.

Conclusion

With proper preoperative evaluation and employing accurate surgical techniques, excellent results can be achieved through breast augmentations, a superior- or inferior-based inverted-T mastopexy, or an augmentation mastopexy. The breast augmentation should follow a process that selects an implant and approach that optimizes results and adheres to tissue-based planning and the limitations imposed by the breast footprint and envelope preoperatively. As it relates to mastopexies, it is the authors' opinion that too much focus has been placed on avoidance of the inframammary scar in mastopexy procedures. This has often led to excessive vertical lengths in the lower pole and bottoming out of the breasts postoperatively. Whereas minimizing or eliminating the inframammary scar can be quite effective in the most experienced hands in appropriately selected patients, the inverted-T mastopexy can be mastered by most surgeons and leaves a postoperative appearance at the end of the procedure that most accurately predicts the final results of the mastopexy. The significant advantage of the superior pedicle technique in the appropriately selected patient is not the elimination of an inframammary scar, but rather the parenchymal shaping and lower breast pole unloading (either through resection or autoaugmentation) that is possible with this technique. The inferior pedicle technique is easy to master and quite versatile, but is generally reserved for those patients where superior or superomedial pedicle technique

is not as feasible, including the need for significant nipple-areolar complex elevation or potential loss of the superior pedicle blood flow from previous procedures such as a biopsy or mastopexy. When performing an augmentation mastopexy, the risks are greater to the viability of the tissues. The impact of the breast implant on the circulation of the NAC and skin flaps can be significant, and the decisions intraoperatively should be directed at minimizing these risks. Whereas short-scar mastopexies can be an excellent option in mastopexies, the expansion effect of the implant often mandates removal of excess skin to prevent long-term bottoming out and lower pole stretch deformities.

Disclosure Dr. Calobrace has been a speaker and consultant for Mentor, Allergan, and Sientra. He also holds a position on the Sientra Medical Advisory Board. He has no financial disclosures. Dr. Mays is a speaker and consultant for Sientra and Galatea and has no financial disclosures.

References

1. Spears SL, Murphy DK, Slicton A, Walker PS. Inamed silicone breast implant core study results at 6 years. Plast Reconstr Surg. 2007;120:8S–16S.
2. Cunningham B, McCue J. Safety and effectiveness of Mentor's MemoryGel implants at 6 years. Aesthet Plast Surg. 2009;33:440–4.
3. Araco A, Caruso R, Araco F, Overton J, Gravante G. Capsular contracture: a systematic review. Plast Reconstr Surg. 2009;124:1808–19.
4. Virden CP, Dobbke MK, Stein P, Parsons CL, Frank DH. Subclinical infection of the silicone breast implant surface as a possible casue of capsular contracture. Aesthet Plast Surg. 1992;16:173–9.
5. Pajkos A, Deva AK, Vickery K, Cope C, Chang L, Cossart YE. Detection of subclinical infection in significant breast implant capsules. Plast Reconstr Surg. 2003;111:1605–11.
6. Rieger UM, Mesina J, Kalbermatten DF, Haug M, Frey HP, Pico R, et al. Bacterial biofilms and capsular contracuture in patients with breast implants. Br J Surg. 2013;100:768–74.
7. Mladick RA. "No-touch" submuscular saline breast augmentation technique. Aesthetic Plast Surg. 1993;17:183–92.
8. Wixtrom RN, Stutman RL, Burke RM, Mahoney AK, Codner MA. Risk of breast implant bacterial contamination from endogenous breast flora, prevention with nipple shields, and implications for biofilm formation. Aesthet Surg J. 2012;32:956–63.
9. Moyer HR, Ghazi B, Saunders N, Losken A. Contamination in smooth gel breast implant placement: testing a funnel versus digital insertion technique in a cadaver model. Aesthet Surg J. 2012;32(2):194–9.
10. Adams WP, Rios JL, Smith S. Enhancing patient outcomes in aesthetic and reconstructive breast surgery using triple antibiotic breast irrigation: six-year prospective clinical study. Plast Reconstr Surg. 2006;118(Suppl 7):46S–52S.
11. Stevens WG, Nahabedian MY, Calobrace MB, Harrington JL, Capizzi PJ, et al. Risk factor analysis for capsular contracture: a 5-year Sientra study analysis using round, smooth and textured implants for breast augmentation. Plast Reconstr Surg. 2013;132(5):1115–23.
12. Schaub TA, Ahmad J, Rohrich RJ. Capsular contracture with breast implants in the cosmetic patient: saline versus silicone. A systematic review of the literature. Plast Reconstr Surg. 2010;126:2140–9.
13. Namnoum JD, Largent J, Kaplan HM, Oefelein MG, Brown MH. Primary breast augmentation clinical trial outcomes stratified by surgical incision, anatomical placement and implant device type. J Plast Reconstr Aesthet Surg. 2013;66(9):1165–72.
14. Barnsley GP, Siigurdson LJ, Barnsley SE. Textured surface breast implants in the prevention of capsular contracture among breast augmentation patients: a meta-analysis of randomized controlled trials. Plast Reconstr Surg. 2006;117:2182–90.
15. Hakelius L, Ohlsen L. Tendency to capsule contracture around smooth and textured gel-filled silicone mammary implants: a 5-year follow-up. Plast Reconstr Surg. 1997;100:1566–9.
16. Burkhardt B, Eades E. The effect of biocell texturizing and povidione-iodine irrigation on capsule contracture around saline-inflatable breast implants. Plast Reconstr Surg. 1995;96:1317–25.
17. Coleman DJ, Foo IT, Sharpe DT. Textured or smooth implants for breast augmentation? A prospective controlled trial. Br J Plast Surg. 1991;44:444–8.
18. Malata CM, Felderg L, Coleman DJ, Foo IT, Sharpe DT. Textured or smooth implants for breast augmentation? Three year follow-up of a prospective randomized controlled trial. Br J Plast Surg. 1997;50:99–105.
19. Weiner RC. Relationship of incision choice to capsular contracture. Aesthet Plast Surg. 2008;32:303–6.
20. Hammond DC, Migliori MM, Caplin DA, Garcia ME, Phillips CA. Mentor Contour Profile Gel implants: clinical outcomes at 6 years. Plast Reconstr Surg. 2012;129:1381–91.
21. Maxwell GP, Van Natta BW, Murphy DK, Slicton A, Bengtson BP. Natrelle style 410 form-stable silicone breast implants: core study results at 6 years. Aesthet Surg J. 2012;32:709–17.
22. Jewell ML, Jewell JL. A comparison of outcomes involving highly cohesive, form-stable breast implants from two manufacturers in patients undergoing primary breast augmentation. Aesthet Surg J. 2010;30:51–65.

23. Caplin DA. Indications for the use of MemoryShape breast implants in aesthetic and reconstructive breast surgery: long-term clinical outcomes of shaped versus round silicone breast implants. Plast Reconstr Surg. 2014;134(3S):27S–37S.
24. Muntan CD, Sundine MJ, Rink RD, Acland RD. Inframammary fold: a histological reappraisal. Plast Reconstr Surg. 2000;105:549–56.
25. Teitelbaum S. The inframammary approach to breast augmentation. Clin Plast Surg. 2009;36:33–43.
26. Tebbetss JB, Adams WP. Five critical decisions in breast augmentation using five measurements in 5 minutes: the high five decision support process. Plast Reconstr Surg. 2005;116:2005–16.
27. Adams WP. The process of breast augmentation: four sequential steps for optimizing outcomes for patients. Plast Reconstr Surg. 2008;122:1892–900.
28. Tebbetts JB, Teitelbaum S. High- and extra-high-projection breast implants: potential consequences for patients. Plast Reconstr Surg. 2010;126:2150–9.
29. Calobrace MB, Kaufman DL, Gordon AE, Reid DL. Evolving practices in augmentation operative tehniques with Sientra HSC round implants. Plast Reconstr Surg. 2014;134(Suppl 1):57S–67S.
30. Hammond DC. Technique and results using MemoryShape implants in aesthetic and reconstructive breast surgery. Plast Reconstr Surg. 2014;134(Suppl 3):16S–26S.
31. Schwartz MR. Algorithm and techniques for using Sientra's silicone gel shaped implants in primary and revision breast augmentation. Plast Reconstr Surg. 2014;134(Suppl 1):18S–27S.
32. Strasser EJ. Results of subglandular versus subpectoral augmentation over time: one surgeon's observations. Aesthet Surg J. 2006;26:45–50.
33. Goes JCS, Landecker A. Optimizing outcomes in breast augmentation: seven years of experience with the subfascial plane. Aesthetic Plast Surg. 2003;27:178–84.
34. Serra-Renom J, Garrido MF, Yoon T. Augmentation mammoplasty with anatomic soft, cohesive silicone implant using the transaxillary approach at a subfascial level with endoscopic assistance. Plast Reconstr Surg. 2005;116:640–5.
35. Graf R, Pace DT, Damasio RC, Rippel LR, Araugo LG, Neto T, et al. Subfascial breast augmentation. In: Innovations in plastic and aesthetic surgery. New York: Springer; 2008. p. 406–13.
36. Tebbetts JB. Dual plane breast augmentation: optimizing implant-soft-tissue relationships in a wide range of breast types. Plast Reconstr Surg. 2001;107:1255–72.
37. Maxwell GP, Gabriel A. The evolution of breast implants. Plast Reconstr Surg. 2014;134(Suppl 1):12S–7S.
38. Maxwell GP, Gabriel A. The evolution of breast implants. Clin Plast Surg. 2009;36:1–13.
39. Schusterman MA. Lowering the inframammary fold. Aesthet Surg J. 2004;24:482–5.
40. Binelli L. A new periareolar mammoplasty: the "round block" technique. Aesthetic Plast Surg. 1990;14:93–100.
41. Lejour M. Vertical mammoplasty for breast reduction and mastopexy. In: Spear SL, editor. Surgery of the breast: principles and art. Philadelphia: Lippincott-Raven; 1998. p. 73.
42. Hall-Findlay EJ. Pedicles in vertical breast reduction and mastopexy. Clin Plast Surg. 2002;29:379–91.
43. Wise RJ. Treatment of breast hypertrophy. Clin Plast Surg. 1976;3:289–300.
44. Marchac D, Olarte G. Reduction mammoplasty and correction of ptosis with a short inframammary scar. Plast Reconstr Surg. 1982;69:45–55.
45. Regnault P. Breast ptosis. Definition and treatment. Clin Plast Surg. 1976;3:193–203.
46. Hall-Findlay EJ. Applied anatomy: key concepts for modern breast surgery. In: Hall-Findlay EJ, editor. Aesthetic breast surgery: concepts and techniques. New York: Thieme; 2011.
47. Adams WP, Moses AC. Use of poly-4-hydroxybutyrate mesh to optimize soft-tissue support in mastopexy: a single-site study. Plast Reconstr Surg. 2017;139:67–75.
48. Hammond DC, O'Connor EA. The lower island flap transposition (LIFT) technique for control of the upper pole in circumvertical mastopexy. Plast Reconstr Surg. 2014;134:655–60.
49. Ribeiro L, Accorsi A, Buss A, Marcal-Pessoa M. Creation and evolution of 30 years of the inferior pedicle in reduction mammaplasties. Plast Reconstr Surg. 2002;110:960–70.
50. Hoffman S. Some thoughts on augmentation/mastopexy and medical malpractice. Plast Reconstr Surg. 2004;113:1892–3.
51. Nahai F, Fisher J, Maxwell GP, Mills DC II. Augmentation mastopexy: to stage or not. Aesthet Surg J. 2007;27:297–305.
52. Spears SL. Augmentation mastopexy: "surgeon beware". Plast Reconstr Surg. 2003;112:905–6.
53. Stevens WG, Macias LH, Spring M, Stoker DA, Chacón CO, Eberlin SA. One-stage augmentation mastopexy: a review of 1192 simultaneous augmentation and mastopexy procedures in 615 consecutive cases. Aesthet Surg J. 2014;34:723–32.
54. Calobrace MB, Herdt DR, Cothron KJ. Simultaneous augmentation/mastopexy: a retrospective 5-year review of 332 consecutive cases. Plast Reconstr Surg. 2013;131:145–56.
55. Tessone A, Millet E, Weissman O, et al. Evading a surgical pitfall: mastopexy-augmentation made simple. Aesthet Plast Surg. 2011;35:1073–8.
56. Lee MR, Unger JG, Adams WP. The tissue-based triad: a process approach to augmentation mastopexy. Plast Reconstr Surg. 2014;134:215–25.
57. Persoff MM. Mastopexy with expansion-augmentation. Aesthet Surg J. 2003;23:34–9.
58. Spring MA, Macias LH, Nadeau M, Stevens WG. Secondary augmentation-mastopexy: indica-

tions, preferred practices, and the treatment of complications. Aesthet Surg J. 2014;34(7):1018–40.
59. Williams C, Aston S, Rees TD. The effect of hematoma on the thickness of pseudosheaths around silicone implants. Plast Reconstr Surg. 1975;56(2):194–8.
60. Hvilsom GB, Hölmich LR, Henriksen TF, Lipworth L, JK ML, Friis S. Local complications after cosmetic breast augmentation: results from the Danish Registry for plastic surgery of the breast. Plast Reconstr Surg. 2009;124:919–25.
61. Codner MA, Mejia JD, Locke MB, Mahoney A, Thiels C, Nahai FR, et al. A 15-year experience with primary breast augmentation. Plast Reconstr Surg. 2011;127:1300–10.
62. Ransjo U, Asplund O, Gylbert L, Jurell G. Bacteria in the female breast. Scand J Plast Reconstr Surg. 1985;19:87.
63. Spears SL, Howard MA, Boehmler JH, Ducic I, Low M, Abbruzzesse MR. The infected or exposed breast implant: management and treatment strategies. Plast Reconstr Surg. 2004;113:1634–44.
64. Spears SL, Seruya M. Management of the infected or exposed breast prosthesis: a single surgeon's 15-year experience with 69 patients. Plast Reconstr Surg. 2010;125:1074–84.
65. Sforza M, Andjelkov K, Husein R, Zaccheddu R. Will 1-stage implant salavage after periporsthetic breast infection ever be routine? A 6-year successful experience. Aesthet Surg J. 2014;34:1172–8.
66. Mofid MM, Klatsky SA, Singh NK, Nahabedian MY. Nipple-areola complex sensitivity after primary breast augmentation: a comparison of periareolar and inframmary incision approaches. Plast Reconstr Surg. 2006;117:1694–8.
67. Okwueze MI, Spear ME, Zwyghuizen AM, Braün SA, Ajmal N, Nanney LB, et al. Effect of augmentation mammoplasty on breast sensation. Plast Reconstr Surg. 2006;117:73–83.
68. Wong C, Samuel M, Tan B, Song C. Capsular contracture in subglandular breast augmentation with textured versus smooth breast implants: a systematic review. Plast Reconstr Surg. 2006;118:1224–36.
69. Pollock H. Breast capsular contracture: a retrospective study of textured versus smooth silicone implants. Plast Reconstr Surg. 1993;91:123–30.
70. Spear SL, Baker JL Jr. Classification of capsular contracture after prosthetic breast reconstruction. Plast Reconstr Surg. 1995;96(5):1119–24.
71. Pfeiffer P, Jørgensen S, Kristiansen TB, Jørgensen A, Hölmich LR. Protective effect of topical antibiotics in breast augmentation. Plast Reconstr Surg. 2009;124(2):629–34.
72. Gryskiewicz JM. Investigation of accolate and singulair for treatment of capsular contracture yields safety concerns. Aesthet Surg J. 2003;23(2):98–101.
73. Riccioni G, Bucciarelli T, Mancini B, Di Ilio C, D'Orazio N. Antileukotriene drugs: clinical application, effectiveness and safety. Curr Med Chem. 2007;14(18):1966–77.
74. Wan DW, Rohrich RJ. Revisiting the management of capsular contracture in breast augmentation: a systematic review. Plast Reconstr Surg. 2016;137:826–41.
75. Maxwell GP, Gabriel A. Acellular dermal matrix for reoperative breast augmentation. Plast Reconstr Surg. 2014;134:932–8.
76. Spears SL, Schwartz J, Dayan JH, Clemens MW. Outcome assessment of breast distortion following submuscular breast augmentation. Aesthetic Plast Surg. 2009;33:44–8.
77. Collins MS, Miranda RN, Meideros LJ, Silva de Meneses MP, Iyer SP, Butler CE, et al. Characteristics and treatment of advanced breast implant–associated anaplastic large cell lymphoma. Plast Reconstr Surg. 2019;143:41S–50S.