

# MOC-PS<sup>SM</sup> CME Article: Breast Reduction

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**Learning Objectives:** After reading this article, the participant should be able to: 1. Understand and describe the anatomy of the breast as it relates to reduction mammoplasty. 2. Appropriately evaluate a patient considering reduction mammoplasty. 3. Be familiar with the different procedures available for reduction mammoplasty. 4. Describe the common early and late complications following reduction mammoplasty and their management.

**Summary:** The goal of this continuing medical education module is to present the preoperative assessment, formation of a surgical treatment plan and its execution, postoperative patient management, and identification and treatment of early and late postoperative complications in breast reduction surgery.

*The Maintenance of Certification module series is designed to help the clinician structure his or her study in specific areas appropriate to his or her clinical practice. This article is prepared to accompany practice-based assessment of preoperative assessment, anesthesia, surgical treatment plan, perioperative management, and outcomes. In this format, the clinician is invited to compare his or her methods of patient assessment and treatment, outcomes, and complications with authoritative, information-based references.*

*This information base is then used for self-assessment and benchmarking in parts II and IV of the Maintenance of Certification process of the American Board of Plastic Surgery. This article is not intended to be an exhaustive treatise on the subject. Rather, it is designed to serve as a reference point for further in-depth study by review of the reference articles presented. (Plast. Reconstr. Surg. 121: 1, 2008.)*

In 2006, there were 145,822 breast reductions performed in the United States, positioning breast reduction as the fifth most common plastic surgical procedure performed by plastic surgeons.<sup>1</sup> Breast reduction has one of the highest patient satisfaction rates among plastic surgery procedures, with 93 percent of women reporting they would undergo the surgery again.<sup>2</sup> Reduction mammoplasty has also been shown to improve body self-image.<sup>3</sup>

There are many procedures available to accomplish breast reduction, each with its unique combination of skin incision and resection patterns and approach to breast reshaping. The inferior pedicle Wise pattern reduction mammoplasty has long been the favored procedure in the United States.<sup>4</sup> Lassus and Lejour<sup>5,6</sup> were instrumental in popularizing the vertical pattern breast reduction in Europe, and this trend is now being adopted by North American surgeons as well.<sup>7-9</sup> The goal of this continuing medical education module is to present

the preoperative assessment, formation of a surgical treatment plan and its execution, postoperative patient management, and identification and treatment of early and late postoperative complications in breast reduction surgery.

## ANATOMY

In-depth knowledge of breast anatomy—in particular, the blood and nerve supply to the nipple-areola complex—is prerequisite to any type of

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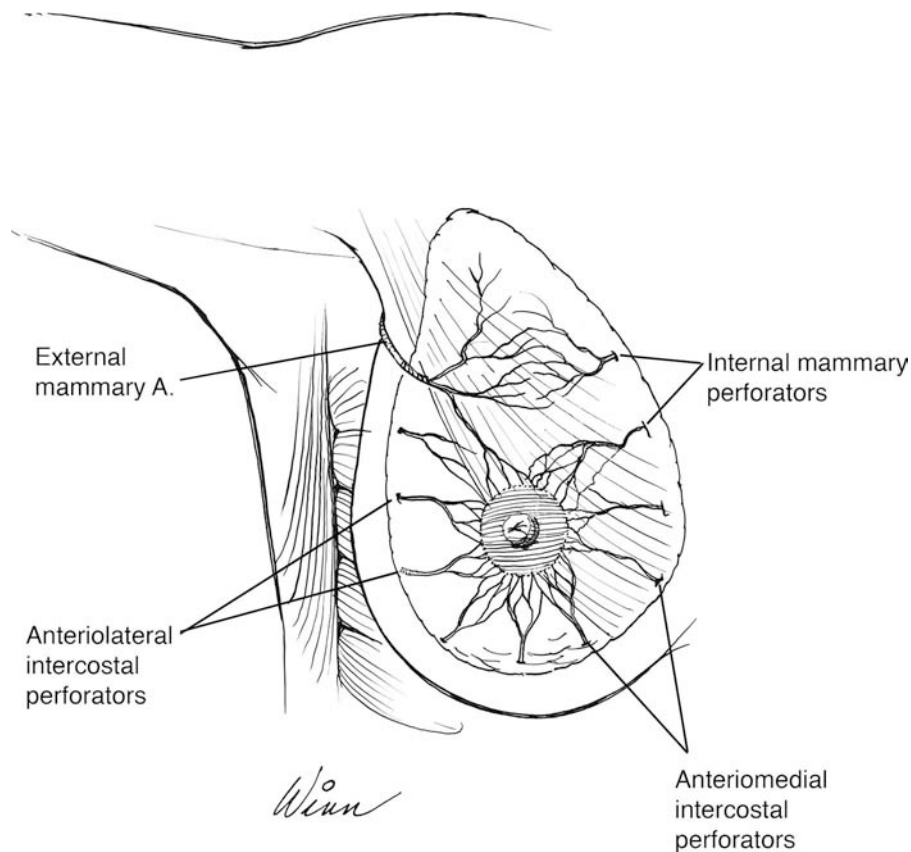
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The test for the MOC-PS–aligned CME article “Breast Reduction” by Nahai and Nahai is available at <http://www1.plasticsurgery.org/ebusiness4/OnlineCourse/CourseInfo.aspx?Id=12790>.



**Fig. 1.** The robust and radial blood supply to the nipple-areola complex is illustrated. Multiple perforators from the external mammary, anterolateral intercostal, anteromedial intercostal, and internal mammary arteries supplying the nipple-areola complex allow for multiple pedicle choices to maintain nipple-areola complex viability during breast reduction. It is important to widen the base of any pedicle the longer the distance the nipple is to be repositioned.

surgical procedure on the breast. Key sensory nerves are the lateral and medial cutaneous branches of the intercostal nerves T3, T4, and T5. The lateral branches exit the chest wall at the midaxillary line and progress medially along the pectoralis major fascia, with terminal sensory endings in the breast skin and the nipple-areola complex.<sup>10</sup> Branches from the lower cervical plexus supply sensation to the upper breast.

The blood supply to the breast is based on musculocutaneous perforators from the internal mammary, anterolateral intercostal and anteromedial intercostal, and fasciocutaneous perforators from the lateral mammary branches of the long thoracic artery. This network of vessels communicate with each other and branch and terminate at all four quadrants of the nipple-areola complex. In addition, the subdermal plexus is arranged in a radial pattern around the nipple-areola complex and provides for numerous pedicle options, including inferior, central, medial, supe-

rior, and lateral pedicles (Fig. 1). The viability of breast skin flaps is dependent on flap thickness, flap length-to-base width ratio, the presence of inflow vessels, and subdermal microcirculation. Factors such as smoking, radiation, and previous surgery can affect blood flow at these levels and result in breast flap necrosis. Cooper's suspensory ligaments are the connective tissue support structures within the breast. These ligaments originate from the pectoralis muscle fascia and course through the breast parenchyma to attach to the dermis of the overlying skin. These attachments can be stretched with pregnancy, weight gain, and aging, resulting in excess breast mobility and ptosis.

#### PREOPERATIVE PATIENT ASSESSMENT

In addition to the standard medical history and examination of pertinent systems, conditions that affect wound healing (such as smoking or diabetes) or bleeding times are of particular importance. Any history of easy bruising or extended

bleeding times should be noted and a workup initiated when appropriate. Patients seeking breast reduction are often overweight, so any history regarding the risk of deep venous thrombosis or cardiopulmonary disease should be known. Any history of prior treatment for back pain, neck pain, or inframammary intertrigo should be documented, as most insurance companies will require this assessment before approving breast reduction. Familial or personal history of breast masses, breast cancer, abnormal mammograms, or current use of hormones (birth control pills or hormone replacement therapy) should be noted. History of pregnancy and breast feeding and maximum breast size during pregnancy and current bra size are recorded. Subjective report of nipple sensibility is also documented.

The physical examination includes patient height, weight, and calculation of the body mass index [weight in kilograms  $\div$  (height in meters)<sup>2</sup>]. A breast examination should be performed to assess the breasts for symmetry, the presence of masses, any evidence of shoulder notching from the bra, intertrigo, and the degree of breast ptosis. The description and grading of breast ptosis has been reported previously.<sup>11</sup> A set of objective breast measurements should be taken with a minimum measurement of the sternal notch to nipple distance and nipple to inframammary fold distance. Other helpful measurements are nipple-areola complex width, breast width, and nipple-to-sternal midline distances. Some authors include measurement of breast circumference and width to estimate breast weight.<sup>12</sup>

### Deep Venous Thrombosis/Pulmonary Embolism Prophylaxis

Women with a body mass index greater than 30 undergoing breast reduction have a low but real risk of deep venous thrombosis/pulmonary embolism.<sup>13</sup> Operative times greater than 2 hours can increase this risk. Established effective precautionary practice includes the use of pneumatic compression devices with or without thromboembolic disease hose. A recent meta-analysis has demonstrated a 60 percent decrease in the incidence of deep venous thrombosis/pulmonary embolism with the use of pneumatic compression devices.<sup>14</sup> To be fully effective, these devices should be on the patient and functioning before the induction of general anesthesia. The use of chemoprophylaxis administered subcutaneously in the perioperative period for plastic surgery procedures is currently controversial. There are no randomized

clinical trials to evaluate the role of chemoprophylaxis in plastic surgery, and the risk of hematomas is unknown. Although the benefits and safety of chemoprophylaxis in general surgical and orthopedic procedures has been demonstrated, we cannot extrapolate the safety profile, in particular, the risk of hematoma, to plastic surgery procedures that involve a significant amount of undermining and raw surfaces. Current recommendations are that mechanical prophylaxis is used on any procedure lasting more than 1 hour and that chemoprophylaxis be used on major procedures such as abdominoplasty, thigh lift, belt lipectomy, transverse rectus abdominis myocutaneous flap reconstruction, surgical positions likely to contribute to venous stasis and/or compression, combined procedures, and procedures lasting more than 4 hours.<sup>13,15</sup>

### Smoking and Breast Reduction

Fortunately, smoking rates in the United States have been on the decline, attributable in part to comprehensive tobacco control programs.<sup>16</sup> There is a direct link between smoking and delayed wound healing that represents a significant unfavorable shift in the risk-to-benefit ratio for breast reduction.<sup>17</sup> Many plastic surgeons insist that anyone who smokes more than the occasional cigarette must absolutely stop smoking at least 2 weeks before surgery. Patients can be referred to a smoking cessation program. A newer non-nicotine-containing medication, varenicline (Chantix; Pfizer, Inc., New York, N.Y.), has demonstrated some of the most effective smoking cessation rates among pharmacologic treatments.<sup>18,19</sup> If necessary, serum nicotine levels can be checked before the procedure.

### INFORMED CONSENT

Informed consent includes a discussion of the location of surgical scars, the possibility that these scars can widen or thicken and that they are permanent. Temporary and permanent changes in nipple sensation, difficulty with breast-feeding or lactation, postoperative breast asymmetries, delayed wound healing, skin necrosis, partial or total nipple loss, hematoma, and seroma should be discussed. In addition to sharing preoperative and postoperative photographs of good results, it is beneficial to share photographs demonstrating some of the possible long-term complications and less favorable outcomes. Preoperative breast asymmetry is brought to the patient's attention and the possibility of asymmetry postoperatively is discussed. A well-educated and well-informed patient

with realistic expectations is more likely to tolerate a complication or less than ideal result than one who is not informed and ill prepared for the possibility of a suboptimal outcome. As Goldwyn<sup>20</sup> said, the more the patient considers her reduction an aesthetic procedure, the less likely she is to be satisfied. The more she considers it a reconstructive procedure, the more likely she is to be satisfied. Breast reduction is a procedure covered by most insurance companies, provided that a minimum weight of tissue is removed. It can be challenging in some patients to estimate an accurate amount of tissue to be removed. These patients are informed of the possibility that their breast reduction may not meet certain insurance company criteria and thus the cost will not be covered.

### **Breast Reduction and Postoperative Lactation**

For women considering breast reduction that have yet to have children, the question of lactation following surgery should be addressed. Any significant resection of subareolar breast tissue will decrease the amount of breast tissue that is potentially milk producing. Several studies have demonstrated that approximately 70 percent of breast reduction patients can breast-feed but that only 30 percent do, similar to the rates in an unoperated population.<sup>21,22</sup> Although milk production may occur, lactation will be impossible following free nipple grafting.

### **Mammograms and Breast Cancer Surveillance**

Preoperative mammograms are obtained based on the recommendations made by the American Cancer Society. Women younger than 40 years with a family history of breast cancer or other risk factors and any woman older than 40 should have a mammogram before breast reduction to rule out the presence of abnormal findings. Women are informed that reduction mammoplasty will result in scarring and possible calcifications within the breast parenchyma that may be seen on future mammograms. For that reason, all women are advised to have a baseline mammogram 3 to 6 months after surgery that will serve as a baseline study with which to compare future studies.

The incidental finding of a cancer in breast reduction specimens is rare, less than 0.5 to 0.8 percent in large series.<sup>23,24</sup> A positive finding after surgery should be followed with a thorough workup, oncologic consultation, and treatment recommendations made based on findings. In the rare event that a suspicious mass is found during the breast reduction, an intraoperative frozen sec-

tion can be performed to establish a diagnosis. Confirmation of a benign diagnosis does not require further action and the procedure can be completed as planned. If an equivocal or malignant diagnosis is made, the entire mass can be resected and the biopsy site marked (with clips or staples), and once an appropriate stopping point is reached, the breast can be closed and the case terminated. A formal workup should then take place with proper staging and oncologic consultation. This management strategy leaves most options available and involves the patient in the decision process. In some cases where the resection specimen contains the entire malignancy; radiation treatment according to a breast conservation therapy protocol may be the only adjuvant therapy necessary.<sup>25,26</sup> Any formal oncologic procedure without proper staging, planning, and consent is not advised.

### **Choice of Location and Setting for Breast Reduction Surgery**

For the vast majority of patients, breast reductions are performed on an outpatient basis, either in a hospital, outpatient surgical center, or office-based surgicenter that has been accredited by the Association of Accrediting Ambulatory Surgical Facilities or state authorities. An office-based operating room that is not accredited is not the ideal setting and should be avoided. The patient's general health, body mass index, and American Society of Anesthesiologists classification are taken into account when making the decision on an inpatient or outpatient procedure.

## **PROCEDURE OPTIONS IN BREAST REDUCTION**

There are many surgical options for breast reduction. Often the choice of surgical procedure is based on patient morphology, including body mass index and degree of nipple displacement, and the surgeon's comfort level, training, and experience with certain procedures. Excellent results are produced with a variety of procedures; the key is to couple the patient's needs and goals with a suitable operation (Table 1). All procedures, except for liposuction only and reduction with free nipple graft, center on maintaining a vascular pedicle to the nipple-areola complex. There are four major steps in a reduction procedure: access incisions, parenchymal resection, breast shaping, and management of excess skin. Preinjection of the breast with epinephrine-containing solution should avoid the planned vascular

**Table 1. Choosing the Best Option for the Breast Reduction Approach\***

Breast Characteristic	Skin Excision Pattern and Final Scar				
	Periareolar	Vertical	Short Horizontal T, J, or L	Longer Horizontal T	Traditional Full Length Horizontal T
Size of reduction					
<500 g	+	+	+		
500–1000 g		+	+	+	
>1000 g		+	+	+	+
Skin elasticity					
Normal	+	+	+	+	+
Inelastic		+	+	+	+
Skin excess					
Minimal	+	+	+	+	+
Moderate		+	+	+	+
Massive				+	+
Parenchyma					
Firm and fibrous	+	+	+	+	+
Soft and fatty		+	+	+	+
Skin-parenchyma relationship					
Firmly adherent	+	+	+	+	+
Loosely adherent			+	+	+

\*General recommendations for choosing skin excision patterns in breast reduction are based on the characteristics of the breast. Taking into account the size of the reduction, skin elasticity, skin excess, quality of the parenchyma, and the skin-parenchyma relationship, the appropriate skin excision patterns are indicated. A given skin excision pattern can usually accommodate a number of parenchymal resection techniques.

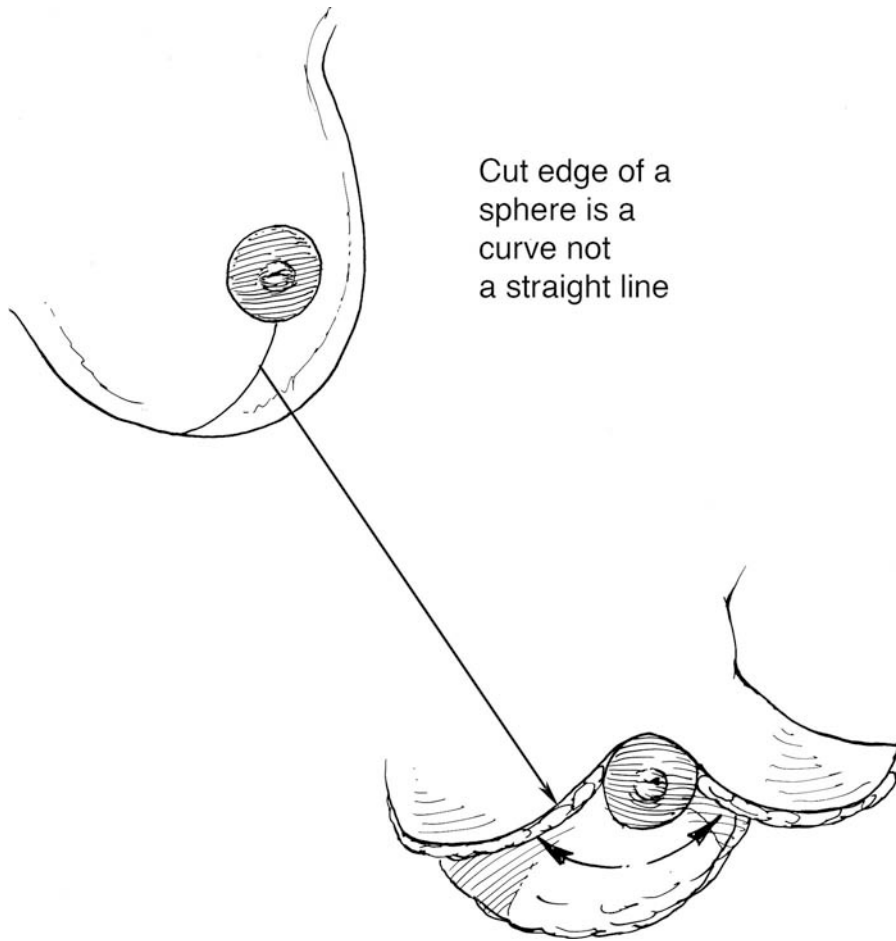
pedicle to the nipple-areola complex. The safety and efficacy of epinephrine use and tumescent solution infiltration in reduction mammoplasty has been reported.<sup>27</sup> These methods decrease blood loss and decrease operative times. Although there is a theoretical increased risk of postoperative bleeding, this has not been proven.

The most common access incisions are the Wise and vertical patterns. The Wise pattern skin incision affords the widest access to the breast parenchyma and can accommodate a variety of pedicles. Making curvilinear incisions along the vertical and horizontal limbs instead of straight lines results in a more rounded final breast shape. Thinking in three dimensions, the cut edge of a sphere is not a straight line but a gentle curve (Fig. 2). The vertical pattern skin incision affords adequate access to the breast parenchyma but to a lesser degree than the Wise incision. Multiple pedicle options are also possible. The circumareolar, Benelli type,<sup>28,29</sup> access incision is limited by concentric skin excision around the nipple-areola complex. It offers more limited access to the parenchyma and limited pedicle choice to the nipple-areola complex.

There are a variety of patterns of parenchymal resection, and most can be undertaken through the skin incisions described above. With any type of resection, preservation of the pedicle to the nipple-areola complex is the priority. Breast shape is three dimensional, and the resection pattern should take into account the preservation and

readjustment of this shape. Once the pedicle choice is made, the resection is undertaken with the final breast shape in mind. Typically, there is an incongruous amount of breast tissue laterally, which is usually addressed with direct resection and/or liposuction. Medial breast fullness is desirable, so tissue in this area is resected more conservatively, if at all. The same is true for upper breast fullness; tissue here is either preserved or, if resected, the breast reshaping fills the upper pole through transfer of new tissue to this area by means of reshaping technique.

The central mound technique<sup>30</sup> of breast shaping is perhaps one of the easiest to visualize and execute, as it essentially mimics the shape of a round breast implant. The inferior pedicle Wise pattern shapes the breast by transposing the pedicle cephalad and supporting it with medial and lateral breast flaps.<sup>31,32</sup> The superior pedicle and superomedial pedicle techniques preserve upper breast tissue and use the medial and lateral breast pillars for projection, pedicle support, and eventual lower breast shape.<sup>5</sup> In the case of breast amputation and free nipple grafting (where a vascular pedicle to the nipple-areola complex is not a concern), Wise pattern lateral and medial breast flaps are closed around superocentrally preserved breast tissue. Ways of improving long-term results have been described, including an inferior “breast mound” to preserve the rounded appearance of the lower pole of the breast.<sup>33,34</sup> Whichever method of parenchymal resection is used, it is



**Fig. 2.** The cut edge of a sphere is not a straight line but a curve. By taking this into consideration when planning vertical or horizontal skin incisions on the breast, a natural rounded final breast shape can be achieved as opposed to a boxy, linear, or unnatural contour.

important to remember that it is not what is removed but what is left behind that counts.

In the final stage, excess skin is addressed. With the Wise pattern resection, excess skin is typically resected with the breast parenchyma. Final tailoring usually involves resection of medial and lateral dog-ears along the horizontal inframammary fold incision. If possible, final skin tailoring is performed in curvilinear fashion to mimic the curve on the cut end of a spherical object (Fig. 2). This maintains a rounded appearance and avoids a boxy flattened breast, especially in the inferior pole. With the vertical pattern incision, once the medial and lateral pillars are brought together, the excess vertical skin is tailor tacked to flatten the breast on lateral view, much like the inverted image of a naturally appearing breast (Fig. 3). The excess skin at the base of the vertical component can be tailored for a purse-string closure, a mini-T closure, or a laterally ex-

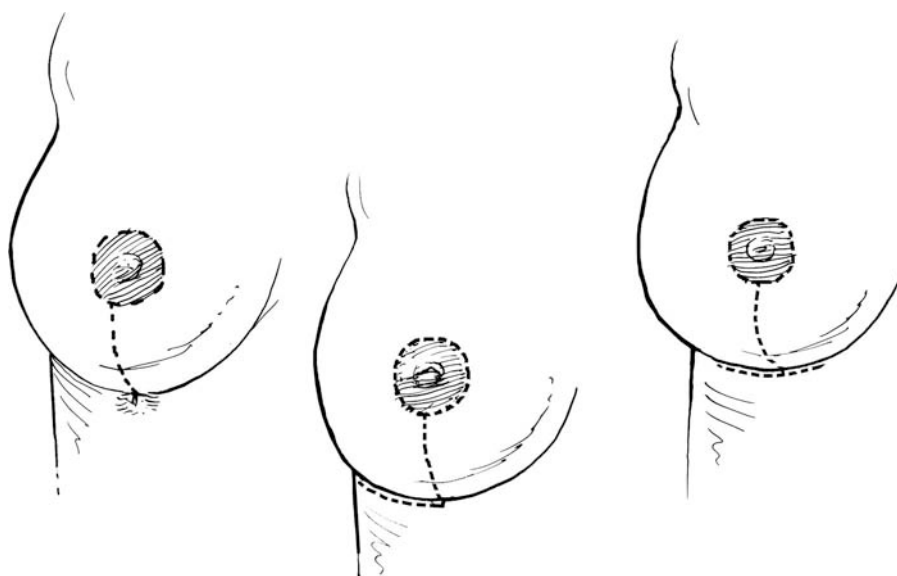
tended L or J closure (Fig. 4). The Benelli technique removes excess skin only in a concentric manner around the nipple-areola complex and relies on a purse-string closure to gather the wound edges around the nipple-areola complex. In larger resections, this can result in pleating, a starburst scar pattern, and flattening of the breast. The best results are achieved with a small resection. Another method of breast reduction is the “no vertical scar” technique originally described by Passot<sup>35</sup> and more recently reported on by Lalonde et al.<sup>36</sup> and Nagy et al.<sup>37</sup> Its proponents claim that the elimination of the vertical scar improves safety and aesthetic results.

#### Liposuction Alone

Liposuction-alone breast reduction is most effective in patients with mild volume excess, normal skin elasticity, and minimal ptosis. It is gen-



**Fig. 3.** The on-table goal of breast shape in a vertical pattern breast reduction is the inverted shape of a natural breast. The vertical limb is tailored to appear flat from the lateral view, mimicking the flatter upper pole slope of an unoperated breast. The flattened vertical limb rounds out and settles to a more natural appearance, usually within 1 month of surgery.



**Fig. 4.** Three common methods of closure at the base of the breast are illustrated. Choice of purse-string (*left*), J or L (*center*), or shortened T (*right*) is based on skin excess, skin-parenchyma relationship, skin elasticity, and surgeon preference (Table 1).

erally low impact and safe.<sup>38,39</sup> Liposuction alone is not a good choice in the young, more fibrous breast that has little fatty tissue.

### **Benelli Type Circumareolar Reduction**

This procedure accesses the breast parenchyma through a circumareolar incision. A central mound is preserved and surrounding breast tissue is removed. A donut skin excision is performed, and closure depends on a purse-string suture. This procedure is best for the mild to moderate reductions (approximately 200 g or less) with up to 3 cm of nipple-areola complex elevation needed. The circumareolar reduction has not gained wide acceptance in the United States because most reductions here are larger volumes. The purse-string closure can result in a flattened breast, pleating, and a starburst scar.

### **Wise Skin Pattern Reduction**

The Wise pattern skin excision and inferior dermoglandular pedicle represents the most popular breast reduction technique used by plastic surgeons in the United States.<sup>4</sup> This skin pattern excision is very versatile and can accommodate an inferiorly, superiorly, or centrally based dermoglandular pedicle. It is applicable to a wide range of reductions, has a relatively easy learning curve, achieves predictable results, and has one of the safest and most reliable vascular pedicles to the nipple-areola complex, with a good record of maintaining nipple sensibility.<sup>40,41</sup> Some of the disadvantages of this procedure are the lengthy scars, the need for significant flap undermining, and the risk of bottoming-out and pseudoptosis of the breast over time. A reliance on the skin to shape the breast rather than breast shaping through parenchymal sutures can result in flat, boxy, non-projecting breasts.

### **Vertical Reduction**

The vertical pattern breast reduction has been slowly gaining popularity in the United States. It has a circumareolar scar and a scar vertically down to the inframammary fold. It is particularly effective at preserving breast projection and shape. A vertical skin pattern may be combined with superior, medial, lateral, or inferior pedicles. This technique is effective for a wide range of reductions, reaching its limits as the inframammary fold to nipple-areola complex distance increases beyond 15 to 18 cm. In these patients, the redundant skin at the inframammary fold is less likely to be adequately managed with a purse-string suture alone,

so a small T, L, or J excision of skin may be needed. This technique does have a long learning curve and does require some time postoperatively for tissue settling until the final breast shape is achieved.

### **Breast Amputation and Free Nipple Graft**

For extremely large (>2000 g) reductions and very ptotic breasts with very long nipple to notch distances, a reliable pedicle to the nipple-areola complex cannot always be preserved. In these patients, an amputation is performed based on the Wise skin pattern and the nipple is preserved and repositioned as a free graft on a deepithelialized bed. This is a safe and effective procedure for extremely large breasts and a less risky option for smokers. The nipple often undergoes desquamation in the course of healing, leading to partial pigment loss and loss of nipple projection. Pigment loss is more distressing and harder to manage in patients with black skin.

### **Preoperative Markings**

Markings should be made with the patient standing or sitting upright with the shoulders relaxed and slightly rolled back and face looking forward. There are many descriptions of particular marking techniques in breast reduction. Whatever the technique, there are several key principles common to all. Sternal midline and breast midlines are marked. The key marking that all other markings depend on is the new location of the nipple-areola complex. There are many methods and anatomical landmarks by which the new position of the nipple-areola complex can be based such as the anterior projection of the inframammary fold. Markings made with the breast weight partially supported (breast supported with the nonmarking hand) can aid in avoiding positioning the nipple-areola complex too high and keeping the horizontal incision within the inframammary fold. For the vertical technique, the nipple should be marked 1 to 2 cm lower than these standard markings. It is advisable to not fixate on a single measurement when deciding on the new position of the nipple-areola complex but rather to take into account the collective anatomical findings. These might include the patient's height, new location of the nipple-areola complex relative to the humerus, and an imaginary line from the xiphoid to the anterior axillary fold, estimating the location of a low cut bra, shirt, or bathing suit line. Paying attention to these relationships avoids positioning the nipple-areola complex too high.

**Table 2. Guidelines for Skin Markings That Will Enhance Results\***

- Partially support the breast unweighted, mimicking breast weight after reduction, during the marking of the NAC and IMF (A and B). This will help keep these structures in their planned position after the reduction is complete and avoid poor NAC placement or poor IMF scar location.
- Marking the sternal midline and breast midlines will help ensure final symmetry and assist in demonstrating any asymmetries, especially the relationship of the NAC to the midline.
- Place additional ink, tattoo, or otherwise (e.g., superficial nick) at the marking that represents the junction of the vertical limb and NAC (C and C'). These points can become ambiguous during the course of the procedure. Enforcing this mark helps ensure a fixed neoaerolar circumference and a proper fit with the NAC during inset.
- Consideration should be given to making all vertical and horizontal markings on the breast with a slight curve (D), as the cut edge of a sphere is not a straight line but a curve. This will help reproduce some of the natural curve of the breast in the final result.
- Err on marking the NAC too low versus too high. A nipple that is low can more easily be raised at a second procedure than can a nipple that is too high be lowered.
- The orientation of the NAC can be marked with a cross-hair or otherwise (e.g., tattooed at the 12-, 3-, 6-, and 9-o'clock positions) before incision to help ensure proper inset without rotation or twisting.
- In the vertical reduction technique, keep the lower extent of the vertical markings greater than 2–4 cm above the native IMF. The IMF will rise during the procedure; therefore, the vertical scar will be kept above the IMF. Marking too close to the IMF and the scar is liable to end up below the IMF.
- In the Wise pattern skin resection, the vertical limb from the base of the NAC to the IMF should be somewhat shorter than desired in the final result (usually between 5 and 7 cm). This will take into account some of the bottoming-out that occurs during settling and avoid pseudoptosis.

NAC, nipple-areola complex; IMF, inframammary fold.

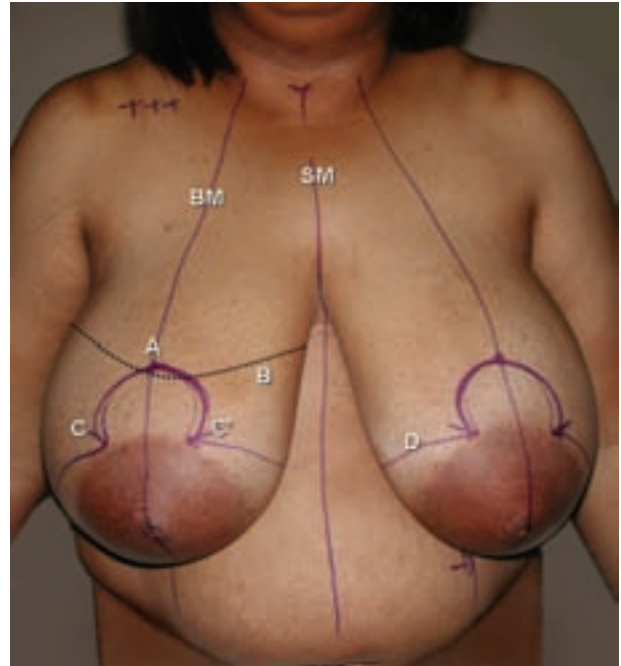
\*These are guidelines for making markings that will enhance results in breast reduction surgery (see Fig. 5).

The inframammary fold is marked, also with the breast supported to avoid placing this mark too low. If liposuction is to be performed as an adjunct, markings are made before surgery. Additional guidelines for markings that will enhance results are listed in Table 2 (see also corresponding Fig. 5).

## POSTOPERATIVE MANAGEMENT

### Immediate Phase

Breast incisions can be topped with adhesive tapes in the operating room. Liquid adhesives, such as benzoin or Mastisol (Ferndale Laborato-



**Fig. 5.** These markings correspond to the guidelines in Table 2. The breast should be supported unweighted during the marking of the nipple-areola complex and inframammary fold (A and B). This will help keep these structures in their planned position after the reduction is complete and avoid poor nipple-areola complex placement and poor inframammary fold scar location. Notice in the photograph that with the unweighted breast, marking the nipple-areola complex at the inframammary fold may result in a nipple-areola complex positioned too high. Additional ink, tattoo, or otherwise (e.g., superficial nick) should be placed at the marking that represents the junction of the vertical limb and nipple-areola complex (C and C'). This point can sometimes become ambiguous during the course of a procedure. Enforced markings here help ensure a fixed neoaerolar circumference and a proper fit with the nipple-areola complex during inset. Consideration should be given to making all vertical and horizontal markings on the breast with a slight curve (D), as the cut edge of a sphere is not a straight line but a curve. This will help reproduce some of the natural curve of the breast in the final result.

ries, Ferndale, Mich.), can prolong the adherence of tapes but may cause skin irritation and blistering. If drains are placed, they are typically removed on the first postoperative day, unless concomitant breast liposuction was performed, in which case the drains may be left in longer. Inpatients are monitored for nipple viability and hematoma by observing symmetry and firmness. All patients are given instructions to limit physical activity for 2 weeks or more. Activities of daily living are typically resumed on the first postoperative day. The first postoperative visit is at 1 week or earlier if needed. The tapes are exchanged and an exam-

ination confirms the state of the nipple, incisions, skin flaps, and overall breast symmetry.

### Long-Term Postoperative Care

Patients are given taping instructions for all incisions. In the absence of skin irritation, taping can be continued for 3 months to minimize scar appearance. A soft elastic nonwire support bra can be worn for the first 2 weeks and then weaned until the end of the fourth week, when the patient may wear their bra of choice. Follow-up should be arranged at 6 and 12 months to assess final breast shape, symmetry, and nipple-areola complex sensibility.

## MANAGEMENT OF COMPLICATIONS

Complications range from mild to severe and may be early or late. Total complication rates have been reported to range from 6 to 43 percent. The most common complication, independent of reduction technique, is delayed wound healing, which has been reported to be as low as 2.2<sup>42</sup> to 10 percent<sup>43</sup> to as high as 20 to 30 percent.<sup>44,45</sup> Proper patient selection and surgical planning will help decrease the chances of certain undesirable outcomes. Gentle handling of tissues, being mindful of the dermoglandular neurovascular pedicle, maintenance of breast flaps of adequate thickness, and closure without undue tension are also important. Despite all this, in the best of hands and in the optimal patient, complications will occur. Fortunately, many of the complications that occur with reduction mammoplasty can be resolved with favorable outcomes.

### Early Complications

#### Delayed Wound Healing

Delayed wound healing is the most common complication in reduction mammoplasty regardless of technique and is related to closure with undue tension, underlying pressure from a seroma or hematoma, flap necrosis and ischemia, infection, or background disease that delays wound healing (diabetes, poor nutrition, smoking, steroids).<sup>44-47</sup> Typical locations for wound dehiscence are the T-junction: the three-way intersection of the vertical and horizontal incisions, the purse-string closure of a vertical reduction, and the junction of the nipple-areola complex and vertical limb incision. Sometimes, delayed primary closure can be performed; however, these areas are often managed conservatively and left to close on their own once the underlying problem has been addressed.

### Poor Nipple Vascularity

Partial or total nipple necrosis can be a devastating complication. Early and frequent nipple monitoring with appropriate identification of a nipple with vascular compromise followed by appropriate action may avoid total nipple loss. Sometimes, the appearance of the nipple during inset is the initial sign that a problem may occur. A pale or bluish nipple with limited bleeding on the cut edge warrants very close postoperative observation. Poor or dark blue blood flow from a pin prick is also worrisome. Sometimes, the closure of all wounds, emergence from general anesthesia, patient rewarming, and a normal nonpharmacologic blood pressure will reverse the changes associated with poor vascularity to the nipple, and it will turn pink with normal capillary refill within the first hour after the end of general anesthesia. An objective assessment of the blood flow to the nipple is the fluorescein intravenous dye test and a Wood's lamp.<sup>46</sup> If there is an indication of compromised vascularity, an immediate free nipple graft should be performed. A free nipple is grafted to healthy deepithelialized vascularized dermis. Grafting onto fat or a poorly vascularized area will not work. If the nipple shows signs of ischemia in the early postoperative period despite normal blood pressure and core body temperature, immediate action is taken. Provided that undue pressure on the nipple pedicle from a hematoma is ruled out, the nipple should be released from its inset position, effectively relieving undue tension on the nipple pedicle. The nipple will generally retract 1 or 2 cm. If the nipple does not show immediate signs of improved blood flow, the patient should be taken back to the operating room for conversion to a free nipple graft onto a well-vascularized bed. For cases where partial or total nipple necrosis was not identified or apparent in the early postoperative period, conservative wound care until closure is achieved by primary healing is best. Nipple reconstruction is then undertaken at an appropriate time. Depigmentation can be treated with tattooing, but results vary. Total nipple loss will require reconstruction with skin grafts and/or local flaps.

#### Hematoma

Although not common, a hematoma may be hard to recognize until it is sizable. The presence of breast swelling, distensibility of the skin, and large areas of undermining can make a small hematoma hard to identify. Hematoma may occur within hours after surgery or up to 2 weeks postoperatively. Presentation of a hematoma can include unilateral pain, swelling beyond expectation with significant asymmetry, tight and discolored skin flaps, or excessive bloody output from a drain

or suture line. Hematomas should be drained at the time of diagnosis in the operating room, with adequate lighting and access to hemostatic devices. Often, a definitive bleeding point is not found, but it should be pursued. Fluid resuscitation and blood administration are prescribed as indicated. Late hematomas should be aspirated with a large-bore needle or surgically drained to avoid abscess formation and contour deformities.

#### **Skin Flap Necrosis**

Flap necrosis may be devastating and occurs when flaps are made too thin, the patient smokes (or is exposed to secondary smoke), or pressure necrosis occurs from dressings that are too tight or because of pressure from an underlying hematoma. As with the worrisome nipple, blood flow to suspect skin flaps can be measured objectively with intravenous fluorescein. If debridement and immediate direct closure without undo tension can be achieved, it is preferable. In more severe cases with large areas of tissue loss, conservative wound management with healing by secondary intention or early skin grafting is advised. Skin graft take on soft breast fat with poor circulation can be difficult to achieve. Hyperbaric oxygen therapy can accelerate healing but is costly.<sup>47</sup> A wound vacuum-assisted closure device may be considered in severe cases or in preparation for a skin graft.

#### **Deep Venous Thrombosis/Pulmonary Embolism**

The most worrisome and life-threatening complication is deep venous thrombosis and/or pulmonary embolism. In the event of difficulty breathing or poor oxygen saturation within the first several days after surgery, deep venous thrombosis/pulmonary embolism is the assumed diagnosis until proven otherwise. The most rapid and minimally invasive method of diagnosis is a contrast-enhanced computed tomographic scan of the chest.<sup>48</sup> If contrast is contraindicated or a computed tomographic scan is unavailable, a ventilation/perfusion lung scan can be performed. A Doppler ultrasound examination of the lower extremities can also be performed looking for evidence of thrombosis. Management of deep venous thrombosis/pulmonary embolism has been described previously.<sup>49</sup>

#### **Infections**

Cellulitis can occur and may present as local erythema, increased pain or drainage, and/or fever. It should be treated immediately with the appropriate antibiotics and followed closely. Passage of a needle into the breast can rule out seroma or diagnose an underlying abscess. Abscess is rare, but should it occur, it should be drained.

### **Late Complications**

#### **Seroma**

Untreated seromas can cause wound separation and delayed healing. If a seroma is suspected, it can be needle aspirated in the clinic. Often, multiple aspirations are required before the seroma resolves. Seromas recalcitrant to multiple aspirations can be excised directly and closed over drains with suturing to obliterate the dead space.

#### **Scars**

Scars can be a problem because of poor location or hypertrophy/keloid formation. Simple taping is a very effective means of avoiding scar hypertrophy.<sup>50</sup> Should hypertrophy or keloids occur, treatment should start at the earliest indication. When they do occur, the vertical limb is usually spared. Direct lesion injections with steroids alone or in combination with 5-fluorouracil have been shown to be effective.<sup>51</sup> Scars above or below the inframammary fold can be distressing to the patient. Effort should be made to minimize medial extension of incisions on the breast, as the scar can be seen with low-cut clothing. With vertical scar reduction, the inframammary fold is often raised as a result of the reduction; thus, the vertical incision marking should end within 2 to 4 cm above the inframammary fold or the scar may extend below the inframammary fold. With circumareolar procedures, as the reduction volume increases, so does the risk of permanent skin pleating and starburst scar formation. These can be treated with conversion to a vertical or Wise scar pattern reduction for extra skin removal and formation of a new circumareolar skin-to-nipple-areola complex relationship that will avoid pleats and starburst scars.

#### **Shape**

A problem shared by all breast reduction techniques is bottoming-out or pseudoptosis, defined as an excess amount of breast tissue extending below the inframammary fold with a normal nipple position. This is more often associated with the Wise pattern inferior pedicle reduction. Any effort to reshape a breast that has been previously reduced must take into account the pedicle to the nipple-areola complex and avoid its injury. Regardless of the access incisions, breast reshaping and skin tightening is used to recapture an acceptable breast shape. Small puckers, more common in vertical reductions, are excised directly, as are dog-ears that can occur with Wise pattern incisions.

#### **Nipple Position**

Abnormal nipple position is very unforgiving and can mar the appearance of otherwise well-shaped symmetric breasts. Any effort to reposition

a nipple must take into account the original pedicle to the nipple-areola complex and avoid vascular compromise. Minor nipple asymmetry can be managed with crescent skin removal from above the nipple. Nipples that need to be raised more than 1 cm must be released circumferentially and repositioned with the excess skin inferior retailed and incorporated into the vertical incision. Nipples that are too high are very problematic and difficult to manage. If there is concomitant bottoming-out of the breast, it is best to reshape the breast relative to the nipple. If the nipple is truly too high, it must be repositioned lower on the breast mound, leaving a scar above the nipple.

### Asymmetry

Minor asymmetry in shape or size is often acceptable to the patient, especially if the same asymmetric right-to-left relationship that was present preoperatively is maintained postoperatively. Significant size asymmetry can be managed with liposuction or further parenchymal resection.

### Fat Necrosis

Fat necrosis presents as a local area of firm or hard tissue. This is usually noted close to the breast surface, as it is more easily palpated there. Deeper areas of fat necrosis may be diagnosed only by radiography. Should fat necrosis occur, it should be needle aspirated to confirm the diagnosis and to rule out a neoplasm followed by excision or aspiration if symptomatic.

### Changes in Nipple Sensation

All patients are informed during the consent process that nipple sensation can permanently decrease, increase, or not change after reduction mammoplasty. Early changes in sensation are often temporary and should be managed expectantly until at least 6 months after surgery. Changes in nipple sensation have been documented up to 1 year after surgery. Multiple reports exist comparing techniques based on sensory outcomes. One demonstrated that no difference exists between medial and inferior dermoglandular pedicles and that resection weight was not a variable in sensory outcomes.<sup>52</sup> Another study did not find a difference between the techniques that preserved breast tissue at the base of the breast, but found that decreased sensation occurred with techniques that resected base of breast tissue.<sup>53</sup> No difference based on amount of breast tissue resected was found, confirming prior reports.

## CONCLUSIONS

With one of the highest satisfaction rates among plastic surgery procedures, breast reduction can be rewarding for both the patient and the

physician. A clear understanding of breast anatomy is a prerequisite to performing any of the many techniques available. Common and critical to all techniques is the preservation of the vascularity to the nipple-areola complex. Currently, the most frequently used method for breast reduction is the Wise pattern inferior pedicle technique, although the vertical reduction method is gaining in popularity. Excellent results can be achieved with many different types of procedures. Identification and proper early intervention of complications are important and integral to practicing safe and efficacious reduction mammoplasty.

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### CPT Codes Commonly used in Breast Reduction Surgery

Code	Descriptor
19318	Breast reduction, unilateral
19318-50	
<b>OR</b>	
19318	Breast reduction, bilateral
19318-50	

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