

Safe Reproducible Breast Reduction

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Summary: Breast reduction is a common operation performed by plastic surgeons. Patients can have significant improvement in physical symptoms in addition to increased self-esteem, body image, and quality of life as a result. The authors describe common techniques for breast reduction and provide representative photographs and videos of these techniques. An evidence-based review is provided for patient selection criteria, common surgical techniques, and methods to avoid and treat complications. Information is also provided on patient education about breast reduction. In most cases, breast reduction is safe to perform in the outpatient setting. The Wise pattern and vertical pattern are among the most common techniques for skin incisions, and the inferior and superomedial pedicles are two of the most common pedicles used in breast reduction. Enhanced Recovery After Surgery protocols are helpful to effectively control pain and reduce narcotic use postoperatively. Patient satisfaction after breast reduction surgery is typically high. Multiple techniques are available to successfully perform breast reduction. The plastic surgeon needs to select patients carefully and determine the appropriate technique to use. Patient education about the operation, recovery, expected result, and risks is an important component of achieving an optimal result. (*Plast Reconstr Surg Glob Open* 2023; 11:e5245; doi: [10.1097/GOX.0000000000005245](https://doi.org/10.1097/GOX.0000000000005245); Published online 22 September 2023.)

INTRODUCTION

Breast reduction is a common operation performed by plastic surgeons. Nearly 100,000 breast reduction operations were completed in the United States in 2020.¹ Breast reduction can be sought for medical necessity to address upper back pain, neck pain, and inframammary skin rashes; for improving the aesthetic contour of the breast; or for both medically necessary and aesthetic reasons. Patients can have long-lasting significant improvement in physical symptoms in addition to improved self-esteem, body image, and quality of life as a result of breast reduction surgery.²⁻⁵ The aim of this article is to provide the tools for performing breast reduction safely, by providing an evidence-based review of patient selection criteria for breast reduction, common surgical techniques, and methods to avoid and treat complications from this operation. Salient information is included to educate patients about breast reduction.

GOALS OF THE PROCEDURE

The ideal breast reduction outcome encompasses improvement in physical, psychological, and aesthetic

components. Functionally, patients should experience improvement in upper back and neck pain, improvement in upper body posture, and decreased inframammary rashes. Psychologically, patients should have an improvement in self-esteem and body image. Aesthetically, there should be an improvement in the shape and position of the breast on the chest wall, along with re-sizing and re-positioning of the nipple-areolar complex on the smaller breast mound.

Most patients can undergo breast reduction safely as an outpatient as evidenced by a recent study of 18,780 cases, which showed no difference in complication rates between patients who were discharged same-day compared with patients who were observed overnight or admitted to the hospital after breast reduction.⁶ Patients with significant comorbidities may require overnight stay for observation postoperatively. Patient satisfaction with this operation performed in the outpatient setting is high.⁷

Patients should be educated on the plan for postoperative pain control. Enhanced Recovery After Surgery protocols have been utilized effectively with resultant decrease in the use of narcotic pain medication intraoperatively and postoperatively.⁸⁻¹¹ Multimodal pain management includes preoperative dosing of nonnarcotic medications such as acetaminophen, gabapentin, and a non-steroidal anti-inflammatory drug (NSAID); use of local anesthetic during the operation (which may include the use of long-acting or

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liposomal local anesthetic); and use of oral nonnarcotic pain medications (acetaminophen, NSAIDs, gabapentin) coupled with a small amount of narcotic postoperatively.

DESCRIPTION OF MOST EFFECTIVE PROCEDURES

Reduction mammoplasty has two distinct components, which interface to produce a harmonious aesthetic and functional result. The first component is composed of the skin and subcutaneous tissue (“skin flaps”). The second component is a pedicle created from glandular tissue and includes the nipple–areolar complex. During the operation, attention is paid to shaping the skin flaps and pedicle to produce a “hand-in-glove” fit between the two elements, which eliminates dead space and creates an aesthetically pleasing breast shape.

The Wise pattern and vertical pattern techniques have been commonly adopted with use of inferior and superomedial pedicles. The incision pattern does not dictate the pedicle type. Examining a patient with a particular pattern from prior breast reduction does not permit even the most experienced plastic surgeon to ascertain which pedicle was used.

Pre-incision Markings

The patient is marked in the standing position. The patient is alerted to breast or chest wall asymmetry and queried about the goal bra cup size, which guides the surgeon to achieve the patient’s wishes and manage expectations. Patients are educated that bra band size does not alter with breast reduction, as bra band size is a measurement of the ribcage.

The chest midline is marked, using the sternal notch as a guide. The breast meridian is marked starting at the midclavicular line, continuing down the breast central axis onto the upper abdomen. The Pitanguy point is marked by transposing the inframammary fold position at the meridian onto the breast’s anterior surface.¹² This mark is performed with the surgeon’s eyes at breast level; otherwise, it may be marked too superiorly. This point is the new location of the nipple papule. A measuring tape is used to confirm symmetry from the sternal notch to the new nipple location, which ranges from 20 to 26 cm and may vary with patient torso length.¹³ The inframammary fold is marked from the medial aspect of the breast to the anterior axillary line or lateral aspect of the inframammary fold.

Wise Pattern

Dr. Robert Wise devised the skin resection known as the Wise pattern using silicone molds after a brassiere shape that resulted in inverted-T closure.¹⁴ These markings have been modified based on measured anatomic principles. The Pitanguy point is used as the apex to mark medial and lateral limbs (7–11 cm length each), which will become the vertical limb of the pattern when closed (triangulation technique).¹⁵ A longer limb will produce a larger breast. The angle of divergence between the medial and lateral limbs should not exceed 90 degrees, and using 70–80 degrees results in less closure tension. A goniometer can be used to measure this angle.¹⁶ If the Wise pattern can incorporate all

Takeaways

Question: What are methods for performing breast reduction safely with reproducible results?

Findings: Breast reduction is a commonly-performed operation with many safe techniques available. Two of the most common incision patterns are vertical and Wise pattern; two most oft-used pedicles are the superomedial and inferior pedicles. Plastic surgeons should counsel patients about the risk of complications and be comfortable treating complications should they arise. Most patients have a high level of satisfaction with the result.

Meanings: Plastic surgeons should be comfortable with various techniques of performing breast reduction. Expertise is required for proper patient selection, preoperative counseling about risks and benefits, and postoperative care, including complication treatment.

of the pigmented areolar skin, this is beneficial for the cosmetic outcome, but not required. If pigmented areolar skin is outside the Wise pattern marks, it can be excised under local anesthesia 6 months postoperatively. Curvilinear lines are drawn from the inferior ends of the medial and lateral limbs, starting with a right angle and then curving to meet the inframammary fold mark. If a McKissock stencil is used, it is placed 1–2 cm superior to the mark of the Pitanguy point. The outline of the stencil is traced with the medial and lateral vertical limb marks ranging from 5 to 7 cm in length, which are shorter to account for the nipple–areolar complex position drawn using the stencil.¹⁷ (See Video 1 [online], which shows the inferior pedicle Wise pattern preoperative marking, de-epithelialization, and flap dissection.)

Vertical Pattern

A mosque-shaped marking pattern is used to create a circumareolar scar with an inferior vertical extension.^{18–20} The Pitanguy point is used to determine future nipple position. This point will ascend superiorly 1–2 cm in the final result, therefore the final nipple point should be marked 1–2 cm lower. The inferior-most point of the mosque-shaped pattern is marked 2–4 cm above the inframammary fold on the breast meridian. The breast is manually displaced medially and laterally to draw the medial and lateral limb incisions, which meet at the inferior-most point at the meridian. A superior or superomedial pedicle is typically used with this pattern.

Dissection

Long-acting peripheral nerve blocks and local anesthetics have been shown to decrease intraoperative and postoperative narcotic use.^{8,21–23} Tumescence technique with epinephrine-containing solution can decrease intraoperative blood loss, but has not been shown to decrease hematoma incidence. Additionally operative time may increase as a result of the interface between the electrocautery tip and tumesced tissue.²⁴

Using an areola marker, the nipple–areolar complex is marked at a diameter of 38–46 mm. Scoring the new nipple–areolar complex diameter is performed under manual pressure from an assistant or after applying a

breast tourniquet. The incision marks are scored, incising to a partial-thickness dermal depth at the pedicle base. The pedicle is de-epithelialized sharply. If performing free nipple grafting, the nipple–areolar complex is removed full-thickness and kept on the back table wrapped in a damp sponge in separate sterile containers noting laterality. (See **Video 2 [online]**, which shows inferior pedicle Wise pattern tissue resection and breast shaping.)

Superomedial Pedicle

The superomedial pedicle, based on the second and third superficial branches of the internal mammary arteries,²⁵ is designed with a 6–8-cm base. Pedicle length-width ratio should be no greater than 2:1. The pedicle is de-epithelialized sharply. The incisions around the pedicle are deepened with electrocautery down to the chest wall without exposing pectoralis fascia. The lateral breast flap is defined with a 1- to 2-cm thickness, maintaining the dissection plane at the interface of subcutaneous and parenchymal tissues.¹⁵ At the incision apex, dissection is beveled superiorly and laterally, creating an inverted crescentic space for the pedicle to rotate in a tension-free manner. The bulk of the breast gland resection is performed inferiorly and laterally, with a small amount of medial resection to preserve medial breast fullness. If using a vertical scar incision, the glandular tissue resection is performed similarly and liposuction is often used adjunctively.^{18,20} (See **Video 3 [online]**, which shows superomedial pedicle Wise pattern breast reduction.)

Inferior Pedicle

The inferior pedicle, based on the deep branch of the fourth intercostal artery and fifth superficial branch of the internal mammary artery, is typically used with a Wise pattern. The pedicle is designed with an 8- to 10-cm base width¹⁵ and is de-epithelialized and defined by deepening the incisions down to chest wall, without exposing the pectoralis fascia. (Fig. 1) The superior breast flap is

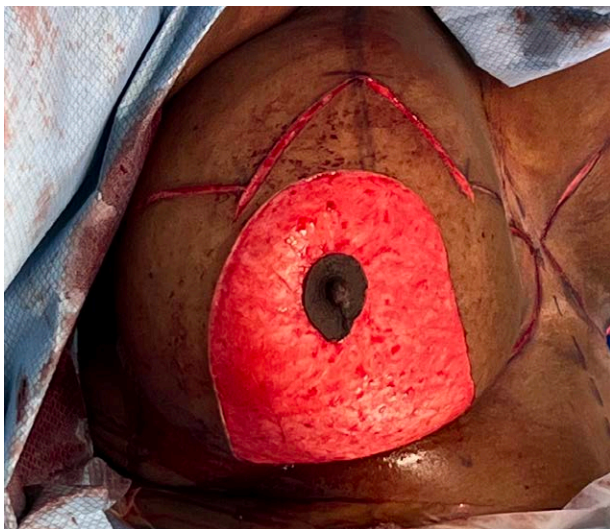


Fig. 1. Inferior pedicle de-epithelialized.

developed at a 1–2-cm thickness. The bulk of the breast glandular tissue is resected laterally, and a small amount medially. Glandular tissue may be resected superior to the pedicle depending on desired volume reduction. Surgeon preference varies in the order of dissecting the pedicle and the superior breast flap (Figs. 2 and 3; **Videos 1 and 2 [online]**).

Adjunctive Liposuction

Suction-assisted lipectomy can be used as an adjunct to parenchymal resection. This is useful in the vertical pattern skin resection, where the lateral breast border and axillary “bra roll” can be difficult to shape. Reports using superior, inferior, and lateral pedicles have been published, although theoretically this strategy can be used with any pedicle technique.^{26–29} Although there are reports of liposuction-only reduction mammoplasty,^{20–24} this technique has not been widely adopted.^{30–33}

Free Nipple Grafting

If there is concern about nipple perfusion, free nipple–areolar complex grafting can be performed.³⁴ After obtaining the nipple–areolar complex as a full-thickness graft, the chosen incision pattern is used to resect glandular tissue. The nipple–areolar complex is then replaced as a graft by de-epithelializing the recipient site. The graft is defatted and secured using nonabsorbable and/or absorbable fine sutures. A bolster dressing is placed to secure the graft for 5–7 days. Patients should be made aware that in free nipple grafting, sensation will be lost, and there may be alterations in pigmentation.

Closure

Preliminary Closure

Preliminary closure is performed by temporarily reapproximating the incisions with staples. The lateral skin flap is advanced along the inframammary fold to decrease tension on the T-junction, define the lateral breast border, and prevent a lateral standing cutaneous deformity. If the triangulation technique is used, the patient is sat up on the operating room table at 90 degrees, and a 38 or 42 mm areola marker is used to denote the final nipple position on the most projecting aspect of the breast. The nipple to inframammary fold distance as well as the sternal notch to nipple distance is measured for symmetry. For a vertical scar incision or with the use of a McKissock stencil, the junction between the nipple–areolar complex and the vertical limb are temporarily reapproximated with staples first, while displacing the nipple–areolar complex superiorly, followed by tailor tacking the remainder of the incisions. Symmetry of the breast size and contour and nipple–areolar complex position is checked, and areas of asymmetry are addressed. (See **Video 4 [online]**, which shows inferior pedicle Wise pattern nipple–areolar complex positioning and closure.)

Maturation of the Nipple–areolar Complex

For a Wise pattern incision, the areola marking may be excised full-thickness, or it may be de-epithelialized and then incised with a cruciate incision. The

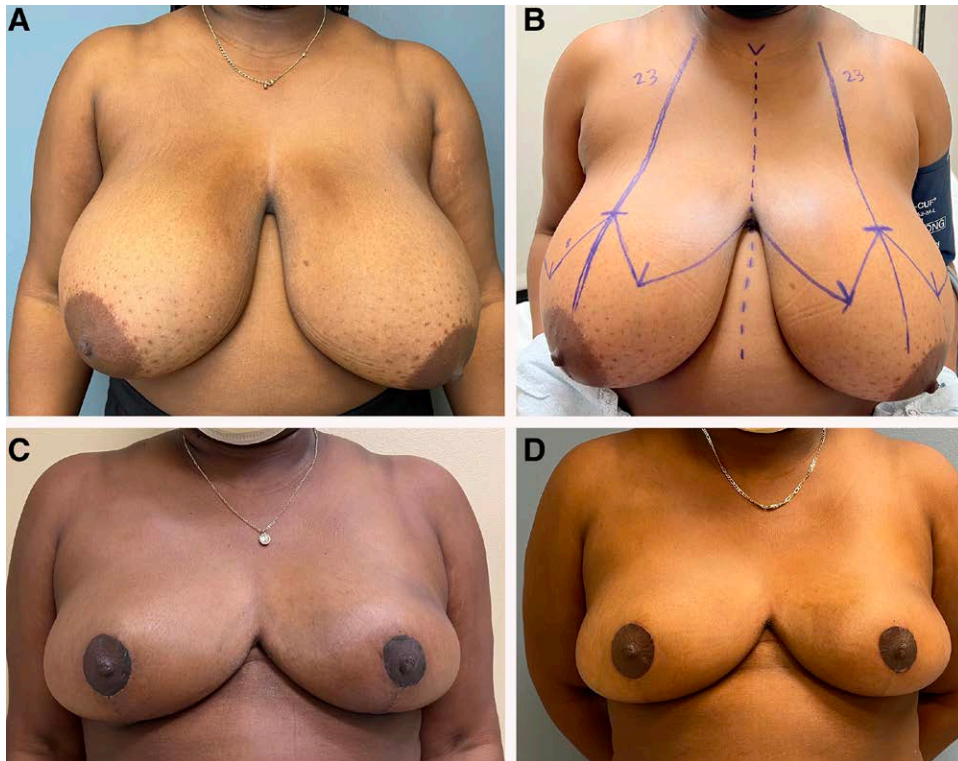


Fig. 2. Wise pattern inferior pedicle breast reduction. A, Preoperative. B, Wise pattern markings. C, Four weeks postoperative after bilateral inferior pedicle Wise pattern reduction (>1000g per side). D, Six months postoperative after bilateral inferior pedicle Wise pattern reduction.

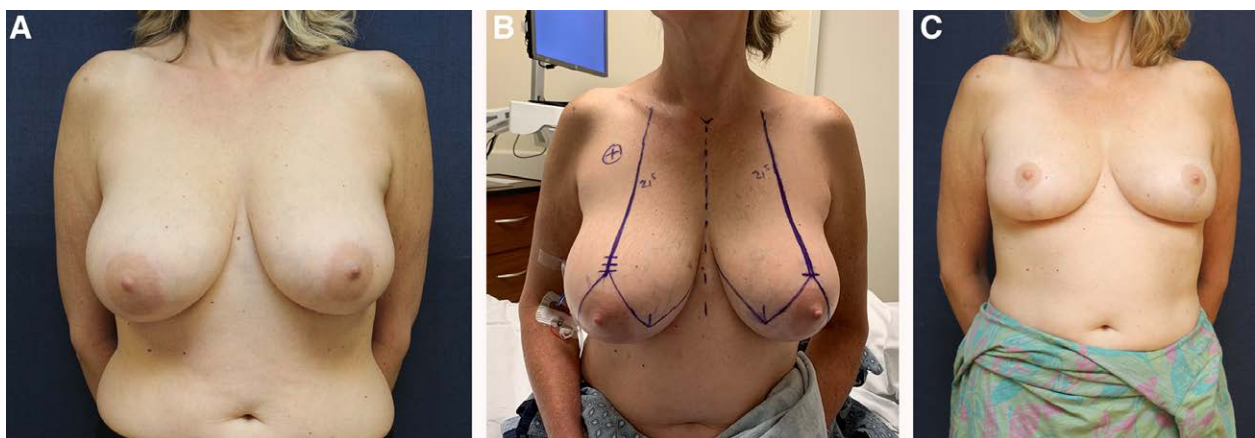


Fig. 3. Wise pattern inferior pedicle breast reduction. A, Preoperative. B, Wise pattern markings. C, One year postoperative after bilateral inferior pedicle Wise pattern reduction.

nipple–areolar complex is then delivered through the incision, checking the pedicle to ensure no kinking, undue folding, or twisting has occurred. For a superomedial pedicle, the medial aspect of the areola marking contains a portion of the pedicle, and this is, therefore, de-epithelialized only. The lateral aspect of the areola marking is excised full-thickness. The dermis at the inferior portion of the superomedial pedicle can be incised if there is tension to bring the nipple–areolar complex to its new site.

Definitive Closure

For a vertical scar incision, the medial and lateral pillars are closed using several 3-0 PDS or Vicryl sutures in a buried interrupted fashion. The skin is closed in layers using 3-0 Monocryl interrupted buried deep dermal sutures and 3-0 and/or 4-0 Monocryl running subcuticular sutures. Steri-strips and/or methylmethacrylate glue are used to cover the incisions, followed by a compression bra. Drains are not routinely used as they do not decrease the incidence of hematoma and increase postoperative pain.^{35–37}

AVOIDING AND MANAGING COMPLICATIONS

Preoperative workup should include a measured height and weight as opposed to using patient-reported values, as patients may inaccurately record these values, which can affect surgical planning.³⁸ Elevated body mass index (BMI) increases the risks of overall surgical complications³⁹ such as wound healing complications, infection, and deep vein thrombosis, with the BMI cut-point ranging from 30 to 35.^{40–45} Higher breast tissue resection weight has been correlated with an increased complication rate, including an increased incidence of delayed wound healing.^{43,46} Delayed wound healing at the triple point or T-junction in Wise pattern reductions is not uncommon, and the vast majority will heal via secondary intention.

Smoking and nicotine use are associated with an increased risk of complications after breast reduction.^{47–51} Nicotine causes peripheral vasoconstriction and produces negative effects on wound healing, including tissue necrosis.⁵² There are many avenues besides traditional tobacco cigarettes for the delivery of nicotine, including gum, patches, and electronic cigarettes. Regardless of the vehicle for nicotine consumption, the presence of nicotine in the patient's system at the time of surgery is associated with an increased risk of complications.⁵³ It is recommended that patients stop smoking or using nicotine for a minimum of 4 weeks before surgery and 2 weeks after surgery, to reduce the risk of complications.⁵⁴ Plastic surgeons may test patients for nicotine and its metabolites preoperatively to identify patients who have been nonadherent to cessation recommendations. Nicotine testing can be performed via urine assay (which may take up to 14 days to return) or urine point of care testing (which can be performed on the day of surgery).⁵⁵

To avoid nipple–areolar complex necrosis, it is critical to ensure that the chosen pedicle measurements are accurate, and attention is paid to the pedicle creation technique. Maintaining the venous network by preserving superficial veins during de-epithelialization can prevent venous congestion.⁵⁶ If the nipple–areolar complex seems congested or poorly perfused after temporary inset, maneuvers should be undertaken to check pedicle position and the pressure on the pedicle from surrounding tissue or hematoma formation.⁵⁷ Warm irrigation can be used to improve vasospasm. Topical 2% nitroglycerin paste can be applied intraoperatively to the nipple–areolar complex, which can assist with mild outflow concerns. If the nipple–areolar complex appears to have compromised vascularity after closure, sutures are removed. If perfusion improves, definitive closure is deferred. Delayed closure after several days is performed once edema has subsided.⁵⁷ Laser angiography with indocyanine green can be used intraoperatively to determine nipple–areolar complex perfusion, and if compromise is confirmed, free nipple grafting can be performed immediately.

For perfusion concerns recognized immediately after surgery in the recovery room, return to the operating room can be initiated for conversion to a free nipple graft. However if evidence of nipple–areolar complex necrosis is present at a postoperative visit more than 48 hours postoperatively, treatment is largely supportive. Local wound care is performed, and the nipple–areolar complex

should be permitted to demarcate for at least 14–21 days. Once healed, pigmentary alterations can be corrected with medical grade tattoo.⁵⁸

Bleeding is a risk with any operation. Typically, breast reduction is a relatively low blood-loss operation, although there can be a significant amount of raw surface as a result of operative dissection. The use of intravenous tranexamic acid has become popular to reduce blood loss in elective plastic surgery operations.⁵⁹ Recent studies have shown a small reduction or no difference in hematoma formation with its use in breast reduction, and therefore, larger studies are needed to further understand the benefits and risks of use of tranexamic acid in this context.^{60,61}

Fat necrosis is a known complication of breast reduction and is the result of poor perfusion of adipose tissue within the breast. Patients who smoke or who have a BMI greater than 25 have a higher risk of fat necrosis.⁶² It manifests as a firm mass within the breast, and typically is not evident until edema is resolving or has fully resolved. Imaging or biopsy can be performed if needed. Once a diagnosis of fat necrosis has been established, the treatment is usually supportive. Excision is not typically recommended, as this may cause breast shape distortion and additional scar formation.

PEARLS AND PITFALLS

It is critical for the plastic surgeon to perform a thorough preoperative assessment to determine appropriateness for breast reduction surgery. A history of breast surgery is vital to understand which pedicle or technique will be appropriate, and which ones are off limits. Special considerations should be undertaken for patients with a high Caprini score, patients on anticoagulation, patients with diabetes, and patients with other comorbidities. Not every patient who desires breast reduction is a candidate for surgery.

Patients aged 40 years and older should have bilateral screening mammograms performed within the 12 months before surgery. Patients between the ages of 35 and 40 are eligible for screening mammograms to establish a baseline, which are recommended before breast reduction. All breast tissue removed should be sent for routine pathology analysis. Even with negative preoperative mammography, there is still a small risk of positive pathology (malignancy and high risk lesions) after breast reduction.⁶³ Patients with high-risk lesions (such as atypical ductal hyperplasia) on pathology after breast reduction should be sent to a medical or surgical oncologist to discuss their individual risk profile and possible interventions or further workup. The estimate of breast cancer risk in reduction specimens of women without a history of breast cancer is less than 2%.⁶⁴

Rather than imposing a minimum age for surgery, performing surgery at least 3 years after menarche can minimize the likelihood of postoperative breast regrowth. In the subset of young patients who are classified as obese per BMI, it may be beneficial to wait until 9 years postmenarche, as the risk of breast regrowth is higher in this patient population.⁶⁵ Patients older than 60 years of age can safely undergo breast reduction surgery if medical comorbidities are well controlled, although older patients have an increased risk of postoperative venous thromboembolic events.^{66,67}

Patients who have had prior reduction may be candidates for re-reduction, especially if they have recurrent breast growth and symptoms of macromastia. Re-reduction can be performed safely by performing superior de-epithelialization to elevate the nipple–areolar complex (if needed) rather than creating a new pedicle.⁶⁸ This is a useful technique especially when the original pedicle is not known.

WHAT PATIENTS SHOULD KNOW BEFORE HAVING THIS PROCEDURE

Patient satisfaction after breast reduction is usually high, and over 95% of patients would choose to undergo the operation again.⁶⁹ Patients should be notified about expected recovery outcomes, both in the short term and long term. In the short-term, pain is mild to moderate for most patients. The majority of patients can be managed with minimal use of narcotics.

Patients are guided through the informed consent process to understand benefits and risks. Complications are uncommon, but it is important to discuss them in addition to the potential treatment plan should they occur. It is important to notify patients of the possibility of sensation changes or sensation loss as a result of breast reduction, regardless of the pedicle technique used by the surgeon (with the exception of free nipple grafting which will result in sensation loss of the entire nipple–areolar complex). Studies comparing superomedial and inferior pedicle show that nipple sensation loss was 11% with superomedial pedicle and 13% with inferior pedicle, which was not statistically significant.^{70,71}

Breastfeeding should be discussed with patients of childbearing age. Breastfeeding success after breast reduction has been shown not to differ from breastfeeding success in patients who have not had breast reduction; therefore, patients can be assured that the breastfeeding capacity should not be expected to be altered as long as a pedicle technique is used. Pedicle type does not affect breastfeeding capacity.^{72,73}

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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