



Breast Surgery

Power-Assisted Liposuction Mammoplasty (PALM): A New Technique for Breast Reduction

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Abstract

Background: Resection and reshaping of the parenchyma are common procedures to produce a natural breast shape in reduction mammoplasty and mastopexy. The challenges of these practices include maintaining sensitivity of the nipple-areola complex (NAC), achieving upper-pole fullness, and preserving an adequate blood supply for patients with massive breast ptosis.

Objectives: The authors describe their experience with power-assisted liposuction mammoplasty (PALM), a novel technique for breast reduction.

Methods: One hundred fifty consecutive women (300 breasts) who underwent PALM were evaluated in a prospective study. Minimizing skin undermining and glandular resection ensured maximal blood supply to the breast. A lateral pedicle was created to preserve NAC sensitivity. The transposed gland was contained within a large pocket made in the upper-inner quadrant. Glandular suspension sutures from the dermis to the chest wall stabilized the breast and recreated the inframammary fold.

Results: The mean distance from the nipple to the sternal notch was 36 cm, the mean NAC elevation was 16 cm, the mean lipoaspirate volume per breast was 650 cc, and the mean glandular resection mass per breast was 240 g. Complications included wound infection (6 of 300 breasts, 2%), wound dehiscence (3 breasts, 1%), and seroma (9 breasts, 3%). Partial areolar necrosis occurred in 2 of 150 patients (1.3%), and 9 patients (6%) underwent revisional surgery.

Conclusions: PALM is a safe and reliable option for breast reduction and is indicated for patients with massive breast ptosis.

Level of Evidence: 4



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Conventional techniques for reduction mammoplasty and mastopexy include free nipple,¹ Wise pattern,² bipedicle,³⁻⁵ inferior pedicle,^{6,7} vertical pedicle,⁸⁻¹¹ superomedial,¹²⁻¹⁴ superolateral,^{15,16} and septal-based pedicle.^{17,18} Each of these techniques has specific advantages, but all of these approaches are associated with challenges regarding the creation of upper-pole fullness, the preservation of an adequate blood supply in cases of massive breast ptosis, and the maintenance of sensitivity of the nipple-areola complex (NAC).

Parenchymal reshaping and resection is key for achieving the patient's desired breast shape in contemporary reduction mammoplasty and mastopexy. Breast liposuction¹⁹⁻²⁷ alone or in combination with parenchymal resection has been

regarded as a safe and reliable option for reduction mammoplasty since the early 1980s. Reduction mammoplasty by liposuction, with aspirate volumes exceeding 2000 mL, is a suitable technique for breasts of various sizes.^{8,9} Liposuction-assisted reduction mammoplasty yields favorable results and is associated with very low morbidity rates. The safety and reliability of vertical reduction mammoplasty with liposuction

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has been confirmed over a 10-year postoperative monitoring period.^{8,9,26,28} Complications of vertical reduction mammoplasty with liposuction include kinking of the pedicle in excessively fibrous breasts, creation of a poorly defined inframammary fold, reduction in NAC sensitivity, and delayed wound healing.²⁸⁻³³

Power-assisted liposuction mammoplasty (PALM) is a novel surgical technique that was developed to address the limitations of contemporary breast reduction techniques and the complications accompanying vertical reduction mammoplasty with liposuction. The key points of PALM are presented in Figure 1 and Table 1. This technique preserves maximal arterial and venous blood supply to the breast by basing the NAC on the central, lateral, and superior pedicles. The amount of resected parenchymal tissue is minimized and parenchymal transposition is facilitated by means of power-assisted liposuction as the primary tool for reducing breast volume. Glandular rotation and NAC elevation are ensured by the creation of a subcutaneous, upper-pole pocket to fit the elevated and transposed breast tissue comfortably and without tension while providing upper-pole fullness. Placement of robust sutures from the dermis to the chest wall provides glandular suspension, maintains

long-term upper-pole fullness, and recreates the inframammary fold.

Because this technique preserves the blood supply to the breast and NAC, PALM is safe for patients who desire long NAC elevations in breast hypertrophy and/or massive ptosis. In the authors' experience, the appropriate resection pattern is determined by the planned NAC elevation. When the desired NAC elevation is ≤ 10 cm, vertical wound closure is planned preoperatively. For NAC elevations > 10 cm, a short T or J wound-closure pattern can be determined intraoperatively following elevation of the NAC to the desired position and redraping of the parenchymal tissues. In this study, the authors describe the indications, surgical approach, and outcomes of PALM.

METHODS

Patients and Study Design

One hundred fifty consecutive women (300 breasts) who underwent primary breast reduction with PALM from January 2008 to January 2012 were evaluated in a prospective study. Other than typical contraindications for general

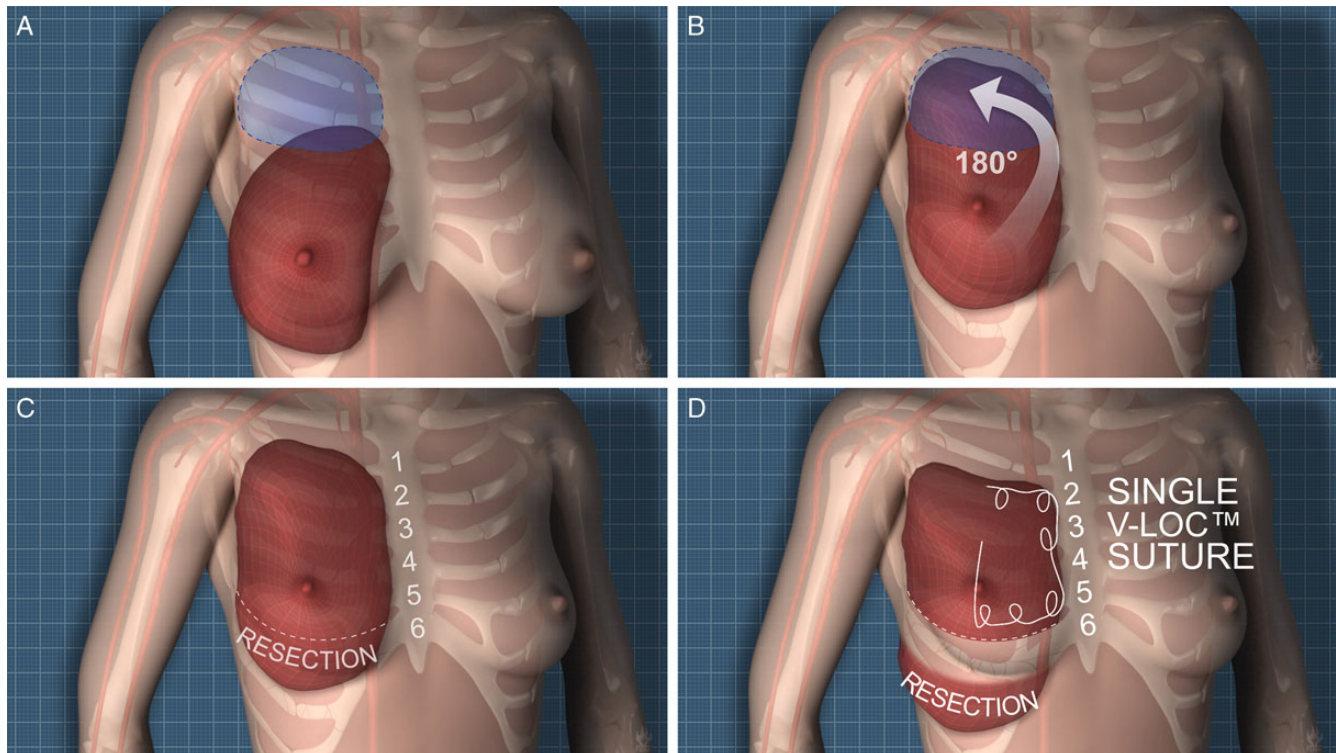


Figure 1. Indications for power-assisted liposuction mammoplasty (PALM). (A) Blue dotted line and shading indicate the upper pocket. Red shading denotes the shape of the ptotic breast. (B) The gland is rotated 180° superomedially to lift the breast and fill the pocket. (C) Resection of glandular excess. Numbers indicate the rib spaces. (D) Solid white line denotes single V-Loc suture placement from dermis to chest wall for glandular suspension. Suturing extends from the second, third, fourth, and sixth rib spaces and is continued laterally from the sixth rib space to the breast axis to recreate the inframammary fold. With the same V-Loc device, suturing is continued superficially to close the wound.

Table 1. Key Procedural Steps in PALM

(1)	Maximizing the NAC arterial supply and venous return by relying on breast liposuction for volume reduction, minimizing glandular resection, and preserving the central, lateral, and superior pedicles
(2)	Liposuction of the lower pole and areolar zones to minimize tension and kinking of the NAC and gland during transposition.
(3)	Tunnelization of the area below the inframammary fold to facilitate skin retraction and redraping and avoid puckering
(4)	Facilitating glandular rotation and NAC elevation by creating an subcutaneous upper-pole pocket that can fit the elevated and transposed breast tissue comfortably and without tension while providing upper-pole fullness
(5)	Placement of sutures from the dermis to the chest wall for glandular suspension to maintain and ensure longevity of upper-pole fullness and to recreate the inframammary fold
(6)	Liposuction of the lower-lateral quadrant of the breast to improve the contour and shape of the breast or overall breast liposuction to further reduce breast size or refine symmetry

NAC, nipple-areola complex; PALM, power-assisted liposuction mammoplasty.

anesthetic and/or breast reduction, there were no contraindications for patients presenting for primary breast reduction with PALM. Patients were supplied with detailed information regarding the PALM surgical procedure. All patients provided written informed consent. Preoperatively, all patients received clinical breast examinations, bilateral mammography, and breast ultrasonography. Patients were photographed pre- and postoperatively. The study adhered to the Declaration of Helsinki Guidelines.

Data Collection and Analysis

Demographic data including age, body mass index (BMI), smoking status, previous breast surgery, nipple-to-sternal notch (N-SN) distance, and preoperative breast size and comorbidities such as obesity, diabetes mellitus, coronary artery disease, hypertension, and breast cancer were noted. Intraoperative data were recorded, including the weight of the resected specimen, the total volume of fat aspirated per breast, the extent of NAC elevation, and the type of final scar. Complications including seroma, hematoma, partial areolar necrosis, wound infection, and wound dehiscence were assessed during follow-up. Data were integrated and analyzed in a computerized database.

Operative Procedures and Specimen Collection

Preoperative Markings

Preoperative markings were made with the patient standing. The N-SN distance for each breast was determined

with a measuring meter and marked on the patient. Additional preoperative markings included the midline axis, the breast meridian, the vertical axis of the breast, the inframammary fold, the planned position of the NAC, the zones of liposuction, and the borders of the superior pocket (Figure 2). The latter was planned to extend laterally from the axis of the breast, medially to 2 to 3 cm from the midline, superiorly to the first rib, and inferiorly to the third rib space. The planned subcutaneous pocket was higher than the footprint of the breast to enable the transposed gland to be fit under minimal tension and to accommodate some glandular ptosis postoperatively. The position of the subcutaneous pocket did not affect the new position of the NAC because it was located at the level of the inframammary fold.

Periareolar markings were drawn in a mosque pattern as described by Lejour.⁹ The circumference of the mosque was dependent on the breast size³⁴ and ranged from 14 to 20 cm in length and 4 to 10 cm in width. Vertical wound closure lines were drawn along the breast axis by rotating the breast superolaterally and then superomedially and marking 6 cm from the lower edges of the mosque pattern. These lines were joined 2 to 4 cm above the inframammary fold to indicate the planned vertical scar. When a short T or J wound-closure pattern was planned, the vertical lines were interrupted at 6 cm and continued as diagonal lines pointing medially and laterally at opposite directions to 2 to 4 cm above the original inframammary fold. These lines then were joined by a horizontal line parallel to the original inframammary fold to indicate the position of the new inframammary fold.

Once preoperative markings were made on 1 breast, symmetric markings were made on the contralateral breast by pushing the breasts together and duplicating the periareolar and medial/vertical markings. A video demonstrating the preoperative markings and surgical technique is available as Supplementary Material at www.aestheticsurgeryjournal.com.

Surgical Techniques and Processing of Lipoaspirates

Following administration of general anesthetic, the patient was placed in the supine position with the arms abducted. The preoperative markings, breast gland, and lower pole of each breast were infiltrated with Klein's solution³⁵ by means of a power-assisted liposuction system (Lipomatic Eva SP, Euromi SA, Verviers, Belgium). The infiltration volume was dependent on breast size and ranged from 100 to 400 mL (mean, 280 mL).

The same power-assisted liposuction system was utilized for liposuction of the breast. The authors' extensive experience with the Lipomatic device translated to more precise zones of liposuction, less surgeon fatigue, and reduced operating times. Liposuction was performed on the lower outer quadrant, retroareolar, and inferior regions of the breast by means of a multiple-hole blunt cannula (hole diameter, 4 or 5 mm). Additional subcutaneous

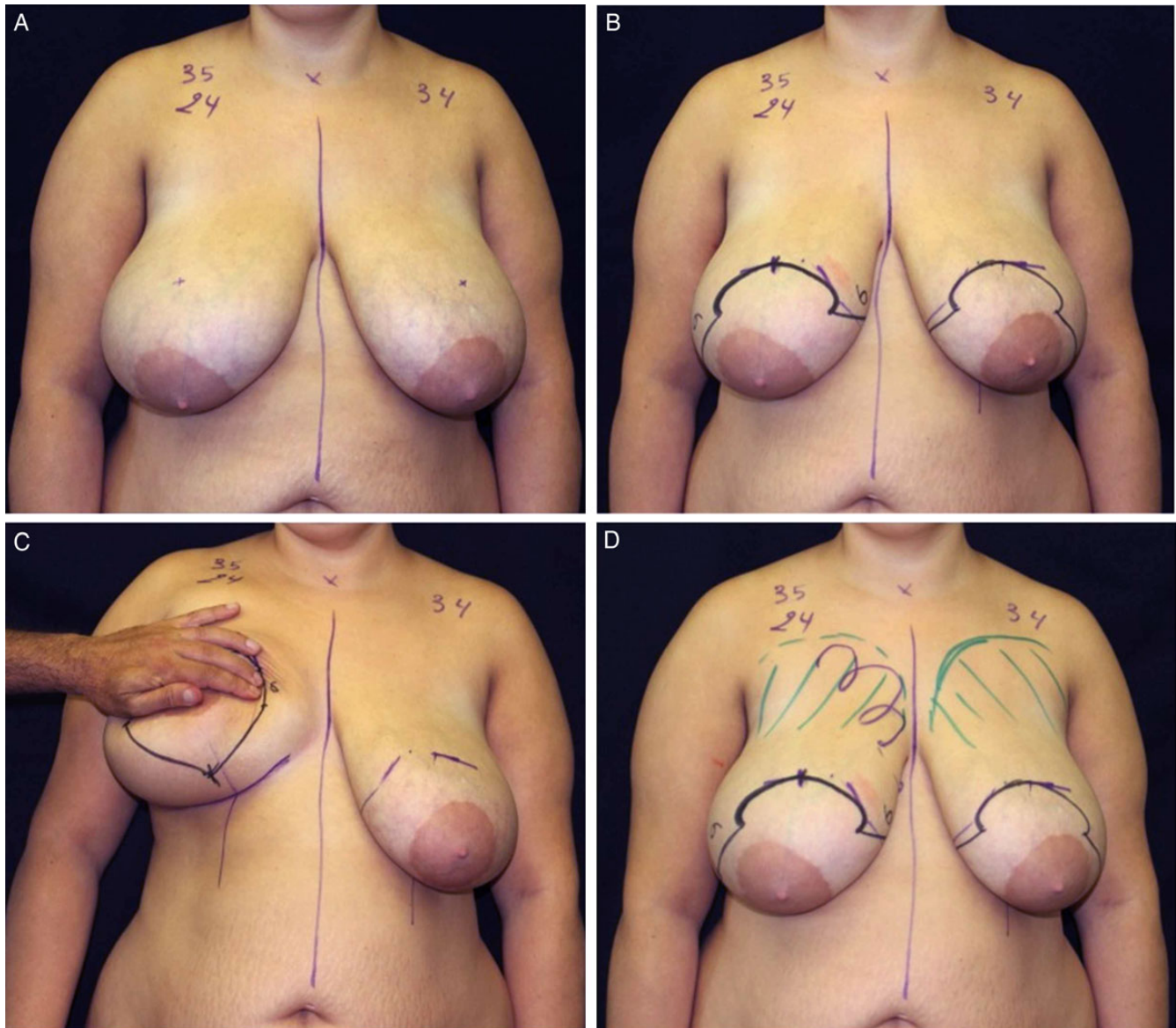


Figure 2. Preoperative planning and markings in this 41-year-old woman who presented for PALM. (A) The distance from sternal notch to nipple, the midline axis, the inframammary fold, and the new position of the nipple-areola complex (NAC) are marked on the patient. (B) Periareolar markings are made in the shape of a mosque. (C) Vertical incision lines are marked along the breast axis by rotating the breast superolaterally then superomedially and drawing 6-cm lines from the lower edges of the mosque pattern. The lines then are joined together 2 to 4 cm above the inframammary fold. (D) Borders of the superior pocket (green) and pattern for placement of suspension sutures from the dermis to the chest wall (purple) are marked.

tunnelization was performed at the retroareolar space, lateral aspect, and lower poles of the breast, with tunnelization extending below the inframammary fold to facilitate transposition of the breast to its new position under minimal tension. The aspirate volume depended on the shape and size of the breast, the extent of breast ptosis, the type of breast parenchyma, and the intended amount of breast tissue to be resected (Figure 3).

Volumes of breast lipoaspirates were determined after each procedure. Lipoaspirates were examined macroscopically for homogeneity after passage through a strainer. The

homogeneous material, comprising thick adipocytic tissue was evaluated separately from the nonhomogeneous material, comprising blood vessels, glandular tissue, and other components. These adipose and nonadipose fluids were processed by fixation in formaldehyde for 6 to 48 hours, inclusion in paraffin, sectioning, and staining with hematoxylin-eosin by standard methods. Stained samples were examined under a microscope for pathologic features.

The NAC was delineated with a 42-mm areola marker, and the pedicle was deepithelialized along preoperative markings with a scalpel. At the border of the incision, the

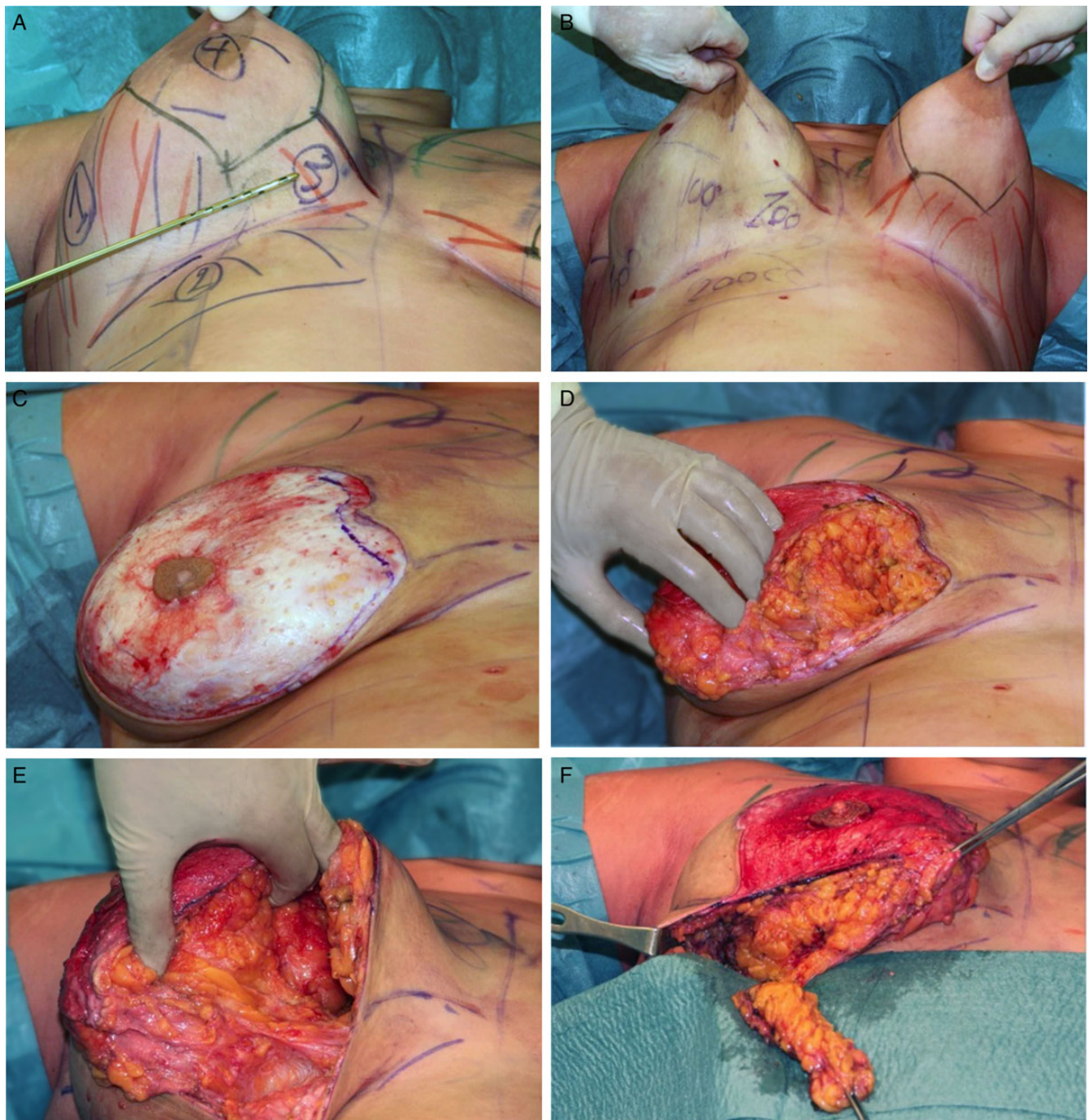


Figure 3. Intraoperative views of this 41-year-old woman who underwent PALM. (A) Zones are marked in preparation for power-assisted liposuction of the lower outer quadrant (zone 1), retroareolar (zone 4) and inferior parts of the breast (zones 1 and 3). Transposition of the gland is facilitated by additional subcutaneous tunnelization of zones 2 and 4 and by redraping of the skin to recreate the new inframammary fold. (B) Intraoperative view following aspiration of 950 mL from the right breast. (C) Deepithelialization of the breast. Blue markings indicate glandular dissection. (D) Inferior and lower-lateral dissection of the gland to the pectoralis fascia. Lateral dissection was initiated 6 cm from the base of the mosque pattern. (E) Subcutaneous dissection of the wide upper-inner pocket with preservation of the superior, central, and lateral pedicles. (F) Resection of glandular excess of the lower pole by pulling the gland medially and superiorly. (G, H) Superomedial rotation of the gland by 180° to fill the pocket and placement of glandular suspension sutures (2-0 V-Loc) from the dermis to the chest wall. Suturing extended from the second, third, fourth, and sixth rib spaces and then was directed laterally to the breast axis line to create the new inframammary fold. (I, J) Redraping of the breast skin envelope and closure of the periareolar and vertical wounds under minimal tension. (K) The right breast with reduction completed. (L) The patient following bilateral reduction. Additional liposuction of the lower lateral quadrants was performed to decrease fullness and achieve bilateral symmetry. This patient underwent total liposuction of 1050 mL and 1100 mL from the right and left breasts, respectively, and resection of 100 g glandular tissue from each breast.

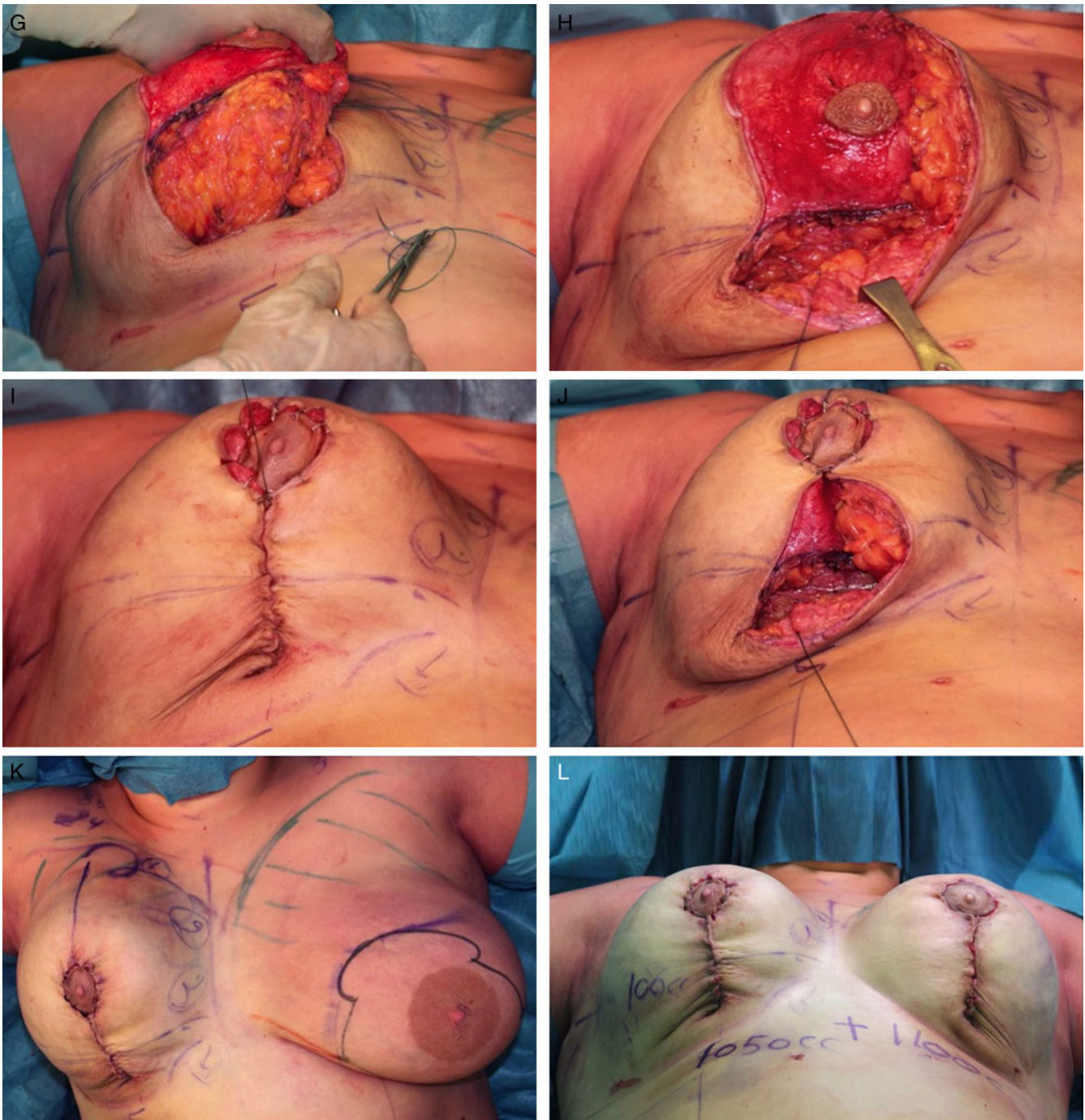


Figure 3. Continued.

scalpel was beveled to deepithelialize 2 mm of epidermis; this maneuver was important for subsequent wound closure. A scalpel then was applied to incise the gland along preoperative markings. Dermal dissection was performed 2 mm from the edge of this wound with a rim of dermis extending beyond the epidermis along the wound edge. During NAC dissection, a wide surface area of deepithelialized skin was preserved circumferentially (Figure 3).

Inferior and lower lateral dissection of the gland then was performed to the pectoralis fascia. Lateral dissection was initiated 6 cm from the base of the mosque pattern and was facilitated by the liposuction and tunnelization performed earlier in the procedure. The thickness of the inferior pole flap was similar to a postmastectomy skin flap, and skin undermining was limited. Medial dissection was performed in beveled fashion 2 to 3 cm from the edge of the

medial vertical line to the pectoralis fascia, and fullness of the medial flap was maintained. A wide upper-inner pocket then was created subcutaneously and dissected on the pectoralis fascia. This pocket was extended laterally from the axis of the breast, medially 2 to 3 cm from the midline, superiorly to the first rib, and inferiorly to the third rib space. Because the upper-inner pocket would ultimately contain the upper bulk of the transposed gland, it was extended to minimize tension on the NAC and ensure upper-pole fullness. This dissection approach preserved the rich periareolar venous network of the NAC and the superior, central, and lateral pedicles.

The NAC and breast parenchyma were rotated superomedially by 180° to lift the breast and fill the upper-inner pocket. The NAC then was fixed to its predetermined position. Barbed running sutures (V-Loc 180, 2-0, Covidien, Mansfield, MA) were placed from the dermis to the chest wall to suspend the breast tissue in the subcutaneous pocket. Caution was taken with needle bites at the caudal edge of the dermal flap to avoid medial tension on the NAC and a medially pointing nipple. Sutures were extended medially in a horizontal fashion from the middle aspect of the pocket at the level of the second rib to the medial edge of the pocket 2 to 3 cm from the midline. Suspension then was continued caudally with V-Loc sutures placed in a vertical fashion from the second, third, fourth, and sixth rib cartilages (Figure 3).

Once the breast was suspended in the desired position, estimation and resection of excess tissue below the inframammary fold was performed. Following transposition of the gland, excess tissue in this inferior region of the breast was derived from the lower lateral area (ie, the lateral area of the breast in the inverted T technique). V-Loc sutures were placed horizontally and laterally along the sixth rib space to the breast axis line and then were continued superficially.

The periareolar and vertical wounds were redraped with skin staples; these were removed upon final skin closure. When vertical wound closure was not determined preoperatively, the decision was made intraoperatively regarding the pattern of skin closure (ie, short T or J closure). The vertical and periareolar wounds were approximated with 2-0 V-Loc running sutures, and skin closure was achieved under minimal tension. A subcutaneous drain was placed and secured to the skin at the lower part of the wound closure site. The same procedure then was performed on the contralateral breast.

Subsequent liposuction was performed when necessary. Indications for additional liposuction included (1) excess fat necessitating additional volume reduction, (2) breast asymmetry or fullness in the lower lateral quadrant requiring correction, (3) the need for subcutaneous undermining of the lateral breast to relieve persistent tension following the transposition of the breast to its new position, and/or

(4) the need to reduce tension in the lower lateral quadrant of the breast.

Postoperative Care

A drain was left in place in the lower area of each breast scar for 48 hours or until drainage became serosanguinous or serous and decreased in daily amount. Gauze dressing was placed over breast wounds. Patients were discharged from the hospital 1 to 2 days postoperatively (average, 1.3 days) with instructions to wear a compression bra for 6 weeks. All patients received postoperative breast imaging annually.

Assessment of Patient Satisfaction

At 6 months postoperatively, patients were asked to complete a nonanonymous questionnaire prepared by the authors to assess their satisfaction with the surgical outcome and with pre- and postoperative care and to evaluate their psychological and physical well being (a blank copy of the questionnaire is available as Supplementary Material at www.aestheticurgeryjournal.com).

RESULTS

One hundred fifty consecutive women (300 breasts) underwent breast reduction with PALM. The mean age of the patients was 36 years (range, 22-67 years), the mean BMI was 32 kg/m² (range, 25-43 kg/m²), the mean N-SN distance was 36 cm (range, 29-47 cm), and the mean NAC elevation was 16 cm (range, 10-27 cm; Table 2). Eighteen of 150

Table 2. Patient Demographics and Operative Data

No. of patients	150
No. of breasts	300
Mean age, y (range)	36 (22-67)
Mean BMI, kg/m ² (range)	32 (25-43)
No. of current smokers (%)	12 (8%)
Mean NAC elevation, cm (range)	16 (10-27)
Mean lipoaspirate volume per breast, mL (range)	650 (300-2900)
Mean glandular resection mass, g (range)	240 (50-600)
No. of breasts treated with vertical wound closure (%)	63 (21%)
No. of breasts treated with short T-pattern wound closure (%)	216 (72%)
No. of breasts treated with J-pattern wound closure (%)	21 (7%)
Follow-up, mo	12-30

BMI, body mass index; NAC, nipple-areola complex.

patients (12%) were current smokers. The mean lipoaspirate volume was 650 mL per breast (range, 300-2900 mL), and the mean glandular resection mass was 240 g (range, 50-600 g). Six patients (4%) presented with gigantomastia as defined by Dafydd et al.³⁶ The mean body weight of these 6 patients was 91 kg (range, 83-97 kg), and the mean glandular resection mass per breast was 3.1 kg (range, 2.9-3.5 kg).

A short T wound-closure pattern was applied for 216 of 300 breasts (72%), whereas vertical and J closure patterns were applied for 63 breasts (21%) and 21 breasts (7%), respectively. Patients were monitored for an average of 26 months (range, 12-30 months; Table 2, Figures 4-6). All patients presented with improved upper-pole fullness at ≥ 12 months postoperatively.

Postoperatively, wound infections developed in 6 of 300 breasts (2%), wound dehiscence occurred in 3 breasts (1%), and seroma was detected in 9 breasts (3%; Table 3). No patients developed total necrosis of the areola, but partial areolar necrosis occurred in 2 patients (1.3%), both of whom were smokers. One of these patients underwent NAC elevation of 19 cm bilaterally and aspiration of 1400 mL and 1450 mL from the right and left breasts, respectively. This patient developed a bilateral wound infection that was diagnosed on day 8 postoperatively and that progressed to partial areolar necrosis. The other patient underwent NAC elevation of 17 cm bilaterally and aspiration of 1600 mL from each breast. This patient developed a partial wound dehiscence at the junction of the areolar and vertical sutures on the right breast that overlapped with an infection at the same location. Both patients who developed partial areolar necrosis were successfully treated with a conservative approach involving local wound care, targeted antibiotic therapy, and frequent follow-up appointments. Nine of 150 patients (6%) underwent revisional surgery.

Of 150 patients, 109 (73%) completed a questionnaire at 6 months postoperatively to assess satisfaction (Figure 7). Ninety-nine of 109 respondents (91%) indicated that they would repeat the surgical procedure or recommend it to a friend, 102 respondents (94%) were satisfied with their breast shape, and 93 respondents (85%) were either somewhat or very satisfied with their breast scars. Seven respondents (6%) indicated an absence of nipple sensitivity preoperatively and did not answer questions pertaining to postoperative nipple sensitivity. Of 102 respondents who completed the section pertaining to nipple sensation, 91 patients (89%) reported satisfaction with their nipple sensitivity postoperatively compared with their sensitivity preoperatively. Eleven of these respondents (11%) reported that they experienced changes in nipple sensitivity postoperatively and were somewhat dissatisfied with this outcome. None of the 102 respondents with preoperative nipple sensitivity indicated an absence of nipple sensitivity at 6 months postoperatively.

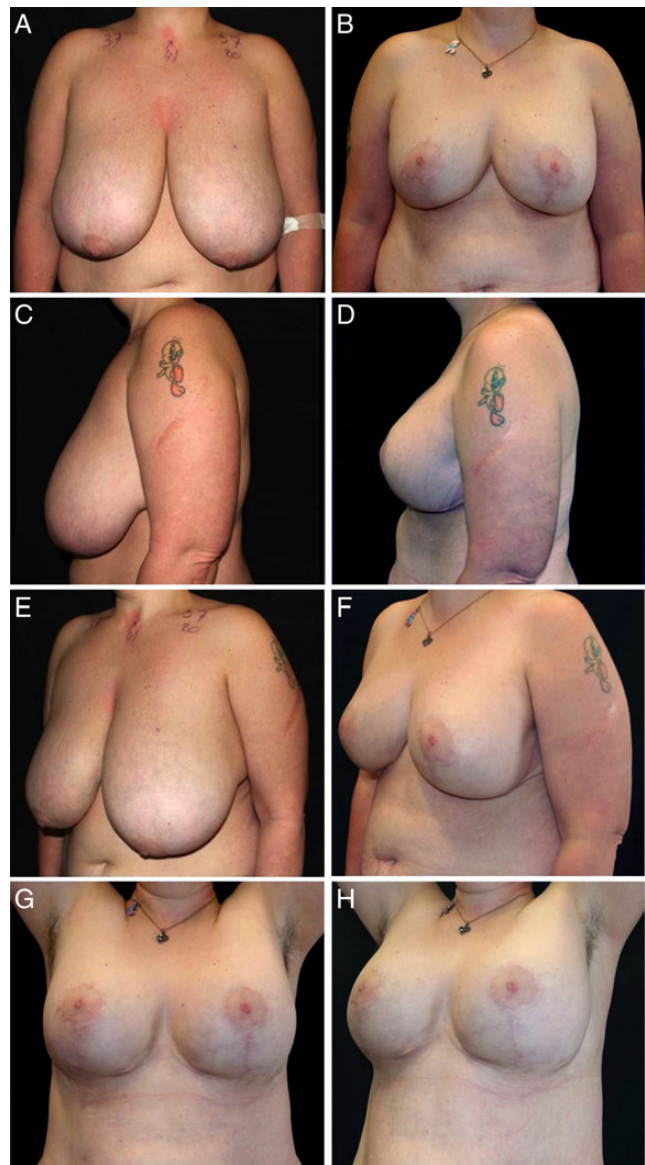


Figure 4. (A, C, E) This 41-year-old woman presented with bilateral breast ptosis with 37-cm distances from the nipple-to-sternal notch on both breasts. She underwent PALM with NAC elevation by 17 cm bilaterally, liposuction of 400 mL from the right breast and 700 mL from the left, and glandular resection of 150 g from the right breast and 280 g from the left. (B, D, F) Two years postoperatively. (G, H) Short T scar at 2 years postoperatively.

DISCUSSION

The goals of reduction mammoplasty and mastopexy include safety and predictability; the achievement of an appropriate size, shape, and projection of the breast; long-lasting results; a fast recovery; and minimal complications.³⁷⁻³⁹ Successful outcomes in reduction mammoplasty are attributed to skin quality, the patient's age and expectations, the degree of breast ptosis, and the surgeon's experience and

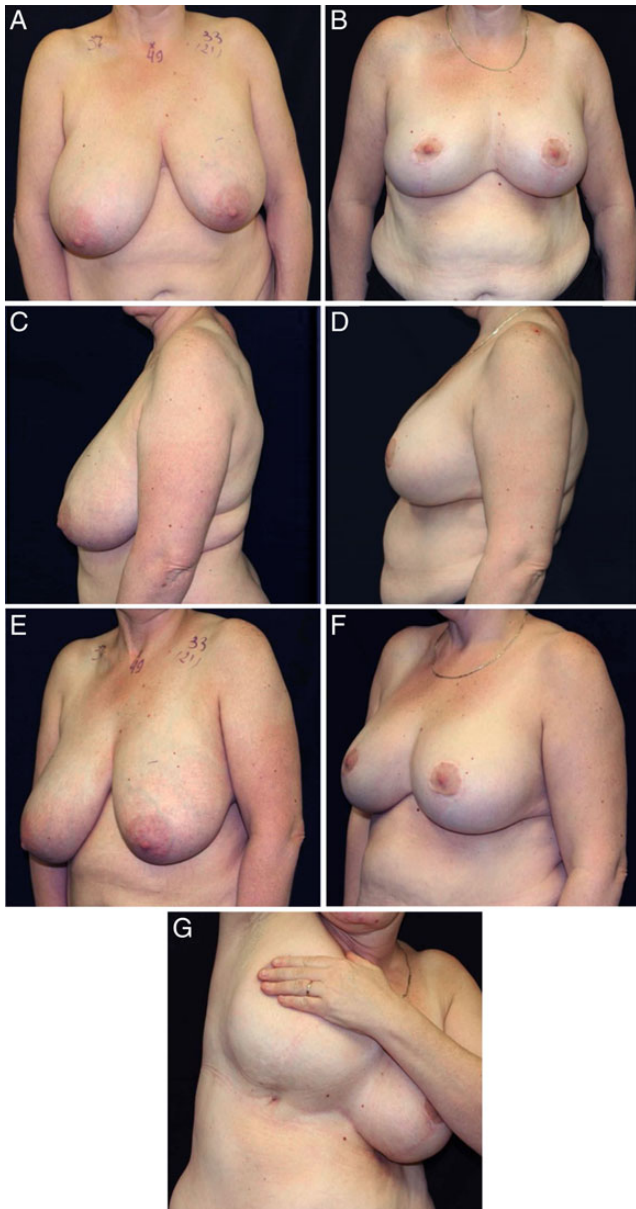


Figure 5. (A, C, E) This 49-year-old woman presented with asymmetric breasts and bilateral breast ptosis with distances from the nipple-to-sternal notch of 37 cm on the right breast and 33 cm on the left. She underwent PALM with NAC elevation of 16 cm on the right breast and 12 cm on the left, liposuction of 800 mL from the right breast and 400 mL from the left, and glandular resection of 260 g from the right breast and 150 g from the left. (B, D, F) Thirty months postoperatively. (G) Vertical scar at 30 months postoperatively.

understanding of breast anatomy.¹⁷ PALM affords a customizable approach to reduction mammoplasty and mastopexy that can accommodate patients with gigantomastia and massive breast ptosis and avoids the challenges of conventional vertical mammoplasty, including kinking of the pedicle, venous congestion of the NAC, and reduced NAC sensitivity postoperatively.

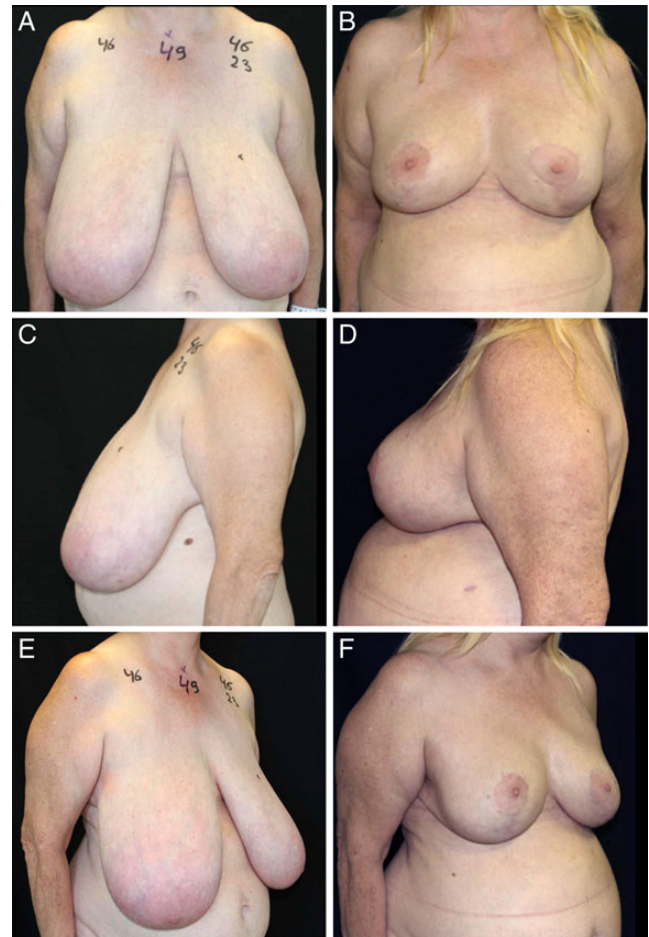


Figure 6. (A, C, E) This 49-year-old woman presented with extensive breast ptosis with a distance of 46 cm from the nipple-to-sternal notch bilaterally. She underwent PALM with NAC elevation of 23 cm bilaterally, liposuction of 2400 mL from the right breast and 2200 mL from the left, and glandular resection of 300 g from the right breast and 350 g from the left. (B, D, F) Two years postoperatively.

Breast liposuction alone or in conjunction with parenchymal resection has been well established as a safe and reliable procedure to decrease breast weight and volume.^{19-28,40,41} In our personal experience, liposuction is suitable for breasts with lateral fullness. By removing excess tissue and restoring a natural contour while decreasing pulling forces and facilitating superior rotation of the breast, liposuction enables longevity of the desired breast shape and delays ptosis. When asymmetry occurs following bilateral breast reduction, liposuction is an adequate and reliable option for reestablishing breast symmetry and refining the shape of the breast. PALM includes liposuction for volume reduction and breast shaping, thereby limiting parenchymal resection to the inferior pole of the breast.

By reducing volume above the NAC, liposuction ensures tension-free folding of the NAC during its superior transposition even in cases of severe ptosis in which massive

folding and substantial elevation of the NAC are anticipated and the superior pedicle provides insufficient blood supply to the NAC. Liposuction and tunnelization below the inframammary fold by means of a power-assisted liposuction system can better define the breast contour and can enhance skin retraction and redraping following vertical wound closure to minimize wrinkling, puckering, and the need for scar revision.

In this study, lipoaspirates from PALM were sent for pathologic examination. Although all patients underwent

preoperative mammography and breast ultrasound to rule out any findings requiring intervention, pathologic analysis of the aspirate was performed as an additional measure of control. In addition, health insurance companies mandated that breast reduction would only be a covered benefit if ≥ 400 g of tissue was removed per breast. Pathologic examination enabled third-party documentation that sufficient tissue was removed.

PALM preserves maximal blood supply to the breast by minimizing the extent of tissue dissection and resection, instead relying on breast liposuction for volume and weight reduction. Dissection is restricted to a portion of inferior pole and the medial aspect of the breast, and tissue resection is minimal and mainly restricted to a portion of the lower outer quadrant. The lateral, superior, and central pedicles are preserved in PALM, ensuring a robust blood supply to the breast parenchyma and NAC.

Techniques for vertical reduction mammoplasty are limited in their preservation of NAC sensitivity. In contrast, PALM maintains NAC sensitivity by means of a lateral pedicle containing Würinger’s horizontal septum,⁴² which carries a neurovascular supply to the NAC and can be integrated into septum-based mammoplasty with the methods developed by Hamdi et al.¹⁷ With a continuous blood supply to the NAC, greater NAC elevations are feasible. Deepithelialization of a wide surface area of skin around the NAC allows for protection of the periareolar vein

Table 3. Complications Following PALM (N = 150 Patients [300 Breasts])

Complication	No. of Breasts (%)
Wound infection	6 (2)
Wound dehiscence	3 (1)
Seroma	9 (3)
Hematoma	0 (0)
Partial areolar necrosis	3 (1)
Total necrosis	0 (0)
	No. of Patients (%)
Revisional surgery	9 (6)

PALM, power-assisted liposuction mammoplasty.

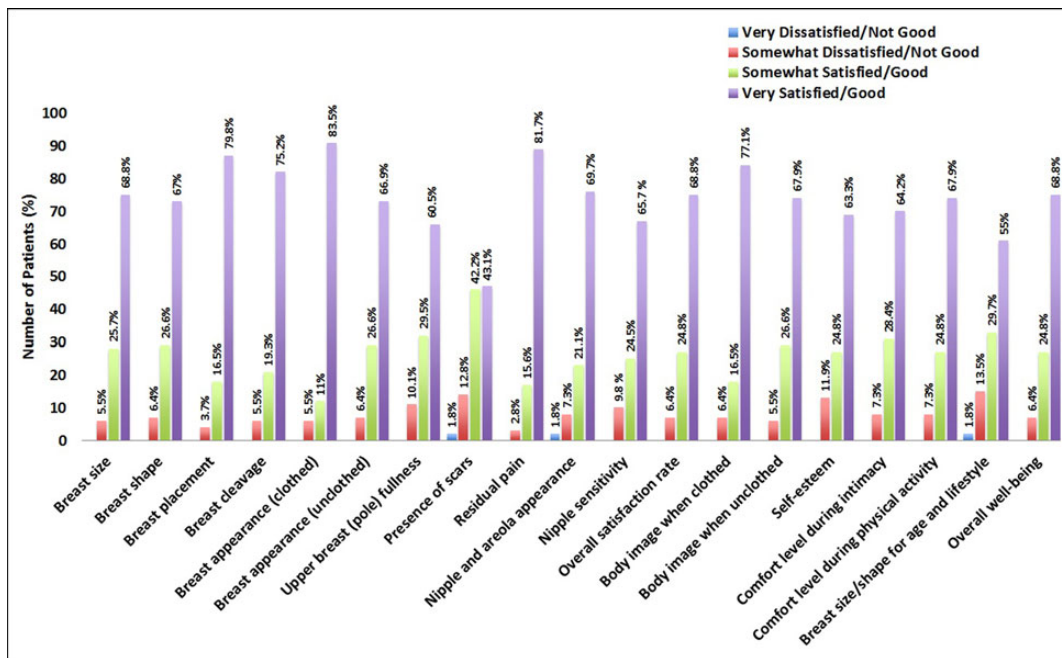


Figure 7. Results of the patient satisfaction questionnaire. Of 150 patients who underwent PALM, 109 completed the nonanonymous questionnaire prepared by the authors. Blue bars indicate patients giving “very dissatisfied/not good” responses, red bars indicate “somewhat dissatisfied/not good,” green bars indicate “somewhat satisfied/good,” and purple bars indicate “very satisfied/good.” Overall, 99 of 109 (90.8%) respondents indicated that they would repeat surgery or recommend it to a friend.

Table 4. Complications Associated With PALM vs Those of Other Surgical Techniques for Reduction Mammoplasty

Complication Type	Complication Rate				
	Vertical Mammoplasty by Lejour ^a	Lejour Vertical Mammoplasty by Others ^{b,c}	Modified Vertical Mammoplasty ^{b,c}	Inferior Pedicle Breast Reduction ^c	PALM
Wound infection	0.4%	0.4%-9.0%	NA	0%-12.0%	2.0%
Wound dehiscence	5.6%	4.2%-40.0%	22.0%	2.0%-19.0%	1.0%
Seroma	5.0%	4.2%-30.0%	NA	0%-1.0%	3.0%
Hematoma	1.3%	1.0%-5.0%	NA	0.3%-2.0%	0.0%
Partial areolar necrosis	0.4%	1.0%-15.0%	5.0%	0.8%-6.0%	1.0%
Total necrosis	NA	NA	NA	0.8%-6.0%	0.0%
Revisional surgery	NA	7.0%-20.0%	NA	0%-10.0%	6.0%

NA, not applicable; PALM, power-assisted liposuction mammoplasty. ^aLejour,²⁸ a study of 250 personal consecutive patients. ^bHanna MK, Nahai F. Vertical reduction and mastopexy: problems and solutions. *Vertical Scar Mammoplasty*. 2005:123-130. ^cBoehm K, Nahai F. Vertical reduction: techniques. Mathes SJ, ed. *Plastic Surgery*. Vol. 6. 2nd ed P 588-600.³⁸

polygon⁴³ and maintains the venous networks supplying the NAC. Breast tissue resection is minimized in PALM to support adequate venous drainage of the NAC through large transposition distances that are required for patients with gigantomastia and pronounced breast ptosis. In this study, we performed PALM to achieve NAC elevations as large as 27 cm.

Because the blood supply to the breast is preserved in PALM, the rate of complications involving wound healing is decreased (Table 4). Wound-healing complications frequently are encountered in vertical mammoplasty.²⁸ By maintaining a 2-mm dermal rim around the edge of the breast wound, PALM facilitates wound closure and ensures apposition and eversion of the wound edges under minimal tension; this improves wound healing and minimizes excessive scarring. The preservation of a large area of deepithelialized tissue around the gland carrying the NAC also creates a firm anchoring structure at the deepithelialized edges for sutures from the dermis to the chest wall during glandular transposition.

PALM involves the creation of a large superior pocket that comfortably fits the transposed parenchymal tissue and that minimizes tension on the NAC upon final wound closure. Glandular suspension sutures from the dermis to the chest wall are associated with several benefits. Single V-Loc sutures are placed from the second rib at the upper pole to the sixth rib inferiorly to fix the breast parenchyma in its new position. These robust sutures ensure parenchymal support and prolong upper-pole fullness by joining the dermal edges of the glandular flap to the chest wall and to the large pocket accommodating the flap. V-Loc sutures also are applied to define the new inframammary fold positioned 2 to 4 cm cephalad to its original location, depending on the extent of ptosis. Following glandular suspension in the desired position, 3-0 V-Loc sutures are applied for vertical and periareolar wound closure under minimal tension.

We advocate V-Loc sutures for glandular suspension and skin closure because these devices minimize operating times, foreign-body reactions, and wound complications by requiring less suture material and fewer knots than other closure products. PALM can be completed with only 2 V-Loc sutures. In addition, V-Loc sutures involve minimal compression of glandular and fatty tissue during suspension of the gland in its new position because fewer knots are required. In the authors' opinion, the application of V-Loc sutures can decrease the rate of fat necrosis from compression of the parenchyma and gland when approximating the 2 pillars in superior pedicle breast reduction.

PALM is compatible with various patterns of skin closure. When the NAC elevation is ≤10 cm, vertical wound closure is determined preoperatively; this pattern is associated with satisfactory outcomes. For NAC elevations > 10 cm, the decision for a short T or J closure is made intraoperatively following elevation of the NAC to the desired position and redraping of the parenchymal tissues. Most of the patients in this study presented with ptotic breasts requiring NAC elevations > 10 cm. Therefore, short T closure patterns were predominant.

Of 150 patients in this study, 23 patients (15%) became pregnant postoperatively, including 8 primary pregnancies and 15 secondary or tertiary pregnancies. All of these patients were able to breastfeed after PALM. The preservation of breastfeeding capacity with PALM is attributed to limited glandular resection and maintenance of maximal breast parenchyma.

Limitations

Although liposuction is a commonly performed procedure in plastic surgery, few surgeons have experience with breast liposuction and specifically with power-assisted liposuction of the breast. Thus, a limitation of PALM is the

learning curve for surgeons to acquire the skills required to undertake power-assisted breast liposuction. The safety and reliability of breast liposuction is well established,¹⁹⁻²⁸ and power-assisted liposuction is gaining popularity among plastic surgeons. Owing to the meticulousness and precision required for breast liposuction, the senior author recommends performing liposuction in small volumes and avoiding cases of gigantomastia and massive ptosis until adequate skills are developed.

Glandular breasts present a challenge for PALM because glandular tissue is difficult to treat with liposuction. However, glandular breasts do not constitute a contraindication for PALM. Satisfactory results can be achieved by (1) increasing the amount of glandular resection from the lower pole while preserving the lateral septum, (2) applying delicate and precise liposuction of the breast, and (3) dissecting a larger upper-pole pocket to accommodate the transposed gland. The authors acknowledge the lack of standardized control and comparison groups as additional limitations of this study.

CONCLUSIONS

PALM combines breast liposuction and mammoplasty in an approach that ensures maximal blood supply to the breast by preserving the superior, lateral, and central pedicles and minimizing skin undermining and glandular resection. PALM is a safe and reliable alternative for reduction mammoplasty and mastopexy. Because it preserves the blood supply to the breast, PALM is indicated for patients with gigantomastia and extensive ptosis. The long-term outcomes of PALM include an aesthetically pleasing breast shape with superior pole fullness and without bottoming out or boxiness.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

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REFERENCES

1. Thorek M. Possibilities in the reconstruction of the human form 1922. *Aesthetic Plast Surg*. 1989;13:55-58.
2. Wise RJ. A preliminary report on a method of planning the mammoplasty. *Plast Reconstr Surg*. 1956;17:367-375.
3. Strombeck JO. Mammoplasty: report of a new technique based on two pedicle procedure. *Br J Plast Surg*. 1960;13:79-90.
4. McKissock PK. Reduction mammoplasty with a vertical dermal flap. *Plast Reconstr Surg*. 1972;49:245-252.
5. Hirsowitz B, Moscona AR. Modification of the bipedicle vertical dermal flap technique in reduction mammoplasty. *Ann Plast Surg*. 1982;8:363-369.
6. Robbins TH. A reduction mammoplasty with the areola-nipple based on an inferior dermal pedicle. *Plast Reconstr Surg*. 1977;59:64-67.
7. Robbins TH. Reduction mammoplasty by the Robbins technique. *Plast Reconstr Surg*. 1987;79:308-309.
8. Lejour M, Abboud M, Declety A, Kertesz P. Reduction of mammoplasty scars: from a short inframammary scar to a vertical scar. *Ann Chir Plast Esthet*. 1990;35:369-379.
9. Lejour M. Vertical mammoplasty and liposuction of the breast. *Plast Reconstr Surg*. 1994;94:100-114.
10. Lejour M. Vertical mammoplasty: update and appraisal of late results. *Plast Reconstr Surg*. 1999;104:771-781.
11. Lassus C. A 30-year experience with vertical mammoplasty. *Plast Reconstr Surg*. 1996;97:373-380.
12. Orlando JC, Guthrie RH Jr. The superomedial dermal pedicle for nipple transposition. *Br J Plast Surg*. 1975;28:42-45.
13. Hauben DJ. Experience and refinements with the superomedial dermal pedicle for nipple-areola transposition in reduction mammoplasty. *Aesthetic Plast Surg*. 1984;8:189-194.
14. Hall-Findlay EJ. A simplified vertical reduction mammoplasty: shortening the learning curve. *Plast Reconstr Surg*. 1999;104:748-749.
15. Blondeel PN, Hamdi M, Vande Sijpe KA, Van Landuyt K, Thiessen FE, Monstrey S. The latero-central glandular pedicle technique for breast reduction. *Br J Plast Surg*. 2003;56:348-359.
16. Strauch B, Elkowitz M, Baum T, et al. Superolateral pedicle for breast surgery: an operation for all reasons. *Plast Reconstr Surg*. 2005;115:1269-1279.
17. Hamdi M, Van Landuyt K, Tonnard P, Verpaele A, Monstrey S. Septum-based mammoplasty: a surgical technique based on Wuringer's septum for breast reduction. *Plast Reconstr Surg*. 2009;123:443-454.
18. Ryssel H, Germann G, Reichenberger R. Craniomedial pedicled mammoplasty based on Wuringer's horizontal septum. *Aesthetic Plast Surg*. 2010;34:494-501.
19. Courtiss EH. Reduction mammoplasty by suction alone. *Plast Reconstr Surg*. 1993;92:1276-1284.
20. Jakubietz RG, Jakubietz DF, Gruenert JG, Schmidt K, Meffert RH, Jakubietz MG. Breast reduction by liposuction in females. *Aesthetic Plast Surg*. 2011;35:402-407.
21. Matarasso A, Courtiss EH. Suction mammoplasty: the use of suction lipectomy to reduce large breasts. *Plast Reconstr Surg*. 1991;87:709-717.
22. Matarasso A. Suction mammoplasty: the use of suction lipectomy to reduce large breasts. *Plast Reconstr Surg*. 2000;105:2604-2607.
23. Gray LN. Liposuction breast reduction. *Aesthetic Plast Surg*. 1998;22:159-162.

24. Gray LN. Update on experience with liposuction breast reduction. *Plast Reconstr Surg*. 2001;108:1006-1010.
25. Moskovitz MJ, Muskin E, Baxt SA. Outcome study in liposuction breast reduction. *Plast Reconstr Surg*. 2004;114:55-60.
26. Lejour M, Abboud M. Vertical mammoplasty without inframammary scar and with breast liposuction. *Perspect Plast Surg*. 1990;4:67-90.
27. Moskovitz MJ, Baxt SA, Jain AK, Hausman RE. Liposuction breast reduction: a prospective trial in African American women. *Plast Reconstr Surg*. 2007;119:718-726; discussion 727-728.
28. Lejour M. Vertical mammoplasty: early complications after 250 personal consecutive cases. *Plast Reconstr Surg*. 1999;104:764-770.
29. Pickford MA, Boorman JG. Early experience with the Lejour vertical scar reduction mammoplasty technique. *Br J Plast Surg*. 1993;46:516-522.
30. Kreithen J, Caffee H, Rosenberg J, et al. A comparison of the LeJour and Wise pattern methods of breast reduction. *Ann Plast Surg*. 2005;54:236-242.
31. Poell JG. Vertical reduction mammoplasty. *Aesthetic Plast Surg*. 2004;28:59-69.
32. Hamdi M, Greuse M, DeMey A, Webster MD. Breast sensation after superior pedicle versus inferior pedicle mammoplasty: prospective clinical evaluation. *Br J Plast Surg*. 1999;54:39-42.
33. Greuse M, Hamdi M, DeMey A. Breast sensitivity after vertical mammoplasty. *Plast Reconstr Surg*. 2001;107:970-976.
34. Hamdi M. Septum-based lateral or medial mammoplasty. In: Hamdi M, Hammond DC, Nahai F, ed. *Vertical Scar Mammoplasty*. Berlin, Germany: Springer Verlag; 2005:85-95.
35. Klein JA. Anesthetic formulation of tumescent solutions. *Dermatol Clin*. 1999;17:751-759.
36. Dafydd H, Roehl KR, Phillips LG, Dancey A, Peart F, Shokrollahi K. Redefining gigantomastia. *J Plast Reconstr Aesthet Surg*. 2011;64:160-163.
37. Hanna MK, Nahai F. Vertical reduction and mastopexy: problems and solutions. In: Hamdi M, Hammond DC, Nahai F, ed. *Vertical Scar Mammoplasty*. Berlin, Germany: Springer Verlag; 2005:123-130.
38. Boehm K, Nahai F. Vertical reduction: techniques. In: Mathes SJ, ed. *Plastic Surgery*. 2nd ed Vol. 6. Philadelphia: Saunders, Elsevier, 2006:588-600.
39. Bonomi S, Salvai A, Settembrini F, Gregorelli C, Musumarra G, Rapisarda V. Inferiorly based parenchymal flap mammoplasty: a safe, reliable, and versatile technique for breast reduction and mastopexy. *Plast Reconstr Surg*. 2012;130:116e-125e.
40. Lejour M. Reduction mammoplasty by suction alone (discussion of Courtiss EH). *Plast Reconstr Surg*. 1993;92:1286-1289.
41. Lejour M. Evaluation of fat in breast tissue removed by vertical mammoplasty. *Plast Reconstr Surg*. 1997;99:386-393.
42. Würinger E, Mader N, Posch E, Holle J. Nerve and vessel supplying ligamentous suspension of the mammary gland. *Plast Reconstr Surg*. 1998;101:1486-1493.
43. Bayramiçli M. The central pillar technique: a new septum-based pedicle design for reduction mammoplasty. *Aesthet Surg J*. 2012;32:578-590.