

Ultrasonographically Determined Pedicled Breast Reduction in Severe Gigantomastia

Karaca Başaran, M.D.
Adem Ucar, M.D.
Erdem Guven, M.D.
Atilla Arinci, M.D.
Memet Yazar, M.D.
Samet Vasfi Kuvat, M.D.

Istanbul, Turkey

Background: The free nipple breast reduction method has certain disadvantages, such as nipple hyposensitivity, loss of lactation, and loss of projection. To eliminate these risks, the authors describe a patient-based breast reduction technique in which the major supplier vessels of the nipple-areola complex were determined by color Doppler ultrasonography. Pedicles containing these vessels were designed for reductions.

Methods: Sixteen severe gigantomastia patients with a mean age of 41 years (range, 23 to 60 years) were included in the study. Major nipple-areola complex perforators were determined with 13- to 5-MHz linear probe Doppler ultrasonography before surgery. Pedicles were designed according to the vessel locations, and reductions were performed with superomedial-, superolateral-, or mediolateral-based designs.

Results: Different combinations of internal mammary and lateral thoracic artery perforator–based reductions were achieved. None of the patients had areola necrosis. Mean reduction weight was 1795 g (range, 1320 to 2280) per breast.

Conclusions: Instead of using standard markings for severe gigantomastia patients, custom-made and sonographically determined pedicles were used. This technique can be considered as a “guide” for the surgeon during very large breast reductions. (*Plast. Reconstr. Surg.* 128: 252e, 2011.)

Various techniques can be used to reduce mild to moderately large breasts. However, the ideal reduction method for severe gigantomastia cases (1 kg per breast reduction) remains controversial. Therefore, most of the authors still prefer the “free nipple” technique.¹

Major disadvantages of the free nipple technique are nipple hypopigmentation, graft failure, and decreased breast projection.^{2,3} Therefore, it would be wise to use a pedicled technique where the nipple-areola complex is preserved. For this purpose, we aimed to design a study where safe, ultrasonographically determined, “custom-made” pedicles were chosen for breast reduction.

The major supply of the nipple-areola complex was determined radiologically by a highly sensitive Doppler ultrasonographic probe. Pedicles containing these major perforators were designed instead of using conventional markings. Breast reductions with different pedicle designs were accomplished accordingly.

From the Departments of Plastic and Reconstructive Surgery and Radiology, Istanbul Medical Faculty.

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PATIENTS AND METHODS

Sixteen patients with severe gigantomastia and a mean age of 41 years (range, 23 to 60 years) were included in the study. Patients were followed up for 15 months (range, 6 to 19 months) on average. Mean body mass index was 32.6 kg/m² (range, 24 to 60 kg/m²). Patient data were recorded, including age, weight, body mass index, additional diseases, and cigarette smoking status (Table 1). Standard measurements, such as suprasternal notch-to-nipple and nipple-to-inframammary crease distances, were recorded.

Radiographic Analysis

Patients were analyzed by the same radiologist (A.U.) before surgery and marked in supine position with 13- to 5-MHz linear probe (Antares; Siemens, Erlangen, Germany) Doppler ultrasonography. The probe was placed on the breast starting around the areola and traveling medially, laterally, and cranially. Vessels in continuity with the areola were marked. Perforators not in con-

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Table 1. Patient Demographics, Breast Measurements, and Resection Weights

	Value
No. of patients	16
Age, years	
Mean	41
Range	23–60
Body-mass index, kg/m ²	
Mean	32.6
Range	24–40
Follow-up, months	
Mean	15
Range	6–19
Suprasternal notch–to–nipple distance, cm	
Right	37
Left	36
Range	32–42
Nipple–to–inframammary sulcus distance, cm	
Right	19
Left	18
Range	17–23
Weight of resection per breast, g	
Right	1810
Left	1780
Range	1320–2280

tinuity with the periareolar region were excluded. Vessels traveling most superficial to the skin surface, with the largest diameter and linear axis, were marked roughly on the skin surface. For the purpose of documentation, the supply artery at the entrance to the areola was designated as zone 3. The artery entrance to the breast tissue whether laterally or medially was called zone 1. Finally, zone 2 was designated as the region between these zones (Fig. 1). Artery diameter and depth measurements were recorded from all zones bilaterally (Table 2). For example, the mean arterial diam-

eter was 1.35 mm at zone 1, 1.1 mm at zone 2, and 0.85 mm at zone 3. Mean skin surface distances were 10.5 mm at zone 1, 10.25 mm at zone 2, and 8.45 mm at zone 3. An example of Doppler images in all zones of a patient is shown in Figure 1.

Patient Markings

After determination of the major vessels entering the areola, patients were marked in the standing position. Wise pattern skin excision was planned. Standard sternal notch, midline, inframammary folds, and meridians were marked. The new nipple site was determined at the level of the inframammary fold. The amount of skin excision was determined during breast movement medially and laterally. Keyhole limb angles were determined later. With attention to the preoperatively determined major perforator localizations, pedicles containing the nipple-areola complex were marked roughly. The artery entering the pedicle was highlighted in case further thinning or base narrowing during surgery was needed.

Surgical Technique

After standard Wise pattern breast reduction incisions, the pedicle is incised and deepithelialized (Fig. 2). The pedicle containing the areola is raised with a 2-cm thickness and beveled toward the base. The pedicle is not thinned or narrowed at this point before inset of the areola. The glandular tissue remaining inferior, lateral, or medial to the pedicle is excised en bloc. Whether the areola fits its new position easily is checked. Further thinning or base narrowing is performed as

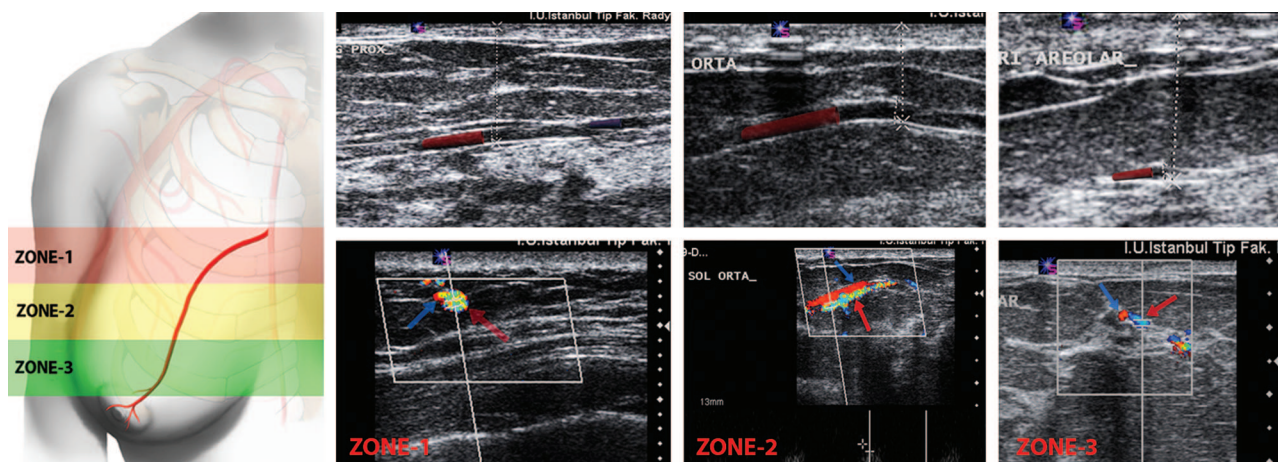


Fig. 1. Doppler images of the main perforators. For the purpose of documentation, measurements were taken in three different zones. The dotted lines designate the distance of the artery to the surface in all zones. Arteries are highlighted with red, whereas veins are highlighted with blue (above). Red arrows indicate the artery, whereas the blue arrows designate the veins on spectral images (below).

Table 2. Artery Diameter and Depth Measurements in Three Zones

	Diameter (mm)		Depth (mm)	
	Mean	Range	Mean	Range
Right				
Zone 1	1.4	1.3–2.1	10.6	8.7–14.8
Zone 2	1.1	0.9–2.0	10.3	8.3–14.5
Zone 3	0.8	0.5–1.2	8.8	5.4–11.7
Left				
Zone 1	1.3	1.2–2.2	10.4	7.9–14.0
Zone 2	1.1	0.8–1.9	10.2	7.1–14.1
Zone 3	0.9	0.4–1.1	8.1	6.1–10.9

required. The precise entrance of the vessels to the pedicle enables the surgeon to stay away from the dangerous points at this moment. After rotation and adaptation of the areola, inferior keyhole limbs and T-point sutures are placed. Finally, the skin is closed and drains are placed. The major surgical steps are demonstrated in Figure 2.

RESULTS

Pedicles originating at the internal mammary artery in 10 patients, the lateral thoracic artery in four patients, and the combination of both (internal mammary artery and lateral thoracic artery) in two patients were used (Figs. 3 and 4). Mean resection weight was 1810 g (range, 1380 to 2280 g) for the right breast and 1780 g (range, 1320 to 2220 g) for the left breast. None of the patients had areola necrosis. Bottoming-out in three patients and subjective nipple hypesthesia in three patients were recorded. Patients were followed for complications such as minor skin breakdown, seroma, hematoma, necrosis, infection, and revision requirements (Table 3).

DISCUSSION

Preservation of the nipple-areola complex cannot be explained as simply “continuation of secondary sex characteristics.” Therefore, most surgeons still insist on preservation of the nipple-areola complex.^{3–12} However, the ideal technique for preserving the nipple-areola complex during breast reduction in gigantomastia patients is still arguable.

The free nipple technique is a relatively simple and safe method for reducing large breasts within a short operative time. Inverted T-scar free nipple reduction was first described by Thorek in 1922.⁴ The main disadvantages are nipple malposition, partial or total nipple-areola loss, areola pigmentation changes, and loss of breast projection.⁵

The optimal method of reduction for severe gigantomastia (1 kg reduction per breast) patients is not clear. The use of vertical scar mammoplasty, which has been regarded as a suitable method for mild to moderate breasts,^{6,7} is limited for large breasts.² Inferior pedicled breast reduction is the most commonly used physiologic (with nipple-areola complex preservation) method for breasts with large volume and skin envelope.^{6–8,13–15} However, it has certain disadvantages,⁸ including the difficulty of using it for breast volumes over 1100 g, impaired wound healing seen commonly at the T region, leaving too much scar, projection loss, and bottoming-out deformities observed in the long term.^{2,16}

Superomedial pedicled reduction was first described by Orlando and Guthrie in 1975.^{17,18} It was later modified by Hall-Findlay. The Hall-Findlay method is an effective and reliable way of reducing a large amount of breast with short scars. It also has a low complication rate.¹⁹ For example, in a study conducted by Serra et al.,²⁰ 210 patients had vertical scar superomedial pedicled (Hall-Findlay method) breast reductions. The total complication rate was 10 percent, with a 5.2 percent revision rate. Although this technique has certain advantages in most cases, it cannot be considered ideal for all cases.¹³

Another popular reduction technique is the superolateral pedicled method. In a series reported by Cárdenas-Camarena,²¹ this technique was applied to 702 patients, with a mean reduction weight of 660 g (maximum, 1380 g). They had nipple necrosis in nine cases only. Strauch et al.²² used the same method in patients with reductions over 1500 g and reported a nipple loss rate of only 0.2 percent.

The main arteries supplying the nipple-areola complex were reported as internal thoracic, lateral thoracic, thoracoacromial, and intercostal perforators.^{23–25} According to Palmer and Taylor,²⁶ the internal thoracic artery was the dominant perforator in 70 percent of cases. The only vessel to contribute 100 percent to nipple-areola complex viability (thus demonstrating its importance) was found to be the internal thoracic artery.

According to Hall-Findlay,²⁷ the breast has two main arterial systems, which are the deep and the superficial systems. The deep system that originates mainly from the fourth intercostal branch of the internal mammary artery constitutes the central and the inferior pedicles. These pedicles cannot be found with a handheld Doppler device. In contrast, the superficial system is composed of the superolateral pedicle (lateral thoracic artery), su-

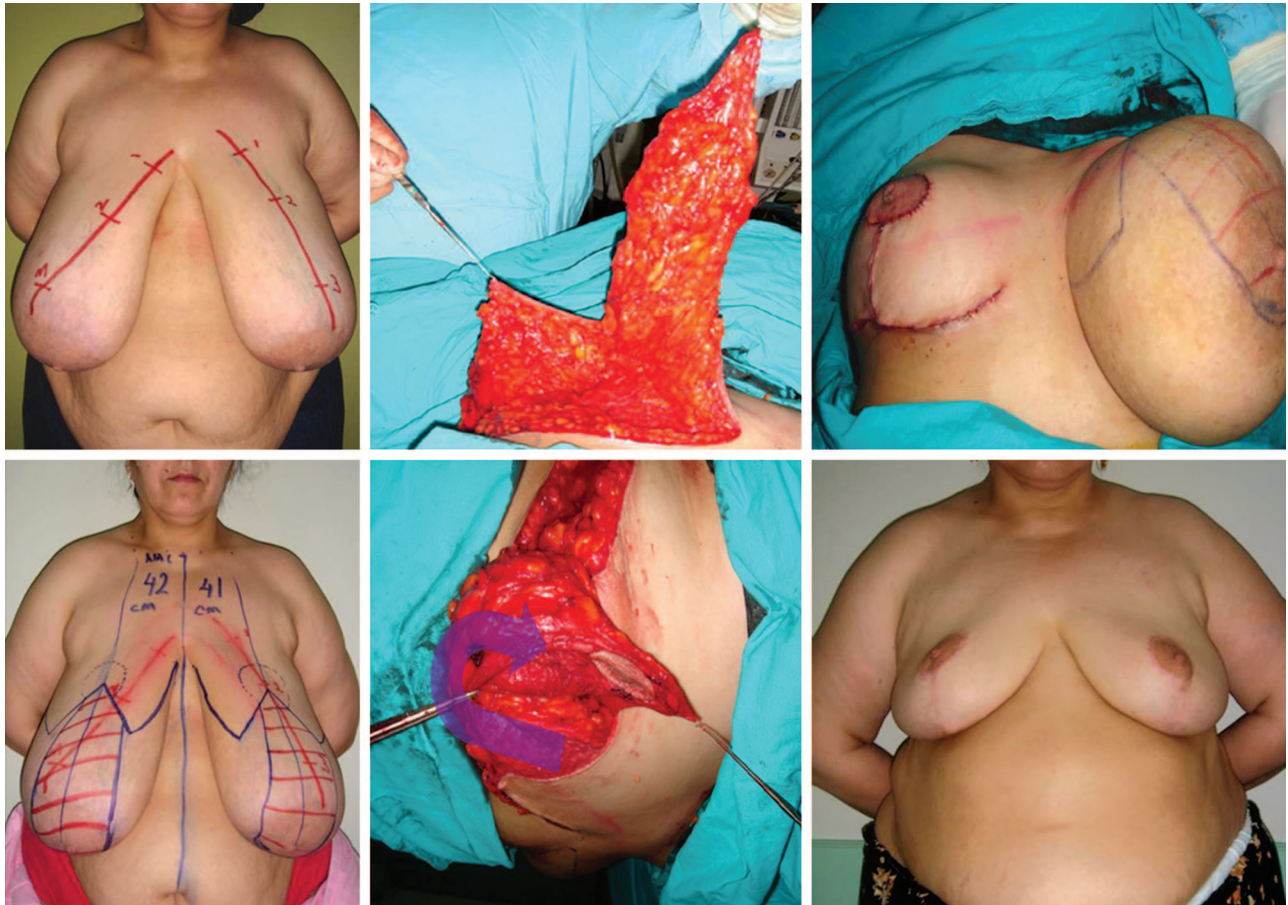


Fig. 2. Patient markings and the operative technique. (Above, left) Preoperative markings and identification of the major pedicle reaching the areola radiologically. (Below, left) Rough design of the pedicles that could possibly be modified during surgery. (Center) The pedicle is raised and rotated almost 90 degrees. (Above, right) Perioperative view. (Below, right) Early postoperative result.

terior pedicles (internal mammary artery, second intercostal space), and the medial pedicle (internal mammary artery, third intercostal space). These vessels (particularly the superior pedicles) are quite superficial (approximately 1 cm deep), which enables them to be found with a handheld Doppler probe.

Michelle le Roux et al.²⁸ noticed that the internal mammary artery perforators and superficial veins were traveling quite superficial around the areola, approximately 1 cm deep, which was very similar to our findings. This necessitates very gentle and precise tissue handling around the areola. In our study, we found that the main perforators originated mostly from the internal mammary artery and secondarily from the lateral thoracic artery. With guidance of the exact location of the strongest perforator, we could reduce severe cases (average reduction weight, 1795 g per breast) confidently.

In this study, we preferred to use personal and sonographically determined pedicles instead of

the above-mentioned standard reduction techniques. In the literature, breast vasculature assessment before reduction has been used by some authors. For example, Hall-Findlay evaluated 83 patients for the superior pedicle with a Doppler device. She roughly documented the locations of pedicles. However, this evaluation was not performed on severe gigantomastia patients, in which the viability of the nipple-areola complex was of great concern.²⁷ Hall-Findlay²⁹ suggested that the superomedial perforator usually entered the areolar opening just medial to the breast meridian, which was 1 cm deep to the surface. She also marked the superficial branch of the lateral thoracic artery for hemostasis during surgery.

In a short letter published by Horta et al.,³⁰ the authors detected the exact location of the superomedial pedicle by a handheld Doppler device. They became sure that the main superolateral or superomedial perforator was included in the pedicle. Although the mean reduction weight was 820 g in their study, they particularly suggested

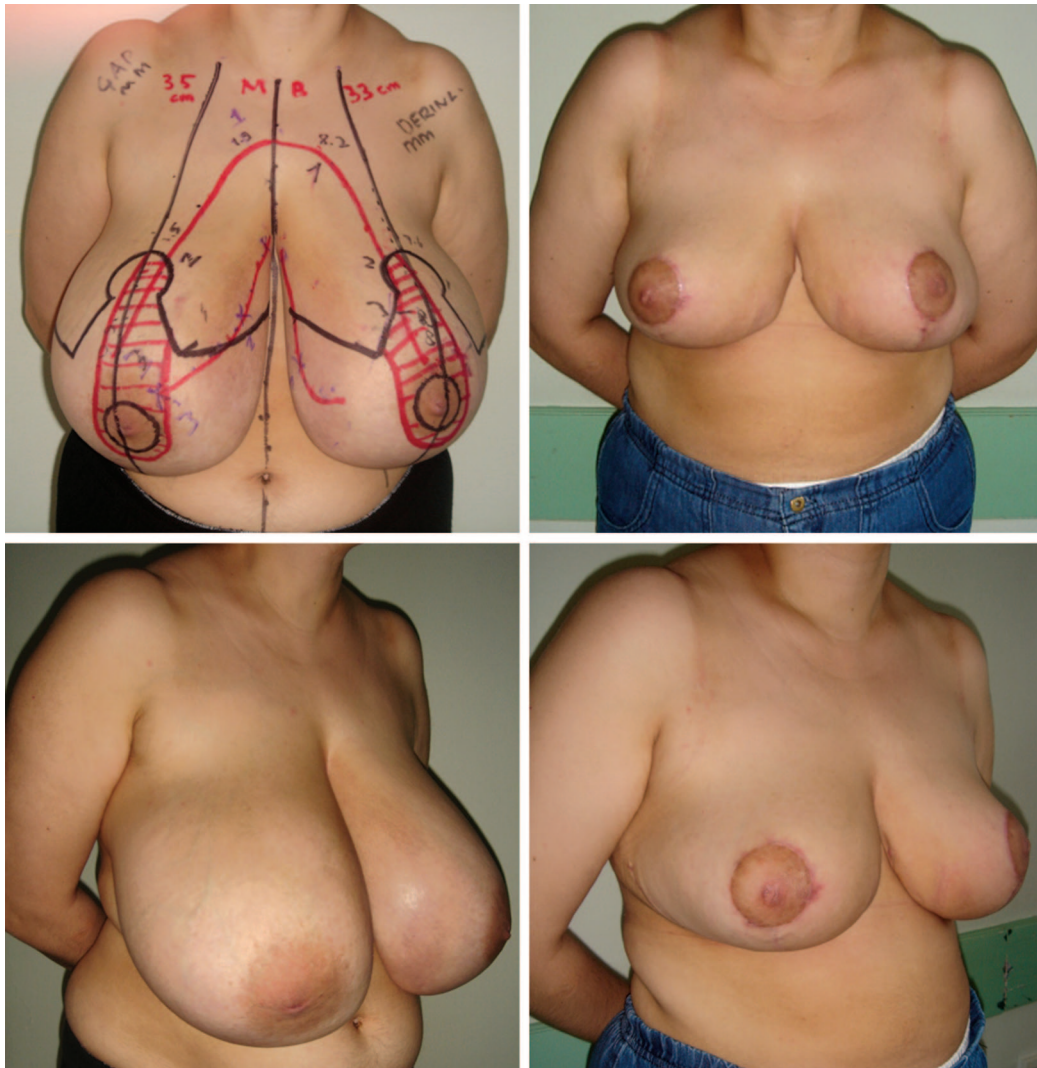


Fig. 3. (Left) Preoperative and (right) 5-month postoperative views.

that the use of Doppler would be wise for severe breast hypertrophy cases.

Initially, we also used a handheld Doppler probe together with color Doppler imaging where the signals corresponded to the latter. However, the sensitivity (vessel depth and the location) was very crucial in terms of nipple viability. Therefore, to be more precise, we used a highly sensitive Doppler probe instead of a handheld one. This was particularly important during the pedicle base narrowing or thinning.

With popularization of perforators, preoperative evaluation of these vessels has become more important. The modalities used mostly are magnetic resonance or computed tomographic angiography and Doppler ultrasonography.^{31,32} Cina et al.³¹ compared multidetector computed tomography and color Doppler ultrasonography for

deep inferior epigastric perforator flaps in breast reconstruction. They found that color Doppler imaging was more useful for vessel size. However, they noted the effectiveness of multidetector computed tomography to visualize the intramuscular track and superficial venous connections of the perforators. With regard to cost-effectiveness and patient health, Doppler ultrasonography seems to be a better option. In our study, we visualized the perforators with a sensitive Doppler ultrasonography probe that can detect arteries as small as 0.2 mm in diameter.

One major point is the venous return of the areola. In a study conducted by Michelle le Roux et al.,²⁸ veins were found very superficial, particularly medial to the areola. A major problem with areola necrosis has commonly been caused by venous insufficiency. To reduce the risk of venous

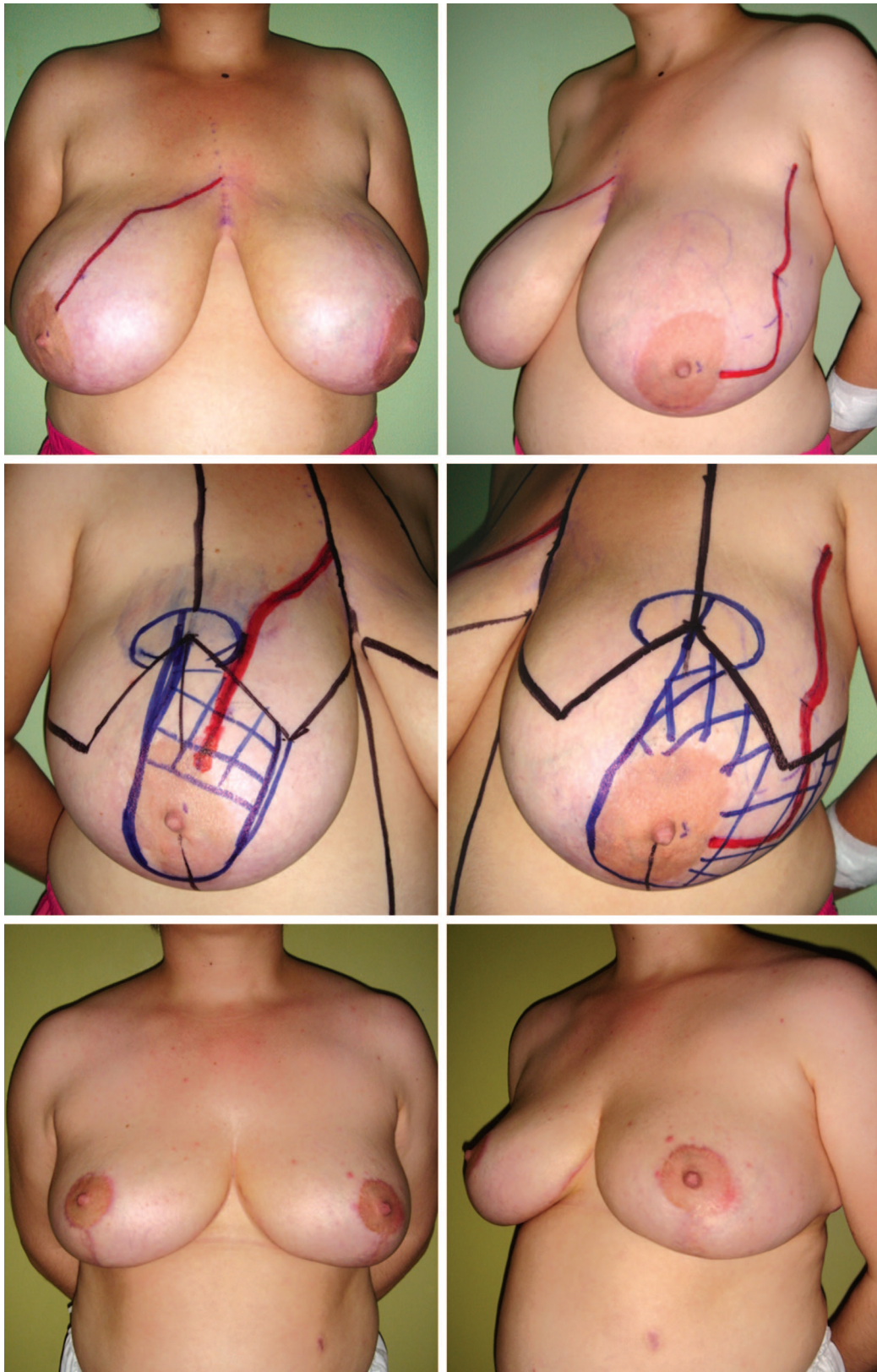


Fig. 4. (Above and center) Preoperative and (below) 1-year postoperative views. Asymmetric pedicles were chosen (superomedial on the left breast and superolateral on the right breast).

Table 3. Complications

	No. (%)
No. of patients	16
Complications	
Infection	0 (0)
Wound breakdown (T point)	2 (12.5)
Hematoma	0 (0)
Seroma	0 (0)
Hypertrophic scar	1 (6.25)
Scar revision	2 (12.5)
Nipple necrosis	0 (0)
Nipple hypesthesia	3 (18.75)
Bottoming-out deformity	3 (18.75)

problems, certain precautions have been taken. First, during radiologic evaluation, veins concomitant or adjacent to the main perforators have been searched for. They have been included in the pedicle as much as possible, particularly around the areola. Other than the deep plexus, the importance of the superficial venous plexus has been demonstrated by Michelle le Roux et al.²⁸ To preserve the superficial plexus, particularly around the areola, deepithelialization was performed cautiously. Visible superficial veins were included and marked. They were not disrupted during secondary pedicle revisions. Lastly, we did not use injections before deepithelialization, to prevent vein damage.

Nipple sensitivity is another point to be discussed. Nipple-areola complex sensibility is very difficult to determine. In the literature, there is no strict consensus regarding the innervation of the nipple. Comparison of the superomedial and superolateral pedicles has been performed.³³ In the superomedial technique described by Hall-Findlay,²⁹ the author thought that breast sensation was quite satisfactory because of preservation of the superficial and deep branches of the fourth nerve together with the anterior intercostal system and clavicular nerves. However, Cárdenas-Camarena²¹ reported the superiority of the superolateral pedicle because of preservation of the major nerve of the nipple, which was the lateral cutaneous branch of the fourth intercostal nerve. In our study, because of the versatility of the pedicles, nipple sensation could not be addressed. However, theoretically, the lateral cutaneous branches of the fourth nerve for the superolateral pedicle and the anterior intercostal branches for the superomedial pedicles could have been preserved. Further studies are required to prove this judgment. In addition, already diminished sensation of gigantomastia patients preoperatively was another difficulty in evaluation of the sensibility. In our study, three patients re-

ported nipple hypesthesia, which was a subjective assessment.

Lactation capacity after surgery is another topic of discussion. Although lactation is related more to the amount of glandular tissue left behind, further studies are required to evaluate effective lactation after different pedicled reductions. Cruz and Korchin³⁴ reported a high incidence of breastfeeding difficulties even before reduction, a finding that makes this topic more complicated.

In severe cases of gigantomastia, we think that preoperative radiographic evaluation and documentation of the main nipple-areola complex supply has certain advantages. First, a custom-made, patient-specific reduction is possible instead of only standard techniques. These breasts are already distorted anatomically, and it is not wise to rely on standard pedicle designs. Variability of the vessels even between the same breasts of the patient puts the patient at risk. The strongest pedicle, the superomedial pedicle, can emerge from different intercostal spaces and travel uniquely.²⁹ This is more important for severe mammary hypertrophy cases where nipple-areola complex viability is at risk during pedicled reductions. Thinner pedicles could be prepared to enable rotation easily. For example, in cases where pedicle reduction is required, the pedicle could be thinned from the deep surface and kept away from the major artery entrances to the pedicle. Even the pedicle bases could be incised when necessary.

CONCLUSIONS

The main advantage of our method is prevention of the disadvantages of free nipple breast reduction as mentioned above. However, our technique's main objective was not to prove the use of pedicled reductions in very large breasts. We suppose that "ultrasonographically determined pedicled breast reduction" should be considered as a "guide" for the surgeon during very large breast reductions. A handheld Doppler probe can also be used before the pedicle design, which is more practical. We strongly encourage surgeons to at least check the vessels before surgery with a handheld Doppler probe. However, it is without doubt less sensitive than the highly sensitive color Doppler imaging. Although there are certain advantages of the technique we described previously, the involvement of the radiologist, the requirement of an ultrasonographic device, and the additional cost of the examination might be considered as disadvantages.

Karaca Başaran, M.D.

Plastic Reconstructive and Aesthetic Surgery
Istanbul Medical Faculty
Istanbul University
34093 Çapa
Fatih, Istanbul, Turkey
basarankaraca@gmail.com

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