Original Article

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Detection of the Superior Perforator with Doppler Ultrasonography in Superomedial Pedicle Reduction Mammaplasty: A Retrospective Evaluation of Vascular Safety

Mert Ersan, Hilal Aybüke Yıldız

Department of Plastic, Reconstructive and Aesthetic Surgery, Yeditepe University Faculty of Medicine, İstanbul, Türkiye

ABSTRACT

Objective: The superomedial pedicle technique combines aesthetic advantages with reliable vascularity in reduction mammaplasty. This study evaluated the safety and clinical outcomes of Doppler ultrasonography–guided identification of the superior perforator in the superomedial pedicle design.

Materials and Methods: This retrospective study included 22 female patients who underwent bilateral superomedial pedicle reduction mammaplasty between April 2023 and April 2025. In all patients, the superior perforator was detected preoperatively using a portable handheld Doppler ultrasonography device and was incorporated into the pedicle design. All patients underwent surgery via an inverted-T pattern with the superomedial pedicle. The mean follow-up period was 1.2 years.

Results: The superior perforator was identified in all patients (mean time: 3.0±0.4 minutes). No partial or total necrosis of the nipple-areola complex was observed in any patient. Wound dehiscence occurred at the T-incision site in four patients, transient areolar hypoesthesia was observed in three patients, and hypertrophic scarring developed in one patient. Aesthetic outcomes were evaluated in all patients by physical examination and standardized photography.

Conclusion: Detection of the superior perforator with Doppler ultrasonography enables individualized planning of the superomedial pedicle and enhances vascular safety. This approach provides a feasible, individualized, and reliable surgical technique for reduction mammaplasty, thereby reducing complication rates.

Keywords: Doppler ultrasonography; mammaplasty; perforator flap; surgical flaps; treatment outcome

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Key Points

- Preoperative Doppler ultrasonography enables identification of the superior perforator and individualized planning of the superomedial pedicle.
- Incorporating the superior perforator increases vascular safety and minimizes the risk of nipple–areola complex necrosis.
- The superomedial pedicle technique provides reliable outcomes, low complication rates, and satisfactory aesthetic outcomes in reduction mammaplasty.

Introduction

Reduction mammaplasty is one of the fundamental procedures in plastic surgery, performed to alleviate physical complaints and improve aesthetic appearance (1-3). One of the most critical factors determining surgical success in these operations is the safe transposition of the nipple-areola complex (NAC) to its new anatomical location while preserving adequate vascularity. Therefore, the choice of pedicle in surgery plays a crucial role in maintaining circulation and achieving aesthetic outcomes.

Several pedicle techniques have been described in the literature, including inferior, superior, medial, lateral, central, and superomedial approaches (3, 4). The superomedial pedicle provides dual perfusion by incorporating both superior and medial perforators. This dual perfusion offers an anatomical advantage, particularly in large and ptotic breasts in which the rotational distance of the NAC is increased (5). However, despite its anatomical reliability, variability in the location and dominance of perforators may still pose a risk for ischemic complications.

Corresponding Author:
Hilal Aybüke Yıldız MD; aybuke.yildiz@yeditepe.edu.tr

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Doppler ultrasonography is increasingly used in pedicle planning due to its noninvasive nature, practicality, and ability to localize perforators in real time (6). In particular, since the superior perforators run approximately 1 cm beneath the skin, these vessels can be identified by Doppler ultrasonography (3).

The aim of this study was to retrospectively evaluate the effects on vascular safety and complication rates of including superior perforators, identified by handheld Doppler ultrasonography, in the medial pedicle during reduction mammaplasties performed with the superomedial pedicle technique. We hypothesized that preoperative Doppler identification of the superior perforator would enhance vascular safety and reduce complication rates in superomedial pedicle reduction mammaplasty.

Materials and Methods

Study Design

This retrospective study included 22 female patients who presented to the Yeditepe University Kozyatağı Hospital from April 2023 to April 2025 with complaints of breast hypertrophy (macromastia) and underwent bilateral superomedial-pedicle reduction mammaplasty. All surgeries were performed by the same plastic surgeon (M.E.). This study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Yeditepe University Non-Interventional Clinical Research Institutional Review Board on September 9, 2025. The approval was documented under the application number 2025-08-Y0918. Informed consent was obtained from all participating patients. This study received no external funding. The primary outcome of the study was the incidence of NAC necrosis. Secondary outcomes included other postoperative complications, such as hematoma, seroma, and surgical site infection, and minor complications, including wound dehiscence, hypertrophic scarring, and areolar hypoesthesia. In addition, aesthetic satisfaction was assessed based on standardized clinical examination and photographic evaluation.

Patient Selection

Female patients aged 18–59 years, classified as American Society of Anesthesiologists (ASA) I or II by the ASA, were included in the study. Breast ultrasonography was requested for all patients under 40, and mammography for those aged 40 or older. Patients with BIRADS 1 or 2 results were included, while those with BIRADS 3 findings were referred to the general surgery department for further evaluation by specialists before inclusion in the study. Patients scheduled for revision surgery, those with a history of breast or axillary surgery, those diagnosed with breast cancer or other prior breast disease, those with coagulopathy or severe systemic disease, and those unable to provide informed consent were excluded from the study.

Ultrasonographic Mapping

A portable high-frequency ultrasound device (Clarius L20, Clarius Mobile Health, Canada) was used to detect the superior perforator. During ultrasonography, power Doppler mode was activated to evaluate flow direction and intensity in the vessels. The procedure was performed directly by the primary surgeon (M.E.). The ultrasonographic image of the superior perforator is shown in Figure 1.

Imaging was performed with the patient supine during preoperative markings to ensure consistency with the surgical position. The superior perforator was typically sought and identified along the medial border of the pectoralis major muscle at the level of the second intercostal space. The Power Doppler mode, using a high-frequency linear probe, clearly visualized arterial flow approximately 1 cm beneath the skin surface.

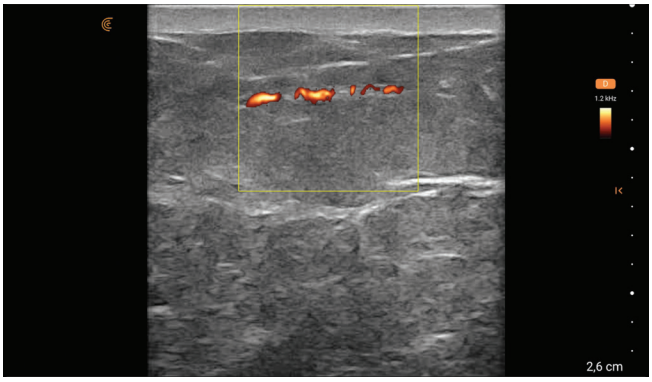

Figure 1. Visualization of the superior perforator using a high-frequency ultrasound device (Clarius L20, Clarius Mobile Health, Canada)

The identified perforator was marked on the skin and included in the surgical plan. Once the patient was positioned on the operating table, the same region was re-evaluated intraoperatively, and the location of the perforator was confirmed. This allowed the preoperative mapping and intraoperative vascular localization to be harmonized and the pedicle boundaries to be determined to include this vascular structure.

Using this method, the superior perforator was incorporated into the pedicle, creating a superomedial pedicle supplied by both superior and medial sources and enhancing vascular safety.

Surgical Technique

All patients were placed under general endotracheal anesthesia. After appropriate positioning, skin antisepsis was performed, and sterile draping was applied. The surgical plan, previously drawn to include the superior perforator identified by Doppler ultrasonography, was followed for bilateral superomedial pedicle-based breast reduction.

The pedicle was de-epithelialized within the planned borders. Adequate amounts of breast parenchyma were excised from the inferior and lateral quadrants via surgical incisions. The superior perforator was identified during excision, and its vascular integrity was preserved. After achieving hemostasis, the pedicle was transposed to its new position.

Flap fixation was achieved with 2/0 polydioxanone sutures in combination with 2/0 and 3/0 poliglecaprone sutures. Subcutaneous tissue was closed continuously with 4/0 poliglecaprone, and the areolar circumference with 5/0 poliglecaprone. Size-10 active silicone drains (Jackson-Pratt; Ethicon, Johnson & Johnson, USA) were placed in each breast. Steri-Strip (3M, USA) was applied along the incision lines. The procedure was completed with the application of appropriate dressings and a medical-grade breast support garment.

Postoperative Evaluation

Patients were evaluated postoperatively at 1, 3, 6, and 12 hours and on postoperative day 1 for NAC circulation and possible complications. Discharge was planned when drainage volumes fell below 25 mL (typically postoperative day 1 or 2), and patients were prescribed antibiotics and anti-inflammatory medications.

At the first-week follow-up, wound sites were re-evaluated, Steri-Strips were reapplied, and wound care instructions were provided. Patients were instructed to continue wearing the medical breast support bra until postoperative week 4.

At postoperative week 1 and at months 1, 3, 6, and 12, standardized photographs were taken using a digital camera (Canon EOS 5D Mark II, Canon Inc., Tokyo, Japan).

Statistical Analysis

The data obtained in this study were analyzed using descriptive statistics. For continuous variables, the mean, standard deviation, minimum, and maximum were reported; for categorical variables, frequencies and percentages (%) were presented. Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA). In addition, an a priori power analysis was performed using PASS software (NCSS, Power Analysis and Sample Size, Version 11.0, Utah, USA), based on the complication rates reported in the literature, to determine the required sample size (2). To assess a reduction in complication rates from 15% ($P_0 = 0.15$) to 5% ($P_1 = 0.05$), a two-sided binomial test at the 0.05 significance level ($\alpha = 0.05$) was used. The required sample size was calculated to be 75 breasts (corresponding to 38 patients) to achieve 83% statistical power. However, due to the retrospective design and strict inclusion criteria, the final sample consisted of 22 patients (44 breasts), which limited the study to descriptive analysis. There were no missing data, and no patients were lost to follow-up during the study period.

Results

As the sample size was limited, only descriptive statistics were presented; no comparative or inferential analyses were performed. The mean age of the 22 female patients included in the study was 39 years (range: 24–56 years), and the mean body mass index was 30.8 kg/m² (range: 23.4–36.2). Two patients (9.1%) had type 2 diabetes, and three (13.6%) were active smokers. The mean follow-up period was 1.2 years, with the shortest follow-up being 6 months and the longest being 24 months.

In all cases, the superior perforator was successfully identified preoperatively using handheld Doppler ultrasonography. The superior perforator was identified in all patients within 3.0±0.4 minutes. The perforators were typically located at the level of the second intercostal space and approximately 1 cm below the skin surface. Video 1 and Video 2 show sagittal and transverse sectional views and power Doppler imaging of the superior perforator. In all patients, the superomedial pedicle was shaped to include this perforator. Surgical excisions were performed using the inverted-T resection pattern in all cases.

The mean weight of excised tissue was 512 g for the right breast (range: 312–1220 g) and 503 g for the left breast (range: 323–1118 g). The mean operative time was 138±16 minutes. Pedicle rotation was performed while preserving vascular integrity in all cases.

No partial or total NAC necrosis was observed in any patient (Figure 2). Major complications such as hematoma, seroma, or infection were not observed. Minor complications included dehiscence at the junction of the T-incision in four patients (18.1%), hypertrophic scarring in one patient (4.5%), and transient areolar hypoesthesia resolving within three months in three patients (13.6%).

In follow-up evaluations conducted through physical examination and standardized photography, all patients reported high levels of satisfaction both aesthetically and functionally (Figure 3). Demographic, surgical, and postoperative data are presented in Table 1.

Discussion and Conclusion

In this series of 22 patients, Doppler-guided identification of the superior perforator enabled consistent inclusion of a reliable vascular source, with no cases of NAC necrosis and a low overall complication rate. Reduction mammaplasty is an effective surgical intervention that addresses not only aesthetic concerns but also functional problems such as neck and shoulder pain, intertrigo, physical limitations, and social discomfort (7). The primary determinant of surgical success is the ability to safely transfer the NAC to its new anatomical position while preserving circulatory integrity. In this context, the type of pedicle selected plays a critical role in both vascular safety and aesthetic outcomes.

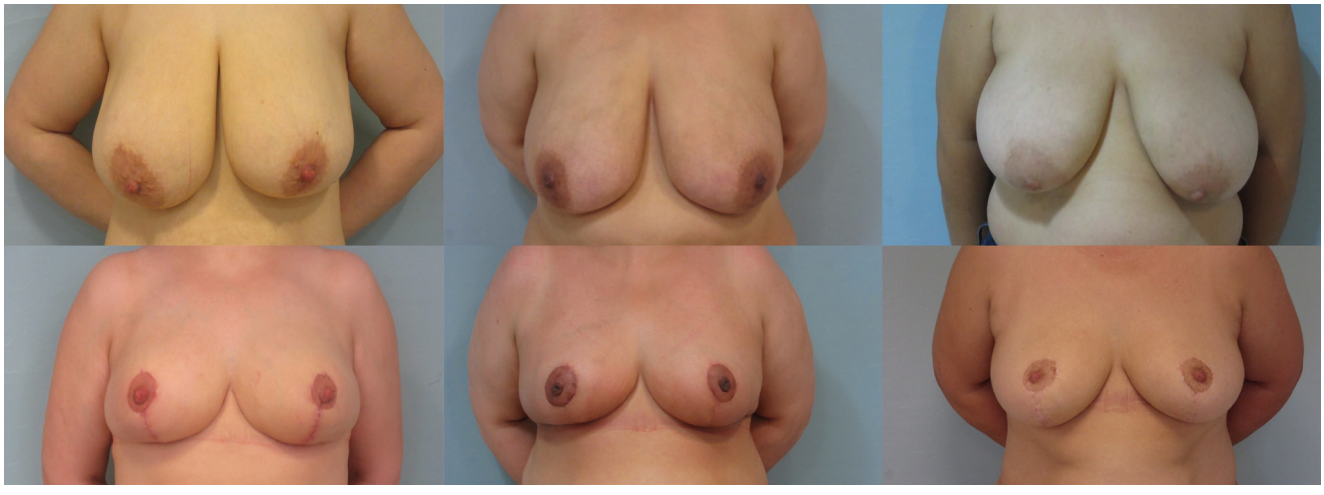

Figure 2. Preoperative and postoperative images (1st month, 6th month, and 1st year from left to right) of three different patients. Neither partial nor total nipple-areola complex necrosis was observed in any patient

Figure 3. Preoperative and postoperative 1st month views of a 43-year-old patient presenting with macromastia, who underwent superomedial pedicle inverted-T scar reduction mammaplasty after localization of the superior perforator by ultrasound. No major complications, including partial or total nipple-areola complex necrosis, hematoma, seroma, or infection, were observed, A: Preoperative frontal view, B: Preoperative right oblique view, C: Preoperative right lateral view, D: Preoperative left oblique view, E: Preoperative left lateral view, F: Postoperative 1st month frontal view, G: Postoperative 1st month right oblique view, H: Postoperative 1st month right lateral view, I: Postoperative 1st month left oblique view, J: Postoperative 1st month left lateral view

Table 1. Demographic, surgical and postoperative data

Variable	Mean ± standard deviation or n (%)
Age (years)	39±17
Body mass index (kg/m²)	30.8±7.4
Patients with type 2 diabetes	2 (9.1%)
Active smokers	3 (13.6%)
Follow-up period (months)	6–24
Superior perforator detection time (minutes)	3.0±0.4
Excised tissue (right breast, g)	512±205
Excised tissue (left breast, g)	503±198
Operative time (minutes)	138±16
Nipple-areola complex necrosis	0
Hematoma, seroma, infection	0
Minor complications	Dehiscence: 4 (18.1%), hypertrophic scar: 1 (4.5%), areolar hypoesthesia: 3 (13.6%)

The main pedicle techniques described in the literature include the inferior, superior, medial, central, lateral, and superomedial pedicles (3, 4). Each technique is vascularized by different arterial sources and varies in surgical applicability, rotational flexibility, aesthetic projection, and risk of complications. The inferior pedicle is supplied by anterior perforating branches of the internal thoracic artery and superficial branches of the lateral thoracic artery. It is technically straightforward but has been associated with long-term disadvantages such as "bottoming-out" deformity (8). The central pedicle directly supplies the NAC through internal thoracic perforators within the breast parenchyma (9). However, because of the intraparenchymal location of the perforators, it carries certain risks during breast reduction surgery (10).

The superior pedicle is nourished by internal thoracic artery perforators emerging at the level of the second intercostal space. Because of its more superficial course, it can be easily identified using Doppler ultrasonography and safely used in small- to moderately sized breasts owing to its short rotation distance (3). The medial pedicle is usually supplied by branches of the internal thoracic artery arising at the level of the third intercostal space. Advantages of this pedicle include preservation of the breast ducts, preservation of breast sensation, and the potential to provide aesthetically pleasing medial breast fullness (3).

However, when planned alone, the medial pedicle may limit vascular safety, particularly in large reductions or when long rotational distances are required. Insufficient perfusion at the distal tip of the pedicle may lead to venous congestion or necrosis of the NAC.

The superomedial pedicle offers a significant advantage in overcoming the limitations of the medial pedicle. The combined use of medial and superior perforators expands the vascular base of the pedicle. This dual perfusion plays a critical role, particularly in large-volume breasts and cases of advanced ptosis. Moreover, support from the superior perforator to the upper pole helps maintain breast projection and enhances its aesthetic fullness over time (11). When ultrasonographic planning is added to the surgery, preoperative mapping of the superior perforator further increases the safety of this modification of the medial pedicle. Moreover, by allowing full-thickness rotation without thinning, the superomedial pedicle preserves dermoglandular integrity and supports both arterial inflow and venous drainage via internal thoracic perforators and the dermal plexus, thereby reducing the risk of NAC necrosis and potentially shortening operative time compared to other pedicle techniques (12).

The clinical utility of Doppler ultrasonography becomes particularly evident in cases where perfusion may be uncertain. In such scenarios, relying solely on anatomical landmarks may not account for patient-specific variations. Preoperative Doppler mapping enables the surgeon to identify the dominant perforator, allowing for more confident pedicle planning and potentially reducing intraoperative uncertainty. This approach may be especially helpful in large reductions where the nipple–areola complex must be transposed over longer distances.

In this study, an individualized superomedial pedicle was created by incorporating the superior perforator into the medial pedicle using Doppler ultrasonography. The reduction in complication rates through Doppler-guided planning has been emphasized in many studies. For instance, Elmelegy et al. (4) reported no NAC necrosis among 105 cases in which dominant perforators were identified by Doppler ultrasonography. Similarly, Başaran et al. (13) utilized Doppler-guided pedicle planning in 16 patients with gigantomastia and successfully maintained low complication rates despite high excision volumes.

The relatively constant, superficial anatomical position of the superior perforators enables rapid mapping with power Doppler. In this study, the superior perforators were successfully identified in an average time of 3.0±0.4 minutes. The identified perforators were included in the surgical planning for all cases. This approach enabled harmonization between the preoperative and intraoperative vascular mapping, thereby providing a safe zone for pedicle selection and rotation planning (5, 6, 12).

The use of preoperative Doppler in this study enabled more precise identification of dominant perforators and minimized intraoperative uncertainty regarding vascular supply. Individualizing pedicle selection based on confirmed perforator anatomy yielded a reproducible, patient-centered surgical approach that enhances vascular safety. The clinical outcomes of this approach were also highly favorable. In our study, no major complications such as NAC necrosis, seroma, hematoma,

or infection were observed in any patient. Only a limited number of patients experienced transient areolar hypoesthesia, T-incision dehiscence, and hypertrophic scarring. Notably, three of the four cases of T-incision dehiscence occurred in active smokers. This once again demonstrates the adverse effects of smoking on wound healing (14). In the series of 938 cases reported by Bauermeister et al. (2), a 16% complication rate associated with the superomedial pedicle was noted; however, the vast majority of complications were minor, and no NAC necrosis was observed. When evaluated alongside these findings, the low complication rates observed in our study further support the reliability of Doppler-guided pedicle planning.

Study Limitation

However, certain limitations of the study should be acknowledged. Although a priori power analysis was conducted to determine the appropriate sample size, the final number of participants remained below the target due to the retrospective design. As a result, statistical analysis was limited to descriptive measures. Aesthetic outcomes were evaluated only through physical examination and standardized photography; validated patient-reported outcome instruments, such as the BREAST-Q, were not used. Therefore, the absence of objective patient-reported data represents a notable limitation. Additionally, the lack of a comparison group precluded direct comparison with other pedicle techniques. Although a notable association was observed between active smoking and T-incision dehiscence, no statistical analysis could be performed due to the small sample size. Likewise, potential associations between diabetes and minor complications were not assessed. To address these limitations, prospective studies with larger cohorts should incorporate comparison groups, validated patient-reported outcome measures, and objective perfusion imaging techniques such as indocyanine green angiography.

The integration of the superior perforator, identified preoperatively with Doppler ultrasonography, enables a vascularly reliable and technically feasible superomedial pedicle design for reduction mammaplasty. Although descriptive, this study provides preliminary evidence that preoperative Doppler identification of the superior perforator allows for individualized pedicle planning and may improve vascular safety. Larger prospective comparative studies are warranted to validate these findings and to clarify their potential impact on complication rates.

Video 1. Sagittal and transverse localization of the superior perforator with power Doppler imaging

Video 2. Oblique course of the superior perforator and power Doppler imaging

Ethics

Ethics Committee Approval: This study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Yeditepe University Non-Interventional Clinical Research Institutional Review Board on September 9, 2025. The approval was documented under the application number 2025-08-Y0918.

Informed Consent: Informed consent was obtained from all participating patients.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.E.; Concept: M.E., H.A.Y.; Design: M.E., H.A.Y.; Data Collection or Processing: M.E., H.A.Y.; Analysis or Interpretation: M.E., H.A.Y.; Literature Search: M.E., H.A.Y.; Writing: M.E., H.A.Y.

Conflict of Interest: No conflict of interest was declared by the authors.

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