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Review

“Reduction mammoplasty with superomedial pedicle technique: A literature review and retrospective analysis of 938 consecutive breast reductions”



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Summary Background: The superomedial pedicle reduction mammoplasty has been noted in the literature to provide superior aesthetic results and longevity as well as shorter operative times. However, the inferior pedicle continues to be the most commonly utilized technique in the United States. There is a lack of large-volume outcome studies examining how the superomedial pedicle technique compares against more established reduction methods.

Methods: A retrospective review of 938 reduction mammoplasties was performed at a single institution over a 10-year period. A literature review of superomedial and inferior pedicle complication rates were performed. Study variables were compared against overall mean complication rates for the two techniques. Logistic regression, paired student T-Tests, and Chi-square analyses were used to calculate adjusted odds ratios and to compare continuous and categorical variables.

¹Active role in literature review, data collection and analysis, statistics analysis, manuscript writing, creation of figures and tables, and revisions.

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Results: Mean reduction weight was 730 g per breast, ranging from 100 to 4700 g. Overall complication rate was 16%, of which 10% were minor complications related to delayed wound healing. No cases of skin flap necrosis occurred. Increased complications were highly correlated with a BMI > 30, breast reduction weights > 831 g, and sternal notch to nipple distances > 35.5 cm.

Conclusions: The superomedial pedicle reduction mammoplasty technique is safe and reliable with a complication rate lower than the inferior pedicle technique. Based on our findings we propose that residents should be exposed to this method of reduction mammoplasty as part of a compilation of techniques learned in residency and that practicing surgeons would benefit from becoming familiar with its applications.

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Background

Symptomatic breast hypertrophy is a physically and mentally debilitating medical condition. The physical symptoms associated with this syndrome include persistent neck, shoulder, and back pain, painful shoulder notching from brassiere straps, chronic intertriginous rashes of the inframammary folds, kyphosis, and neuropathies caused by the patient's heavy breasts.¹⁻⁴ Conservative therapy has been found to be ineffective in providing permanent relief with no published studies supporting the cost effectiveness of these measures as a first line therapy for the treatment of symptomatic breast hypertrophy.^{5,6}

Several studies have delineated the role of reduction mammoplasty in the relief of physical symptoms and improvement in quality of life.⁷⁻¹⁶ Reduction mammoplasty not only helps resolve these physical symptoms and functional limitations imposed upon women by breast hypertrophy but has also been shown to significantly improve self-esteem and reduce the emotional strain produced by their related anxiety and depression.¹⁷⁻²⁰ More recent studies have even demonstrated improvement with patient weight loss, exercise/physical activity levels, and eating behaviors.²¹

Considering these benefits, many women elect to undergo reduction mammoplasty. According to the American Society of Plastic Surgeons (ASPS), 129,937 breast reductions were performed in 2017.²² This operation can be performed by a number of techniques including suction lipectomy, free nipple grafting, and various pedicle designs

and skin resection patterns. Traditional teachings have asserted that an inferior pedicle confers the most vascular reliability and thus is the technique of choice by the majority (69%) of plastic surgeons in the United States.²³ However, the superomedial pedicle technique is gaining acceptance as a reliable vascular pedicle and as an attractive alternative approach for reduction mammoplasty.

First described in 1957 by Arie, the superior pedicle was found to be unreliable resulting in compromised nipple viability for long pedicle reconstructions.²⁴⁻²⁶ This technique was further refined by Orlando and Guthrie in 1975 with the incorporation of more medial parenchyma into the pedicle to ensure adequate vascularity of the nipple areolar complex.²⁷ Later studies employing this approach have demonstrated safety with its utilization in larger breast reductions and a complication rate equivalent to that of the inferior pedicle technique.^{28,29} Comparatively, studies have also exhibited decreased OR time, better cosmetic durability (less bottoming out or pseudoptosis over time), and superior appearance (fuller medial breast volumes and cleavage).³⁰⁻³⁴

Herein, we report our experience with the superomedial pedicle technique and examine its use in a larger patient population. The purpose of this study is to provide supporting data to help establish its safety and reliability as an alternative approach to reduction mammoplasty. Surgical technique is reviewed and complication rates compared against currently published literature utilizing the superomedial pedicle technique and more commonly used inferior pedicle technique.

Methods

A retrospective chart review was performed of a series of consecutive patients at a single institution undergoing bilateral reduction mammoplasty for symptomatic breast hypertrophy. Data spanning over a 10-year period (2007-2016) comprising of 469 female patients (938 breast reductions) who underwent 864 superomedial breast reductions was analyzed. Patients included in the study were all females between the ages of 18 and 76 who elected to undergo bilateral reduction mammoplasty for symptomatic macromastia. Patients excluded were all males and those females who underwent reduction mammoplasty for unilateral macromastia. Patient criteria for surgical technique selection are discussed below.

Literature review

A systematic review of the literature was conducted to evaluate all current published reports on superomedial and inferior pedicle reduction mammoplasty techniques in regards to related surgical complications (1987-2018). Inclusion criteria consisted of any publication in electronic or printed media directly studying or commenting on the use of the superomedial pedicle or inferior pedicle technique in reduction mammoplasty. Three medical databases (PubMed, Ovid MEDLINE, and Google Scholar) were searched using the above indicated techniques and plastic and reconstructive surgery search terms. The current literature was critically appraised and quality of selected articles were assessed and manually filtered for relevance by two reviewers. Only studies printed in English were included.

Surgical technique

During the preoperative clinical evaluation, the patient is measured in the standing position with shoulders and arms in adduction. The following measurements are obtained: breast ptosis and grade, nipple to sternal notch distance, nipple to inframammary fold (IMF) distance, distance between the nipples, nipple areolar complex width, and clavicle to nipple distance bilaterally. The patient is then photographed. The ideal patient is someone with a BMI < 30 kg/m², nipple to sternal notch < 30 cm, nipple to inframammary fold < 21 cm and grade 2 ptosis.³⁵

On the day of surgery, the patient is marked in the standing and anterior facing position with arms relaxed at sides (Figure 1). We begin by drawing a line in the midline from the sternal notch to the umbilicus. Next, a line is drawn bilaterally, measured 7 cm lateral to the sternal notch, which goes from the clavicle to the nipple. This line marks the breast meridian. Pitanguy's point is then measured by palpating the inframammary crease and transposing this location to the overlying breast to mark the new nipple areolar complex (NAC) location. We then proceed with the use of a wire template to mark a wise incision pattern. Next, the patient is positioned laterally with her hands behind her back. The point where the lateral breast meets the chest wall is marked and a line is drawn medially at the inframammary crease to the medial corner of the breast.

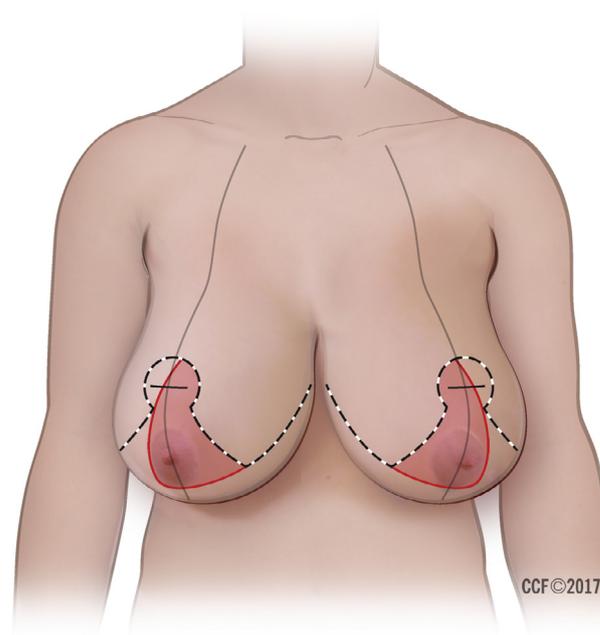


Figure 1 Pre-operative patient markings

Preoperative markings for bilateral reduction mammoplasty using the superomedial dermoglandular pedicle (indicated by shaded area) with wise-pattern skin reduction technique are applied in the surgical holding area. Patient positioned anteriorly with arms relaxed at sides: 1. Midline - line drawn from sternal notch to umbilicus, 2. Breast meridian - line drawn bilaterally, measured 7 cm lateral to sternal notch, from clavicle to nipple, 3. Pitanguy's point - measured by palpating the inframammary crease and transposing this location to the overlying breast to mark the new nipple areolar complex location, 4. Wise incision pattern - a wire template, adjusted to each patient, is used to mark the wise incision pattern; usually the pattern has 6 cm limbs with 120-degree angle. Patient positioned laterally with hands behind back: 5. Lateral breast incisions - the point where the lateral breast meets the chest wall is marked and a line is drawn medially at the inframammary crease to the medial corner of the breast.

The patient is then taken to the operating room where she is positioned supine with arms abducted to less than 90°. All bony prominences are padded and sequential compressive devices are placed to each lower extremity. The patient is then prepped with povidone-iodine. Lidocaine 1% with 1:100,000 epinephrine mixed with 0.5% bupivacaine at a ratio of 50:50 is injected into the incision markings. A 42 mm cookie cutter is used to mark the circumference of the new NAC. A 15-blade scalpel is used to score the incision and de-epithelialize the circumferential incision around the new NAC. The same technique is used for the contralateral breast. Next, all skin markings are scored to the level of the dermis with a 10-blade scalpel. The superomedial pedicle is then designed and de-epithelialized. The minimal width of the pedicle base is 8 cm.

Afterwards, we remove the breast tissue in a medial to lateral fashion ensuring that a cuff of normal parenchyma is left adherent to the pectoralis fascia. Extreme care is taken not to undermine the pedicle to avoid devascularization. In this method, the blood supply to the NAC originates

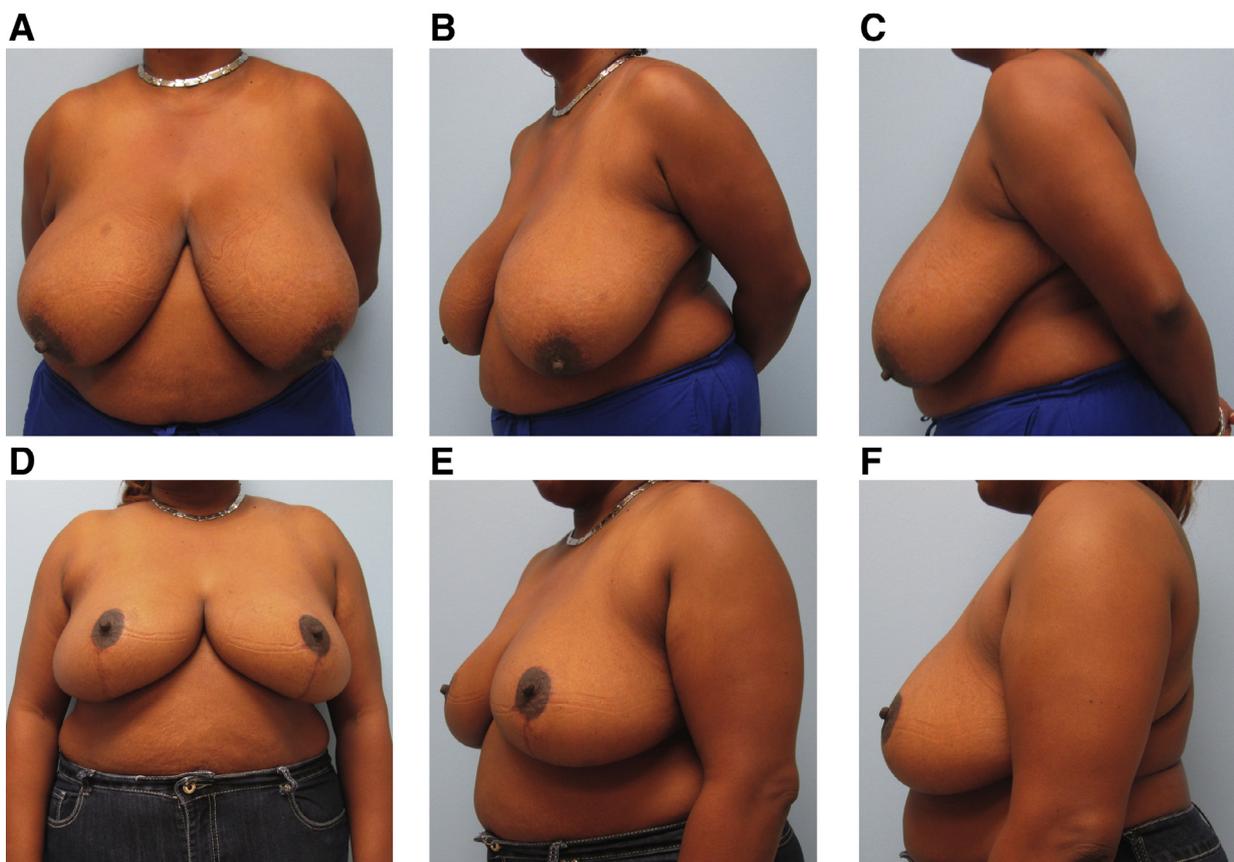


Figure 2 Pre and post reduction mammoplasty using superomedial pedicle. Preoperative photographs (*top*) of a 41-year-old patient with gigantomastia and six month postoperative photographs (*bottom*) after bilateral reduction mammoplasty using the superomedial dermoglandular pedicle with wise-pattern skin reduction technique (1290 g and 1260 g reductions). (Photos courtesy of Steven A. Earle, M.D.).

from the internal mammary artery perforators as well as the underlying breast parenchyma which is supplied by the intercostal perforators and thoracoacromial artery. The pedicle is then swung into the keyhole. Next, hemostasis is achieved with topical thrombin and Arista™ (plant based absorbable hemostatic powder). The flaps are then stapled to assess for symmetry and NAC position. The patient is then placed in the sitting position and evaluated. Specimens are weighed and compared. During stapling the superior-lateral flap should be advanced medially and the superior-medial flap should be moved laterally to prevent dog-ears and also to take tension off of the triple point. Prior to closure we place drains to prevent any accumulation of fluid.

The operation is completed by performing closure of the skin incisions with 3-0 and 4-0 poliglecaprone 25 suture. Steri-Strips are then applied. Sterile gauze padding and a cotton brassiere with anterior Velcro closure are applied to the chest.

Patient is seen within five days. At this visit the drains are inspected and removed if their volume is less than 30 mL per 24 h. Their activity is limited to no hands above the head and no bending the torso at the hips for the first two weeks. After two weeks, the patient can transition to light activity with a bra of their choice. After six weeks all restrictions are removed. They return at six months to monitor their progress and obtain updated photographs (Figure 2).

Data collection

Electronic medical records were utilized to collect demographic data from the pre-operative clinic notes, operative reports, pathology report, and post-operative clinic notes. Demographic variables recorded included age, BMI, personal history of prior breast disease or surgery, history of diabetes, and tobacco use. Pre-operative breast measurements including ptosis grade, nipple to sternal notch distance (N-SN), and nipple to inframammary fold distance (N-IMF) were obtained. The operative report was utilized to collect pedicle type and skin resection pattern. Specimen reduction weight and final histopathology were collected from the pathology report. Post-operative visits were reviewed and all complications were recorded. These included post-operative seroma, hematoma, infection, delayed wound healing, return to OR, partial nipple necrosis, full nipple necrosis, and skin flap necrosis.

Statistical analysis

The above variables were analyzed and complication rates calculated per individual breast. Complication rates were then compared against known published complication rates for the superomedial pedicle and inferior pedicle

reduction mammoplasty. Logistic regression and generalized estimating equation model were used to adjust for within patient variability and to determine odds ratios utilizing 95% confidence intervals with regards to the relationship of study variables to complications. Paired student T-tests and Chi-square analyses were performed to compare continuous variables and categorical variables respectively. Demographic variables were reported with their mean and corresponding standard deviation. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 265 articles were identified from the aforementioned sources discussing reduction mammoplasty complications in plastic and reconstructive surgery. Thirty-three articles discussed complication rates specific to either the superomedial or inferior pedicle reduction mammoplasty techniques. Within this subset, only two articles compared the two techniques and provided individual complication rates.^{35,41} Articles chosen dated from 1987 to 2018. Of those selected, 17 articles discussed complications in relation to using the superomedial technique; the mean complication rate was 16.9%, ranging from 1.6% to 43%.^{29,33-46} Twenty articles discussed complications in relation to using the inferior pedicle technique; the mean complication rate was 29.7%, ranging from 0.6% to 71%.^{9,13,30,47-62}

Review of electronic medical records resulted in a total of 938 breast reductions that were performed in 469 patients by three surgeons at a single institution over a 10-year period. Thirty of the 938 breast reductions were excluded due to being unilateral reductions performed for asymmetry corrections following contralateral breast autologous flap reconstructions. All 30-breast reductions that were excluded had employed the superomedial pedicle technique. Of the 908 breast reductions included in the study, the superomedial pedicle technique was utilized in 834 reductions (92%), inferior pedicle technique in 57 reductions (6%), and free nipple graft in 17 reductions (2%). Further data review and statistical analysis was performed on those patients who had undergone a superomedial pedicle technique breast reduction.

The inverted T/Wise-pattern incision was primarily used in the superomedial pedicle reductions performed (754 breasts), followed by the vertical pattern incision (80 breasts). Mean age and BMI was 41.5 (\pm 13.2 years) and 30.2 (\pm 5.4 kg/m²), respectively. Patient co-morbidities observed in the study included diabetes (15 patients) and tobacco use (10 patients), other co-morbidities reviewed (prior chemo and or radiotherapy) were not possessed by the study participants. Mean reduction weight was 730 g per breast, with weights ranging from 100 to 4700 g (Table 1). All patients achieved symptomatic relief following surgery.

Total complications and calculated complication rates were determined per breast. A total of 154 complications occurred with use of the superomedial pedicle technique with an overall complication rate of 16%, of which 10% were from minor complications related to delayed wound healing (Table 2). Total complications included: major (hematoma 20 (2%), 17 of which required re-operation; infection 9 (1%); partial nipple necrosis 24 (3%)) and minor (delayed wound

Table 1 Reduction weight parameters and breast measurements.

	Left		Right	
	Mean	Range	Mean	Range
N-SN	32.0	22-52	32.2	21-53
N-IMF	15.0	7-30	15.1	7-31
Reduction Weight	730.1	100-3800	724.3	117-4700

All reduction weight parameters and breast measurements are for patients who underwent superomedial pedicle reduction mammoplasties. N-SN = nipple to sternal notch distance; N-IMF = nipple to inframammary fold distance; Reduction weight in grams

Table 2 Complications after superomedial pedicle reduction mammoplasty.

Complications	Breasts (%)	
Minor	84	(10%)
Delayed wound healing	84	(10%)
Seroma	0	(0%)
Major	70	(6%)
Hematoma	20	(2%)
Infection	9	(1%)
Return to OR *	17	(2%)
Partial NN	24	(3%)
Full NN	0	(0%)
Skin Flap Necrosis	0	(0%)
Total	154	(16%)
>1	24	(3%)
None	680	
Total Breasts	834	

(%) = percent of total patient breasts with complications; * all patients requiring return to OR were for hematoma evacuation, patients included within hematoma category; OR = operating room; NN = nipple necrosis; > 1 = patient breast with greater than one complication

healing 84 (10%)). No cases of full nipple-areolar complex or skin flap necrosis occurred.

There was no statistically significant increase in complication rate observed in patients with diabetes, history of tobacco use, increase N-IMF distance, or incision pattern used in this study. Increase complication rates were seen in patients with a BMI > 30 (OR 2.29 [95% CI 1.56-3.36], $p < 0.001$), ptosis grade of 3 (OR 1.99 [95% CI 1.34-2.97], $p < 0.001$), nipple to sternal notch distance > 35.5 cm (OR 3.07 [95% CI 2.05-4.62], $p < 0.001$), and reduction weight > 831 g (OR 2.24 [95% CI 1.53-3.29], $p < 0.001$). Less pronounced, yet still statistically significant, were increase complications noted with each 1 cm increase of nipple to sternal notch distance as well as each 100-gram increase in reduction weight (Table 3).

Our analysis demonstrated a statistically significant increase in complications associated with a BMI > 30, ptosis grade of 3, breast reduction weight > 831 g, and a nipple to sternal notch distance > 35.5 cm. Patients with nipple to sternal notch distance > 35.5 cm accounted for 17% of population and 40% of complications (62 out of 154).

Table 3 Univariable odds ratios for any complication after superomedial pedicle reduction mammoplasty.

Treatment group	Estimate	95% CI		P-value
		Lower	Upper	
BMI				
≥ 25	2.16	1.21	3.84	0.009
≥ 30	2.29	1.56	3.36	<0.001
≥ 35	3.10	1.99	4.81	<0.001
Ptosis Grade				
1 vs. 2	0.26	0.02	4.41	0.35
1 vs. 3	0.14	0.01	2.25	0.16
2 vs. 3	0.53	0.35	0.79	0.002
3 vs. 1 or 2	1.99	1.34	2.97	<0.001
Breast Measurements				
N-SN (per 1 cm increase)	1.12	1.08	1.17	<0.001
N-SN > 35.5	3.07	2.05	4.62	<0.001
N-IMF (per 1 cm increase)	1.10	1.04	1.16	0.001
N-IMF > 20	2.65	1.30	5.40	0.007
Reduction Weight				
per 100 g increase	1.09	1.05	1.13	<0.001
>831	2.24	1.53	3.29	<0.001

Generalized estimating equation model was used to adjust for within patient variability and to determine the univariable odds ratios shown above. BMI = Body Mass Index; N-SN = nipple to sternal notch distance in cm; N-IMF = nipple to inframammary fold distance in cm; Reduction weight in grams.

Discussion

An array of different vascular pedicles have been described in the literature, yet the inferior pedicle technique is still by far the predominant method utilized nationwide for reduction mammoplasties. Data from our study and the literature, however, demonstrate promising results that may provide surgeons with an evidence based-incentive to trial and adopt an alternative technique, the superomedial pedicle, as their vascular pedicle of choice for reduction mammoplasties. Complication rates in our study were found to be equivalent to that of published complication rates associated with the use of the superomedial pedicle (16% vs. 16.9%)^{29,35-46} and were lower than those associated with the use of the inferior pedicle (16% vs. 29.7%)^{9,13,30,47-63}.

Our analysis is the largest single institution series of consecutive patients who have undergone superomedial reduction mammoplasties. It is the first study to have performed a comprehensive literature review of the topic in concern to both superomedial and inferior pedicle complication rates. This provides a unique comparison of the data to allow a more evidence-based approach to surgical decision making. This study and its accumulated data from the literature should be used to illustrate to both trainees and practicing surgeons that adoption of this less common technique is as safe or potentially safer than the inferior pedicle technique, while providing additional benefits. Multiple studies have remarked on optimal long-term breast shape with more superomedial fullness and a lower tendency for pseudoptosis or bottoming out with time due to site of flap origin and retained attachments. Others have also noted easy inset of larger breast reductions and faster operative times attributed to decreased flap de-epithelialization, minimal superior flap creation or undermining, and single en bloc resection of breast parenchyma.^{28,30-34,46}

It was found during the literature review, that the majority of studies did not specify pedicle type used or quoted complication statistics that were performed using mixed pedicle patient population. No large population size studies were noted in the literature that examined complication rates associated with the superomedial pedicle technique nor compared it against other pre-existing or more established reduction mammoplasty techniques. Large database meta-analyses (ex. BRAVO, ACS-NSQIP) that included reduction mammoplasty procedures either did not contain specific information on surgical technique employed or were unable to determine whether pedicle type was a significant factor contributing to the rate of surgical complications.³⁷⁻³⁸

The factors that we have found in our study to increase the complication rate when performing superomedial reduction mammoplasty were BMI > 30, ptosis grade of 3, breast reduction weight > 831 g, and a nipple to sternal notch distance > 35.5 cm. This data was analogous to other studies that have demonstrated higher complication risks with elevated BMI, larger tissue resection weights and nipple to sternal notch distances.^{45,62,64-77} There was no increase complication rate found in relation to patient age or tobacco use as other studies have found.^{65-67,73} Even with these aforementioned risk factors, none of the patients experienced any nipple loss or skin flap necrosis. The majority of complications (61%) were minor resulting from delayed wound healing and were treated favorably in clinic with basic dressing changes and wound care.

A significant number of the overall complications encountered were due to a small portion of the patient population with a nipple to sternal notch distance > 35.5 cm. Therefore, preoperative screening and patient selection excluding this portion of the patient population (17% of the cases) would have reduced the overall complication rate by 40%. This suggests that the nipple to sternal notch distance

should be considered during operative planning and in assisting surgeon decision-making. A modified approach or alternative vascular pedicle may provide more favorable results for individuals with a greater degree of ptosis and nipple to sternal notch distance. If nipple-areola complex viability is a concern because of large breast size and excessive pedicle length, a free nipple graft can be safely combined with this pedicle for a reliable aesthetic outcome.²⁷

There was no association with skin incision pattern and resultant complications, wise pattern incision was primarily used due to surgeon preference and its effectiveness in correcting excessive skin excess seen in patients with grade 2 and 3 ptosis.⁷⁸ Although not the focus of this study, incision type should be taken into consideration for the final aesthetic outcome.⁷⁹ Due to its retrospective nature, surgeon decision-making couldn't be explicitly analyzed, yet trends did appear with the selection of alternative pedicle or combined/modified techniques in patients with significant gigantomastia (individual breast reduction weights > 2,000 g). Homogeneity of study results were capable through the employment of similar approaches utilized across the three surgeons performing the superomedial reduction mammoplasties included within the study.

In conclusion, this analysis and accrued data from the literature offer a thorough overview of the superomedial pedicle technique and its potential risks and complications when comparing it to the more commonly used inferior pedicle technique. The technique is reproducible and predictable, providing a lower complication rate with reported short- and long-term aesthetic benefits. The study impacts both trainees and practicing surgeons providing them with the most recent and complete information on an underutilized technique, and may help them reassess what their vascular pedicle of choice is for future breast reductions.

Ethical approval of studies

The study conformed to the principles outlined in the Declaration of Helsinki.

Financial disclosure

None

Conflict of interest

None

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.bjps.2018.12.004](https://doi.org/10.1016/j.bjps.2018.12.004).

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