

Reshaping Our Understanding of Sensation and Pain Following Breast Reduction Surgery

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Background: This study evaluated the sensory and breast pain outcomes in inferior versus superomedial pedicle breast reduction.

Methods: Twenty patients undergoing the inferior pedicle technique were matched to 20 patients undergoing the superomedial pedicle technique based on age, BMI, and resection weight. Patients were evaluated preoperatively and postoperatively at 1, 3, 6, and 12 months. Monofilament testing was performed on the nipple-areola complex (NAC) and surrounding breast. Patient-reported outcomes included nipple and breast sensation (5-point Likert scale), pain intensity (0–10), and the Patient-reported Outcome Measurement Information System Neuropathic Pain Quality scale.

Results: At the NAC, mean monofilament values and patient-reported sensation were significantly better in the inferior versus the superomedial pedicle group at 1 and 3 months postoperatively ($P < 0.05$) and comparable at 6 and 12 months ($P > 0.05$). At 12 months, 72.5% of patients reported complete (5 of 5) nipple sensation (77.5% inferior versus 67.5% superomedial, $P > 0.05$). At the breast, the mean monofilament values and patient-reported sensation were similar between pedicle groups throughout follow-up. At 12 months, 82.5% of the patients reported complete (5 of 5) breast sensation (85.0% inferior versus 80% superomedial, $P > 0.05$). Rates of postoperative breast pain were similar between groups throughout follow-up ($P > 0.05$). At 12 months, 25% of patients reported breast pain, with neuropathic qualities in 85% of cases.

Conclusions: The inferior pedicle may allow for earlier restoration of quantitative and patient-reported NAC sensation, but long-term sensation is comparable between techniques. A quarter of patients reported persistent breast pain regardless of the pedicle type. (*Plast Reconstr Surg Glob Open* 2025; 13:e6427; doi: 10.1097/GOX.00000000000006427; Published online 10 January 2025.)

INTRODUCTION

Macromastia affects between 1% and 5% of the female population and is associated with significant physical, functional, and psychosocial consequences.^{1,2} Breast reduction

surgery (BRS) effectively improves or resolves many of the symptoms of macromastia and remains one of the most common procedures performed in plastic surgery.^{3–6} The 2 most utilized techniques are the inferior pedicle and superomedial pedicle.^{7,8}

During BRS, nerves innervating the nipple-areola complex (NAC) and breast skin may be transected or injured, resulting in sensory changes in most patients. Loss of sensation can lead to a heightened risk of injury and reduced physical, psychosocial, and sexual well-being.^{9–17} Accordingly, nearly 80% of women undergoing BRS report NAC sensation to be important for their sexual lives.¹⁶

The influence of pedicle technique on sensory outcomes has been controversial,^{16,18–22} with one of the more recent systematic reviews and meta-analyses by Torresetti et al¹⁹ highlighting the low or very-low quality of the current evidence, notably due to the lack of prospective matched cohort studies, as well as insufficient evidence on patient-reported outcomes.

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Received for publication August 21, 2024; accepted November 8, 2024.

Presented at the New England Society of Plastic and Reconstructive Surgeons Annual Meeting in Bretton Woods, New Hampshire, June 14, 2024, and at Plastic Surgery the Meeting in San Diego, CA, September 28, 2024.

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DOI: 10.1097/GOX.00000000000006427

Disclosure statements are at the end of this article, following the correspondence information.

Furthermore, the occurrence of chronic postoperative breast pain has been poorly described. One study found that up to 28% of patients reported persistent breast pain 27 months following BRS.²³ Another study found that 20% of patients reported pain with symptoms meeting the criteria for neuropathic pain in the majority of cases.²⁴ No studies have analyzed the influence of pedicle choice on postoperative breast pain.

Given the current gaps in the literature regarding the influence of pedicle technique on sensory outcomes and rates of postoperative breast pain, this study aimed to compare the quantitative and patient-reported sensory and pain outcomes following inferior pedicle versus superomedial pedicle BRS in a prospective matched cohort study.

PATIENTS AND METHODS

Institutional review board approval was obtained from Massachusetts General Hospital, Boston, MA (2021-P002932). Patients undergoing inferior or superomedial pedicle BRS at Massachusetts General Hospital were prospectively enrolled. Exclusion criteria were age younger than 18 years old, a history of peripheral nerve or neurological disorder, previous breast surgery, and the inability to provide informed consent.

The inferior pedicle technique was performed using a Wise pattern with skin flaps approximately 1 cm thick, whereas the superomedial pedicle technique was performed using a vertical incision with skin flaps approximately 2–3 cm thick. The inferior pedicle technique was performed by 2 attending surgeons, whereas the superomedial technique was performed by a single third attending surgeon.

Sensory evaluation consisted of monofilament testing and patient-reported outcomes conducted preoperatively and postoperatively at 1, 3, 6, and 12 months by a single evaluator. Multiple time points were chosen to evaluate

Takeaways

Question: Do sensory and postoperative breast pain outcomes differ between breast reduction pedicle techniques?

Findings: In a prospective matched cohort study of 40 patients, patients undergoing the inferior pedicle technique had significantly improved monofilament and patient-reported nipple sensation at 1- and 3-month follow-up compared with the superomedial pedicle technique, but sensation was similar afterward. Breast sensation was similar between techniques throughout follow-up. At 12-months follow-up, 25% of patients reported postoperative breast pain, regardless of the technique.

Meaning: Inferior pedicles allowed for earlier nipple sensation, but long-term sensation was similar between techniques. There may be a risk of persisting breast pain.

the kinetics of sensory recovery. Semmes-Weinstein monofilament testing was performed to measure quantitative mechanical detection threshold at the NAC and surrounding breast skin on predefined quadrants. A 5-piece monofilament kit with index values 2.83, 3.61, 4.34, 4.56, and 6.65 was used, with lower values representing better, or more sensitive, mechanical detection (North Coast Medical, Inc., Morgan Hill, CA). [Figure 1](#) illustrates BRS pedicles and areas of sensory testing.

Patient-reported outcomes were collected at the same time as the monofilament testing and included nipple and breast sensation using a 5-point Likert scale (no sensation = 1, a little sensation = 2, some sensation = 3, a lot of sensation = 4, and complete sensation = 5). Postoperative breast pain intensity was evaluated using a numeric rating scale (0–10). The Patient-reported Outcome Measurement Information System Neuropathic Pain Quality scale was used to assess for neuropathic pain.

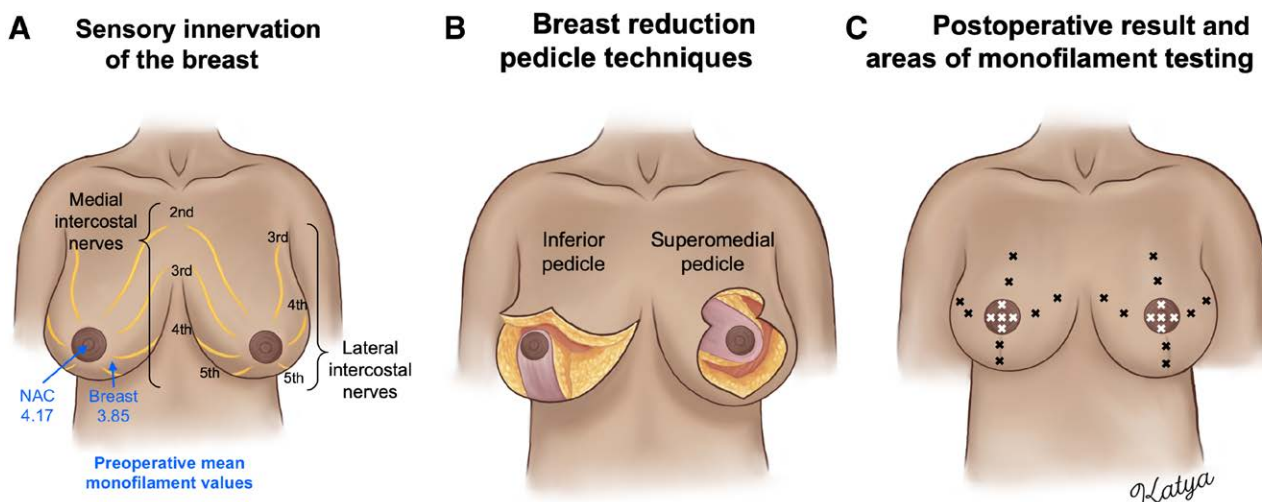


Fig. 1. Breast reduction surgery pedicles and areas of sensory testing. A, Sensory innervation of the NAC and breast by the second to fifth medial and third to fifth lateral cutaneous branches of the intercostal nerves in a patient with macromastia. The lateral fourth intercostal nerve is thought to innervate the largest surface area of the NAC and breast. B, Pedicle techniques in BRS, including the inferior and superomedial pedicles. C, Postoperative result and predefined areas of monofilament testing at the NAC (white crosses) and surrounding breast skin (black crosses).

Table 1. Patient Demographics

Variable	Inferior Pedicle, N = 20 Patients	Superomedial Pedicle, N = 20 Patients	P
Age, y, mean (SD)	38.1 (16.6)	38.7 (18.5)	0.880
BMI, kg/m ² , mean (SD)	29.9 (3.7)	30.0 (5.2)	0.958
Race, n (%)			
White	12 (60.0)	13 (65.0)	0.828
Black	4 (20.0)	3 (15.0)	0.754
Hispanic or Latin American	4 (20.0)	4 (20.0)	1.000
Resection weight, g, mean (SD)	538.8 (231.3)	429.3 (224.3)	0.197

BMI, body mass index.

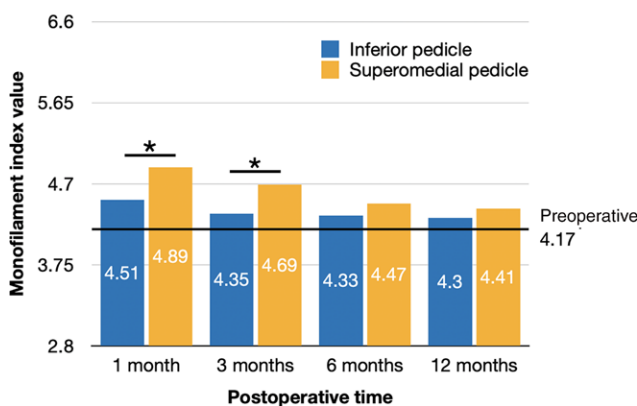
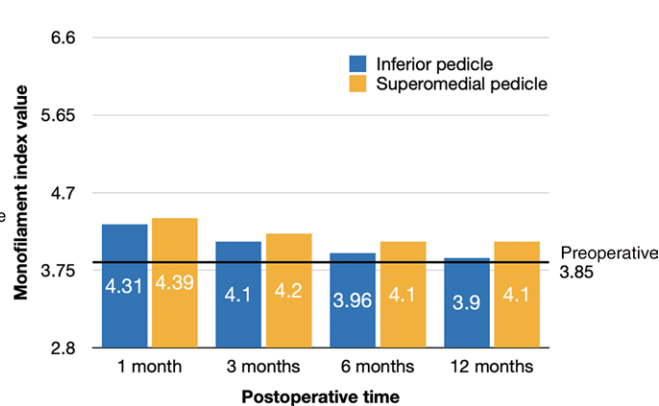
A Mean monofilament values at the nipple areola complex**B Mean monofilament values at the breast**

Fig. 2. Breast reduction surgery pedicles and areas of sensory testing. The mean NAC (A) and breast (B) monofilament values preoperatively and postoperatively in the inferior vs superomedial pedicle techniques. * Statistical significance with a *P* value of less than 0.05.

Data were recorded on REDCap (version 8.1.20; Vanderbilt University, Nashville, TN). Statistical analysis was performed with JMP (SAS Institute, Cary, NC). Patients were matched in a 1:1 ratio based on age (± 10 y), body mass index (± 5 kg/km²), and resection weight (± 250 g). Each breast was independently evaluated. Continuous variables were described using means and SDs or median and range or interquartile range depending on normality. Categorical variables were described using frequencies and percentages. Bivariate analyses were conducted using chi-square or Fisher exact test for categorical variables, and Student *t* test or Wilcoxon rank test for continuous variables. A value of *P* less than 0.05 was considered statistically significant.

RESULTS

Patient Demographics

Among a total of 52 patients who were enrolled and underwent BRS, 40 patients (20 patients who underwent the inferior pedicle technique and 20 matched patients who underwent the superomedial pedicle technique) were included in the final analysis. There were 12 patients who were excluded, including 7 due to incomplete 12-month follow-up, and 5 who were not matched. The mean age of the study population was 38.3 (± 17.3) years, the mean body mass index was 29.9 (± 4.3) kg/m², and the mean resection weight was 472.1 (± 229.8) g. Patient

demographics were similar between both pedicle groups ($P > 0.05$) and are presented in Table 1. There were 3 (7.5%) patients in the inferior pedicle group who developed wound dehiscence. All cases healed conservatively with local wound care and dressings within 3 weeks and without the need of surgical intervention. There were no other complications, included no cases of NAC necrosis.

Monofilament Testing

The mean monofilament values at the NAC were significantly better in the inferior pedicle technique as compared with the superomedial pedicle technique at 1 and 3 months postoperatively ($P < 0.05$) and were comparable between both techniques at 6 and 12 months ($P > 0.05$). Preoperative baseline NAC monofilament values were reached at 3 months postoperatively in the inferior pedicle technique versus 6 months in the superomedial pedicle technique. The mean monofilament values at the breast were comparable between the inferior and superomedial pedicle techniques throughout follow-up ($P > 0.05$), and preoperative baseline values were reached at 3 months postoperatively in both groups. The mean monofilament values of the NAC and breast are presented in Figure 2.

Patient-reported Outcomes

Patient-reported nipple sensation was significantly better in the inferior versus superomedial pedicle group

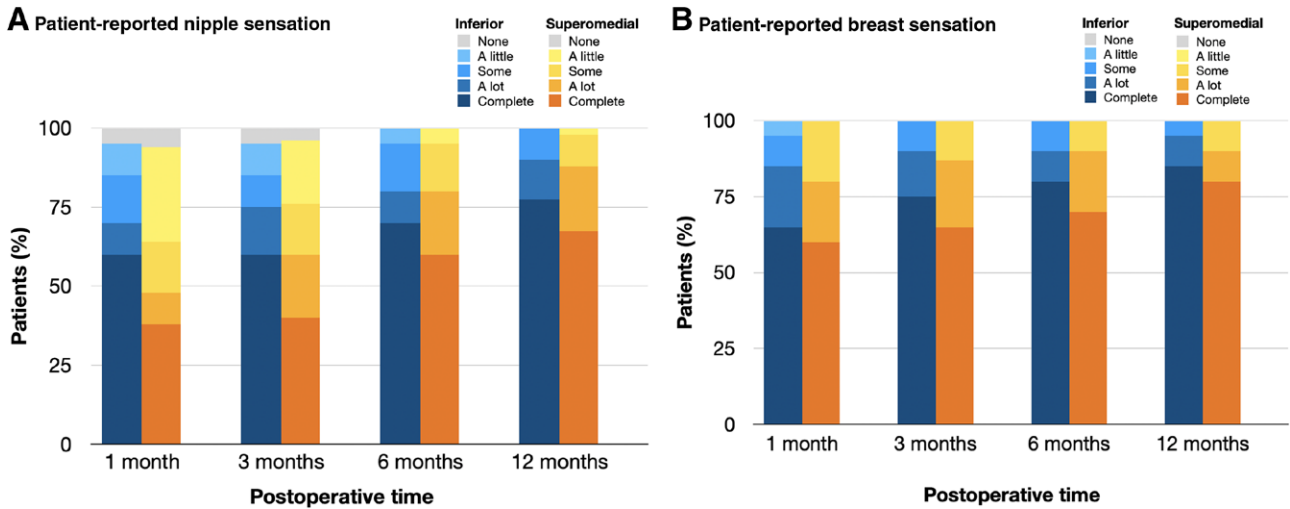


Fig. 3. Breast reduction surgery pedicles and areas of sensory testing. Patient-reported nipple (A) and breast (B) sensation in inferior vs superomedial pedicle techniques. Patients were asked to rate the amount of sensation based on a 5-point Likert scale (1= no sensation, 2 = a little sensation, 3= some sensation, 4 = a lot of sensation, and 5= complete sensation).

at 1 and 3 months postoperatively ($P < 0.05$) and comparable at 6 and 12 months ($P > 0.05$). At 12 months postoperatively, 72.5% of patients reported complete (5 of 5) nipple sensation (77.5% inferior versus 67.5% superomedial, $P > 0.05$). Patient-reported breast sensation was comparable between both pedicle groups throughout follow-up ($P > 0.05$). At 12 months postoperatively, 82.5% of patients reported complete (5 of 5) breast sensation (85.0% inferior versus 80% superomedial, $P > 0.05$). Patient-reported outcomes of nipple and breast sensation are presented in Figure 3.

Postoperative breast pain was reported by 30% of patients at 1 month postoperatively, 35% at 3 months, 30% at 6 months, and 25% at 12 months. Rates of breast pain were similar between inferior and superomedial pedicle techniques throughout follow-up ($P > 0.05$). According to the Patient-Reported Outcome Measurement Information System Neuropathic Pain Quality scale, pain was neuropathic in 70% of cases at 1 month postoperatively, in 82.5% at 3 months, in 80% at 6 months, and in 85% at 12 months. Rates of neuropathic pain were similar between pedicle groups throughout follow-up ($P > 0.05$). Among patients who reported pain, the average pain intensity was 5.3 (± 1.7) at 1 month, 5.2 (± 2.0) at 3 months, 5.9 (± 1.4) at 6 months, and 4.8 (± 1.3) at 12 months. Patient-reported breast pain outcomes are presented in Figure 4.

DISCUSSION

The aim of this study was to compare the sensory and postoperative breast pain outcomes in inferior versus superomedial pedicle BRS. We found that the use of an inferior pedicle conferred earlier objective and patient-reported restoration of NAC sensation. However, long-term sensory outcomes at both the NAC and breast were similar between techniques. Additionally, this study revealed that persistent postoperative breast pain affected

Postoperative Breast Pain

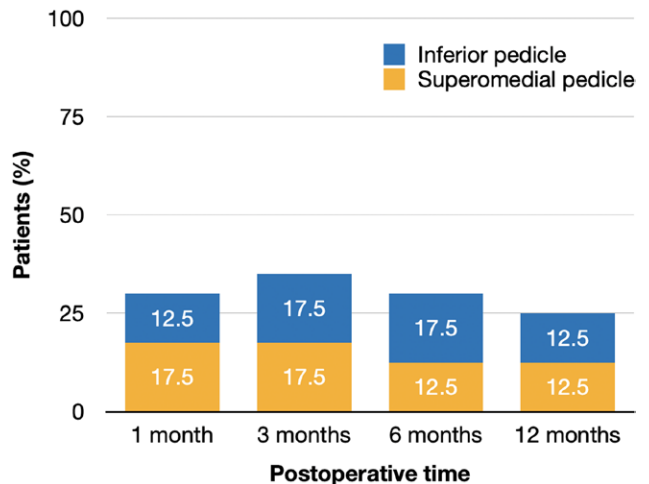


Fig. 4. Rates of patient-reported breast pain in the inferior vs superomedial pedicle techniques.

a quarter of patients, regardless of pedicle type. Together, these data help to better characterize the sensory and pain outcomes following BRS.

Earlier sensation in patients undergoing the inferior pedicle approach aligns with the findings of a recent systematic review and meta-analysis in 2023.¹⁹ This review ranked the restoration of sensation across different techniques, showing that most patients restored baseline sensation following septum-based, bipedicle, inferior and superomedial pedicles. In contrast, the superior and superolateral pedicles were associated with persisting reductions in sensitivity.¹⁹ Specifically, sensation was restored in 219 of 227 (96.5%) patients who underwent inferior pedicles versus 138 of 203 (68%) patients who underwent superomedial pedicles.¹⁹

These findings suggest that the inferior pedicle may offer earlier sensory recovery than the superomedial pedicle, likely due to better preservation of the lateral intercostal nerves arising from the lateral border of the pectoralis major muscle. Accordingly, anatomical studies have identified the lateral fourth intercostal nerve as the primary contributor to both NAC sensation.^{25,26} However, over time, peripheral nerve regeneration may lead to progressive recovery of sensation in both techniques, potentially minimizing long-term differences in sensory outcomes. Nevertheless, larger prospective and controlled cohort studies will be needed to confirm long-term differences in sensation.

Furthermore, reports showing improved sensation with the superomedial pedicle compared with the inferior pedicle add further controversy to the literature. A recent retrospective analysis found that patients undergoing superomedial pedicles experienced earlier objective monofilament sensory recovery at 6 months postoperatively, although long-term outcomes were similar between the 2 techniques.²¹

Interestingly, although monofilament values reached baseline at the NAC and surrounding breast skin long-term, between 20% and 30% of patients still reported incomplete sensation at 12 months postoperatively. This may be due to the incomplete regeneration of other types of sensory functions not tested, such as erogenous, temperature, pin prick, and pain detection. These functions, governed by small unmyelinated fibers, may not recover as well as mechanical detection, which is governed by large, myelinated fibers.^{27,28}

Our study also demonstrated that a quarter of patients who underwent BRS experienced breast pain that was predominately neuropathic in quality. These results are consistent with a prior study analyzing postoperative pain following BRS, in which more than 20% of patients reported pain, which was also mainly neuropathic in quality.²⁴ However, we did not find any difference in pain between pedicle techniques. Little data exist on this phenomenon and may be worth exploring in more detail in future studies.

The main limitations of this study include its small sample size and that pedicle techniques were performed by 3 different surgeons. The presence of surgeon bias may influence sensory outcomes due to differences in surgical techniques related to the level and extent of undermining of the skin flaps and breast parenchyma, the thickness and size of the pedicles, and the mechanisms of dissection. These factors were not controlled for in the current analysis and therefore limit the generalizability of our findings given their potentially significant role in influencing sensory outcomes. Additionally, we did not account for incision pattern type and degree of breast ptosis, and the range of resection weights used for matching remained relatively large (± 250 g). Future studies should aim to control for these variables. Furthermore, we did not evaluate additional important sensory outcomes such as erogenous sensation, temperature, and pain detection thresholds.²⁷ Moreover, the broader implications of pain (eg, pain interference, time off work, pain medications, pain clinic

referrals) were not evaluated and may warrant future investigation. Finally, although our study investigated both objective and patient-reported sensory outcomes of BRS, the impact of these differences on quality of life, patient satisfaction, and psychosocial well-being were not assessed. Future studies should also aim to extend follow-up duration beyond 12 months.

CONCLUSIONS

The inferior pedicle allowed for earlier restoration of both quantitative and patient-reported NAC sensation as compared with the superomedial pedicle, but long-term sensation was similar between techniques. Furthermore, approximately a quarter of patients experienced persistent postoperative breast pain, mainly neuropathic in nature, and regardless of pedicle technique. As such, plastic surgeons may counsel patients undergoing BRS about potential differences in nipple sensation at early follow-up but similar sensation long-term with different pedicle techniques, as well as a risk of persistent neuropathic pain. Future larger prospective and controlled studies are needed to confirm long-term differences in sensation.

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DISCLOSURES

Dr. Carruthers is a consultant for TelaBio. Dr. Austen Jr. is an advisor and receives royalties from Sientra, Cytrellis, and Durvena. Dr. Gfrerer is a consultant for Biocircuit. The other authors have no financial interest to declare in relation to the content of this article.

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