Viability and Sensation of the Nipple–Areolar Complex After Reduction Mammaplasty

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Reduction mammaplasty with nipple–areolar transposition on a medial pedicle was designed as an alternative to amputation and free nipple graft for women with severe mammary hypertrophy. The purpose of this study was to review the viability and sensory outcome of the nipple–areolar complex (NAC) in 72 women (133 breasts) after medial pedicle and inferior pedicle reduction mammaplasty between 1996 and 2000. The medial pedicle was used for 41 women (79 breasts) with moderate to severe mammary hypertrophy. An inferior pedicle was used for 31 women (54 breasts) with mild to moderate mammary hypertrophy. Mean follow-up for all patients was 25 months. Total sensation of the NAC was obtained in 68 of 79 breasts (86%) after medial pedicle reduction mammaplasty and in 50 of 54 breasts (92%) after inferior pedicle reduction mammaplasty. Total viability of the NAC occurred in 74 of 79 breasts (94%) after medial pedicle reduction mammaplasty and in 53 of 54 breasts (98%) after inferior pedicle reduction mammaplasty. Quantitative sensory testing of the NAC using the pressure-specified sensory device demonstrated that static and moving sensory thresholds of the NAC are lowest in the inferior pedicle group followed by the control group and the medial pedicle group. It can be concluded from this study that the medial and inferior pedicle techniques are capable of supporting vascularity and innervation to the NAC. The medial pedicle technique for severe mammary hypertrophy is a good alternative to free nipple grafting. The amount of breast tissue removed does not correlate with sensory outcome for both inferior and medial pedicle techniques. The pressure-specified sensory device is an excellent means of assessing sensory outcome.

Preserving the viability and sensation of the nipple–areolar complex (NAC) is a primary goal of reduction mammaplasty. A variety of reduction mammaplasty techniques by which this is accomplished have been described.[1–6] Anatomic features of the breast that may influence the choice of technique include volume, position of the nipple relative to the sternal notch and infra-mammary fold, and the distance that the NAC will be elevated. Therefore, it is important to choose a technique that will take these factors in consideration to optimize the viability and sensation of the NAC.

Most methods of reduction mammaplasty require transposition of the NAC either on a dermal pedicle or as a free graft. The principal advantages of the dermal pedicle techniques are that the blood supply and innervation to the NAC are usually preserved.[7–9] This is especially true for women with mild to moderate mammary hypertrophy. Limitations of most dermal pedicle techniques become apparent with severe mammary hypertrophy. In these cases, the long length of the pedicle and large volume of resection can lead to compromised circulation that ultimately results in necrosis of the NAC.[8,10–15] Thus, for women with severe mammary hypertrophy, an amputation mammaplasty with a free nipple–areolar graft is usually recommended.[6,14,16] Advantages of this technique include improved viability of the NAC; however, untoward effects can include necrosis, insensitivity, and hypopigmentation.[14,16–20] To minimize these morbidities for women after free nipple graft, an alternative technique for women with severe mammary hypertrophy has been developed.

Reduction mammaplasty with transposition of the NAC based on a medial pedicle has been effective in preserving the viability and sensation of the NAC for women with severe mammary hypertrophy.[1,2] The medial pedicle is oriented with its base along the sternal border to capture the internal mammary perforators and the anteromedial intercostal nerves. Anatomic studies have demonstrated that the medially based internal mammary perforators and anteromedial intercostal nerves are important neurovascular structures of the breast and the NAC.[21–25] Prior experience with this technique in women with severe mammary hypertrophy has demonstrated that viabil-

ity and sensation of the NAC are preserved in 94% of breasts.[1]

The purpose of this study was to assess and quantify the sensation and viability of the NAC after reduction mammaplasty with the medial pedicle and inferior pedicle techniques in women with various degrees of mammary hypertrophy.

Materials and Methods

This is a retrospective review of 72 women who underwent reduction mammaplasty using either a medial or inferior pedicle between 1996 and 2000. The details and techniques of the medial and inferior pedicle techniques of reduction mammaplasty have been described previously.[1–5] The principal surgeon performed all operations. The choice of technique was dependent on breast-related variables that included shape, volume, and position of the NAC. All reductions were performed using a Wise pattern. Preoperative breast volume was estimated and the distance of NAC elevation was calculated. An inferior pedicle was used for women with mild to moderate hypertrophy, and a medial pedicle was used for women with moderate to severe hypertrophy. Preoperative, intraoperative, and postoperative photographs illustrating the medial pedicle technique are depicted in Figures 1 through 10.

The degree of mammary hypertrophy has been defined arbitrarily for this study. Mild hypertrophy is defined as NAC elevation less than 10 cm and a resection weight of less than 600 g per breast. Moderate hypertrophy is defined as NAC elevation between 10 and 15 cm and a resection weight between 600 and 1,200 g. Severe mammary hypertrophy is defined as NAC elevation more than 15 cm and a resection weight more than 1,200 g. The inferior pedicle was chosen for women with mild to moderate hypertrophy because it was felt that the vascularity and innervation would be sufficient. In cases of severe mammary hypertrophy, the medial pedicle was used because of the advantages related to vascularity and innervation. The free nipple graft technique was used only when converting from a pedicle technique.

Fig 1. Preoperative view of a 27-year-old woman. She is 5'4" tall and her body weight is 180 lb. Her bra size is 42DD. The distance from the sternal notch to the nipple is 36 cm on the left and 34 cm on the right. The distance from the nipple to the inframammary fold is 17 cm bilaterally.

Fig 2. Preoperative lateral view.

Postoperative viability and sensation of the NAC was based on physical examination and response to sensory testing. Viability was documented as total necrosis, partial necrosis, and no necrosis. Sensation was based on response to light touch in all 133 breasts, and quantitative sensory testing using the pressure-specified sensory device (PSSD) in 33 breasts.[26] This is a computer-assisted device that functions in principle much like the Semmes–Weinstein monofilaments; however, it differs in that it has a
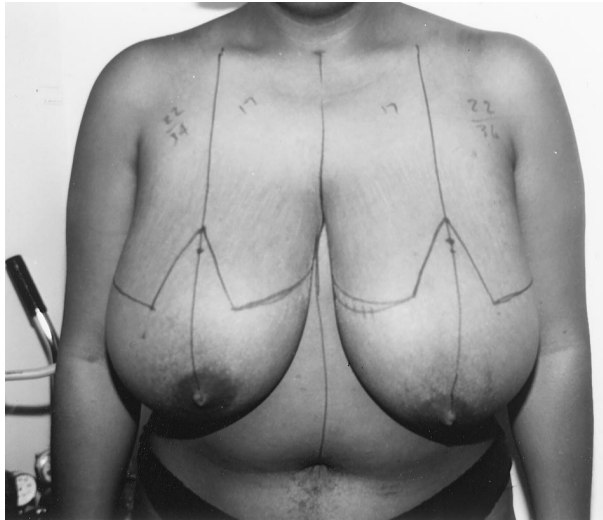
Fig 3. The Wise pattern is outlined. The new position of the nipple–areolar complex is 22 cm from the sternal notch. The change in nipple position is 14 cm on the left and 12 cm on the right.
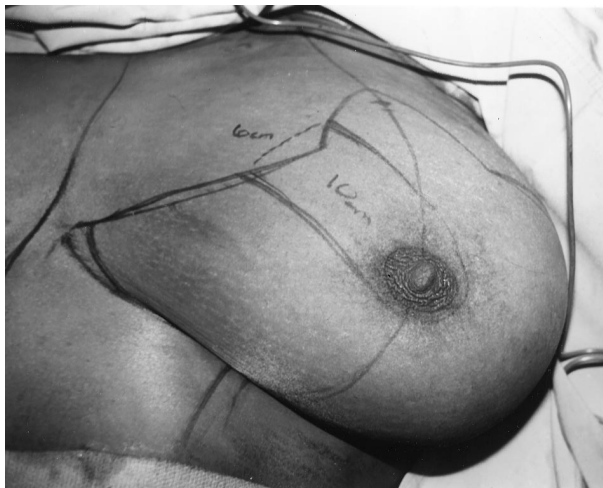

Fig 5. The medial pedicle is elevated. It is a dermoparenchymal pedicle with its blood supply originating from the internal mammary perforators and the intercostal/pectoral perforators.

Fig 4. The medial pedicle is outlined in the supine position. The base of the pedicle is 6 cm and the length of the pedicle is 10 cm.

Fig 6. The medial pedicle is in its natural position.

greater sensitivity. The PSSD is capable of detecting sensory thresholds of 0.3 g per square millimeter, whereas the Semmes–Weinstein filaments are sensitive to 2.0 g per square millimeter. Subjective sensation of the nipple and the areola was graded as completely present, partially present, or absent. Objective sensory testing of the nipple and areola using the PSSD included response to one-point moving and static touch. Preoperative normative data using the PSSD were not obtained. However, postoperative data were compared with control women with moderate to

severe mammary hypertrophy who did not have reduction mammaplasty.

Patient and demographic information including age, weight, and height are provided in Table 1. The medial pedicle was used in 41 women, of whom 38 were bilateral and 3 were unilateral, totaling 79 breasts. Unilateral reduction mammaplasty was performed in women to obtain symmetry after contralateral mastectomy and reconstruction. Mean patient weight was 192.5 lb (range, 150−262 lb) and mean height was 5'5" (range, 4'10"−5'9"). The inferior pedicle was used in 31 women, of whom 23 were bilateral and 8

Fig 7. The medial pedicle is rotated into the apex of the vertical limbs of the Wise pattern. The arc of rotation is smooth, without kinking or twisting of the pedicle.

Fig 8. The weight of resected tissue was 1,250 g on the right and 1,315 g on the left. The nipple is pink and viable after the procedure.

Fig 9. Postoperative view at the 1-year follow-up. The nipple–areolar complex is viable and sensate bilaterally.

Fig 10. Postoperative lateral view demonstrating excellent projection and contour.

Table 1. Patient and Demographic Variables

Variable	Medial Pedicle	Inferior Pedicle
Women	41	31
Bilateral	38	23
Unilateral	3	8
Breasts	79	54
Age (years, mean)	37.7	38.5
Weight (pounds, mean)	192	156
Height (mean)	5'5"	5'4"

The medial and inferior pedicle groups are compared with regard to patient variables.

were unilateral, totaling 54 breasts. Mean patient weight was 156 lb (range, 118−205 lb) and mean height was 5'4" (range, 4'10"−5'8"). The variables requiring evaluation for each breast included the distance from the sternal notch to the nipple, the nipple to the inframammary fold, the base width, as well as the distance from the old nipple position to the new nipple position. Mean follow-up was 25 months (range, 6−49 months).

Results

The breast-related variables for women undergoing reduction mammaplasty with the medial or inferior pedicle techniques are provided in Table 2. For the medial pedicle group, the mean distance from the sternal notch to the nipple was 37 cm (range, 30−48 cm) and from the nipple to the inframammary fold was 19.8 cm (range, 16−26 cm). The mean change in nipple position was 15

Table 2. Breast-Related Variables

Variable	Medial Pedicle	Inferior Pedicle
Distance: SN to NAC (mean, cm)	37	32.3
Distance: NAC to IMF (mean, cm)	19.8	14.1
Distance: Base width (mean, cm)	29	2
Elevation of the NAC (mean, cm)	15	9
Resection weight (mean, grams)	1,490	720
Resection weight (range, grams)	930–2,910	400–1,580

The medial and inferior pedicle groups are compared with regard to variables related to the breast.

cm (range, 12–21 cm). The mean weight of each breast was 1,490 g (range, 930–2,910 g). For the inferior pedicle group, the mean distance from the sternal notch to the nipple was 32.3 cm (range, 25–40 cm) and from the nipple to the inframammary fold was 14.1 cm (range, 9–17 cm). The mean change in nipple position was 9 cm (range, 5–15 cm). The mean weight of breast removed was 720 g (range, 400–1,580 g).

The outcome after medial and inferior pedicle reduction mammaplasty is provided in Table 3. Total preservation of both the viability and sensation of the NAC was obtained in 63 of 79 breasts (80%) after medial pedicle reduction mammaplasty and in 49 of 54 breasts (91%) after inferior pedicle reduction mammaplasty. Morbidities related to the NAC included partial sensory loss, total sensory loss, partial viability, and absent viability, and occurred in 16 of 74 breasts (20%) after medial pedicle reduction mammaplasty and in 5 of 54 breasts (9%) after inferior pedicle reduction mammaplasty.

Compromised flow to the NAC was observed in 2 patients. The first case involved a woman with a body mass index of 73.5 kg per meter (125 kg and 1.7 m). The distance from the sternal notch to the nipple was 42 cm, from the nipple to the inframammary fold was 23 cm, and to the new nipple position was 21 cm. The resected volume was 2,530 g. Intraoperatively, minimal bleeding at the distal edge of the pedicle was noted; therefore, the procedure was converted to a free nipple graft. The second case involved a woman with a body mass index of 62.5 kg per meter (100

kg and 1.6 m). The distance from the sternal notch to the nipple was 46 cm, from the nipple to the inframammary fold was 27 cm, and to the new nipple position was 21 cm. The resected volume was 2,740 g. Intraoperatively, excellent bleeding from the distal edge of the pedicle was noted. Postoperatively, the NAC became progressively necrotic and by day 7, necrosis was complete.

The results of the quantitative sensory testing are included in Table 4. For all groups, one-point moving touch was the most sensitive test for both the nipple and the areola. Quantitative sensory testing of the inferior pedicle group demonstrated an increased threshold relative to the control group. However, the same battery of tests for the medial pedicle group demonstrated a decreased threshold relative to the control group. The difference in sensitivity between the inferior pedicle and the medial pedicle was not significant.

Discussion

Diminished sensation of the NAC after reduction mammaplasty was first reported by Maliniac[27] in 1948. He found that "normal" sensation of the nipple recurred postoperatively in approximately 80% of breasts after nipple transposition on a central pedicle. In addition, 3 to 6 months were required for the sensation to recur. In a subsequent review of breast sensation, Courtiss and Goldwyn[28] concluded that alterations in the sensation of the NAC were likely before and after plastic surgery of the breast. This observation was based on a review of the literature and their own experience. Findings included transient loss of three sensations: pain, crude touch, and light pressure. Many of these sequelae could last as long as 2.5 years after the operation.

More recent studies evaluating sensibility of the NAC have focused on the type of reduction mammaplasty and its correlation with resection volume.[29–32] Review of the literature demonstrates that the incidence of reduced or absent sensation of the NAC ranges from 0 to 74%, and the incidence of partial or total necrosis of the NAC ranges from 0 to 8%.[1,3,7,12,18,29–39] Gonzalez and colleagues,[30] in a prospective study of NAC sensation after reduction mammaplasty with

Table 3. Viability and Sensation of the Nipple–Areolar Complex

NAC factor	Medial Pedicle		Inferior Pedicle	
	Number	Percent	Number	Percent
Total sensation	68/79	86	50/54	92
Partial sensation	6/79	8	3/54	6
Absent sensation	5/79	6	1/54	2
Total viability	74/79	94	53/54	98
Partial viability	4/79	5	1/54	2
Absent viability	1/79	1	0/54	0

The postoperative viability and sensation of the NAC are compared for the medial and inferior pedicle groups.

Table 4. Quantitative Sensory Data

Test	Control	Inferior Pedicle	Medial Pedicle	*P*-value
Nipple: 1-point, moving touch	4.5	1.5	5.4	0.1
Nipple: 1-point, static touch	10.2	4.5	13.3	0.14
Areola: 1-point, moving touch	8.2	4.9	8.3	0.25
Areola: 1-point, static touch	21.4	14.8	23	0.26

The quantitative sensory data with the PSSD for the control, medial pedicle, and inferior pedicle groups are depicted.

NAC transposition on either a central or inferior pedicle, concluded that sensation was retained in 96% of breasts when the resected volume was less than 550 g, and was retained in 85% of breasts when the resected volume was more than 550 g. Sensation was documented using Semmes–Weinstein filaments. It was therefore postulated that as the resected volume increases, the probability of diminished sensation would also increase. This finding has been confirmed by Makki and Ghanem[35] in a retrospective review of 164 patients who underwent reduction mammaplasty for severe mammary hypertrophy. In their study, 51 women (31%) reported diminished sensation of the NAC after a mean resected volume of 1,037 g. Atterhem and associates,[36] in a retrospective review of 242 women, demonstrated that postoperative nipple sensation correlated with the resected volume and was found to be reduced in 52% and absent in 10% of women (mean resected volume, 1,174 g and 1,484 g respectively) after reduction mammaplasty with nipple–areolar transposition on a pedicle or as a free graft.

Most surgeons when confronted with a woman with severe mammary hypertrophy will often perform an amputation mammaplasty with free nipple graft. The traditional indication for this method of reduction is a change in position of the NAC that exceeds 15 cm in height.[3] This is based on the fact that as the resected volume increases, the incidence of complications also increases and includes necrosis and insensitivity of the NAC.[40] Atterhem and associates[36] has demonstrated that the incidence of partial and total nipple necrosis correlates best with resected volume (mean resected volume, 1,485 g and 2,070 g respectively). Blomqvist[29] has demonstrated further that age older than 30 years and obesity are additional risk factors for nipple necrosis. Hoopes and Jabalay[13] have shown that for women with severe mammary hypertrophy, amputation with a free nipple graft will result in greater viability of the NAC; however, the sensation will be diminished. This finding has been confirmed by Townsend,[18] who demonstrated that despite excellent revascularization and viability of the NAC after free graft, sensation was reduced or absent in 34 of 46 breasts (74%).

Reduction mammaplasty with nipple–areolar transposition on a medial pedicle was designed originally as an alternative to amputation mammaplasty with free nipple graft in women with severe mammary hypertrophy.[1] The basis for this technique evolved from anatomic studies demonstrating sufficient blood supply and innervation to the breast and the NAC from the medially based internal mammary perforators and the anteromedial intercostal nerves.[21–25] These anatomic features allow for transposition of the NAC

on a medially based pedicle that has the potential to maintain the viability and sensation of the NAC. Prior experience with this technique for women with severe mammary hypertrophy has demonstrated viability of the NAC in 44 of 45 breasts (98%) and preservation of sensation in 43 of 44 breasts (98%).[1]

The results of the current study demonstrate that for women with moderate to severe mammary hypertrophy, nipple–areolar transposition on a medial pedicle is a safe and well-tolerated procedure and results in total (86%) or partial (8%) sensation in 94% of breasts. This compares well with women who undergo amputation mammaplasty with a free nipple graft, in which the return of partial or total sensation ranges from 50 to 80%.[18,19] Nipple viability was total (94%) or partial (5%) in 99% of breasts, which compares equally with the free nipple graft techniques.[16–20]

The causes for the observed reduction in the viability and sensation of the NAC are variable. Most women with altered viability and sensation were those with severe mammary hypertrophy; however, the alterations are not explained completely by the resected volume and the pedicle length alone. In the woman with complete necrosis of the left NAC, the resected volume was less and the pedicle length was the same as the right breast in which the nipple remained viable. The cause of the necrosis is presumed to be secondary to postoperative factors related to parenchymal edema that may have compromised the distal vascularity of the medial pedicle.

Analysis of the sensory data demonstrates that postoperative sensation after inferior pedicle reduction mammaplasty is better than the medial pedicle. At first glance it may be inferred that this means that the inferior pedicle is capable of supporting the innervation to a greater degree than the medial pedicle. However, it must be remembered that the inferior pedicle was used for women with mild to moderate mammary hypertrophy and that the mean resected volume was substantially less than the medial pedicle breasts (720 g vs. 1,490 g). Other factors that may influence sensation include pedicle length, pedicle orientation, and relief of traction forces on the intercostal nerves.[41] Results of the PSSD demonstrate that the difference in sensation of the NAC after medial or inferior pedicle reduction is not significant. A detailed analysis of these techniques and results has been reported.[42]

In conclusion, the current study demonstrated that the medial and inferior pedicle techniques are capable of supporting vascularity and innervation to the NAC. The medial pedicle technique for severe mammary hypertrophy is a good alternative to a free nipple graft. The amount of breast tissue removed does not correlate with sensory outcome for both inferior and medial pedicle techniques. The PSSD is an excellent means of assessing sensory outcome.

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Open Discussion

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Benjamin Chang, MD (Philadelphia, PA): Dr Nahabedian, you compared pre- and postoperative sensibility in these patients. Some people believe that patients with larger breasts tend to have lower sensibility to begin with. I wonder if that would account for some of the difference you see between the two groups, and not necessarily because of the pedicle technique.

Dr Nahabedian: That's a good question. Unfortunately, this was retrospectively reviewed, and all of these patients were tested postoperatively. The controls that were used were patients with C and D cup breasts but were not part of this study.

Richard J. Zienowicz, MD (Providence, RI): I want to commend you for your honesty in this study. I was just wondering. Are you really shorting yourself on your results? It seems to me that the cases you presented with the medial pedicle were enormous breasts. I'd like to know if you had a corresponding matched control in the inferior pedicle group because that could be responsible for some of those results.

Dr Nahabedian: No, I started doing the medial

pedicle primarily because of its vascularity. So I did it as an alternative to amputation and free nipple graft. I would not use the inferior pedicle on breasts of that size because I would be very concerned about losing the total nipple–areolar complex. I therefore don't have good matched controls between the two groups.

Dr Zienowicz: So at this point would you take those really challenging cases and think about a free nipple graft even though you are using the medial pedicle?

Dr Nahabedian: Absolutely. There are times when I still will do an amputation and free nipple graft technique for the very severe mammary hypertrophy. In the one case where we lost the nipple, I would have converted it to an amputation and free nipple graft technique. However, after I had elevated the dermoparenchymal pedicle, there was bleeding at the distal aspect, which led me to believe that it would remain viable. But I think what ended up happening was that there may have been some compression or edema that may have compromised that distal pedicle and resulted in this problem.