

# Vertical Scar Reduction Mammoplasty: The Fate of Nipple-Areola Complex Position and Inferior Pole Length

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**Background:** A major advantage of vertical scar reduction mammoplasty is the improved long-term projection of the breasts. In their experience with more than 1700 cases, the authors have observed the following important trends: Postoperatively, the nipple-areola complex is located higher than one would predict from the preoperative skin markings, and pseudoptosis does not occur. This study was performed to provide objective measurements to confirm these observations.

**Methods:** Forty-nine consecutive women had the following measurements taken of their right breast preoperatively and on postoperative day 5: distance from the clavicle to the superior border of the nipple-areola complex; the clavicle to the nipple; and the inframammary crease to the inferior border of the nipple-areola complex. Forty-six women were available for follow-up at 4 years, and measurements were repeated.

**Results:** Compared with preoperative skin markings, the nipple-areola complex was located on average 1.3 cm higher on postoperative day 5 and 1.0 cm higher at 4-year follow-up. The average distance from the inframammary crease to the inferior border of the nipple-areola complex had decreased 0.4 cm at 4-year follow-up.

**Conclusions:** Compared with preoperative skin markings, the nipple-areola complex was located significantly higher at both early and long-term follow-up. The authors have adjusted their skin marking technique so that the superior border of the nipple-areola complex is marked at the level of the inframammary crease. At 4 years, the distance from the inframammary crease to the inferior border of the nipple-areola complex was significantly shorter, and pseudoptosis did not occur after vertical scar reduction mammoplasty. (*Plast. Reconstr. Surg.* 121: 1084, 2008.)

One of the major advantages of vertical scar reduction mammoplasty is the improved long-term projection of the breasts following this procedure. With vertical scar reduction mammoplasty, the inferior wedge resection and subsequent suturing of the medial and lateral pillars results in coning of the breast. This results in a narrower, more projecting breast, which is the

hallmark of the procedure.<sup>1</sup> In our 18-year experience of over 1700 cases, we have observed several important trends. We have noted that the final postoperative position of the nipple-areola complex is higher than one would predict from the preoperative skin markings. In addition, we have observed that pseudoptosis does not occur.

Lassus<sup>2-5</sup> and Lejour<sup>6-8</sup> are responsible for much of the pioneering work on vertical scar reduction mammoplasty. In 1999, Hall-Findlay<sup>9-12</sup> described a modification of Lejour's technique using a mosque dome pattern skin marking pattern; a full-thick-

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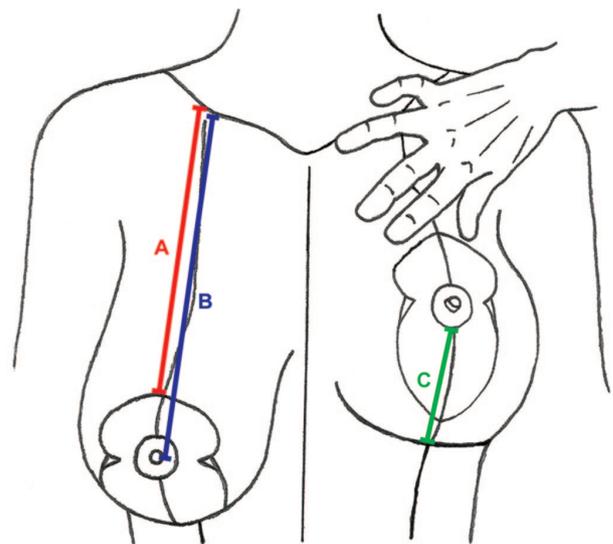
ness medial dermoglandular pedicle to transpose the nipple-areola complex; no skin undermining; no suturing of the pedicle to the pectoralis fascia; and liposuction only rarely to reduce breast volume. To accommodate for the increased projection associated with the procedure, the new position of the nipple was marked 2 cm lower than when this position was marked using the Wise pattern.<sup>12</sup> In 2006, we described a technique that uses a mosque dome skin marking pattern; transposition of the nipple-areola complex on a superior or medial dermoglandular pedicle, depending on its position with respect to the skin markings; an excision en bloc of skin, fat, and gland; postexcision liposuction; and wound closure in two planes, with gathering of the skin of the vertical wound using four-point gathering box stitches.<sup>1</sup> Early in our experience, we observed that, immediately after surgery, the nipple-areola complex was usually located approximately 2 cm higher than was planned for preoperatively. To prevent overly high nipple-areola complexes, we adjusted the preoperative skin markings so that the superior border of the nipple-areola complex was transposed to the level of the inframammary crease.

Two key principles are central to the previously described techniques for vertical scar reduction mammoplasty: (1) using a superior or medial pedicle allows for an inferior wedge resection of the redundant breast skin and parenchyma that contributed to breast ptosis; and (2) the inferior wedge excision allows for the subsequent suturing of the medial and lateral pillars, which results in coning of the breast and is responsible for the pleasing projection associated with these techniques. Along with other authors, we have observed that this increased projection leads to improved long-term breast shape<sup>1,3-6,8-13</sup> and avoidance of pseudoptosis.<sup>1,8,10,11</sup> Although several studies<sup>14,15</sup> have been performed to investigate the long-term changes in nipple position and breast shape following Wise pattern/inferior pedicle breast reduction, only one study has been performed to examine these changes following vertical scar reduction mammoplasty. Keck et al.<sup>16</sup> followed 42 patients for 1 year after vertical scar reduction mammoplasty and reported that the nipple diameter, notch-to-nipple distance, and scar length increased on average 28, 17, and 22 percent, respectively. This study was performed to provide objective measurements to confirm our observations that the nipple-areola complex is located higher postoperatively when compared with preoperative skin markings and that pseudoptosis does not occur following this procedure.

## PATIENTS AND METHODS

Between May 17 and December 13, 2002, 49 consecutive patients underwent vertical scar reduction mammoplasty. The average age of these patients was 36 years (range, 19 to 59 years) and the average body mass index was 29.3 kg/m<sup>2</sup> (range, 19.1 to 46.3 kg/m<sup>2</sup>). The technique performed in this series has been previously described in detail.<sup>1</sup> All 49 patients had measurements recorded immediately preoperatively and on postoperative day 5. Four years after surgery, 46 patients were available for follow-up and were included in this study. All measurements were performed by the senior author (F. L.) on the right breast of each patient using a ruler placed against the patient's skin. Three measurements were recorded at each visit (Fig. 1). The shortest distance between the inferior edge of the clavicle and the planned postoperative position of the superior border of the nipple-areola complex and the shortest distance between the inferior edge of the clavicle and the nipple were recorded with the patient in the sitting position. The distance between the inframammary crease and the inferior border of the nipple-areola complex was recorded with the patient in the supine position.

Measurements recorded at each visit along with the changes in these measurements between



**Fig. 1.** Breast measurements recorded at each visit. *A*, The shortest distance between the inferior edge of the clavicle and the planned postoperative position of the superior border of the nipple-areola complex. *B*, The shortest distance between the inferior edge of the clavicle and the nipple. *C*, The distance between the inframammary crease and the inferior border of the nipple-areola complex.

visits are presented for all patients. In addition, the changes in these measurements are examined based on the type of pedicle and the size of reduction. A paired, two-tailed *t* test, without correction for multiple testing, was performed for all comparisons between measurements. A value of  $p < 0.05$  was considered statistically significant.

## RESULTS

The average total reduction per breast including liposuction, when performed, was 673 g (range, 140 to 2020 g). The average weight of tissue excised per breast was 611 g (range, 140 to 2020 g). Liposuction was used in 27 patients to remove an average of 112 ml per breast (range, 25 to 300 ml). A superior pedicle was used to transpose the nipple-areola complex in 31 patients and a medial pedicle was used in 18 patients. The average total reduction per breast including liposuction, when performed, was 558 g (range, 140 to 1040 g) using a superior pedicle and 871 g (range, 450 to 2020 g) using a medial pedicle. Figure 2 shows the preoperative and early and long-term postoperative appearances of a patient that underwent vertical scar reduction mammoplasty.

Table 1 shows the average and range of measurements recorded preoperatively, on postoperative day 5, and at 4-year follow-up for all breasts. Table 2 shows the difference in these measurements. The average superior transposition of the nipple between preoperative and postoperative day 5 measurements was 8.1 cm (range, 1.5 to 17.5 cm). The nipple-areola complex was located on average 1.3 cm higher (range, -1.0 to 4.0 cm) when compared with the preoperative skin markings, and this change was highly statistically significant. The distance between the inframammary crease and the inferior border of the nipple-areola complex decreased on average 3.0 cm (range, 0.5 to 8.5 cm) between preoperative and postoperative day 5 measurements. Table 3 shows the difference in measurements recorded preoperatively, on postoperative day 5, and at 4-year follow-up when breasts were grouped by the type of pedicle. Using a superior pedicle, the superior border of the nipple-areola complex was located on average 1.2 cm higher (range, -1.0 to 4.0 cm) when compared with the preoperative markings and 1.5 cm higher (range, -1.0 to 4.0 cm) using a medial pedicle. Both of these changes were statistically significant. Table 4 shows the difference in measurements recorded preoperatively, on postoperative day 5, and at 4-year follow-up when breasts were grouped by the size of reduction. Compared with the preoperative markings, the superior border of the

nipple-areola complex was located on average 1.4 cm higher (range, 1.0 to 2.0 cm) for small reductions, 1.0 cm higher (range, -1.0 to 4.0 cm) for medium reductions, and 2.1 cm higher (range, 1.0 to 3.5 cm) for large reductions. All three of these changes were statistically significant.

At 4-year follow-up, the distance from the clavicle to the superior border of the nipple-areola complex increased by 0.3 cm (range, -1.5 to 2.5 cm); however, this change was not statistically significant. In addition, the nipple-areola complex was located on average 1.0 cm higher (range, -1.0 to 4.0 cm) at 4-year follow-up when compared with the preoperative skin markings, and this change remained highly statistically significant ( $p < 0.001$ ). At 4-year follow-up, the distance between the inframammary crease and the inferior border of the nipple-areola complex decreased 0.4 cm (range, -2.0 to 3.5 cm) compared with the postoperative day 5 measurements, and this change was statistically significant.

## DISCUSSION

Several studies have been performed to investigate the long-term changes in nipple position and breast shape following Wise pattern/inferior pedicle breast reduction. Reus and Mathes<sup>14</sup> followed 22 patients over an average of 4.7 years and found that, although overall breast projection and contour were well preserved and the midclavicle to nipple distance did not change, the length of the vertical scar increased over time. This resulted in superior displacement of the nipple-areola complex in its relationship with the breast mound. Furthermore, their study provided evidence that supported limiting the length of the vertical limb at the time of Wise pattern/inferior pedicle breast reduction in anticipation that the vertical limb will lengthen over time, a practice previously suggested by other authors.<sup>17</sup> Freiberg and Carr<sup>15</sup> followed 59 patients over an average of 2.9 years to study the long-term position of the nipple-areola complex, measuring the sternal notch to nipple distance, the areola to inframammary crease distance, and the length of the vertical limb of the scar. Although there was a trend for the sternal notch to nipple and areola to inframammary crease distances to lengthen and for the vertical limb to shorten over time, none of these changes was statistically significant. They concluded that nipple location remains stable following their technique for Wise pattern/inferior pedicle breast reduction.

Keck et al.<sup>16</sup> followed 42 patients for 1 year after vertical scar reduction mammoplasty and reported that the nipple diameter, notch-to-nipple



**Fig. 2.** (Above, left) A 38-year-old woman underwent vertical scar reduction mammoplasty with bilateral superior pedicles, during which 375 g was excised from the right breast and 325 g was excised from the left. (Above, right) Patient marked preoperatively, showing the distance from the inferior edge of the clavicle to the level of the planned postoperative position of the superior border of the nipple-areola complex to be 21 cm. (Center, left) Results 5 days postoperatively. The distance from the inferior edge of the clavicle to the superior border of the nipple-areola complex is 20 cm, resulting in a difference of 1 cm. (Center, right and below, left and right) Appearance at 4-year follow-up. The distance from the inframammary crease to the inferior border of the nipple-areola complex was unchanged.

distance, and scar length increased on average 28, 17, and 22 percent, respectively. To the best of our knowledge, our study is the first to examine both early and long-term changes in nipple-areola com-

plex position and inferior pole length following vertical scar reduction mammoplasty.

Compared with preoperative skin markings, the superior border of the nipple-areola complex

**Table 1. Preoperative, Postoperative Day 5, and 4-Year Follow-Up Measurements for All Breasts**

Measurements	Average (range) (cm)
Preoperative	
Clavicle to superior border of NAC	20.7 (18.0–25.0)
Clavicle to nipple	29.5 (21.5–40.0)
IMC to inferior border of NAC	13.3 (10.0–21.5)
Postoperative day 5	
Clavicle to superior border of NAC	19.4 (17.0–24.0)
Clavicle to nipple	21.4 (18.0–26.0)
IMC to inferior border of NAC	10.3 (6.5–14.0)
4-Year follow-up	
Clavicle to superior border of NAC	19.7 (17.5–24.0)
Clavicle to nipple	21.9 (19.5–26.5)
IMC to inferior border of NAC	9.9 (6.5–14.0)

NAC, nipple-areola complex; IMC, inframammary crease.

is located on average 1.3 cm higher on postoperative day 5 for all breasts. This trend was also consistent when breasts were grouped by the type of pedicle or the size of reduction and was highly statistically significant in all cases. To ensure that this elevation was not the result of postoperative

swelling, we examined the measurements of 36 patients who were seen at 1 month postoperatively and found that the nipple-areola complex was still located significantly higher (1.2 cm; range, –1.0 to 3.0 cm) ( $p < 0.001$ ). At 4-year follow-up, the distance from the clavicle to the superior border of the nipple-areola complex had increased 0.3 cm compared with the postoperative day 5 measurements; however, this change was not statistically significant. When breasts were grouped by the type of pedicle or the size of reduction, this change was only marginally statistically significant when a superior pedicle was used. Comparing the preoperative measurement to the measurement at 4-year follow-up, the superior border of the nipple-areola complex was still located significantly higher by 1.0 cm. Early in our experience, we marked the breast so that the nipple was transposed to the level of the inframammary crease as is the case using the Wise pattern. However, we observed that the final postoperative position of the nipple-areola complex was located higher than one would

**Table 2. Difference in Preoperative, Postoperative Day 5, and 4-Year Follow-Up Measurements for All Breasts**

Measurements	Average (range) (cm)	<i>p</i>
Difference between preoperative and postoperative day 5		
Clavicle to superior border of NAC	–1.3 (–4.0 to 1.0)	<0.001*
Clavicle to nipple	–8.1 (–17.5 to –1.5)	<0.001*
IMC to inferior border of NAC	–3.0 (–8.5 to –0.5)	<0.001*
Difference between postoperative day 5 and 4-yr follow-up		
Clavicle to superior border of NAC	0.3 (–1.5 to 2.5)	0.084
Clavicle to nipple	0.5 (–1.5 to 3.0)	0.004*
IMC to inferior border of NAC	–0.4 (–3.5 to 2.0)	0.024*

NAC, nipple-areola complex; IMC, inframammary crease.

\*Statistically significant.

**Table 3. Difference in Preoperative, Postoperative Day 5, and 4-Year Follow-Up Measurements for Superior and Medial Pedicles**

Measurements	Average (range) (cm)	<i>p</i>
Superior pedicle		
Difference between preoperative and postoperative day 5		
Clavicle to superior border of NAC	–1.2 (–4.0 to 1.0)	<0.001*
Clavicle to nipple	–6.5 (–17.5 to –1.5)	<0.001*
IMC to inferior border of NAC	–2.7 (–8.5 to –0.5)	<0.001*
Difference between postoperative day 5 and 4-yr follow-up		
Clavicle to superior border of NAC	0.5 (–1.5 to 2.0)	0.048*
Clavicle to nipple	0.6 (–1.5 to 3.0)	0.005*
IMC to inferior border of NAC	–0.5 (–3.5 to 2.0)	0.031*
Medial pedicle		
Difference between preoperative and postoperative day 5		
Clavicle to superior border of NAC	–1.5 (–4.0 to 1.0)	0.002*
Clavicle to nipple	–11.0 (–17.5 to –4.5)	<0.001*
IMC to inferior border of NAC	–3.6 (–8.5 to –1.0)	<0.001*
Difference between postoperative day 5 and 4-yr follow-up		
Clavicle to superior border of NAC	0.2 (–1.5 to 2.5)	0.650
Clavicle to nipple	0.4 (–1.0 to 3.0)	0.245
IMC to inferior border of NAC	–0.3 (–2.0 to 2.0)	0.411

NAC, nipple-areola complex; IMC, inframammary crease.

\*Statistically significant.

**Table 4. Difference in Preoperative, Postoperative Day 5, and 4-Year Follow-Up Measurements for Small, Medium, and Large Reductions**

Measurements	Average (range) (cm)	<i>p</i>
Small (<400 g)		
Difference between preoperative and postoperative day 5		
Clavicle to superior border of NAC	-1.4 (-2.0 to -1.0)	0.010*
Clavicle to nipple	-5.0 (-6.5 to -1.5)	0.024*
IMC to inferior border of NAC	-2.1 (-3.5 to -0.5)	0.042*
Difference between postoperative day 5 and 4-yr follow-up		
Clavicle to superior border of NAC	0.5 (0.0 to 2.0)	0.391
Clavicle to nipple	0.6 (0.0 to 2.0)	0.278
IMC to inferior border of NAC	-0.6 (-1.0 to 0.0)	0.080
Medium (401–800 g)		
Difference between preoperative and postoperative day 5		
Clavicle to superior border of NAC	-1.0 (-4.0 to 1.0)	<0.001*
Clavicle to nipple	-6.9 (-17.0 to -1.5)	<0.001*
IMC to inferior border of NAC	-2.6 (-4.5 to -0.5)	<0.001*
Difference between postoperative day 5 and 4-yr follow-up		
Clavicle to superior border of NAC	0.3 (-1.5 to 2.0)	0.091
Clavicle to nipple	0.5 (-1.5 to 3.0)	0.010*
IMC to inferior border of NAC	-0.3 (-3.5 to 2.0)	0.173
Large (>800 g)		
Difference between preoperative and postoperative day 5		
Clavicle to superior border of NAC	-2.1 (-3.5 to -1.0)	<0.001*
Clavicle to nipple	-12.7 (-17.5 to -3.0)	<0.001*
IMC to inferior border of NAC	-4.4 (-8.5 to -1.0)	<0.001*
Difference between postoperative day 5 and 4-yr follow-up		
Clavicle to superior border of NAC	0.2 (-1.5 to 2.5)	0.654
Clavicle to nipple	0.5 (-1.5 to 3.0)	0.311
IMC to inferior border of NAC	-0.6 (-2.0 to 1.0)	0.140

NAC, nipple-areola complex; IMC, inframammary crease.

\*Statistically significant.

predict from the preoperative skin markings. When we measured the distance from the midpoint of the clavicle to the new position of the nipple-areola complex, we found that this distance was consistently shorter by 1 to 3 cm following the operation. We attribute the superior movement of the nipple-areola complex to suturing of the medial and lateral pillars, which produces coning of the breast and pushes the nipple superiorly. This coning effect also causes the lax skin of the superior aspect of the breast to be distributed in a circumhorizontal direction as opposed to distribution in an inferior direction, as would be the case for breast reductions performed using the Wise pattern. In addition, the effect of gravity pulling the weight of the breast inferiorly may be reduced by excision of breast tissue from the inferior pole of the breast, decreasing tension on the skin of the superior aspect of the breast, postoperatively.<sup>16</sup> These effects cause redistribution of the breast skin, resulting in a shortened distance between the midpoint of the clavicle and the superior border of the nipple-areola complex, postoperatively. We consider the nipple-areola complex being persistently located on average 1.0 cm higher following this procedure to be a significant finding, and this must be adjusted for to prevent the serious prob-

lem of overly high nipple-areola complexes. Thus, we modified our marking technique so that the superior border of the nipple-areola complex was transposed to the level of the inframammary crease, as opposed to transposing the nipple to this point. This change leads to the nipple being located approximately 2 cm lower than it would be using the Wise pattern. Hall-Findlay also accommodates for the increased projection associated with her procedure by marking the new position of the nipple 2 cm lower than when this position is marked using the standard Wise pattern.<sup>12</sup>

Other changes between preoperative and postoperative day 5 measurements included significant shortening of the clavicle to nipple distance, indicative of the superior transposition of the nipple-areola complex during breast reduction, and significant shortening of the inframammary crease to inferior border of nipple-areola complex distance, reflecting both excision of breast tissue and gathering of the skin of the vertical wound. Both the superior transposition of the nipple-areola complex and the degree of shortening of the inframammary crease to the inferior border of the nipple-areola complex distance were greater when using a medial pedicle than a superior pedicle and tended to increase as the size of reduction in-

creased. These observations lead us to believe that with increasing breast size comes increasing breast ptosis, as would be expected intuitively.

At 4-year follow-up, the distance from the clavicle to the nipple increased significantly (by 0.5 cm). This minor lengthening of the distance from the clavicle to the nipple, in the absence of a significant lengthening of the distance from the clavicle to the superior border of the nipple-areola complex, may be attributable to relaxation of the skin of the superior aspect of the breast over time or may be attributable to widening of the areolar diameter as observed by Keck et al.<sup>16</sup> At 4-year follow-up, the distance from the inframammary crease to the inferior border of the nipple-areola complex had decreased significantly (by 0.4 cm). We feel that contracture of the vertical scar probably contributes to this shortening in length of the inferior pole of the breast over time. Given that the distance from the inframammary crease to the inferior border of the nipple-areola complex does not increase over time, we can infer that the breast mound does not migrate inferiorly and that pseudoptosis does not occur after vertical scar reduction mammoplasty. Using our technique, it is possible that the parenchymal pillar sutures and gathering the vertical wound using four-point gathering box stitches provides more support to the vertical scar, preventing its lengthening in the early stages of healing. The stability of the vertical scar may help to prevent lengthening of the inferior pole of the breast over time following this procedure. In addition, the inferior wedge resection during this procedure of the redundant breast skin and parenchyma that contributed to primary breast ptosis likely contributes to prevention of pseudoptosis following this procedure. When the change in the length of the inferior pole of the breast was examined by the type of pedicle or the size of reduction, this length did not increase for any group at 4-year follow-up when compared with the postoperative day 5 measurements.

In contrast to our observations that the inframammary crease to inferior border of nipple-areola complex distance and the length of the vertical scar are shorter at 4-year follow-up, Keck et al.<sup>16</sup> reported a 17 percent lengthening of the vertical scar at 1-year follow-up. Although not specified in their article, the different results may be attributable to differences in technique, such as inadequate resection of breast tissue at the inferior pole or excessive gathering of the vertical wound. However, it is unlikely that the different results are attributable to their shorter length of follow-up because 38 of the patients included in our study

were seen at approximately 1 year postoperatively, and we observed a 0.1-cm decrease in the inframammary crease to inferior border of the nipple-areola complex distance that was not statistically significant ( $p = 0.57$ ). We also observed that the vertical scar did not lengthen during this period.

Interestingly, the long-term postoperative length of the inframammary crease to inferior border of the nipple-areola complex distance ranged from 6.5 to 14 cm in this series. In Wise pattern/inferior pedicle breast reductions, it is necessary to limit the length of the vertical scar to allow for its lengthening over time.<sup>11,14</sup> However, in vertical pattern reductions, a much longer vertical scar is acceptable. Lassus<sup>4</sup> measured the distance between the inferior border of the areola and the inframammary crease in young women with beautiful breasts and found measurements ranging from 4.5 to 10 cm and concluded that the distance was dependent on the size of the breast. Lassus<sup>3</sup> reported vertical scar lengths as long as 9 cm in large reductions, and Hall-Findlay<sup>9</sup> showed results where this distance was as great as 12 cm.

## CONCLUSIONS

The results of this study provide objective measurements to confirm our observation that the nipple-areola complex is located higher at both early and long-term follow-up when compared with preoperative skin markings. To account for this change, we adjusted our skin marking technique so that the superior border of the nipple-areola complex is marked at the level of the inframammary crease to prevent the serious problem of overly high nipple-areola complexes. In addition, we provide evidence that the distance from the inframammary crease to the inferior border of the nipple-areola complex does not lengthen over time and can infer that pseudoptosis does not occur following this procedure.

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