

# Breast Reduction versus Breast Reduction Plus Implants: A Comparative Study with Measurements and Outcomes

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**Background:** Breast reduction is well-known to provide an improvement in physical symptoms. However, measurements show that this procedure is less effective in restoring upper-pole fullness. Breast implants effectively augment the upper pole. This study was undertaken to determine the effectiveness and safety of this treatment combination.

**Methods:** This retrospective study consists of 3 parts: (1) a clinical study, (2) breast measurements, and (3) an outcome study. Eighty consecutive women undergoing breast reduction ( $n = 56$ ) or breast reduction plus implants ( $n = 24$ ) were evaluated. All breast implants were inserted submuscularly. All patients were treated with the same vertical reduction technique, using a medially based pedicle and intraoperative nipple positioning. Measurements were compared between preoperative photographs and photographs taken at least 3 months after surgery ( $n = 51$ ). Patient surveys ( $n = 56$ ) were evaluated.

**Results:** There was no significant difference in complication or reoperation rates between groups. Both procedures elevated the breast mound and lower-pole level and increased the breast parenchymal ratio (upper-pole area/lower-pole area). Breast implants significantly increased upper-pole projection ( $P < 0.01$ ). All surveyed patients who had simultaneous implants reported that they were pleased with their decision. Physical symptoms were reduced in both groups. Patient satisfaction was 92.5% for breast reduction and 93.8% for breast reduction plus implants. Both groups reported an improvement in quality of life.

**Conclusions:** Vertical breast reduction with a medial pedicle may be combined safely and effectively with breast implants in patients who desire upper-pole fullness. (*Plast Reconstr Surg Glob Open* 2014;2:e281; doi: 10.1097/GOX.0000000000000252; Published online 23 December 2014.)

The combination of breast reduction and breast implants has received considerable attention recently.<sup>1,2</sup> Combining the 2 operations might

strike some surgeons as contradictory and even unethical.<sup>1</sup> An increasing number of plastic surgeons, however, believe that this combination has a proper place in the plastic surgeon's armamentarium.<sup>2</sup> This study was undertaken to determine the efficacy and safety of this treatment combination and to compare breast measurements and patient-reported outcomes. Such a study has not been previously reported.

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**PATIENTS AND METHODS**

There were 3 components to this study: (1) a clinical study, (2) breast measurement study, and (3) patient surveys. A breast reduction was defined as removal of  $\geq 300$  g of breast tissue from at least 1 breast.<sup>3-5</sup>

**Patients**

A retrospective study was undertaken among 80 consecutive women undergoing breast reduction or breast reduction with implants from 2004 to 2014. Institutional review board approval was obtained from Chesapeake Institutional Review

Board, accredited by the Association for the Accreditation of Human Research Protection Programs, Inc. There were 56 breast reductions and 24 breast reductions plus implants (Table 1). No breast reconstructions or unilateral breast procedures were included.

**Measurements**

Breast measurements were made using the system previously reported (Figs. 1–4).<sup>6</sup> All photographs were taken by the author in the same room, with the same lighting, background, body position, and digital camera—a Nikon D80 camera (Nikon

**Table 1. Patient Data for 80 Women Undergoing Breast Reduction or Breast Reduction plus Implants**

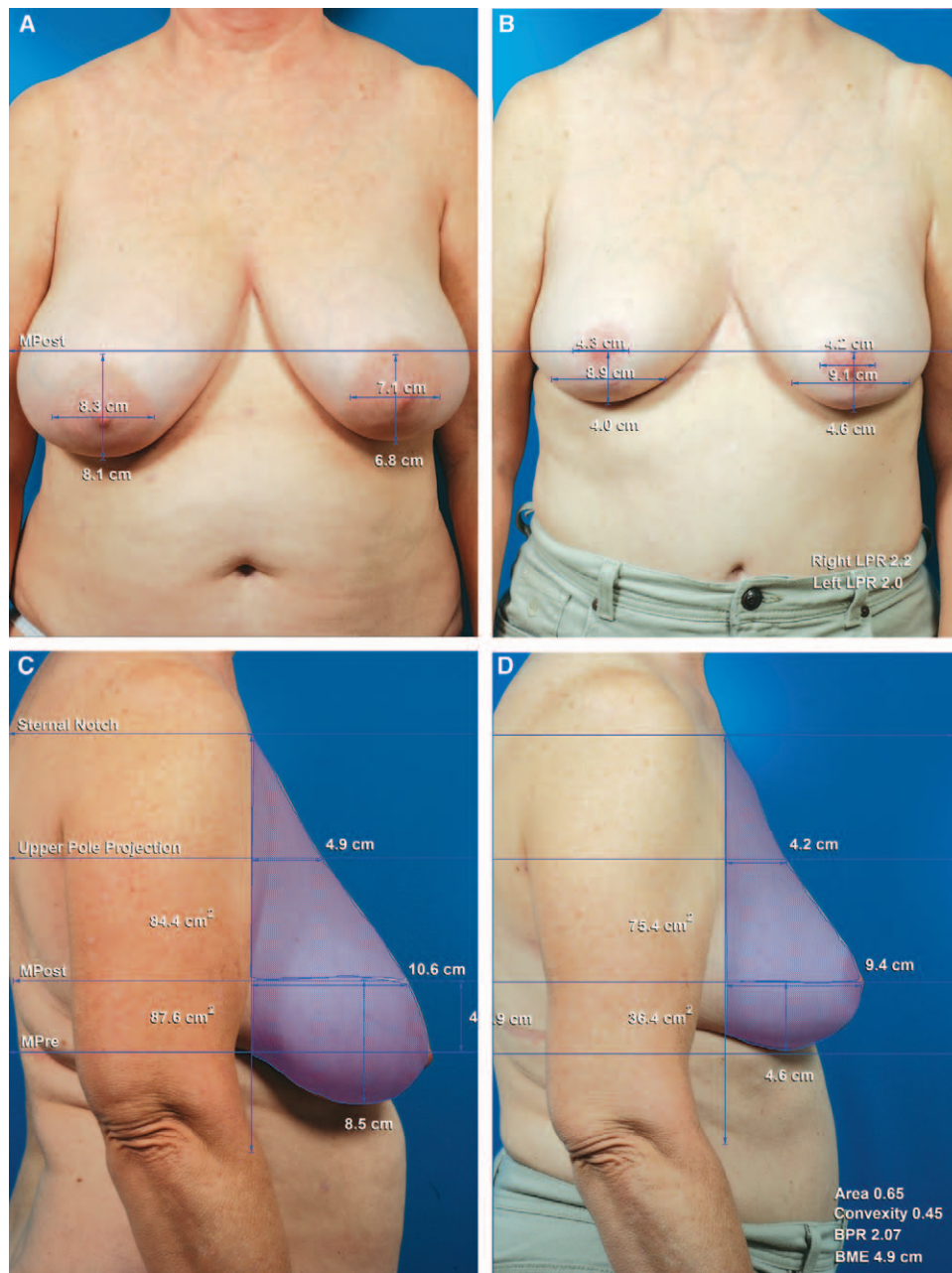
	Reduction (%)	Reduction + Implants (%)	All Procedures (%)	P*
<i>n</i>	56	24	80	
Age, y				
Mean	39.6	43.7	40.8	NS
SD	11.8	9.0	11.1	
Range	19.6–63.3	23.3–59.7	19.6–63.3	
Follow-up time, mo				
Mean	10.1	5.6	8.8	NS
SD	12.6	7.0	11.4	
Range	0.3–58.6	0.4–32.4	0.3–58.6	
Right implant volume, cm <sup>3</sup>				
Mean	—	334	334	—
SD	—	88	88	
Range	—	180–540	180–540	
Left implant volume, cm <sup>3</sup>				
Mean	—	333	333	—
SD	—	90	90	
Range	—	180–540	180–540	
Smoking status				
Nonsmoker	47 (83.9)	22 (91.7)	69 (86.2)	NS
Smoker	9 (16.1)	2 (8.3)	11 (13.8)	
Implant style				
Mentor, saline, Moderate plus Profile†	—	7 (29.2)	7 (29.2)	—
Allergan, saline Moderate Profile‡	—	17 (70.8)	17 (70.8)	
Breast reduction				
Primary	54 (96.4)	21 (87.5)	75 (93.8)	NS
Secondary	2 (3.6)	3 (12.5)	5 (6.3)	
Breast implants				
Primary	—	18 (75.0)	18 (75.0)	—
Secondary	—	6 (25.0)	6 (25.0)	
Right resection weight, g				
Mean	493	370	456	<0.01
SD	170	135	169	
Range	275–953	129–680	129–953	
Left resection weight, g				
Mean	489	368	453	<0.01
SD	176	141	174	
Range	181–1040	195–724	181–1040	
Body mass index, kg/m <sup>2</sup>				
Mean	30.0	29.2	29.8	NS
SD	5.0	5.0	5.0	
Range	20.0–42.7	20.0–38.5	20.0–42.7	
Operating time (breast surgery only), min				
Mean	120	138	126	<0.01
SD	23	26	25	
Range	88–206	107–167	88–206	

\*Independent *t* tests were used to compare the mean between the 2 procedure groups. Fisher's exact test was used to compare the percentages of smokers and the percentages of primary breast reductions between the 2 groups.

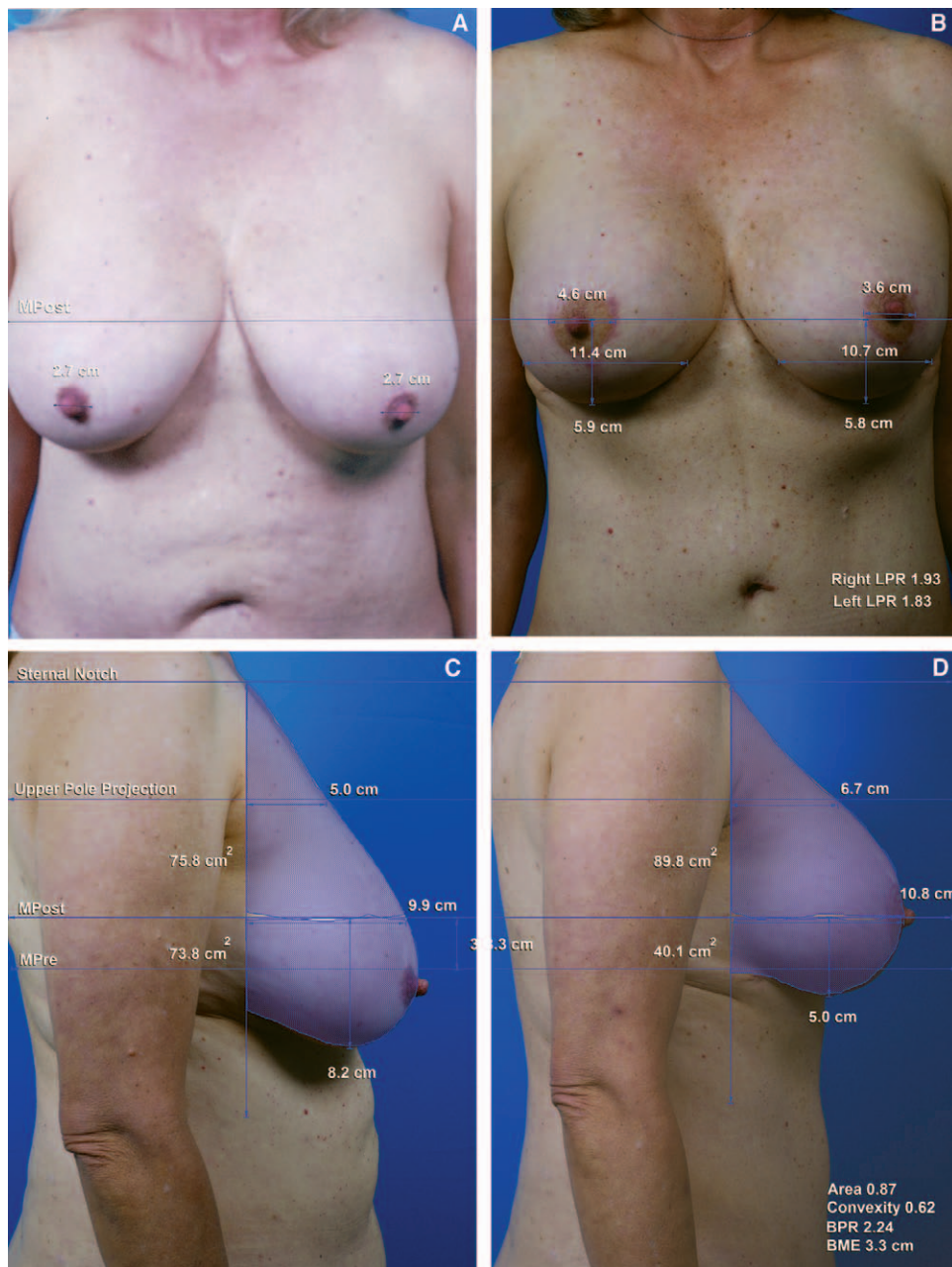
†Mentor (Mentor Corp., Santa Barbara, Calif.) 2000 smooth, round, Moderate plus Profile, saline-filled breast implant.

‡Allergan (Allergan Inc., Irvine, Calif.) Natrelle 68 MP smooth, round, Moderate Profile, saline-filled implant.

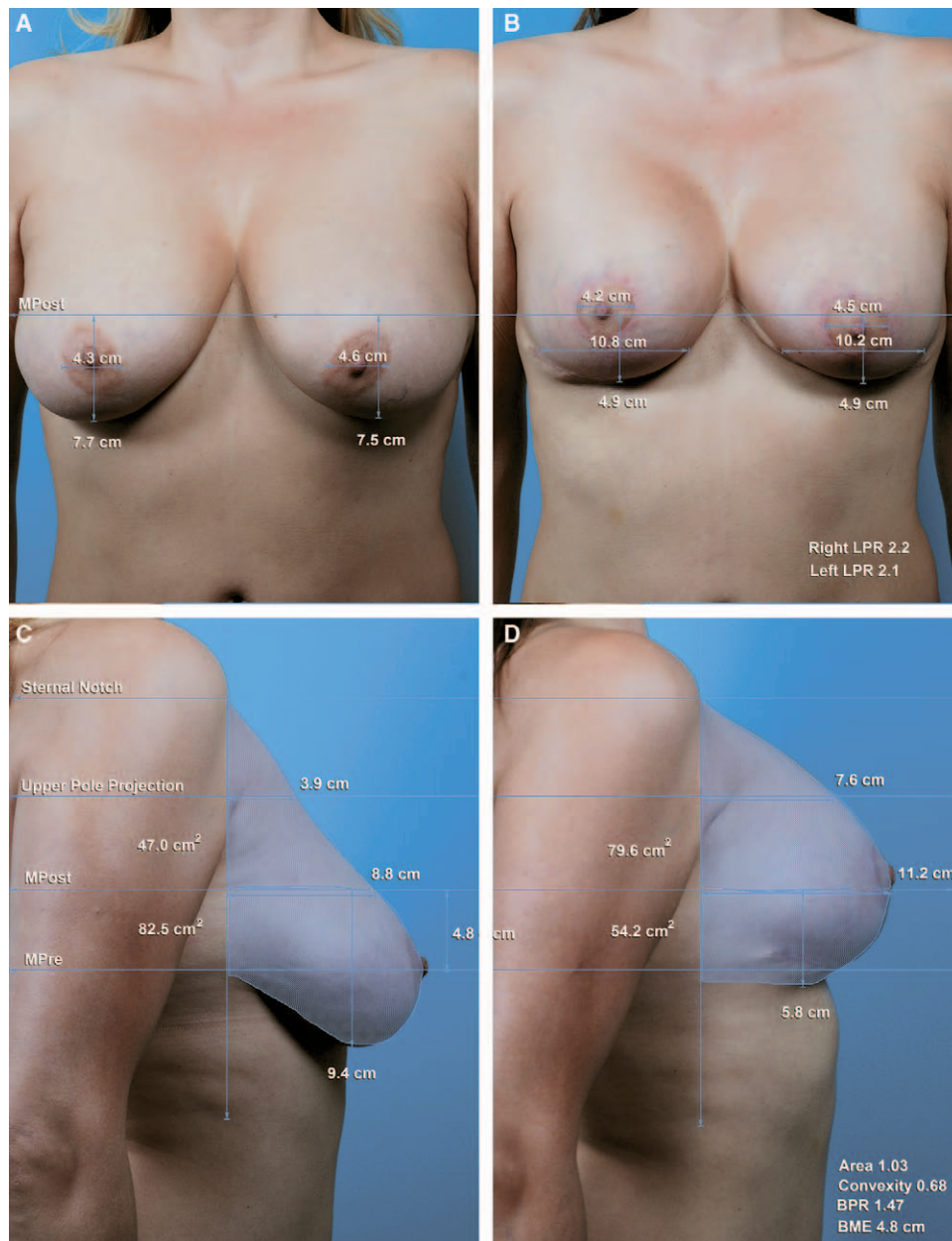
NS, not significant; Dashes were used when the survey question was not relevant because the patients did not have breast implants, or when statistical comparisons were not possible because of small sample sizes.



**Fig. 1.** This 55-year-old woman is seen before (A, C) and 15 months after (B, D) a vertical breast reduction with resection weights of 360 g from the right breast and 228 g from the smaller left breast. Areola diameters are reduced. The right breast area is reduced 35%. Right breast projection and upper-pole projection are both decreased. Her postoperative upper-pole contour is slightly concave. The right lower-pole area has been substantially reduced, increasing her breast parenchymal ratio (BPR). Her breast mound is elevated 4.9 cm. She underwent a simultaneous abdominoplasty and liposuction of the abdomen, flanks, inner thighs, arms, and axillae. The photographs have been matched for size and orientation using the Canfield Mirror 7.1.1 software (Canfield Scientific, Fairfield, N.J.). BME indicates breast mound elevation; LPR, lower-pole ratio; MPost, maximum postoperative breast projection; MPre, maximum preoperative breast projection.



**Fig. 2.** This 59-year-old woman is seen before (A, C) and 9 months after (B, D) a breast reduction plus implants. The resection weights were 293 g from the right breast and 309 g from the left breast. Round, smooth, saline-filled breast implants (Natrell 68 MP; Allergan Corp., Irvine, Calif.) were inserted submuscularly on both sides and inflated to 270 cm<sup>3</sup>. The frontal views (A, B) demonstrate nonboxy lower-pole ratios (LPRs), measuring <2.0 on both sides. The lateral views (C, D) reveal a boost in breast projection (0.9 cm) and upper-pole projection (1.7 cm). The lower-pole level and breast mound are elevated. The upper-pole contour has changed from linear to convex. The patient had a simultaneous abdominoplasty and liposuction of the abdomen and flanks. The photographs have been matched for size and orientation using the Canfield Mirror 7.1.1 software (Canfield Scientific, Fairfield, N.J.). BME indicates breast mound elevation; BPR, breast parenchymal ratio; MPost, maximum postoperative breast projection; MPre, maximum preoperative breast projection.

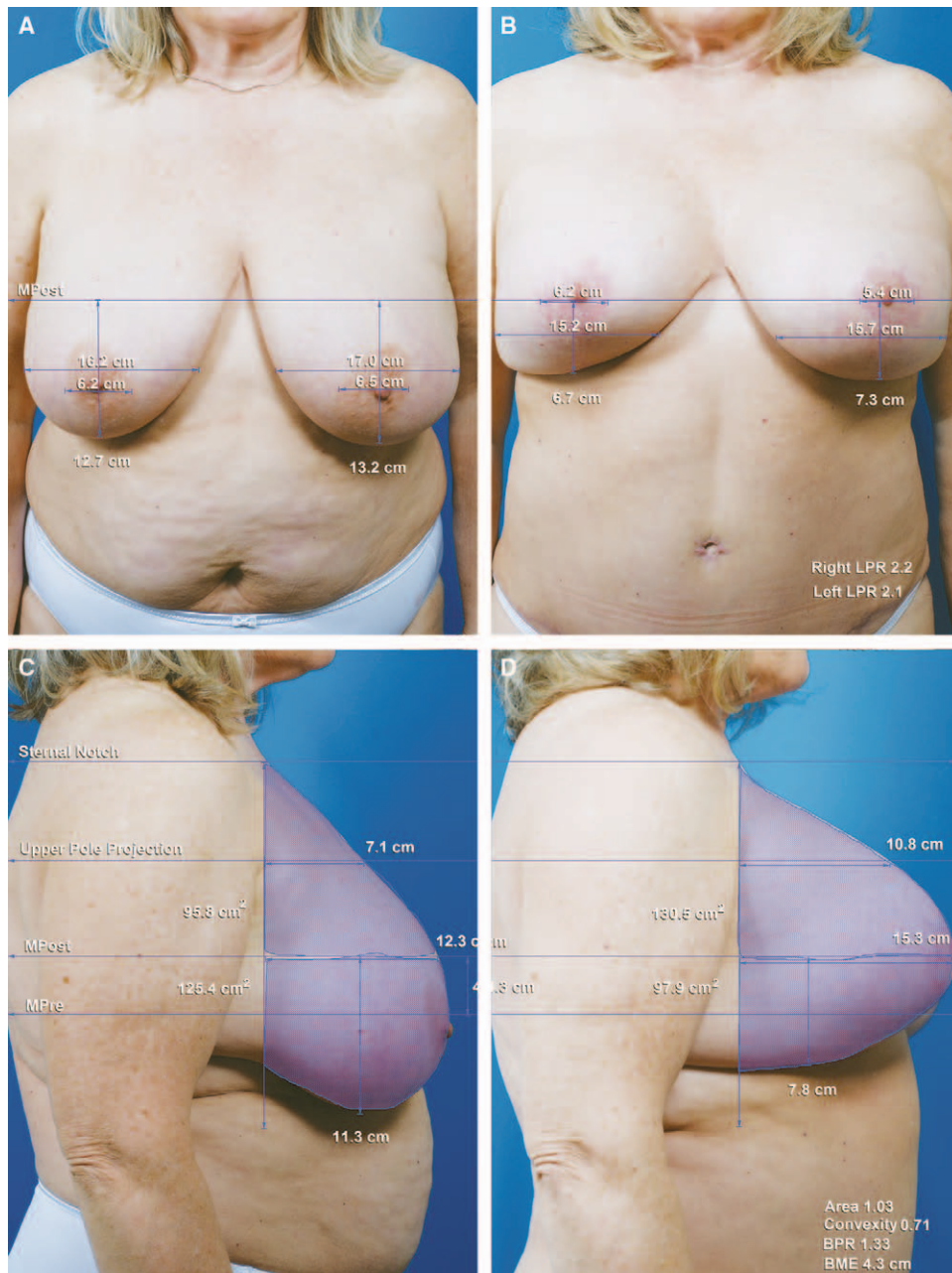


**Fig. 3.** This 35-year-old woman is seen before (A, C) and 3 months after (B, D) a vertical breast reduction plus implants. Her resection weights were 300 g from the right breast and 311 g from the left breast. Round, smooth, saline-filled breast implants (Natrele 68 MP; Allergan Corp., Irvine, Calif.) were inserted submuscularly on both sides and inflated to 180 cm<sup>3</sup>. The change in right breast area is negligible. However, her upper-pole contour (C, D) has changed from concave to convex. There has been a substantial boost in breast projection (2.4 cm) and upper-pole projection (3.7 cm). The photographs have been matched for size and orientation using the Canfield Mirror 7.1.1 software (Canfield Scientific, Fairfield, N.J.). BME indicates breast mound elevation; BPR, breast parenchymal ratio; LPR, lower-pole ratio; MPost, maximum postoperative breast projection; MPre, maximum preoperative breast projection.

Corp., Tokyo, Japan) with a 60-mm fixed focal length lens. Mean values were used to create mammographs<sup>3</sup> (Figs. 5, 6). Only patients with photographs at least 3 months after surgery (51 patients, 63.8%) were included in the measurement study.

### Surgery

All patients underwent a vertical breast reduction using a medially based pedicle<sup>7</sup> and intraoperative nipple siting.<sup>8</sup> A mosque-dome or keyhole preoperative pattern was not used. All breast implants were



**Fig. 4.** This 57-year-old woman is seen before (A, C) and 1 year after (B, D) a vertical breast reduction plus implants. Her resection weights were 254 g from the right breast and 300 g from the left breast. Round, smooth, saline-filled breast implants (Natrell 68 MP; Allergan Corp., Irvine, Calif.) were inserted submuscularly on both sides and filled to 540 cm<sup>3</sup>. The lateral views (C, D) reveal a major boost in breast projection (3.0 cm) and upper-pole projection (3.7 cm). The lower-pole level and breast mound are elevated. She has a convex upper pole. The patient had a simultaneous abdominoplasty and liposuction of the abdomen, flanks, inner thighs, arms, and axillae. The photographs have been matched for size and orientation using the Canfield Mirror 7.1.1 software (Canfield Scientific, Fairfield, N.J.). BME indicates breast mound elevation; BPR, breast parenchymal ratio; LPR, lower-pole ratio; MPost, maximum postoperative breast projection; MPre, maximum preoperative breast projection.

inserted submuscularly. A vertical resection was performed and is displayed in **Video 1**. (See **Video 1**, **Supplemental Digital Content 1**, which demonstrates

the vertical reduction dissection. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available

at <http://links.lww.com/PRSGO/A72>.) The nipple/areola site was determined after creation of the new breast mound. (See **Video 2, Supplemental Digital Content 2**, which demonstrates the intraoperative nipple siting. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A73>.) An inverted-T modification was used in patients in whom the vertical scar extended below the level of the new (elevated) inframammary crease. (See **Video 3, Supplemental Digital Content 3**, which demonstrates the inverted-T modification. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A74>; and see **Video 4, Supplemental Digital Content 4**, which demonstrates the preoperative marking, full details of the surgery and anesthesia, and the patient 24 hours after surgery. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A75>.) All surgery was performed on outpatients in a state-licensed ambulatory surgery center using total intravenous anesthesia.<sup>4</sup>

#### Patient Surveys

Patient surveys were conducted by the author’s office and nursing staff. (See, **Supplemental Digital Content 5**, which displays the patient survey. This content is available at <http://links.lww.com/PRSGO/A76>.) A single-page questionnaire was administered either in person or by telephone to patients at least 3 months after surgery. The response rate was 71.4% for breast reduction patients and 66.7% for women treated with a breast reduction plus implants.

#### Statistical Analysis

Statistical analyses were performed using IBM SPSS for Macintosh version 21.0 (SPSS, IBM Corp., Armonk, NY). Fisher’s exact test was used to compare frequencies for categorical variables. Independent *t* tests were used to assess mean differences between groups. Paired *t* tests were used to assess mean differences between matched pairs (i.e., pre vs post). Because of multiple comparisons, a *P* value of less than 0.01 was considered significant. An a priori power analysis was performed. To achieve 80% power, with an  $\alpha$  level of 0.05, sufficient to detect a moderate treatment difference ( $d = 0.50$ ),<sup>9</sup> 52 subjects would be needed.<sup>10</sup>

## RESULTS

There was no significant difference in mean age, follow-up time, or body mass index between procedures (Table 1). The mean breast resection weights

were significantly greater ( $P < 0.01$ ) for breast reduction patients (right, 493 g; left, 489 g) than for patients treated with a breast reduction plus implants (right, 370 g; left, 368 g). The mean breast implant volume was 334 cm<sup>3</sup> (range, 180–540 cm<sup>3</sup>). The mean operating time for a breast reduction was 2 hours (range, 88–206 minutes). Simultaneous implant insertion added 18 minutes of operating time on average.

To investigate whether patients with measurements were representative of the patient group as a whole, patients who underwent measurements were compared with patients who did not return at least 3 months after surgery and therefore did not have measurements. There were no significant differences in age, body mass index, follow-up time, implant volume, breast resection weight, or operating times between patients with photographs  $\geq 3$  months after surgery and those patients for whom these photographs were unavailable.

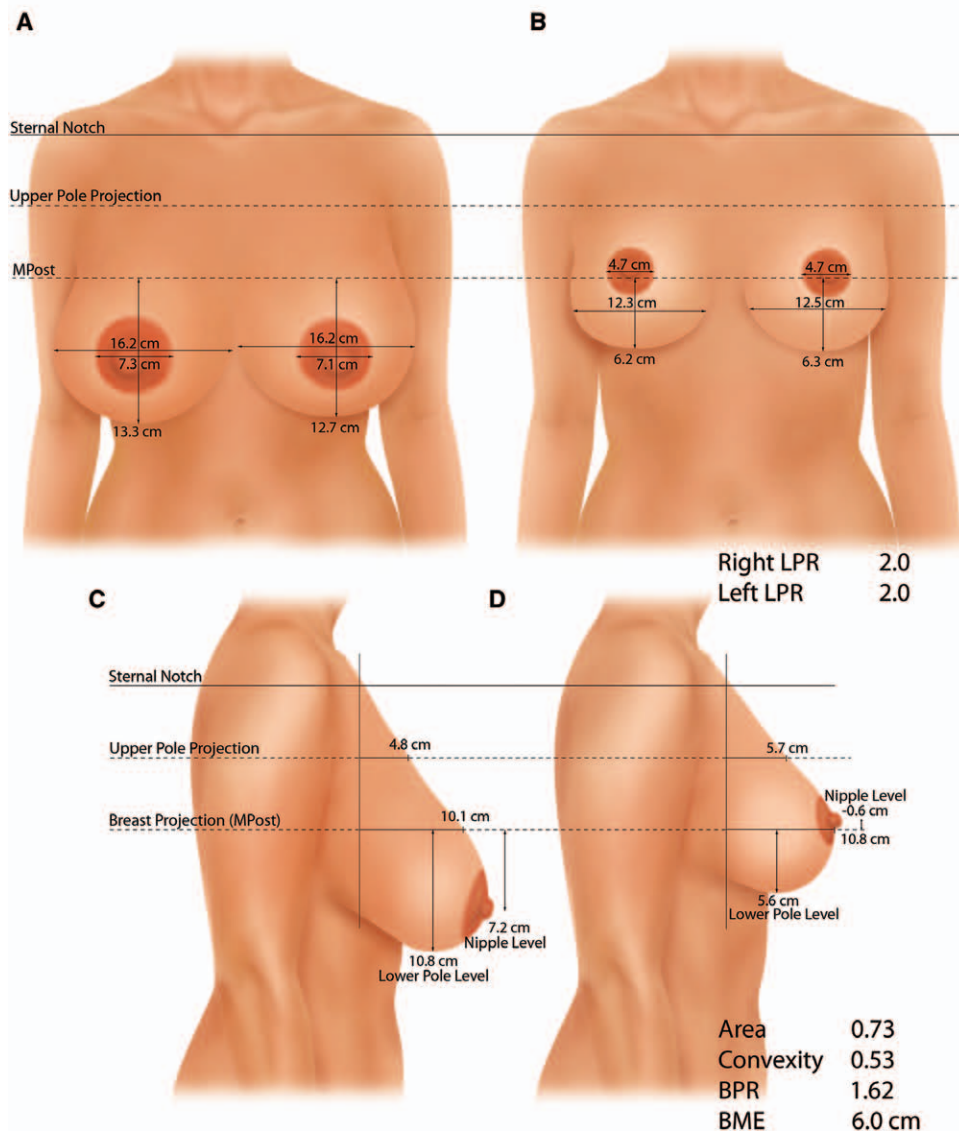
#### Complications

The overall complication rate was approximately 50%, with no significant difference between procedures (Table 2). The most common complication was delayed wound healing in 16 patients (20%). Six breast reduction patients and 1 breast reduction plus implants patient underwent secondary surgery for persistent ptosis. There were 2 seromas treated by aspiration in the office and 1 hematoma, evacuated in the operating room. No patient returned to have her breast implants removed. One patient with asymmetry returned to have 1 breast implant replaced with a larger size. There were no breast implant-related complications.

#### Measurements

Right and left breast measurements are compared in Table 3. The right and left breast area, measured on lateral photographs, decreased in both patient groups ( $P < 0.001$ ), but to a greater degree in patients who did not have simultaneous implants ( $P < 0.01$ ). In both groups, the upper-pole area increased in size ( $P < 0.001$ ). This increment was greater for women who also received breast implants (right, nonsignificant; left,  $P < 0.01$ ). Both procedures reduced the lower-pole areas ( $P < 0.001$ ). Both procedures increased breast projection ( $P < 0.01$ ) and upper-pole projection ( $P < 0.001$ ). Upper-pole projection increased 0.9 cm for the right breast and 0.6 cm for the left breast after reduction. With implants, the increases in upper-pole projection were significantly greater ( $P < 0.01$ ), measuring 1.8 cm for the right breast ( $P < 0.01$ ) and 2.3 cm for the left breast ( $P < 0.001$ ). Both procedures elevated the

## Vertical Breast Reduction



**Fig. 5.** This mammograph provides a 2-dimensional rendering of the mean breast measurements for all patients undergoing a breast reduction (without implants). Postoperative lower-pole ratios (LPRs), provided on the frontal views (A, B), are approximately 2.0, denoting nonboxy lower poles. The areolae are reduced in size. The lateral views (C, D) show a 27% reduction in total breast area. There is a modest increase in breast projection (0.7 cm) and upper-pole projection (0.9 cm). The breast parenchymal ratio is favorable (i.e., >1.5). There is a major elevation of the lower-pole level (5.2 cm) and breast mound (6.0 cm). The nipple is slightly overelevated (0.6 cm above the apex). BME indicates breast mound elevation; BPR, breast parenchymal ratio; MPost, maximum postoperative breast projection.

lower-pole level ( $P < 0.001$ ). The lower-pole ratio<sup>6</sup> is defined as lower-pole width divided by lower-pole length (height) and is an indicator of the boxiness of the lower poles. Values exceeding 2.0 start to appear boxy. The overall mean lower-pole ratio was 2.0 cm, with no significant difference between procedures.

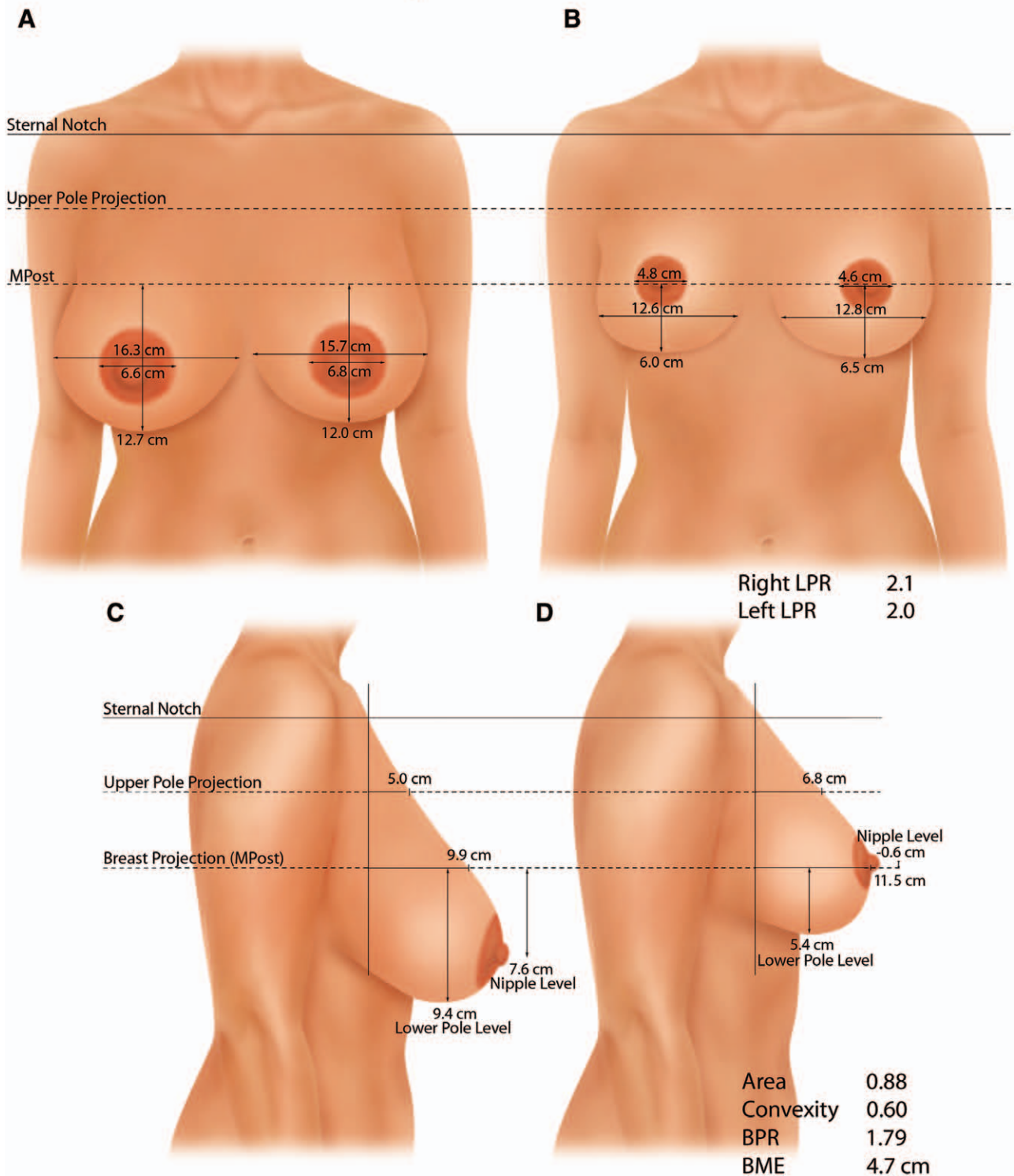
The breast parenchymal ratio<sup>6</sup> is defined as the upper-pole area divided by the lower-pole area and is

a measure of the “perkiness” of the breast. Both procedures effectively increased the breast parenchymal ratio ( $P < 0.001$ ). Breast mound elevation<sup>6</sup> represents the vertical change in position of the most projecting point on the breast. The breast mound was effectively elevated by both procedures. Areola diameters averaged 7.1 cm on the right side and 7.0 cm on the left side before surgery. These diameters were





## Vertical Reduction + Implants



**Fig. 6.** This mammograph provides a 2-dimensional rendering of the mean breast measurements for all patients undergoing a breast reduction plus implants. The frontal views (A, B) demonstrate nonboxy lower poles. The areolae are reduced in size. The lateral views (C, D) show a 12% reduction in total breast area. There is a greater increase in breast projection (1.6 cm) and upper-pole projection (1.8 cm) compared with breast reduction alone. The breast parenchymal ratio is favorable (i.e., >1.5). The nipple is slightly overelevated (0.6 cm above the apex). BME indicates breast mound elevation; BPR, breast parenchymal ratio; LPR, lower-pole ratio; MPost, maximum postoperative breast projection.



**Video 1.** See video, Supplemental Digital Content 1, which demonstrates the vertical reduction dissection. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A72>.



**Video 2.** See video, Supplemental Digital Content 2, which demonstrates the intraoperative nipple siting. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A73>.

significantly reduced ( $P < 0.001$ ) to 4.7 cm after surgery, with no significant difference between procedures. Nipple displacement<sup>6</sup> is defined as the vertical distance between the nipple position and the level of the apex of the breast. For both procedures, the nipple was overelevated approximately 0.6 cm after surgery (Figs. 5, 6).

#### Survey Responses

There was no significant difference in patient age or follow-up time for the surveys (Table 4). Pain ratings were slightly greater for patients who had implants (5.6 vs 4.8 on a scale of 1–10), but the difference was not significant. There was no significant difference in reported nipple numbness. Overall, 92.9% of patients were self-conscious of their



**Video 3.** See video, Supplemental Digital Content 3, which demonstrates the inverted-T modification. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A74>.



**Video 4.** See video, Supplemental Digital Content 4, which demonstrates the preoperative marking, full details of the surgery and anesthesia, and the patient 24 hours after surgery. This content is available in the “Related Videos” section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A75>.

breast appearance before surgery; 26.8% were self-conscious after surgery. All but 1 surveyed patient (98.2%) would repeat the surgery or recommend it to someone else. The mean result rating was 8.7 on a scale of 1–10. All surveyed patients who elected to have implants reported that they were pleased with their decision. An improvement in self-esteem and quality of life was reported by patients in both groups.

## DISCUSSION

Plastic surgeons have observed that many women after a breast reduction resemble candidates for augmentation/mastopexy.<sup>2,4</sup> This is especially true after a Wise-pattern inferior pedicle reduction, which

**Table 2. Complications and Treatments**

	Reduction (%)	Reduction + Implants (%)	All Procedures (%)	<i>P</i>
<i>n</i>	56	24	80	
Complications				
No	29 (51.8)*	12 (50.0)	41 (51.2)	NS
Yes	27 (48.2)	12 (50.0)	39 (48.8)	
Delayed wound healing	10	6	16	
Size asymmetry	4	3	7	
Persistent ptosis	6	1	7	
Redness/infection	5	2	7	
Scar deformity	3	2	5	
Seroma	2	0	2	
Hematoma	1	0	1	
Allergic reaction	1	0	1	
Surgical treatment of complications†				
No	47 (83.9)	19 (79.2)	66 (82.5)	NS
Yes	9 (16.1)	5 (20.8)	14 (17.5)	
Reoperations, total intravenous anesthesia				
Lower-pole revision for persistent ptosis	6	1	7	
Evacuation of hematoma	1	0	1	
Scar revision	0	1	1	
Implant replacement for size asymmetry	0	1	1	
Removal of additional breast tissue	0	1	1	
Total reoperations	7	4	11	
Scar revisions, local anesthesia only	2	1	3	

\*Percentages were calculated for each procedure group. Seven patients had 2 complications each. Therefore, the total number of complications exceeds the number of patients who had complications.

†Reoperations and revisions combined.

NS, not significant.

commonly leaves the breasts looking deflated and boxy.<sup>11</sup> Measurements confirm that an inverted-T (Wise pattern), inferior pedicle mammoplasty does not improve breast projection or upper-pole projection.<sup>11</sup> A vertical reduction mammoplasty provides a modest boost in breast projection and upper-pole projection (<1 cm) and tighter, more circular lower poles than a Wise pattern.<sup>11</sup> In patients who wish to restore upper-pole volume, breast implants are most effective.<sup>3</sup> The author uses the term “breast reduction plus implants”<sup>3,4</sup> to label this combination, avoiding the possibly confusing term “augmentation/reduction.” Measurements on standardized photographs reveal that autoaugmentation (glandular manipulation meant to simulate the effect of a breast implant) is ineffective.<sup>12</sup>

It might seem that resecting approximately 369 g of breast tissue and adding approximately 334 cm<sup>3</sup> of volume in the form of an implant would produce a result similar to a small (i.e., 35 g) mastopexy. However, this is not the case because such a calculation does not take into account the profound changes in proportions of the upper and lower poles (that tend to cancel out when added together) created by a breast reduction plus implants. Figure 2 depicts such a patient. The morphological changes after a small-volume mastopexy are much less pronounced.<sup>3</sup>

Measurement studies reveal that postmammoplasty shape changes occurring after 3 months are

minimal,<sup>3,13</sup> indicating that at 3 months swelling has resolved sufficiently for the purpose of measurements. Thoma et al<sup>14,15</sup> found that improved quality-of-life measures observed 1 month after surgery were maintained 1 year after surgery, justifying a relatively short follow-up period. Longer follow-up times are desirable, of course, but come at the price of a reduced inclusion rate.<sup>3</sup>

Beale et al<sup>16</sup> recently published their experience using predominantly Wise-pattern mastopexies in combination with implants. The authors recommended small implant volumes (<200 cm<sup>3</sup>) to reduce risk. Indeed, pressure on the pedicle might tip the balance to nipple ischemia.<sup>4</sup> A vertical mammoplasty that incorporates a medially based pedicle avoids additional tension or pressure on the pedicle caused by an implant.<sup>4</sup> The base of a medial pedicle is mobile and rides up with the breast mound as the vertical ellipse is approximated.<sup>3,4,11</sup> By contrast, the base of an inferior pedicle remains fixed at the inframammary fold.<sup>3,4,11</sup> A medially based pedicle is much shorter and has a more reliable blood supply than an inferior pedicle,<sup>11</sup> making it safer when an implant is used.<sup>4</sup> The “minus-plus”<sup>17</sup> combination of a vertical mastopexy and implants is synergistic.<sup>4</sup> The often-repeated concern<sup>4,16</sup> that a mammoplasty and implant work at cross purposes relates to the deficiencies of the Wise-pattern technique.<sup>4</sup>

A complication rate of 50% ordinarily might be considered excessive. However, this complication

**Table 3. Breast Area, Breast Projection, Upper-pole Projection, Breast Parenchymal Ratio, and Breast Mound Elevation**

	Reduction	Reduction + Implants	All Procedures	P*
n	40	11	51	
Age, y				
Mean	39.5	43.8	40.4	NS
SD	11.3	10.3	11.1	
Range	19.6–63.3	23.3–59.7	19.6–63.3	
Follow-up time, mo				
Mean	11.6	8.2	10.9	NS
SD	12.2	8.5	11.5	
Range	3.0–58.6	3.0–32.4	3.0–58.6	
Preoperative total right breast area, cm <sup>2</sup>				
Mean	178.6	162.5	175.1	
SD	38.3	36.3	38.1	
Range	117.1–259.7	103.5–221.2	103.5–259.7	
Postoperative total right breast area, cm <sup>2</sup>				
Mean	129.7	142.3	132.4	
SD	27.8	34.0	29.4	
Range	89.6–180.3	99.9–228.4	89.6–228.4	
Difference, cm <sup>2</sup> (SD)	-48.9 (23.2)	-20.2 (33.7)	-42.7 (28.1)	<0.01
Preoperative total left breast area, cm <sup>2</sup>				
Mean	180.3	171.4	178.4	
SD	37.5	42.0	38.3	
Range	107.8–264.0	93.8–223.2	93.8–264.0	
Postoperative total left breast area, cm <sup>2</sup>				
Mean	139.9	154.7	143.1	
SD	29.4	36.8	31.4	
Range	78.0–197.0	93.1–204.9	78.0–204.9	
Difference, cm <sup>2</sup> (SD)	-40.4 (20.8)	-16.7 (17.9)	-35.3 (22.3)	0.001
Preoperative right breast projection, cm				
Mean	10.1	9.9	10.0	
SD	1.5	1.0	1.4	
Range	7.1–13.3	8.2–12.3	7.1–13.3	
Postoperative right breast projection, cm				
Mean	10.8	11.5	11.0	
SD	1.8	1.7	1.8	
Range	7.2–14.3	9.2–15.3	7.2–15.3	
Difference, cm (SD)	0.8 (1.4)	1.6 (1.0)	0.9 (1.3)	NS
Preoperative left breast projection, cm				
Mean	10.9	10.7	10.9	
SD	2.0	1.9	2.0	
Range	6.0–14.2	7.1–13.1	6.0–14.2	
Postoperative left breast projection, cm				
Mean	11.5	12.1	11.6	
SD	1.7	2.0	1.8	
Range	8.0–15.0	8.6–14.6	8.0–15.0	
Difference, cm (SD)	0.5 (1.6)	1.4 (1.0)	0.7 (1.6)	NS
Preoperative right upper-pole projection, cm				
Mean	4.8	5.0	4.9	
SD	1.0	0.8	1.0	
Range	2.1–7.4	3.8–7.1	2.1–7.4	
Postoperative right upper-pole projection, cm				
Mean	5.7	6.8	6.0	
SD	1.2	1.3	1.3	
Range	3.8–8.8	4.7–10.8	3.8–10.8	
Difference, cm (SD)	0.9 (0.9)	1.8 (0.7)	1.1 (0.9)	<0.01
Preoperative left upper-pole projection, cm				
Mean	5.4	5.5	5.4	
SD	1.2	1.4	1.2	
Range	2.9–8.6	2.7–7.4	2.7–8.6	
Postoperative left upper-pole projection, cm				
Mean	6.0	7.8	6.4	
SD	1.1	1.6	1.4	
Range	4.0–9.0	4.4–9.7	4.0–9.7	
Difference, cm (SD)	0.6 (1.0)	2.3 (1.0)	1.0 (1.2)	<0.001

(Continued)

**Table 3. (Continued)**

	Reduction	Reduction + Implants	All Procedures	P*
Preoperative right breast parenchymal ratio				
Mean	0.66	0.87	0.70	
SD	0.20	0.35	0.25	
Range	0.29–1.30	0.31–1.66	0.29–1.66	
Postoperative right breast parenchymal ratio				
Mean	1.62	1.79	1.66	
SD	0.40	0.44	0.41	
Range	1.00–3.23	1.13–2.52	1.00–3.23	
Difference, cm (SD)	0.97 (0.27)	0.92 (0.38)	0.96 (0.29)	NS
Preoperative left breast parenchymal ratio				
Mean	0.86	0.90	0.87	
SD	0.32	0.23	0.30	
Range	0.25–1.78	0.45–1.24	0.25–1.78	
Postoperative left breast parenchymal ratio				
Mean	1.87	1.87	1.87	
SD	0.46	0.34	0.43	
Range	1.22–3.69	1.49–2.56	1.22–3.69	
Difference, cm (SD)	1.00 (0.35)	0.97 (0.30)	1.00 (0.33)	NS
Right breast mound elevation, cm				
Mean	5.96	4.69	5.68	NS
SD	1.65	2.03	1.79	
Range	3.09–10.31	2.59–9.68	2.59–10.31	
Left breast mound elevation, cm				
Mean	4.77	4.55	4.72	NS
SD	1.87	1.36	1.76	
Range	0.00–10.42	2.74–6.77	0.00–10.42	

\*For age, follow-up time, and variables for which only the postoperative scores are presented in this table, the scores were compared between the reduction and reduction + implants groups using independent *t* tests. For the rest of the variables, difference scores (postoperative – preoperative) were compared between the reduction and reduction + implants groups using independent *t* tests. NS, not significant.

rate includes appearance considerations, such as asymmetry, persistent ptosis, and suboptimal scars. These problems are common after reduction mammoplasty.<sup>4</sup> If such aesthetic issues are not included, the complication rate drops in half, to 25%. Other series<sup>15,18</sup> reporting lower complication rates may not include such aesthetic concerns. Interestingly, patients in this study reported an overall complication rate of 25.5%, almost exactly half the rate recorded by their surgeon.

### Surgical Objectives

Originally, a breast reduction was considered a functional procedure, meant to reduce breast mass and elevate the nipple position. These goals were achieved by the 1920s.<sup>19–21</sup> Today, expectations are higher and include aesthetic considerations.<sup>5</sup> Patients having breast reduction are concerned about their symptoms, but the majority quite understandably wish to improve their breast appearance as well.<sup>5</sup> Numerous studies document the physical benefits of a breast reduction.<sup>5</sup> Fewer publications evaluate the patient's perception of the aesthetic result.<sup>5</sup> Patients consistently prefer the aesthetic result and scars of the vertical technique.<sup>22–25</sup> Surgeons<sup>7,26,27</sup> are aware of the flattening, boxiness, and bottoming out that can be apparent after breast reduction. These observations have been confirmed with measurements.<sup>11,12</sup>

### Improving Breast Shape

Historically, the surgeon's focus has been on nipple position.<sup>28</sup> Less importance has been given to the relative contributions and contours of the upper and lower poles. Lateral photographs reveal that a breast reduction typically produces a linear or even concave upper-pole contour (Figs. 1, 5).<sup>11,12</sup> Most women prefer convexity of the upper pole,<sup>29</sup> which is the appearance produced by bras. Only breast implants are capable of providing a substantial boost in upper-pole projection.<sup>3</sup> To provide the illusion of a breast lift (i.e., vertical movement of the breast on the chest wall), a lower-pole reduction and upper-pole augmentation are needed.<sup>3,4</sup> This concept was first described as “minus-plus” in reference to augmentation/mastopexy by Regnault et al.<sup>17</sup> If a patient takes her breasts in the cups of her hands and lifts up, she is interested in such breast remodeling.<sup>3</sup>

Prospective patients need to know that a breast reduction will effectively reduce breast size and eliminate the lower-pole excess, but this procedure alone will not fill out the upper pole or create convexity.<sup>3</sup> For many women (70% in this study), such an outcome is acceptable. These patients may be satisfied that this shape can be produced by bras, or they simply wish to avoid implants or additional cost. However, there are also women (30% in this study) who want more perkiness, and it is best that they are in-

**Table 4. Survey Responses**

	Reduction (%)	Reduction + Implants (%)	All Procedures (%)	P*
<i>n</i>	40	16	56	
Age, y				
Mean	38.7	42.4	39.7	
SD	11.5	8.9	10.9	NS
Range	19.6–63.2	23.3–59.7	19.6–63.2	
Follow-up time, mo				
Mean	17.2	25.2	19.5	
SD	19.6	30.3	23.1	NS
Range	3–78	3–88	3–88	
Back, shoulder, or neck pain before surgery				
No	6 (15.4)	7 (43.8)	13 (23.6)	NS
Yes	33 (84.6)	9 (56.3)	42 (76.4)	
Back, shoulder, or neck pain after surgery				
No	30 (78.9)	13 (81.3)	43 (79.6)	NS
Yes	8 (21.1)	3 (18.8)	11 (20.4)	
Difficulty exercising before surgery				
No	9 (23.1)	3 (18.8)	12 (21.8)	NS
Yes	30 (76.9)	13 (81.3)	43 (78.2)	
Difficulty exercising after surgery				
No	36 (94.7)	16 (100)	51 (96.2)	NS
Yes	2 (5.3)	0 (0)	2 (3.8)	
Reason for surgery				
Improve appearance	3 (7.7)	7 (43.8)	10 (18.2)	
Lessen discomfort	5 (12.8)	0 (0)	5 (9.1)	—
Both	31 (79.5)	9 (56.3)	40 (72.7)	
Days off work				
Mean	9.9	12.5	10.7	
SD	7.7	11.2	8.8	NS
Range	0–30	2–42	0–42	
Duration of pain, d				
Mean	10.9	7.6	10.0	
SD	11.1	6.0	9.9	NS
Range	0–30	1–17.5	0–30	
Back to normal, d				
Mean	32.2	26.3	30.5	
SD	25.1	17.0	23.1	NS
Range	4–90	7–75	4–90	
Pain rating†				
Mean	4.8	5.6	5.0	
SD	3.1	2.3	2.9	NS
Range	1–10	1–10	1–10	
Complications				
No	28 (70.0)	13 (86.7)	41 (74.5)	NS
Yes	12 (30.0)	2 (13.3)	14 (25.5)	
Scars				
Well hidden	6 (15.4)	4 (26.7)	10 (18.5)	
Visible but okay	28 (71.8)	9 (60.0)	37 (68.5)	—
Unhappy	5 (12.8)	2 (13.3)	7 (13.0)	
Nipple numbness				
No	18 (45.0)	5 (31.3)	23 (41.1)	
Yes	22 (55.0)	11 (68.8)	33 (58.9)	NS
Location of numbness				
One side	5 (27.8)	0 (0)	5 (17.2)	
Both	13 (72.2)	11 (100)	24 (82.8)	NS
Did feeling return?				
No	9 (40.9)	2 (20.0)	11 (34.4)	
Yes	10 (45.5)	4 (40.0)	14 (43.8)	—
Partially	3 (13.6)	4 (40.0)	7 (21.9)	
Self-conscious before surgery				
No	3 (7.5)	1 (6.3)	4 (7.1)	
Yes	37 (92.5)	15 (93.8)	52 (92.9)	NS
Self-conscious after surgery				
No	30 (75.0)	11 (68.8)	41 (73.2)	
Yes	10 (25.0)	5 (31.2)	15 (26.8)	NS

(Continued)

**Table 4. (Continued)**

	Reduction (%)	Reduction + Implants (%)	All Procedures (%)	P*
Pleased with result				
No	3 (7.5)	1 (6.3)	4 (7.1)	
Yes	37 (92.5)	15 (93.8)	52 (92.9)	NS
Meet expectations				
No	2 (5.0)	3 (18.8)	5 (8.9)	
Yes	20 (50.0)	9 (56.3)	29 (51.8)	—
Exceeded	18 (45.0)	4 (25.0)	22 (39.3)	
Would you do it again?				
No	1 (2.5)	0 (0)	1 (1.8)	
Yes	39 (97.5)	16 (100)	55 (98.2)	NS
Would you recommend the surgery to someone else?				
No	1 (2.5)	0 (0)	1 (1.8)	
Yes	39 (97.5)	16 (100)	55 (98.2)	NS
Result rating‡				
Mean	8.7	8.6	8.7	
SD	1.8	1.4	1.7	NS
Median	9	9	9	
Range	5–10	6–10	5–10	
Pleased you had implants				
No	—	0 (0)	0 (0)	
Yes	—	16 (100)	16 (100)	—
Improved self-esteem/self-confidence				
Not at all	3 (7.5)	2 (12.5)	5 (8.9)	
A little	12 (30.0)	4 (25.0)	16 (28.6)	—
A lot	25 (62.5)	10 (62.5)	35 (62.5)	
Improved quality of life				
No	3 (7.5)	3 (20.0)	6 (10.9)	
A little	8 (20.0)	5 (33.3)	13 (23.6)	—
A lot	29 (72.5)	7 (46.7)	36 (65.5)	
Breast size				
Just right	20 (80.0)	12 (75.0)	32 (78.0)	
Prefer larger	2 (8.0)	2 (12.5)	4 (9.8)	—
Prefer smaller	3 (12.0)	2 (12.5)	5 (12.2)	

\*Independent *t* tests were used to compare the means between the 2 procedure groups for continuously measured variables. Fisher's exact test was used to compare the percentages of patients in different answer categories between the 2 groups when there were only 2 answer categories. Questions with more than 2 answer categories were not compared because the sample sizes were too small.

‡Patients were asked to rate their postoperative pain level on a scale of 1 (no pain) to 10 (most severe pain).

‡Patients were asked to rate their result on a scale of 1 (worst) to 10 (best).

NS, not significant.

formed of their options. Patients readily understand that the goal is still to make their breasts smaller and that this “icing on the cake” option is available to restore a more ideal shape to a breast that has been distorted by excess size and gravity.

### Functional Benefit

It is reasonable to ask whether the use of implants compromises the functional benefit of a breast reduction. On a first-principles basis, one might assume that a resection of 500 g and insertion of a 300 cm<sup>3</sup> implant is equivalent to a 200 g mammoplasty.<sup>1</sup> This intuitive argument assumes that only total breast mass, and not its distribution, is relevant to symptoms. Surprisingly, Thoma et al<sup>14</sup> reported that relatively small breast reductions (<400 g per breast) often alleviate symptoms, and the resection weight is not significantly related to quality-of-life improvement. These authors concluded that not just size but an unfavorable tissue distribution (i.e., glandular ptosis) may contribute to symptoms.<sup>14</sup> Subsequent outcome studies reveal that patients with

resection weights <375 g per breast<sup>30</sup> and even <300 g per breast<sup>5</sup> often experience physical symptoms that are relieved by surgery. The present study finds that most patients (56.3%) who elect to have implants at the time of breast reduction also experience physical symptoms. After surgery, symptoms of back, shoulder, or neck pain were reported by only 21.1% of women undergoing breast reduction alone and 18.8% of women who also received implants (difference was not significant). There was also a dramatic difference in exercise tolerance after both procedures. Overall, 78.2% of women reported difficulties with exercise before surgery and 3.8% reported such problems after surgery (0/16 for those patients treated with reduction plus implants). Indeed, the data suggest that implants do not undermine the functional benefit of reduction mammoplasty.

### Limitations of the Study

This study is limited by the relatively small (*n* = 24) number of patients undergoing this treatment com-

bination. Only women with a resection weight of at least 300g from 1 breast were included. A much larger sample size would have been achieved if the cutoff had been, for example, 200g per breast. However, using the same cutoff allows comparisons with other studies on these patient groups.<sup>3-6,11</sup> Despite the limited sample size, there was sufficient statistical power to allow reliable conclusions at a rigorous  $\alpha$  level of 0.01. Although no breast implant-related complications were noted during this study period, it is likely that such complications (e.g., implant deflation or capsular contracture) will occur in some patients at a future time.

### Strengths of the Study

This study critically evaluates a novel treatment combination. Consecutive patients were studied. All patients were treated by the same surgeon, at the same facility, and using the same operation and imaged using standardized methods. These factors avoid confounding influences and increase the reliability of the conclusions. For example, if different surgeons treat patients with different operations (a common practice is to use the vertical technique for moderate reductions and a Wise pattern for large ones),<sup>31</sup> it is impossible to exclude the influence of the surgeon and technique. Only by holding these variables constant is it possible to isolate the effect of implants on the surgical result. This study includes direct measurements of the aesthetic result, which are needed to make any evidence-based conclusions about surgical effects on breast shape. It also includes essential patient-reported data.

### CONCLUSIONS

Breast reduction plus implants is a safe and effective treatment option for women with large breasts who desire restoration of upper-pole fullness. There is no increase in the complication rate or compromised improvement of physical symptoms. Recovery times are similar to breast reduction alone. Patient satisfaction is very high (93.8%). None of the patients expressed regret regarding their choice to have implants, and all reported they would have the surgery again. (See Video 4, Supplemental Digital Content 4, which demonstrates the preoperative marking, full details of the surgery and anesthesia, and the patient 24 hours after surgery. This content is available in the "Related Videos" section of the full-text article on <http://www.PRSGO.com> or available at <http://links.lww.com/PRSGO/A75>.)

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