Defining the Kinetics of Breast Pseudoptosis After Reduction Mammaplasty

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Abstract: Despite the clinical relevance of bottoming out, or pseudoptosis, associated with reduction mammaplasty (RM) its evaluation remains an imprecise science. This study aims to further define the kinetics of postoperative pseudoptosis over an extended period of time, after our previous study investigating pseudoptosis in the early postoperative period.

Patients undergoing medial pedicle RM had 3-dimensional photographs taken at year 1 and year 2 intervals postoperatively (year 1 = 300–450 days; year 2 = 700–900 days). Bottoming out was assessed with various 3-dimensional parameters.

The total breast volume and the percent tissue distribution in the upper pole of the breast did not change from year 1 to year 2. The anterior-posterior projection as well as vector measurements for internipple distance and sternal notch to nipple distance also remained stable from year 1 to year 2.

Although previous data from our group documented the occurrence of bottoming out and continued size reduction over the first postoperative year after breast reduction, the present study shows that pseudoptosis does not seem to occur during the second postoperative year.

Key Words: 3-dimensional analysis, 3-dimensional scanning, pseudoptosis, reduction mammaplasty

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Reduction mammaplasty (RM) remains the mainstay of surgical treatment for breast hypertrophy. Despite high overall patient satisfaction with RM, pseudoptosis, or bottoming out, still remains an inevitable consequence of this procedure.[1,2] Previous studies have documented the progression of pseudoptosis after RM through the use of 2-dimensional (2D) measurements such as an increase in the vertical scar postoperatively.[3,4] Our group recently pointed out the limitations of analyzing pseudoptosis with linear measurements and in turn introduced the application of 3D imaging to mathematically describe changes in breast morphology.[5] Others have reported the use of 3D photography to calculate total breast volume and noted its clinical utility for breast augmentation or tissue expander reconstruction.[6,7]

However, the value of 3D photography extends well beyond simple volume measurements. We have shown a variety of new 3D parameters that can be measured including: total breast volume, volumetric tissue distribution in the upper and lower poles, anterior-posterior projection (AP projection), and 3D comparison. These measurements can serve as a baseline data set from which changes of the breast can be documented over time.[8,9] Applying these novel techniques, we recently defined the extent to which bottoming out occurs over the initial 12- to 18-month postoperative period. Significant changes that were noted include: an increase in tissue redistribution towards the inferior pole of the breast by 6.5%, a loss of AP projection by 6.23 mm, and a decrease in the total volume of the breast of 13.6%.[5] To further define the kinetics of postoperative pseutoptosis, the following study was undertaken to continue to monitor the progression of bottoming out in this patient cohort for another year.

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METHODS

Patient Enrollment

Patients undergoing RM with a short-scar medial pedicle technique between August 2005 and August 2008 were offered enrollment into the study. Of all patients enrolled in our ongoing 3D-breast reduction study database, 12 patients had breast scans taken at approximately 2 years postoperatively. Informed consent was obtained in accordance with the guidelines set forth by the New York University Medical Center Institutional Review Board. The 3D scans were taken with a noncontact laser scanner (Konica Minolta–V910) as previously described.[8] All equipment and supplies were located in the offices of the senior authors in New York, NY.

Breast Volume Analysis

All breasts were placed on a reference *x*, *y*, and *z* axis and total breast volume was calculated for each breast. As previously described, a transverse plane was created in the XZ plane that intersects with the lateral borders of the inframammary fold of the preoperative image.[8] This plane remains in a fixed position relative to the chest wall and was applied to all postoperative images.

Vector Measurements

The maximum AP distance of the breast relative to the chest wall was determined for each 3D image. AP projection was defined as maximum perpendicular distance from the chest wall to the nipple areolar complex (ie, point of maximal projection). In addition, vector measurements for internipple distance and sternal notch to nipple distance were also calculated.

3D Color Mapping

3D comparisons of year 1 and year 2 images (test object and reference object, respectively) were used to generate color maps. Maximum and minimum distance deviations were +25 and −40 mm, respectively. Color scales were divided into 40 segments. The software generates an asymmetry score that indicates the average deviation.

Statistical Analyses

All data are presented as the mean ± standard error of the mean. A paired student t test was used to compare the values at the different time periods and a $P < 0.05$ was used to denote statistical significance.

RESULTS

Patient Demographics

Our study group consisted of 12 women who had 3D scans analyzed at 1 and 2 years postoperatively (446 ± 72 and 791 ± 68 days, respectively). The average age of our patient group was 35 ± 10.9 years, with an average preoperative weight of 144.7 ± 35.3 pounds. The preoperative bra size ranged from 32 to 38 cm in circumference and from C to F in cup size. The average weight of the resected specimens was 418.6 ± 108.0 g.

Long-Term Changes in Total Volume and Volumetric Distribution

Total breast volume did not change from year 1 to year 2 postoperatively (585.0 ± 228.8 cm^3 vs. 607.9 ± 218.9 cm^3, $P = 0.25$) (Fig. 1). Volumetric distribution was assessed by applying a transverse plane at the level of the lateral border of the inframammary fold to divide the breast into upper and lower poles. At 1 year postoperatively, 62.0% of the breast volume was above the transverse plane and 38% was below. The breast tissue distribution at 2 years was noted to be similar with 61.6% superiorly and 38.4% inferiorly (Fig. 2).

Long-Term Changes in Vector Analysis of Distances

To assess change in breast shape, the AP projection was analyzed. The average AP distance from the chest wall was 58.1 ± 17.3 mm at 1 year compared with 60.8 ± 16.3 mm at 2 years ($P = 0.62$) (Fig. 3). The vector measurements of the internipple distance (217.6 ± 9.5 mm at 1 year and 217.2 ± 25.9 mm vs. 2 years, $P = 0.96$) and sternal notch to nipple distance (220.6 ± 16.0 mm at 1 year vs. 219.9 ± 15.0 mm 2 Y, $P = 0.93$) also showed no significant changes from year 1 to year 2 (Fig. 4).

3D Comparison

Global comparison of the images identified minimal deviation during the second postoperative year (asymmetry score 0.68 mm) relative to the first postoperative year (4.77 mm) (Fig. 5).

DISCUSSION

This study demonstrates the value of 3D photography to objectively define postoperative pseudoptosis, or bottoming out. This 3D based approach represents a significant advance from previous descriptions of pseudoptosis, which are limited to 2D measurements. We have previously reported data comparing postoperative data 3 months and 1 year after short-scar medial pedicle RM. In that study, we objectively documented bottoming out in quantitative terms. As per our findings, pseudoptosis was defined by a significant change in volume redistribution towards the inferior pole (6.5%), a significant decrease in total breast volume (13.6%), a significant decrease in AP projection (6.2 mm), and a significant asymmetry score of 4.77 mm postoperatively, from 3 months to 1 year.[5]

The present study is unique in that it traces these changes over a longer period of time. During the 1- to 2-year postoperative period after reduction mammaplasty, there were no significant changes in total breast volume, AP projection, and volume distribution. In addition, the asymmetry score of 0.68 mm as opposed to 4.77 mm found in our previous study reinforces that there has been significant stabilization of the breasts over this time period. The continuous monitoring of breast morphology over the 2-year period demonstrated that pseudoptosis may be limited to the first year after surgery. Although we did not intend to limit this study to a 2-year investigation, we believe our data that pseudoptosis stabilizes by that time frame is an important finding worth reporting.

Previous 2D studies have evaluated the presence or absence of pseudoptosis over varying lengths of time, but none have specifically delineated the specific time period over which pseudoptosis stabilizes after RM. For example, Abramson et al evaluated the presence of pseudoptosis after medial pedicle wise pattern RM by

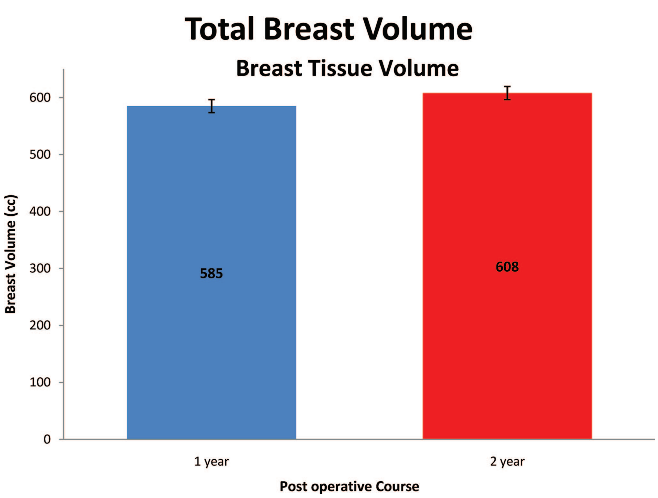

FIGURE 1. The 3D breast volumes were calculated at 1 year and 2 years postoperatively. The graph shows an insignificant change in breast volume of 3.9%. ($P = 0.25$).

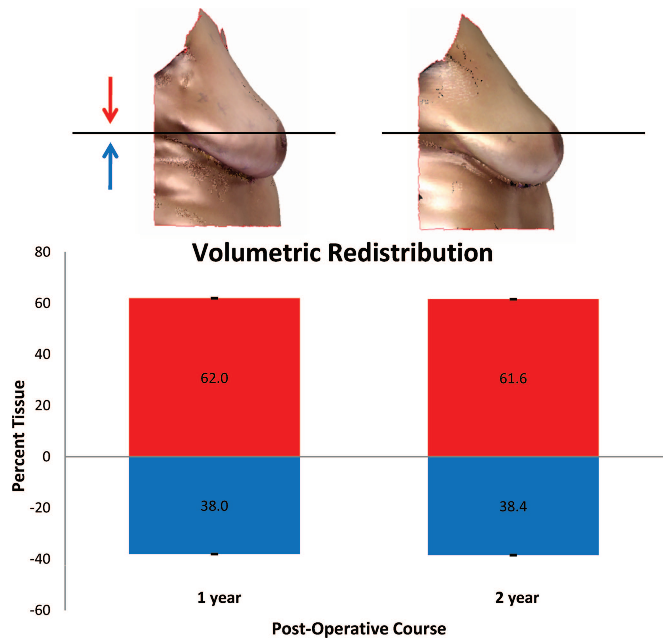

FIGURE 2. The volumes in the superior and inferior poles of each breast were calculated at 1 year and 2 years postoperatively. For each patient, the superior and inferior poles were defined by a horizontal plane that intersected the lateral border of the inframammary fold. At 1 year postoperatively, the volumetric distribution showed 62.0% of breast tissue in the superior pole and 38.0% of breast tissue in the inferior. The volumetric distribution at 2 years postoperatively showed 61.6% of breast tissue in the superior pole and 38.4% of breast tissue in the inferior pole. The percent difference between 1 year and 2 years at both the superior and inferior poles was a statistically insignificant, 0.4%.

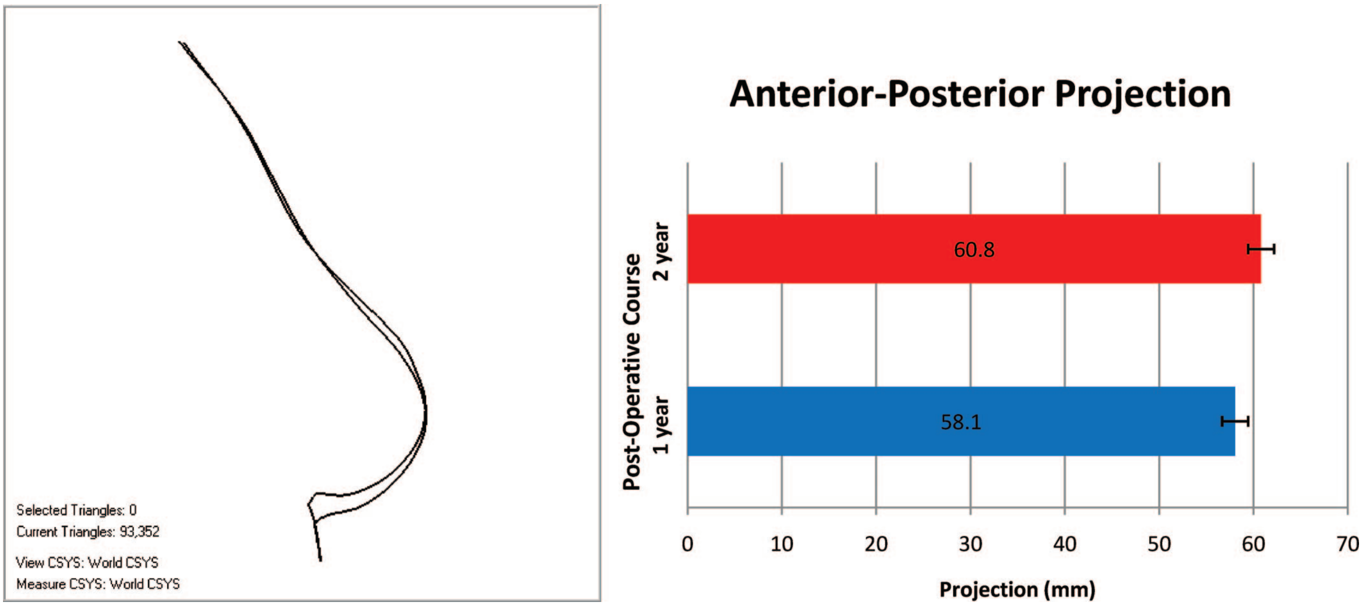

FIGURE 3. The AP projections were calculated for each image. A sagittal cross section through the nipple represents the most anterior distance of the breast from the chest wall and can be used to calculate the AP projection. The graph shows that the AP projection remains unchanged from 58.1 ± 17.3 mm to 60.8 ± 16.2 mm from 1 to 2 years postoperatively. ($P = 0.62$).

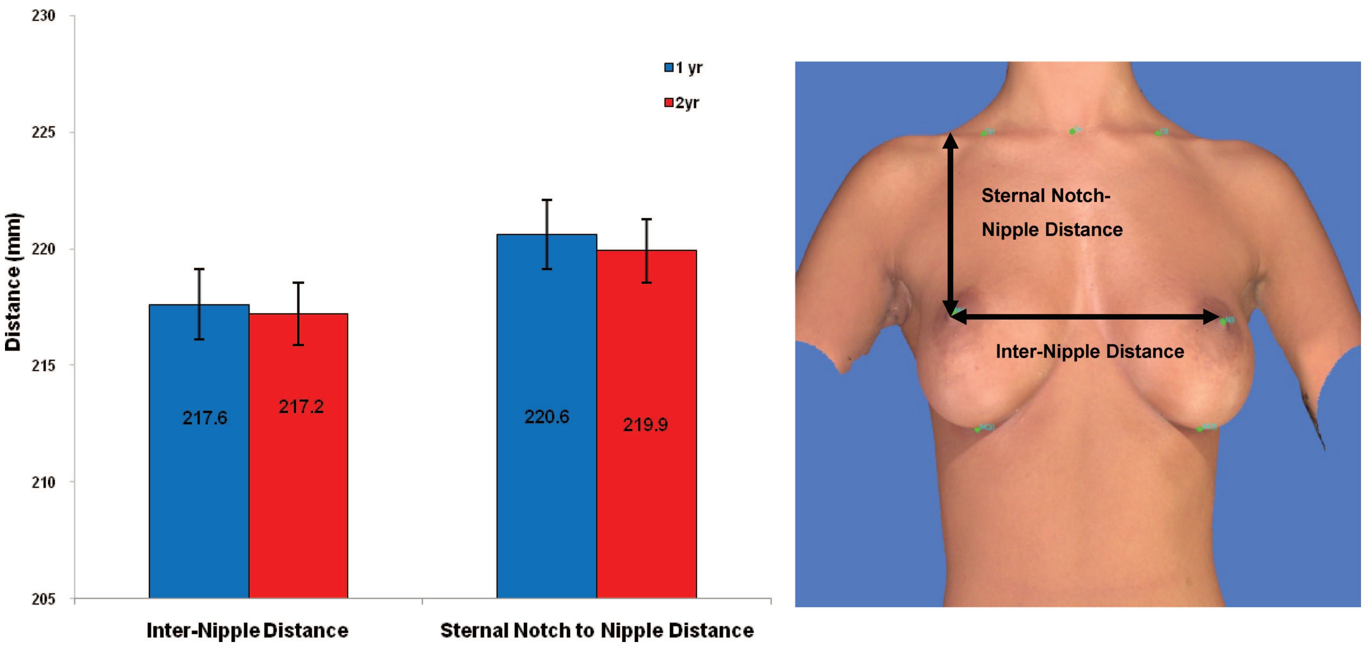

FIGURE 4. The graph shows that the vector measurements of internipple distance (217.6 ± 9.5 mm at 1 year and 217.2 ± 25.9 mm vs. 2 years, $P = 0.96$) and sternal notch to nipple distance (220.6 ± 16.0 mm at 1 year vs. 219.9 ± 15.0 mm 2 years, $P = 0.93$) are stable from 1 to 2 years.

measuring the nipple to inframammary fold distance immediately postoperatively and at 1 year.[10] In a series of 88 patients, they found that this distance increased by 11% when the resection weight was 500 to 1200 g and by 34% if the resection weight was greater than 1200 g suggesting that pseudoptosis was present at 1 year; however, longer term follow-up was not provided. Ahmad and Lista demonstrated that psuedoptosis, as measured by nipple to IMF surface distance, did not increase when comparing postoperative day 5 to postoperative year 4 in a series of 49 patients who underwent vertical scar medical pedicle RM.[11] Although this study contradicts previous reports of pseudoptosis after RM, it is limited by the time points chosen for follow-up. Based on our findings, we believe their report may be distorted secondary to initial postoperative edema at day 5, which may artificially increase this distance. Therefore, resolution of edema and subsequent bottoming out may have been missed.

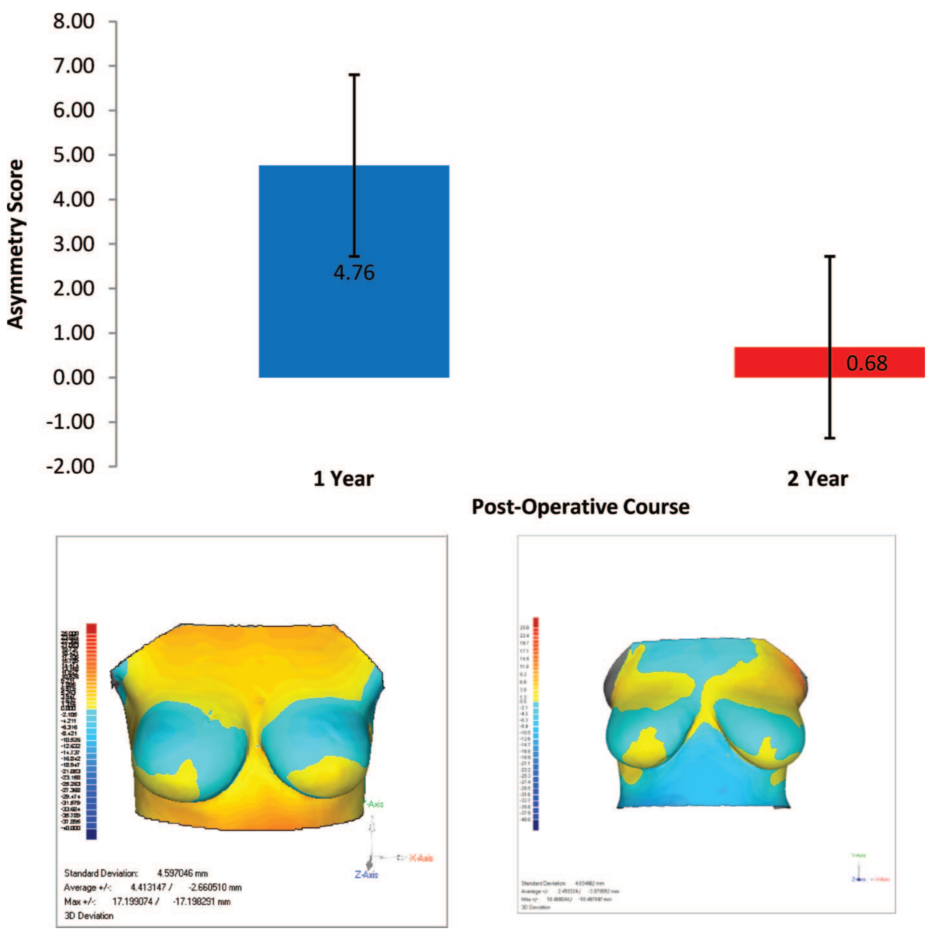

FIGURE 5. Three-dimensional comparison studies were used to analyze the images postoperatively by overlying images from each time period to the corresponding images from the previous time period. Vector sum analysis was used to create color maps where dark blue represents a negative deflection in volume and yellow represents a positive deflection. The figure shows that there was an average asymmetry score of 4.77 mm at 1 year and 0.68 at 2 years postoperatively.

With 3D technology, we report the presence of pseudoptosis in the first year postoperatively that stabilizes at the year 2 period. Whether the breast reaches an equilibrium at 2 years in terms of pseduoptosis, or whether further alterations occur in subsequent years is yet to be determined. Based on the findings of this study, we intend to obtain more frequent scans within the 2-year time period so that we can further delineate when the volume redistribution truly becomes constant. Future scans will also continue to be taken of the patients in our study group to assess any further morphologic changes that may take place. To draw broader conclusions about long-term changes in breast morphology, further studies (5–10 years postoperatively) will be needed.

One potential future application of 3D breast measurements is the establishment of a large database that could be useful to establish normative values, to compare surgical techniques, and to better predict surgical outcomes. Previously, there have also been various types of surface measurements that have been use to document pseudoptosis but this 3D protocol provides a more complete method to evaluate long-term postoperative breast morphology. Clinically, these types of measurements can also be used for patient counseling and for surgical simulation. In regards to pseudoptosis in particular, standards can be established so that true comparisons can be made, which ultimately may better educate physicians and patients in regards to postoperative changes.

A recognized limitation of this study is that the postoperative data sets were predicated on the patient's return visits to the office. Our previous investigation assessed 15 patients whereas this study only evaluated 12 patients due to lost follow-up in 3 patients. In addition, we failed to weigh patients during office visits and thus are unable to asses the role of weight fluctuations on 3D measurements. Along similar lines, patients' menstrual cycle may impact breast size, but this variable is difficult to control for obvious reasons. Of note, this study only evaluated short-scar medial pedicle RM as that is the procedure of choice for the senior authors. But, as stated previously, we envision this type of analysis to be applicable in the evaluation of other techniques as well.

CONCLUSION

This study shows the feasibility of 3D imaging to study the postoperative results of RM. Using this technology we document the true morphologic changes associated with the phenomenon of bottoming out and show that no significant changes occur between the year 1 and year 2 postoperative interval. Further studies can be done to evaluate long-term changes.

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