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Bra Sizing and the Plastic Surgery Herd Effect: Are Breast Augmentation Patients Getting Accurate Information?

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Abstract

Background: Bra sizing is a common method to preoperatively select implants for breast augmentation; however, no series has analyzed the accuracy of this modality postoperatively. Alternatively, previous investigations have validated the accuracy and utility of three-dimensional (3D) imaging for preoperative simulation in breast augmentation.

Objectives: This investigation utilizes 3D analysis to determine if preoperative bra sizing provides equivocal information compared to surgical 3D simulation for patient education and planning prior to a breast augmentation.

Methods: During primary breast augmentation consultation, patients received preoperative 3D images and associated simulations. Sizers, equivocal to the implants chosen in the simulation, were placed in a surgical bra, and 3D images were repeated. Volumetric and contour analyses were compared between the surgical simulation and the bra/sizer image. All patients used a surgical bra and smooth, round silicone sizers (average volume, 302 cc; range, 265-339 cc).

Results: Seven patients (14 breasts) underwent analysis and comparison. The mean bra/sizer volume image was 22.3% greater than the preoperative simulated breast image. The mean absolute difference of all surface points between the two breast images was 9.25 mm (range, 5.98-11.96 mm; standard deviation, 8.59). The maximum anterior displacement of the bra image from the simulated image was 19.52 mm, centered at the upper pole; the maximum posterior displacement was 25.49 mm, centered at the lower pole.

Conclusions: In comparison to 3D simulation, preoperative bra sizing overestimates postoperative volume, and upper pole fullness and underestimates lower pole projection. This investigation outlines some deficiencies of bra sizing and offers solutions for clinical management in primary breast augmentation.

Level of Evidence: 2

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Patients presenting for a breast augmentation consult often desire to know precisely what their breasts will look like after surgery. Creasman et al reported that patients are more likely to undergo surgery with a detailed and accurate projection of their postoperative results.[1] The invention of three-dimensional (3D) imaging has given patients and surgeons a reliable tool to simulate and predict postoperative results and allow patients to articulate their goals for surgery with the surgeon. Previous investigations have validated the accuracy of 3D imaging and analysis comparing the efficacy of preoperative simulations to postoperative outcomes.[1-5] Three-dimensional imaging technology is relatively new and may not be available in all markets.

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Alternatively, there are multiple other methods available to the surgeon in helping the patient visualize their expected outcomes including bra sizing, arithmetic nomograms, or volume distribution devices. Uncertainty exists regarding the best method to predict operative results in breast augmentation.

A recent survey showed that approximately 74% of plastic surgeons use bra sizing/stuffing to predict postoperative outcomes and volumes.[6] The use of preoperative bra sizing with implants is a commonly used interactive tool to simulate predicted results after breast augmentation.[7] Likely, this is because it is the simplest and least expensive way to give an estimate of what patients can expect after surgery. However, few studies if any have validated the accuracy of bra sizing with postoperative outcomes.

A report by Hidalgo and Spector showed that 30% of patients who underwent bra sizing had a disputable size difference of what they had expected preoperatively.[7] This method may overestimate the breast volume and poorly predict topographical changes of the breast envelope that may occur after breast augmentation.

The bra sizing "herd effect" is clearly in effect as many clinicians blindly spend a significant amount of resources on this technique[6] because it has always been done and is the accepted standard, despite its inaccuracy. However, as innovations arise, plastic surgeons must critically assess and compare the most commonly used method for predicting breast augmentation results to newer technology. The purpose of this study was to utilize 3D imaging to determine if preoperative bra sizing provides equivocal information compared to surgical simulation for patient education prior to a breast augmentation.

METHODS

All patients were initially seen as consults for primary breast augmentation between October 2014, through December 2014, by the senior surgeon (W.P.A. Jr.). During preoperative evaluation, informed consent was obtained on all patients for the purposes of this study in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Seven consecutive female patients agreed to take part in this study (Table 1). All patients had not undergone any previous breast surgery and were suitable candidates for treatment with primary breast augmentation alone.

Implant/sizer selection was performed based on accepted tissue-based planning principles as determined by preoperative measurements.[8] Patients then underwent 3D imaging of their breasts using the Vectra M3 imaging system (Canfield Scientific, Fairfield, NJ). Two sets of images were obtained for each patient, these consisted of: (1) a baseline 3D image of the patients' breasts and chest wall; and (2) a 3D image of the breasts in a non-padded brassiere (First Impressions – Post-Surgical Mastectomy Compression) with a silicone size (ie, the bra/sizer image) (Figure 1). The sizer was comfortably centered under the brassiere and over the nipple-areolar complex for all photos. All patients used a surgical bra (size small, 32-36) and smooth, round, silicone sizers. The average volume of sizer was 302 cc (range, 265-339 cc). Subsequently, a 3D image was simulated using the preoperative image and an implant equivalent as the sizer selected. All imaging was obtained by a nonbiased staff member who was trained in the process of 3D imaging and who was not aware of the current study.

The surgical simulation image for each breast (left and right for each patient) was superimposed to the corresponding bra/sizer image. Volumetric and contour analyses were extrapolated between the bra/sizer image and the surgical simulation image by the Vectra software. Additional topographic color maps were generated to highlight the total difference of breast shape.

Table 1. Demographic Information of Patients

Patient	Age (yrs)	Height (in)	Weight (lbs)	Body mass index (kg/m^2)	Preoperative bra size
1	37	59.5	115	22.8	34A
2	24	60	125	24.4	34B
3	35	62	118	21.6	34A
4	29	67	130	20.4	34B
5	44	68	174	26.5	36A
6	37	61	110	20.8	34A
7	38	64	130	22.3	34D

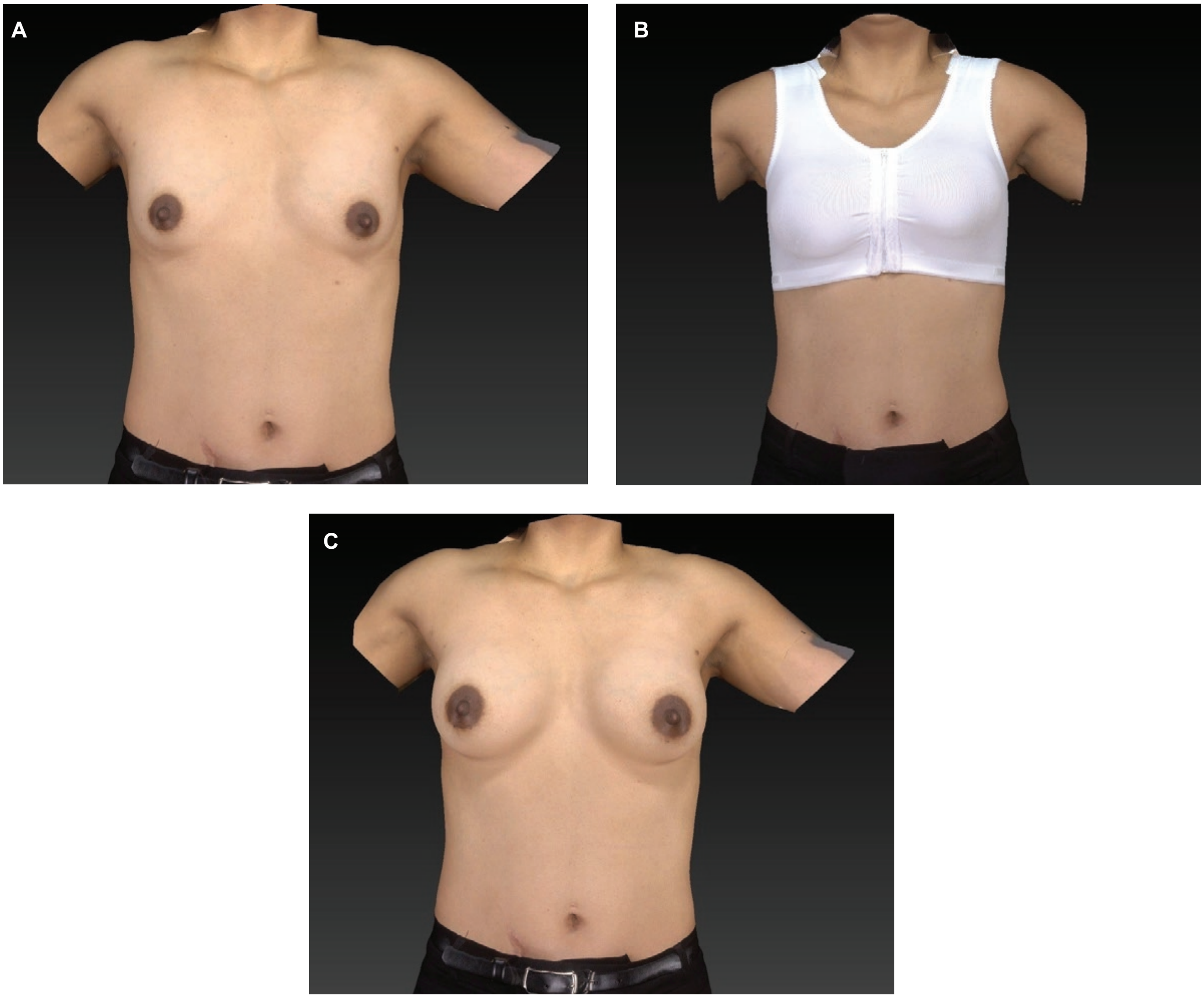

Figure 1. This 37-year-old woman presented for breast augmentation. These images obtained for the patient demonstrate a (A) preoperative 3D image, (B) a 3D image of bra/sizer, and (C) a simulated postoperative image with proposed implant.

All data points were collected and analyzed in STATA SE vs 11.0 (College Station, TX). Paired *t* tests were performed to analyze statistical significant differences between points in the photos. A *P* value of less than 0.05 was used to determine significance.

RESULTS

Seven patients (14 breasts) underwent 3D imaging with the Canfield Vectra System. The mean age of the patients was 35 years (range, 24-44 years) and mean body mass index was 22.7 kg/m^2 (range, 20.4-26.5 kg/m^2). The mean volume of the bra/sizer image was 361.9 cc (standard deviation [SD], 92.18 cc) compared to 281.8 cc (SD, 83.14 cc) of the generated simulator image. The difference in the mean simulator volume to mean bra/sizer volume was −80.64 cc (95% confidence interval −148.84 to −12.45), a 22.3% difference (P = .0223).

An overlay of the bra/sizer image with the surgical simulation was generated for each patient into a topographical color map. These superimposed images outline differences in points of volumetric distribution and depths of projection. The surface area of both images were compared; specifically, the overall absolute difference of all surface points between the superimposed images in aggregate – the root mean square (RMS). The mean RMS between the two images (bra/sizer image and surgical simulation image) for each patient was 9.25 mm (range, 5.98-11.96 mm; SD, 8.59), meaning the difference in points in distance from each other averaged out to be approximately 9.25 mm. The closer this value is to zero, the more exact the match between the two images.

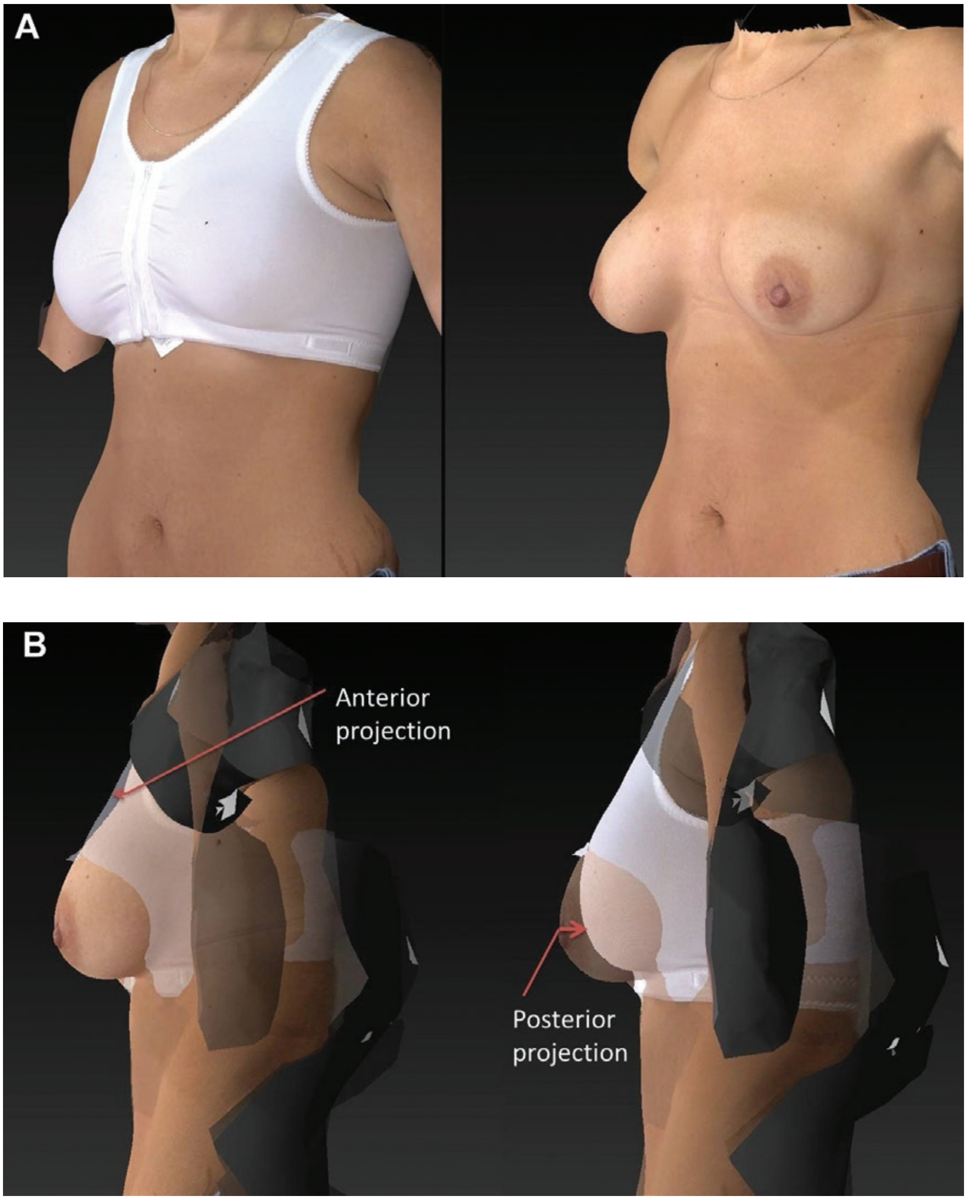

Figure 2. This is a 35-year-old woman presenting for primary breast augmentation demonstrating (A) the bra/sizer photo and the simulated implant photo, which are compared in the same plane. (B) The images are then superimposed in the sagittal plane to outline the differences in anterior and posterior projection.

Table 2. Drawbacks of Using Bra Sizing for Preoperative Planning in Breast Augmentation

1. Overestimates total volume by 20%
2. Produces too much upper pole fullness
3. Inaccurately suggests less anterior-posterior projection in lower pole

The mean maximum anterior displacement of the bra image from the simulated image (in the sagittal plane) was 19.52 mm ($P < .001$). The point of maximum anterior displacement was consistently centered at the superior medial pole. The maximum posterior displacement (in the sagittal plane) of the bra image from the simulated image was −25.49 mm ($P < .001$), this point was consistently centered over the central breast mound, overlying the nipple areola complex. This is illustrated in Figure 2 which shows an overlay of the bra/sizer photo and the simulated photo. The most anterior points are seen in the photo. The upper and medial poles were more anterior in the bra/sizer photo compared to the simulated 3D photos. In addition, the lower pole of the bra/sizer photo was more posterior compared to the simulated breast photograph.

Patients were all seen at 1 week, 3 weeks, and 3 months postoperatively to assess for any concerns or complications. All patients had good wound healing and good implant placement. All patients expressed excellent satisfaction with the size and shape of their breasts post-augmentation.

DISCUSSION

To our knowledge, this is the first study that quantitatively examines the volumetric distribution of breast tissue created by use of prosthetics in preoperative planning and patient education. This study suggests that bra sizing has several limitations (Table 2), such as overestimating the postoperative volume, distorting the volumetric distribution of soft tissue, and inaccurately portraying lower anterior-posterior projection. Others have shown, qualitatively, that bra sizing overestimates postoperative results.[7] Based on our results, we found that there was almost a 2 cm difference in anterior-posterior projection plane at the superior pole, thus inaccurately predicting postoperative results ($P < .001$). The study data suggests that bra sizing inaccurately predicts postoperative results because the sizer inaccurately displaces native breast tissue superiorly. This manual displacement with the bra inaccurately predicts postoperative projection after breast augmentation and falsely adds additional volume and surface area to the patient's perception of the preoperative sizing. Additionally, the bra and sizer combination overestimates the total volume compared to 3D simulations.

Three-dimensional imaging has previously been validated for use in preoperative surgical planning.[1,2,9-11] In breast augmentation, Roostaeian and Adams reported the accuracy between preoperative simulations compared to postoperative breast volume was 90.8%.[2] They noted no significant difference between preoperative surgical simulation and postoperative results. Their results showed a mean absolute difference for surface contour of 4 mm, representing 98% accuracy based on surface area and no significant definable areas along the surface contour of the breast that were consistently different from the postoperative results. These outcomes are very different from the current study comparing 3D bra/sizer images to simulated images, which found a statistically significant difference in breast volume ($P = .0223$). This study also consistently found a point of maximal difference in anterior projection on the superior medial pole on the sizer image of a mean of 19.52 mm ($P < .001$) and a point of maximal posterior projection difference located over the nipple areolar complex of −25.49 mm ($P < .001$).

It is difficult to explain what exactly patients desire when they come in for breast augmentation. Is it overall larger breast volume? Superior pole fullness? Breast position? Hidalgo and Spector showed that 30% of women who underwent sizing with prosthetics did not have the postoperative size they were expecting.[7] They suggested that bra sizing overestimated bra sizing by approximately 30 cc each because of the volume of the bra. Plastic surgeons should consistently strive to provide patients with the most accurate information regarding their postoperative results as this has been shown to improve patient satisfaction with their results.[1]

Other plastic surgeons have attempted to develop educational tools to more accurately determine breast volume after breast augmentation for their patients. Unfortunately, these methods have been complicated and not user friendly for the patient or physician. For example, Karabulut et al developed a nomogram based on postoperative results after breast augmentation with round textured silicone gel filled implants in order to predict postoperative measurements after augmentation.[12] They determined that for every 100 mL of breast volume added there was an increase in 2 cm in bust circumference. However, this method may not be translatable and difficult for the patient to visualize. Three-dimensional imaging provides a tangible, proven postoperative assessment of surgical results that is easy to generate and evaluate.[2] Regardless of the method used, it is important that a method be chosen that is representing accurate information and imparts the patient some control on the final decision.

This study is not without limitations. Imaging obtained in the bra was noted to be larger than the simulated breast volume photos as the bra would add some unexpected volume and may overestimate our difference albeit small given the bra was unpadded thin comfortable material. Sizers were also placed in bra with the sizer centered at the nipple-areola complex. Despite consistency of sizer position, there was inherent variability of breast placement in the surgical bra and thus possible variability in 3D measurements. Additionally, patient positioning, preoperative breast ptosis, and respirations may contribute to inaccurate analysis. To maximize consistent images, images were acquired with hands placed on the hips with the shoulders level and the patient holding their breath. All candidate patients in the study had minimal or no breast ptosis which did not require correction. Finally, this study does have a small sample size (7 patients, 14 breasts), but given that even with small numbers we were able to show definitive statistical results, it suggests that bra sizing poorly estimates postoperative outcomes. Mean patient age was 35 years old; however, we do not believe this had an influence on our results.

The 3D imaging does have some inherent limitations. The initial purchasing price may be expensive and there must be dedicated office space to set up the equipment for routine use. Staff must also be properly trained to acquire images and perform post-image analysis.

Nevertheless, we find it interesting that bra sizing is so widely practiced based on the "herd effect," and surgeons and patients routinely assume that the result of a sizer put in a bra will be equivalent to the surgical result. The findings from this study that "bra sizing" does not result in an accurate simulation should not be a surprise to anyone, as many other areas of plastic surgery are analogous; such as orthognathic procedures where is it is well accepted that moving the underlying bone does not a yield a 1:1 soft-tissue response on the skin surface.

The senior author initially started practice performing bra sizing based on what everyone else was doing; however, he quickly became disenchanted with the practice, primarily from observing a nurse and patients perform this ritual. Patient might say: "Oh my, this is too big!" The nurse would then move the implant down in the bra and the patient would say: "Oh my, now that is too small!" For patients, the process of implant selection is abstract; however, the typical practice of bra stuffing with silicone sizers actually introduces more unknown variables into the equation. This may make it even more confusing and less accurate for the patient. Our preference is to now use 3D imaging with the patient as a comprehensive consultation tool to help accurately facilitate information exchange between the surgeon and patient and also provide them with validated simulations.

We are aware that the finding of this study will not be met with open arms because it is inferring that the majority of surgeons are doing something that is suboptimal. Nevertheless, it is our hope that if surgeons do not have the ability to utilize 3D imaging at their office that they will be able to use the information in the study to modify their bras sizing practices. We recommend the following for those physicians still using bra sizing:

1. Surgeons use an implant sizer that is 20% smaller during sizing than what they would plan to use in surgery (ie, if the plan is to use a 300 cc implant, a 240 cc implant should be placed in the bra).
2. Discuss with the patient the disproportionate increase in upper pole volume with bra sizing, and typically underestimates the lower pole projection.
3. Given the findings of this study – surgeons should consider stopping the practice of bra sizing as it fundamentally contradicts the concepts of tissue-based planning and the modern evolution of the process of breast augmentation.[13]

CONCLUSION

A preoperative surgical simulation with 3D imaging is a reliable and accurate method for determining postoperative shape and volume in primary breast augmentation. In comparison to software simulation, this study suggests bra sizing overestimates the postoperative volume, distorts the volumetric distribution of soft tissue, and inaccurately portrays anterior-posterior projection. This investigation outlines some deficiencies of bra sizing with sizers, which may be informative for patient education and informed consent in breast augmentation. 3D imaging may be a more scientifically accurate and efficient replacement for bra sizing in patients seeking breast augmentation.

Disclosures

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