Aesthetic Surgery Journal
http://aes.sagepub.com/

Three-Dimensional Imaging for Breast Augmentation: Is This Technology Providing Accurate Simulations?

Jason Roostaeian and William P. Adams, Jr

Aesthetic Surgery Journal 2014 34: 857 originally published online 26 June 2014
DOI: 10.1177/1090820X14538805

Three-Dimensional Imaging for Breast Augmentation: Is This Technology Providing Accurate Simulations?

Aesthetic Surgery Journal
2014, Vol. 34(6) 857–875

DOI:10.1177/1090820X14538805
www.aestheticsurgeryjournal.com
SAGE

Jason Roostaeian, MD; and William P. Adams Jr, MD

Abstract

Background: For patients considering breast augmentation, 3-dimensional (3D) imaging provides a preoperative simulation of the postoperative result. However, the clinical accuracy of these simulations has not been assessed.

Objective: The authors compared preoperative simulations with postoperative results of breast augmentation to permit more informed decisions about breast augmentation.

Methods: To determine differences between simulations and actual results, volumetric and contour analyses were performed for patients who underwent 3D imaging both preoperatively and 3 months after breast augmentation. All patients received round smooth silicone implants or anatomically shaped cohesive silicone gel implants; the mean volume was 295 cc.

Results: Twenty patients (40 breasts) underwent 3D imaging both pre- and postoperatively. There were no procedural complications or revisions. The mean difference between preoperative simulation and postoperative breast volume was 27.2 cc (range, 1.4-99.5 cc), representing a 9.2% mean difference in volume and an accuracy of 90.8%. The mean absolute difference (root mean square) of all surface points along the breast in aggregate was 4.0 mm (range, 1.8-8.3 mm). No specific location along the surface contour of the breast could be identified as having the greatest differences.

Conclusions: The preoperative simulation provided by 3D imaging is >90% accurate in predicting postoperative breast volume. The mean absolute differential for surface contour in this study was 4 mm, representing 98.4% accuracy based on average surface area.

Level of Evidence: 3

Keywords

breast augmentation, 3D imaging, Vectra, accuracy, volumetric measurement

Accepted for publication December 16, 2013.

Over the past decade, 3-dimensional (3D) imaging systems have been applied with increasing frequency in plastic surgery. Preoperative planning for breast augmentation, a common cosmetic procedure in the United States, provides an ideal application for 3D imaging, particularly because of the highly individualized approach required to achieve patient goals for volume and shape.[1] A noteworthy benefit of 3D modeling is the ability to measure volume differences at a level of detail that is not possible with conventional 2-dimensional photography or physical examination. The surgeon can also identify differences in breast shape and dimensions that help inform preoperative planning.[2,3] Most if not all patients considering breast augmentation wish to know how their breasts will look postoperatively, but many surgeons have relied on inaccurate techniques such as placing implants in a bra. Thus, the most valuable feature of 3D imaging may be its ability to simulate the postoperative appearance of the implant in the patient's body. Improved patient communication regarding expectations and outcomes

Dr Roostaeian is an assistant clinical instructor in the Division of Plastic Surgery at the University of California–Los Angeles.
Dr Adams is an Associate Clinical Professor of Plastic Surgery at the University of Texas Southwestern Medical School, Dallas.

Corresponding Author:
Dr William P. Adams Jr, 6901 Snider Plaza, Suite 120, Dallas, TX 75205, USA.
E-mail: wpajrmd@dr-adams.com

can lead to higher patient satisfaction and increased conversion rates and can act as a driver for new patients.[1]

Before investing in this relatively new technology, its scientific validity and accuracy should be understood. Efforts have included comparisons of calculated mastectomy specimen volumes with actual volumes based on water displacement, resulting in a difference of −2% between the volumes.[4] In a study of breast augmentation, implant volumes as simulated by the Portrait 3D Surgical Simulation Platform (Axis Three, Miami, Florida) were compared with known implant volumes.[3] The investigators found a mean difference of 12.2% between simulated and actual volumes and further verified that the system's software provided consistent results. In a 2-part breast augmentation study by Creasman et al,[5,6] automated anatomic surface landmark measurements were first validated and then used to compare preoperative simulation (provided by a noncommercially available 3D imaging system) with postoperative results. The authors reported a strong correlation (R = 0.68) between preoperative simulated and postoperative actual measurements; they also found that patients valued the simulations, as demonstrated by an increase in conversion rates from 40% to 73%.

Although various aspects of 3D imaging in breast surgery have been validated, it appears that no study has addressed whether simulations by a commercially available 3D imaging system actually resemble the results. The goal of this study was to assess the accuracy of preoperative simulations produced by the Vectra M3 Imaging System (Canfield Scientific, Inc, Fairfield, New Jersey) by comparing them with actual postoperative results in patients who underwent breast augmentation.

METHODS

All consecutive patients who underwent primary breast augmentation and imaging with the Vectra M3 Imaging System between January 1, 2013, and February 15, 2013, were identified, and their charts were reviewed. Patients whose medical records were incomplete were excluded from the study. The Declaration of Helsinki protocols were followed, and all patients provided written informed consent to participate in this study. All charts were reviewed for demographic data, details of the operation, type of implant, length of follow-up, emergence of postsurgical complications, and need for revision.

To ensure consistency, all images were captured by a single patient coordinator who is highly experienced with the imaging device and was unaware of the study. During the patient's initial preoperative consultation, the Vectra software system produced a preoperative 3D image with the specific implant chosen by the patient and senior author (W.P.A.). The second 3D image was obtained 3 months postoperatively. Volumetric and surface contour analyses were performed by a blinded independent researcher familiar with the 3D imaging system.

All patients received round smooth silicone implants or anatomically shaped cohesive silicone gel implants, which were placed subpectorally in a dual-plane pocket through an inframammary incision. All augmentations were performed by the senior author. The mean implant volume was 295 cc (range, 205-410 cc) (Table 1).

The preoperative simulation was superimposed on the postoperative result to detect differences in volume and surface contour. Fixed anatomic surface markers were utilized to align the images, such as nevi and hyperpigmentation spots. All images had color-coded deviation mapping to enable visualization and quantification of points of elevation and deepening in the breast surfaces. All measurements were recorded in a spreadsheet. The superimposed images were reviewed to determine whether any consistent pattern along the surface contour of the breast could be identified where differences were greatest based on color mapping.

RESULTS

Twenty patients were included in the study. The mean age was 28 years (range, 22-54 years), and mean body mass index was 21 (range, 17-28). Preoperative cup size ranged from A to B. All patients had minimal to no ptosis, which did not exceed grade 1 in any patient. There were no postsurgical complications or revisions, nor were there any requests for a size exchange through the first year of follow-up.

Volumetric Analysis

The mean absolute volume difference between preoperative simulations and postoperative results was 27.7 cc (range, 1.4-99.5 cc; standard deviation [SD] = 26.9) (Figure 1). Based on the mean implant volume of 295 cc, the imaging was accurate to within a mean difference of 9.2% (range, 0.4%-34.1%), denoting mean accuracy of 90.8% (SD = 9.1%).

Surface Topography

Surface contour was compared between the preoperative and postoperative images; the overall mean difference for all surface points along the breast in aggregate was 0.03 mm (range, −3.4 to 4.1 mm; SD = 1.70 mm). However, the overall absolute difference (commonly referred to as the root mean square [RMS]) of all surface points along the breast in aggregate was 4.0 mm (range, 1.8-8.3 mm; SD = 1.29 mm) (Figure 2). The mean differences between the

Table 1. Implant Details and Differences Between Preoperative Simulation and Postoperative Results[a]

				Difference				
Patient No.	Breast	Implant Size, cc	Implant Type	Volume, cc	Minimum, mm	Maximum, mm	Mean, mm	RMS, mm
1	Right	350	Mentor CPG 332	13.2	–12.0	11.2	1.1	5.9
	Left	350	Mentor CPG 332	3.1	–6.9	4.8	0.0	2.4
2	Right	255	Allergan Style 410	66.5	–8.4	4.3	–3.3	4.4
	Left	255	Allergan Style 410	4.8	–7.3	9.9	0.2	2.5
3	Right	265	Allergan Style 15	33.8	–8.4	9.4	–1.8	4.6
	Left	265	Allergan Style 15	59.4	–7.9	6.1	–2.6	3.9
4	Right	339	Allergan Style 15	31.3	–2.2	12.0	1.4	2.6
	Left	339	Allergan Style 15	75.9	–1.9	13.6	3.0	4.1
5	Right	255	Allergan Style 410	18.6	–5.3	5.4	–1.3	2.3
	Left	255	Allergan Style 410	20.4	–6.4	3.7	–1.9	3.0
6	Right	371	Allergan Style 410	30.3	–12.3	16.2	2.1	4.5
	Left	339	Allergan Style 410	31.2	–8.3	11.2	1.1	4.3
7	Right	234	Allergan Style 15	27.6	–5.8	6.1	–1.8	3.1
	Left	234	Allergan Style 15	20.1	–6.7	9.3	–1.7	4.0
8	Right	265	Allergan Style 15	1.8	–4.5	7.5	–0.4	2.8
	Left	265	Allergan Style 15	7.9	–5.3	8.4	–0.9	3.4
9	Right	270	Mentor CPG	23.9	–7.9	10.3	–2.2	4.5
	Left	205	Mentor CPG	12.6	–9.6	9.1	–1.3	4.9
10	Right	304	Allergan Style 15	3.5	–5.6	6.3	0.8	3.0
	Left	304	Allergan Style 15	6.1	–6.9	6.6	0.5	3.3
11	Right	304	Allergan Style 15	8.6	–8.0	6.7	0.3	3.4
	Left	304	Allergan Style 15	5.6	–6.8	7.0	0.1	2.3
12	Right	304	Allergan Style 15	7.6	–8.7	7.2	0.6	4.7
	Left	304	Allergan Style 15	6.9	–8.4	12.9	0.6	4.6
13	Right	265	Allergan Style 15	1.4	–4.0	4.8	0.3	1.8
	Left	265	Allergan Style 15	7.0	–9.1	11.9	–1.0	4.9
14	Right	270	Mentor CPG 332	20.3	–12.2	7.8	–0.2	5.2
	Left	270	Mentor CPG 332	8.1	–7.1	8.1	0.9	4.1
15	Right	286	Allergan Style 15	24.9	–6.4	10.4	0.1	4.7
	Left	286	Allergan Style 15	42.79	–10.6	14.1	0.7	6.6
16	Right	304	Allergan Style 15	10.84	–6.2	10.0	–0.3	4.3
	Left	304	Allergan Style 15	30.56	–4.0	9.6	0.7	3.6
17	Right	380	Sientra MP	99.5	–8.4	18.7	4.1	8.3
	Left	410	Sientra MP	90.1	–7.5	13.6	2.5	5.9
18	Right	270	Mentor CPG 332	35.9	–3.5	13.1	1.4	2.6
	Left	270	Mentor CPG 332	9.8	–6.0	8.8	–0.6	3.2
19	Right	304	Allergan Style 15	10.3	–10.1	7.5	1.8	4.9
	Left	304	Allergan Style 15	18.7	–5.6	7.6	1.8	3.5
20	Right	339	Allergan Style 15	73.0	–7.9	6.3	–2.8	4.0
	Left	339	Allergan Style 15	86.9	–9.7	2.2	–3.4	4.4

[a]Results are expressed as the mean differences between 3-dimensional (3D) preoperative simulation images and actual 3-month postoperative results for volume and surface contour, including measurements taken at the lowest point (closest to the chest wall; minimum) and highest point (farthest from the chest wall; maximum), and the root mean square (RMS).

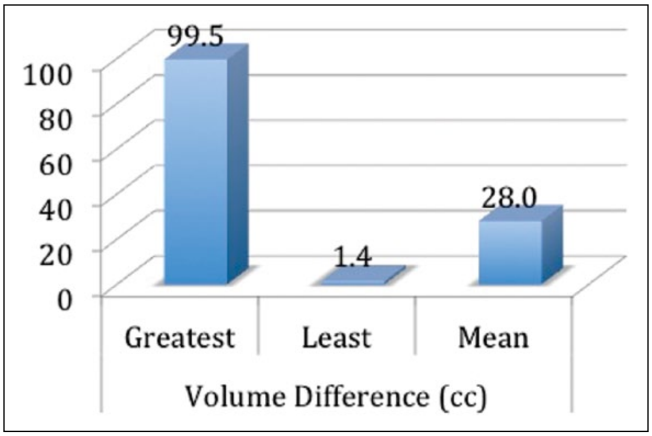

Figure 1. Graphic representation of the greatest, least, and mean volume difference (cc) between the simulation and the actual 3-month postaugmentation result, as measured with Vectra 3D imaging (Canfield Scientific, Inc, Fairfield, New Jersey).

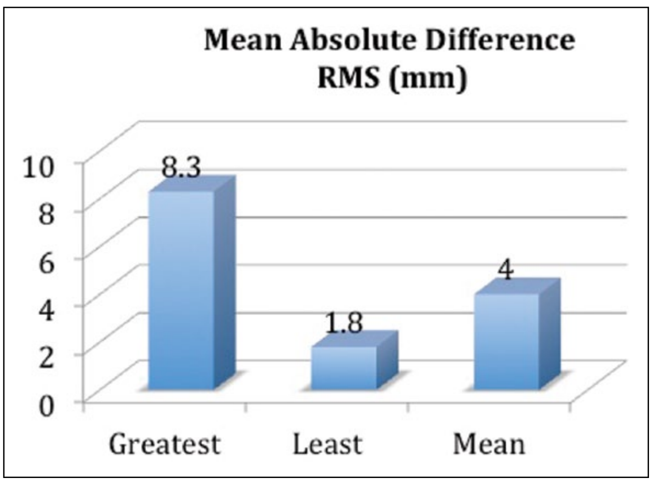

Figure 2. Graphic representation of the greatest, least, and mean root mean square (RMS), representing the absolute difference of all points along the surface of the breast between the simulation and the actual postaugmentation result at 3 months, as measured with Vectra 3D imaging (Canfield Scientific, Inc, Fairfield, New Jersey).

actual postoperative results and preoperative simulations at the lowest point (closest to the chest wall) and the highest point (farthest from the chest wall) were 7.2 mm (range, 1.9-17.2 mm; SD = 2.44 mm) and 9.0 mm (range, 2.2-18.7 mm; SD = 3.52), respectively (Figure 3). No consistent pattern was identified along the surface contour of the breast where differences were greatest (Figures 4-9). Examples of the most accurate simulation (patient 5; Figure 10) and least accurate simulation (patient 17; Figure 11), based on RMS and volume, are shown.

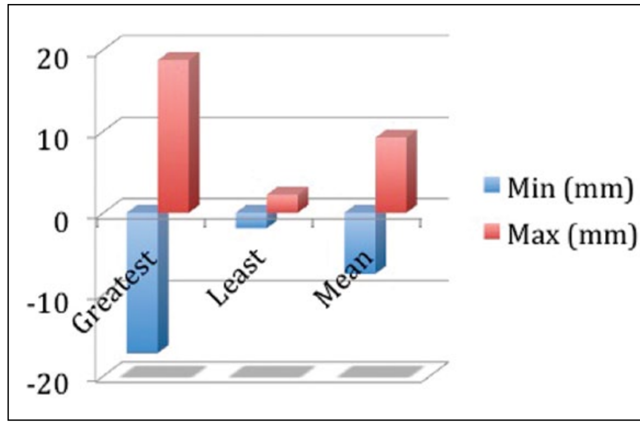

Figure 3. Graphic representation of the mean and range (greatest, least) for maximum (at the highest point, farthest from the chest wall) and minimum (lowest point, closest to the chest wall) differences at aligned points along the surface of the breast between the simulation and the actual 3-month postaugmentation result, as measured with Vectra 3D imaging (Canfield Scientific, Inc, Fairfield, New Jersey).

DISCUSSION

For years, surgeons and patients have relied on inaccurate techniques to simulate breast augmentation results, such as placing implants or rice-filled bags into bras. We live in a 3D world, and it is logical that surgeons and patients communicate accordingly. Three-dimensional imaging of the breast has provided reproducible and clinically valid data for analyzing volume and contour.[7-10] We investigated the accuracy of the Vectra M3 Imaging System in simulating postoperative results of breast augmentation, a common application for 3D imaging. A single practitioner, highly experienced with the imaging device and unaware of the study, captured all preoperative and postoperative images to ensure consistency, minimize bias, and establish standard protocols for the study. We found that the time spent performing 3D imaging never exceeded a few minutes and actually was less than the time required for conventional photography.

During consultation for breast augmentation, 3D imaging enhances the communication between surgeon and patient and allows the patient to choose an implant based on an actual image of her body. However, these simulations had not been validated previously with a commercially available 3D imaging system. Our study showed that Vectra M3 Imaging System provided a mean accuracy within 90% for volume and 4 mm for surface contour differences. It is important to emphasize that these values represent means, and there is a range in the accuracy of measurements, with an SD of 26.9 cc for volume and of 1.29 mm for surface contour (RMS). Although it can be

Figure 4. This 35-year-old woman (patient 2) underwent breast augmentation with 255-cc implants (Style 410; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Frontal views depict the preoperative simulation (A), the actual 3-month postoperative result (B), and the superimposed color map comparing A and B (C). (Refer to Table 1 for patient and implant details.)

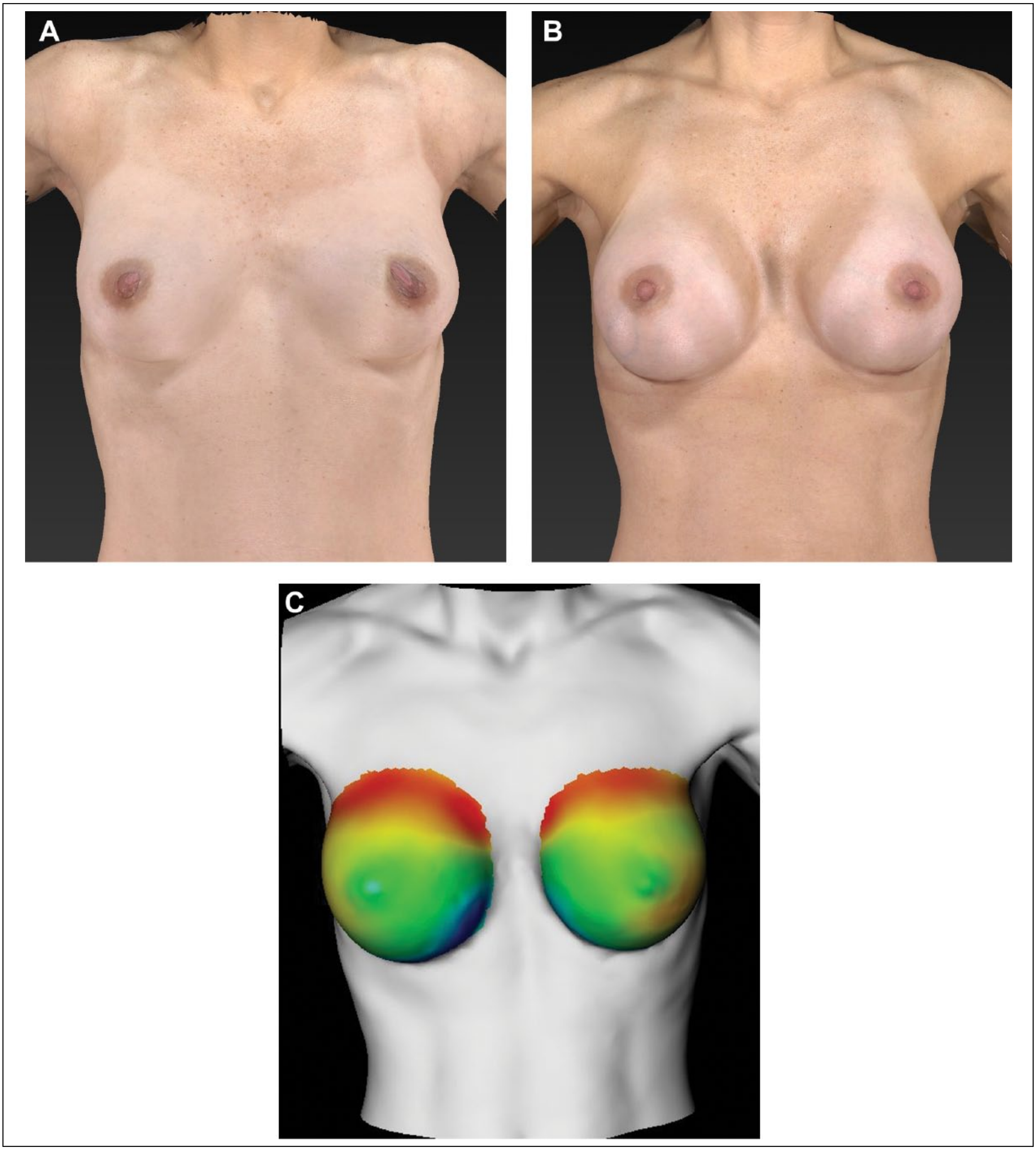

Figure 5. This 37-year-old woman (patient 3) underwent breast augmentation with 265-cc implants (Style 15; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Frontal views depict the preoperative simulation (A), the actual 3-month postoperative result (B), and the superimposed color map comparing A and B (C). (Refer to Table 1 for patient and implant details.)

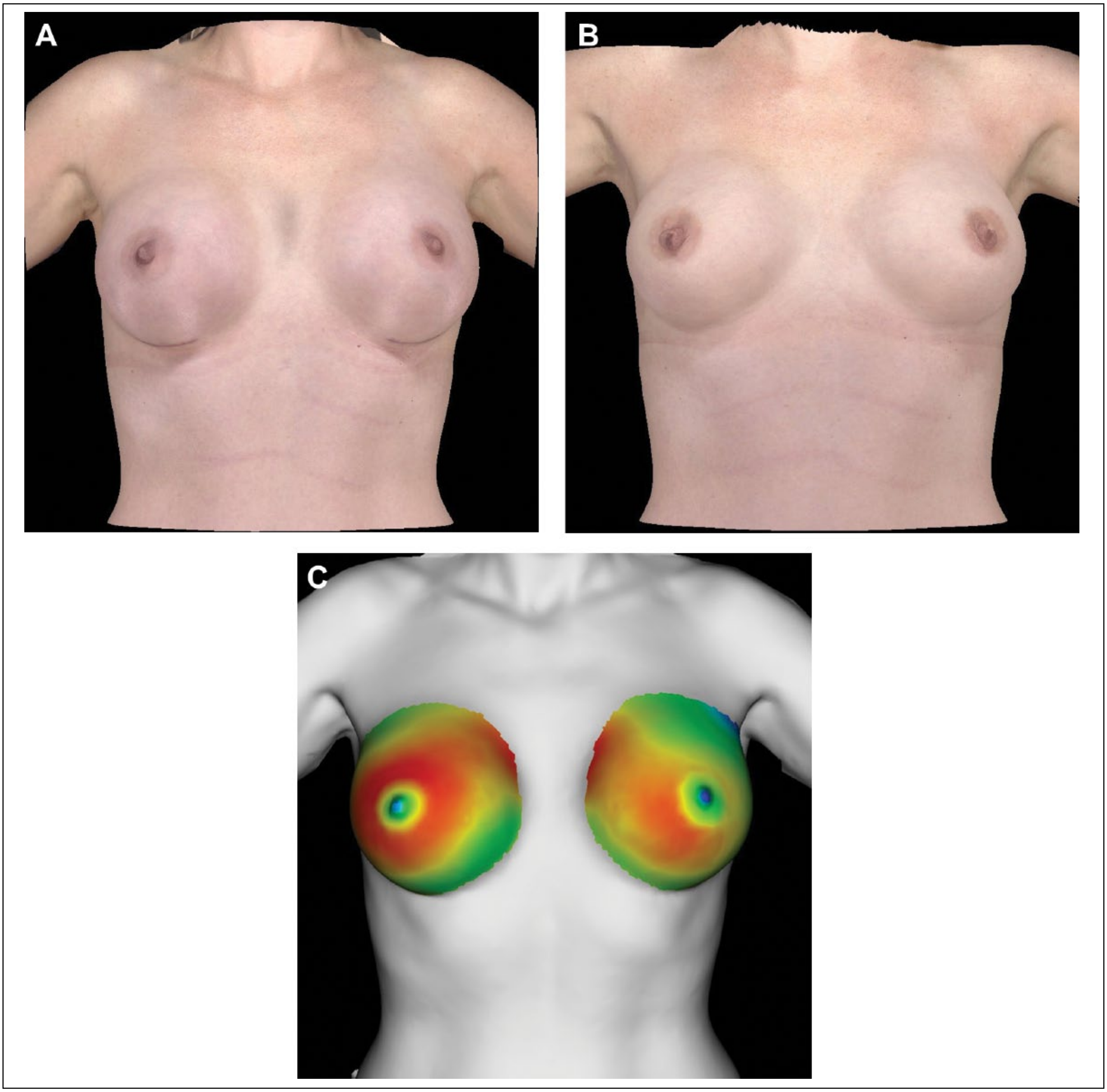

Figure 6. This 40-year-old woman (patient 4) underwent breast augmentation with 339-cc implants (Style 15; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Frontal views depict the preoperative simulation (A), the actual 3-month postoperative result (B), and the superimposed color map comparing A and B (C). (Refer to Table 1 for patient and implant details.)

helpful to cite mean values during consultations with patients, the ranges also must be shared and explained.

To determine differences in surface contour, we used color-coded surface mapping of the superimposed images obtained pre- and postoperatively. Although certain inherent variables may slightly affect quantification of deviation from one image to the other, such as variations in posture, it is likely that these small differences would only increase deviation and therefore appear to make the simulation less accurate. Despite this inherent variability, the mean absolute difference between simulation and actual result (expressed as RMS) of approximately 4 mm is very small.

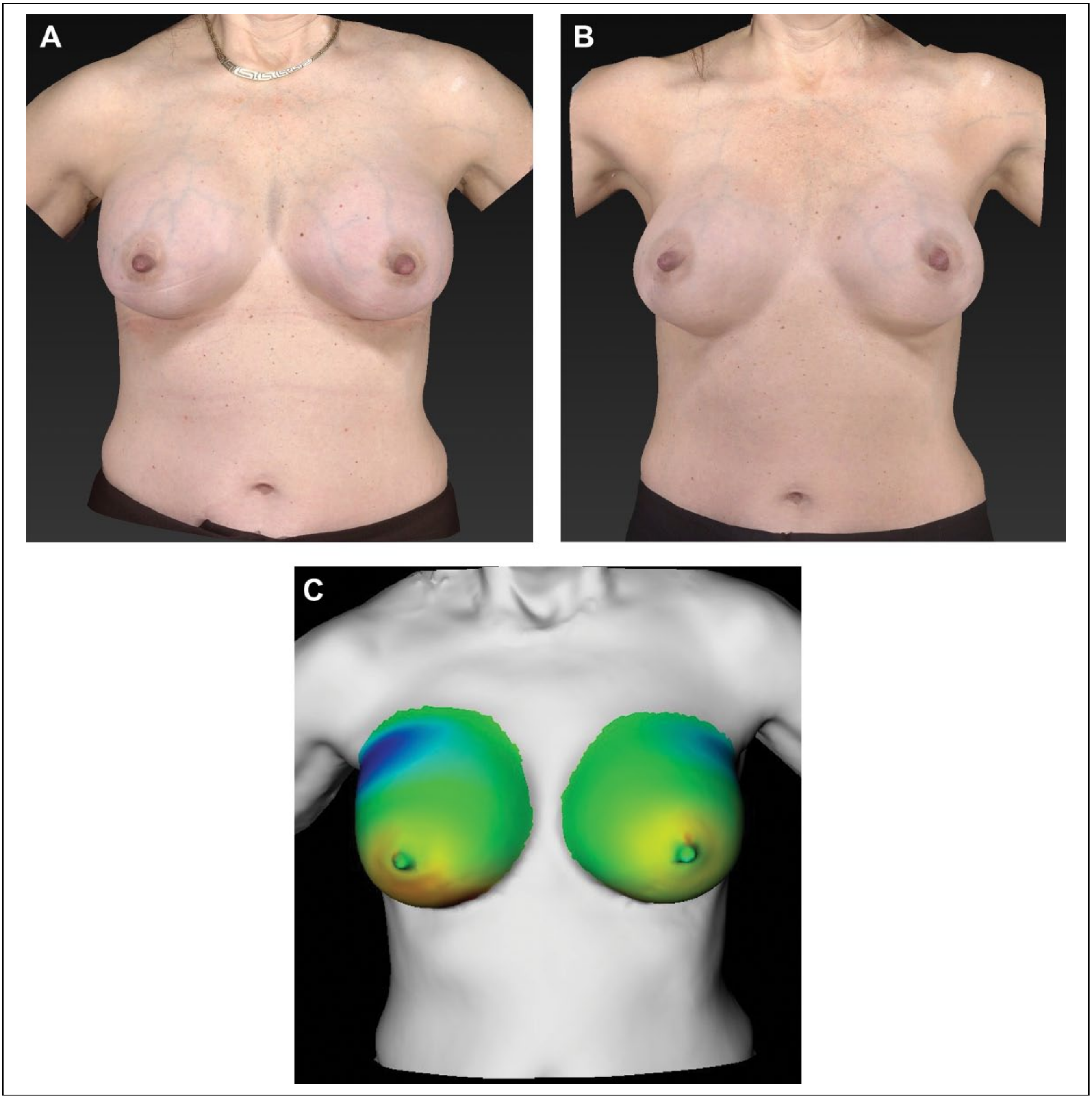

Figure 7. This 47-year-old woman (patient 6) underwent left breast augmentation with a 371-cc implant (Style 410; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Frontal views depict the preoperative simulation (A), the actual 3-month postoperative result (B), and the superimposed color map comparing A and B (C). (Refer to Table 1 for patient and implant details.)

Although it is difficult to evaluate the accuracy of a simulation based on an absolute difference measured in millimeters, the RMS can be extrapolated into a percentage based on deviation from overall surface area of the breast. The average surface area of the breasts in our series was 252 mm^2; therefore, the Vectra 3D imaging was, on average, 98.4% accurate.

We also investigated the least accurate simulations, reflected by higher differences in RMS and volume (patient 17; Figure 11). We found that this patient chose a fill

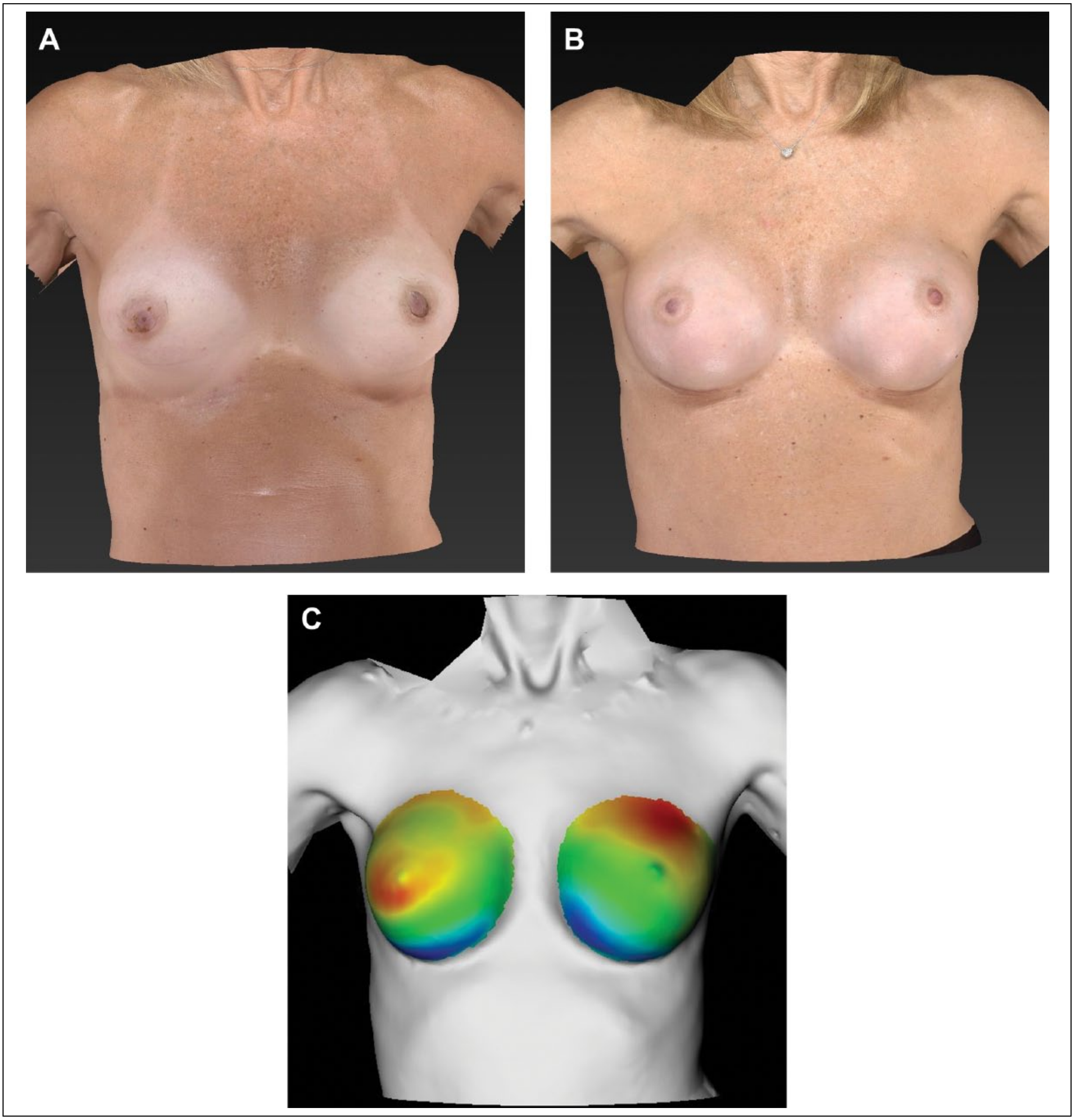

Figure 8. This 54-year-old woman (patient 9) underwent breast augmentation with 270-cc (right breast) and 205-cc (left breast) implants (Contour Profile Gel; Mentor Worldwide LLC, Santa Barbara, California) and 3-dimensional imaging. Frontal views depict the preoperative simulation (A), the actual 3-month postoperative result (B), and the superimposed color map comparing A and B (C). (Refer to Table 1 for patient and implant details.)

volume that was 50 cc greater than the maximum optimal fill volume based on our routine tissue-based planning using tenets of the high-5 system.[2] The simulations in our study were generated using the default simulation from the software, without any manual adjustment. When greater fill volumes are chosen, the extra volume becomes apparent in the upper pole of the breast; however, the default simulation software is set up to demonstrate an optimally

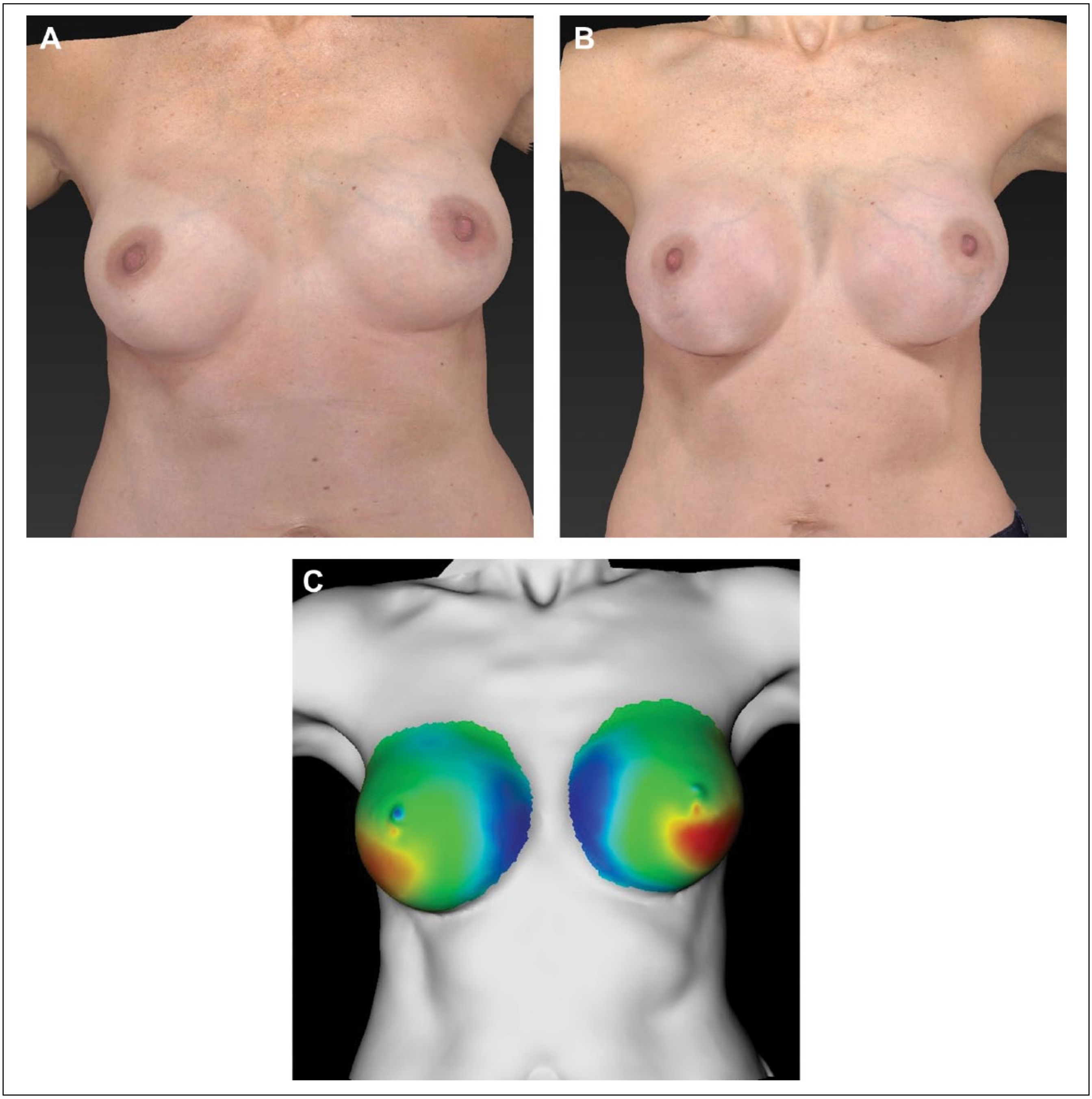

Figure 9. This 41-year-old woman (patient 10) underwent breast augmentation with 304-cc implants (Style 15; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Frontal views depict the preoperative simulation (A), the actual 3-month postoperative result (B), and the superimposed color map comparing A and B (C). (Refer to Table 1 for patient and implant details.)

filled breast and is not able to demonstrate this increase in upper-pole fullness without manual manipulation. It is important to discuss this limitation preoperatively with patients who desire a higher-than-optimal fill volume and are relying on the simulations to choose a particular size. For all other patients in our series, fill volumes were optimal based on measurements, and consequently, the RMS did not vary more than 1 mm to 2 mm from the mean.

An important discussion point is whether a 3-month postoperative result is adequate to represent the final result of breast augmentation. We chose this time point based on data from Eder et al[11] showing that breast volume and

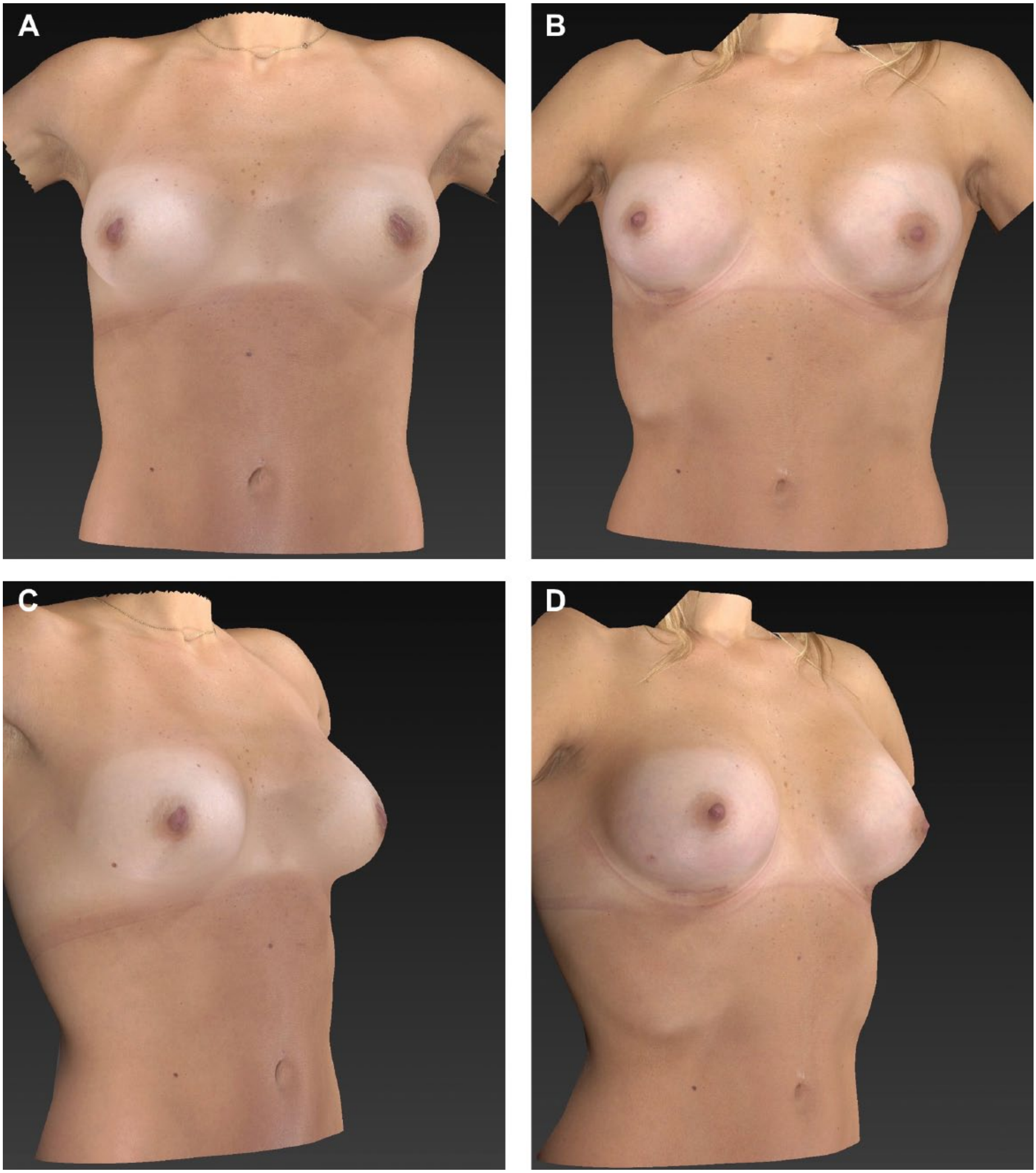

Figure 10. This 30-year-old woman (patient 5) underwent breast augmentation with 255-cc implants (Style 410; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This patient's simulation was the most accurate in our series, reflected by the smallest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

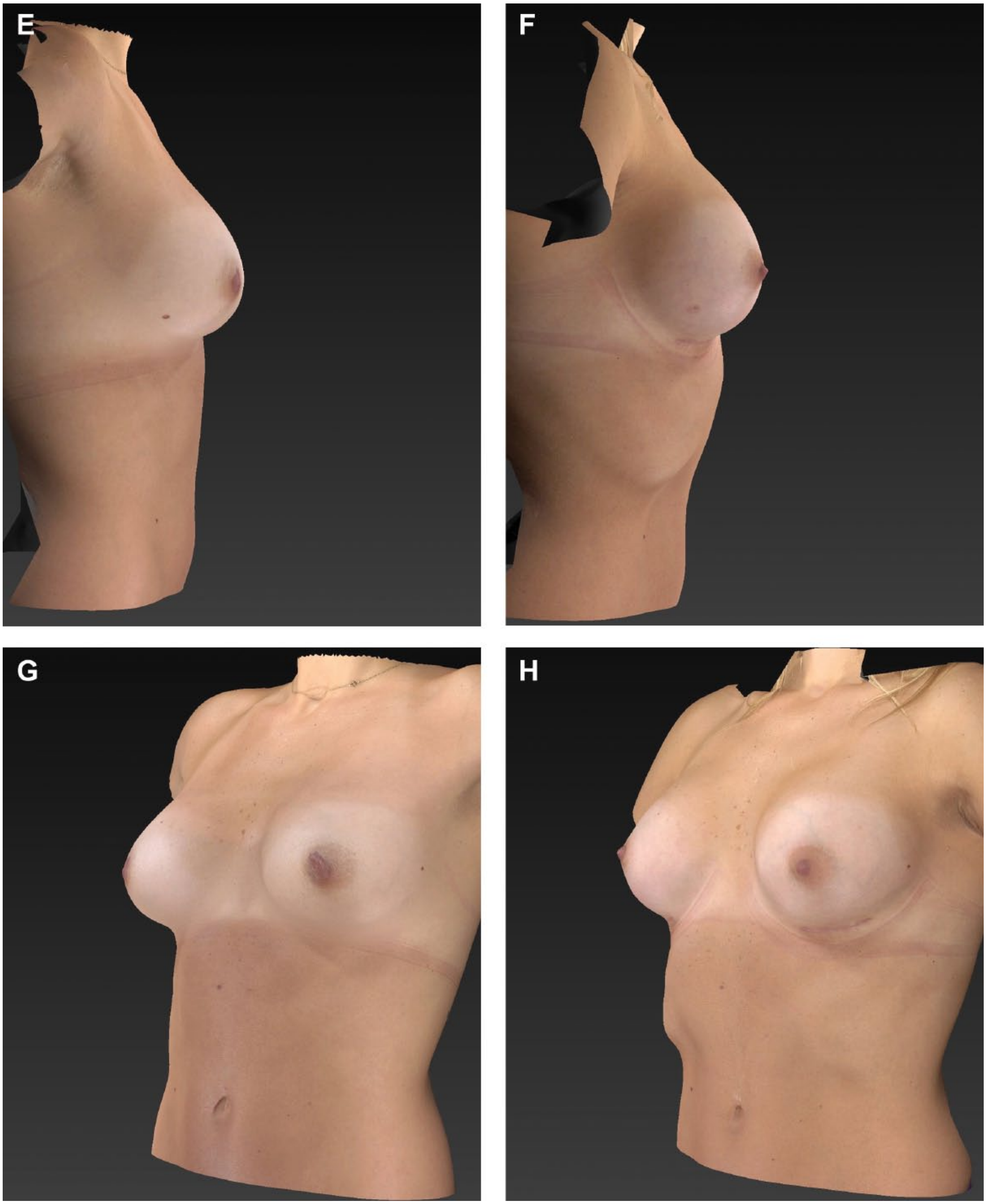

Figure 10. (continued) This 30-year-old woman (patient 5) underwent breast augmentation with 255-cc implants (Style 410; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This patient's simulation was the most accurate in our series, reflected by the smallest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

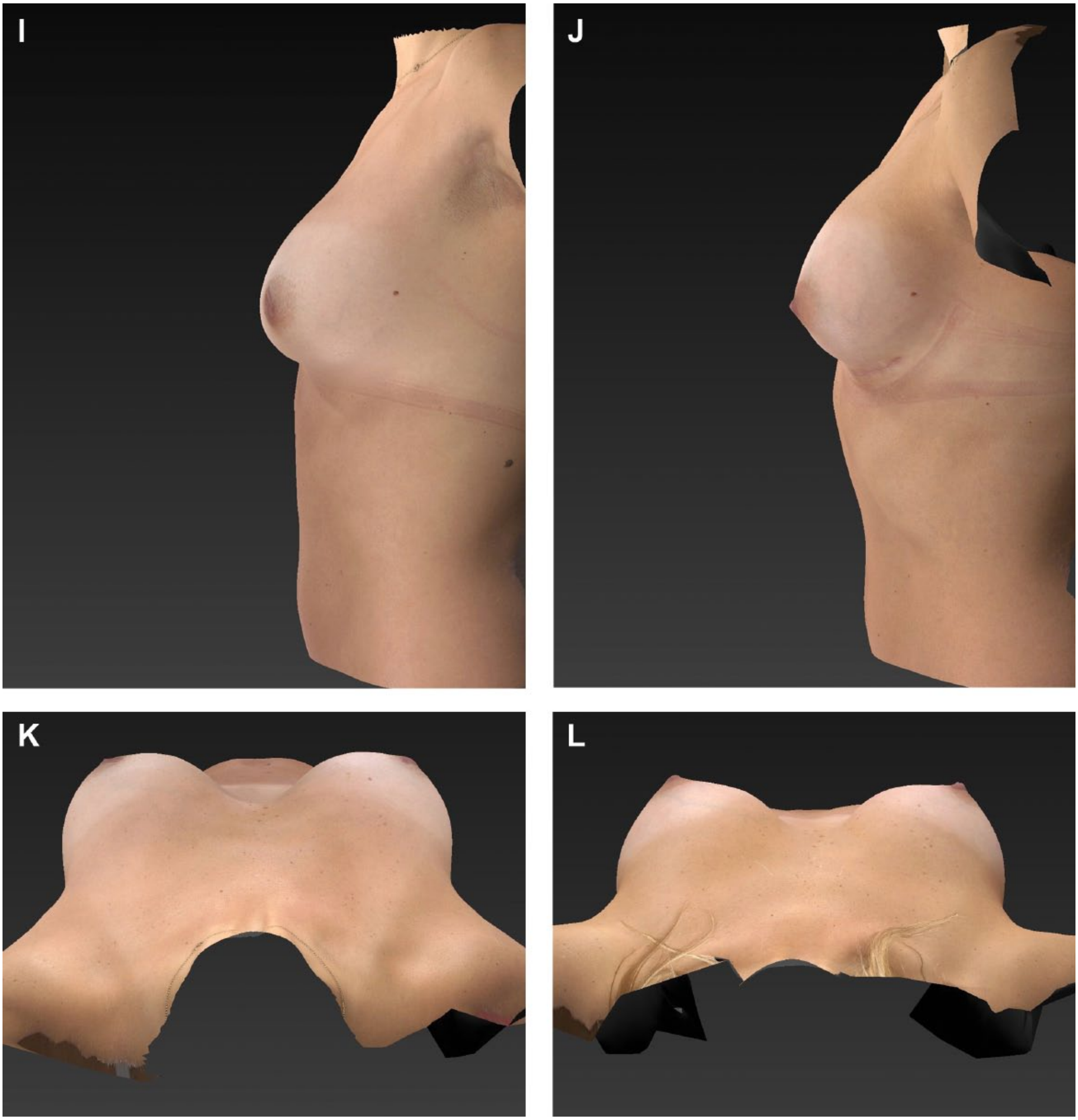

Figure 10. (continued) This 30-year-old woman (patient 5) underwent breast augmentation with 255-cc implants (Style 410; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This patient's simulation was the most accurate in our series, reflected by the smallest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

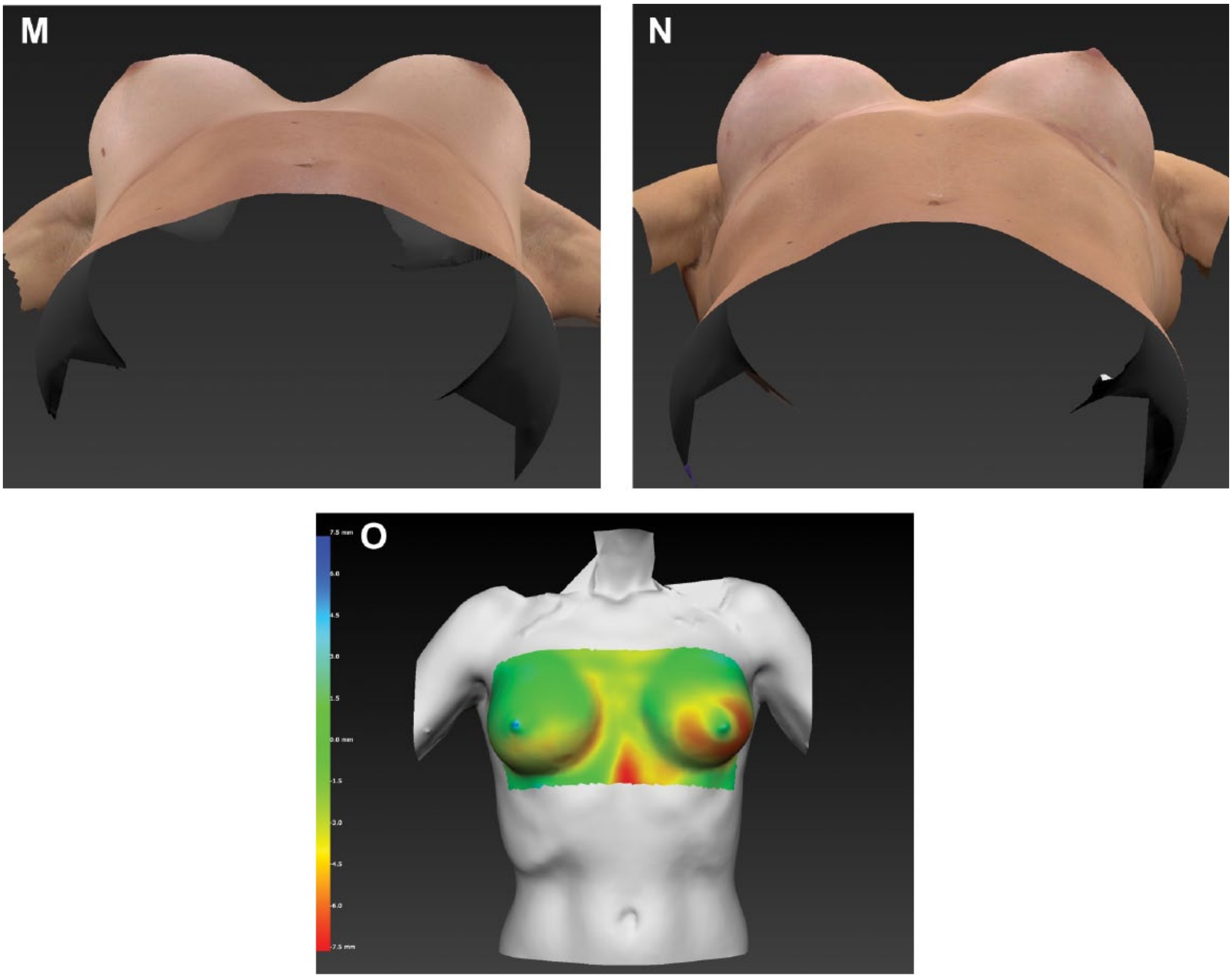

Figure 10. (continued) This 30-year-old woman (patient 5) underwent breast augmentation with 255-cc implants (Style 410; Allergan, Inc, Irvine, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This patient's simulation was the most accurate in our series, reflected by the smallest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

contour did not differ significantly between 3 months and 6 months postoperatively. Creasmen et al[5,6] also found no significant change in breast measurements at 3 months vs 6 months postaugmentation. Moreover, both of these studies further exemplify the benefits of 3D imaging in understanding changes in breast shape postoperatively.

Three-dimensional imaging of the breast can help educate patients and ascertain differences in volume and surface characteristics. As the technology continues to evolve, however, we must validate the information it provides. To our knowledge, the ability of 3D imaging to accurately simulate postoperative volume, surface contour, and overall shape of the breast had not been previously investigated for a commercially available 3D imaging device. Patients are often able to assess changes in volume based on bra cup measurements. However, breast shape is also an important parameter for most patients, and small differences in surface contour and/or shape are visually apparent and often identified by the patient postoperatively. To our knowledge, this is the first study to quantify differences in surface contour between the preoperative simulation and the postoperative result, permitting objective analysis and a more accurate determination of surface differences. The results of 2-dimensional photography typically are analyzed subjectively. It is our hope that subjective and potentially misleading techniques will eventually be abandoned with the advent of more objective and accurate options, such as 3D imaging.

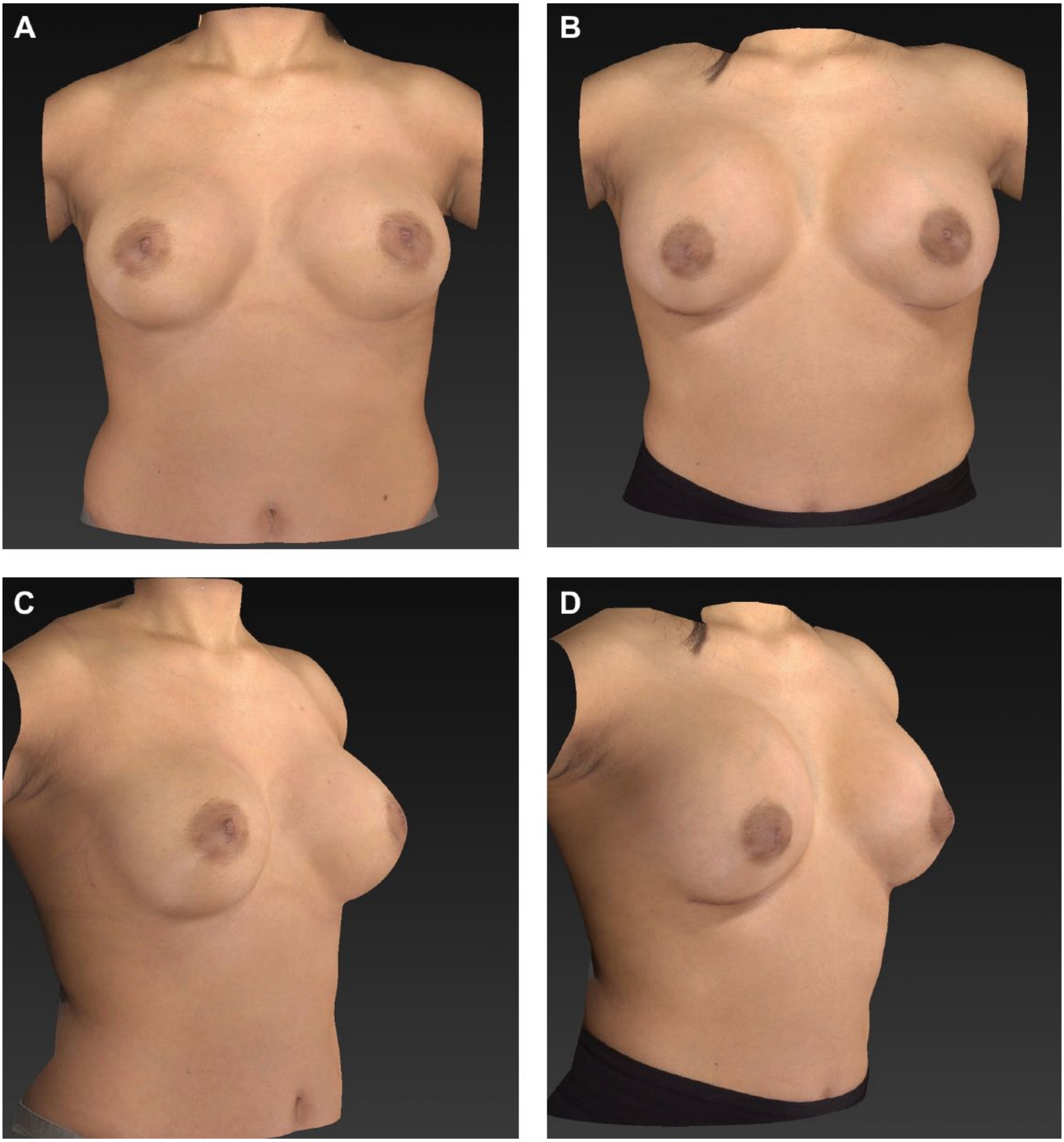

Figure 11. This 31-year-old woman (patient 17) underwent breast augmentation with 380-cc (right breast) and 410-cc (left breast) implants (Sientra MP, Santa Barbara, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This simulation was the least accurate in our series based on the greatest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

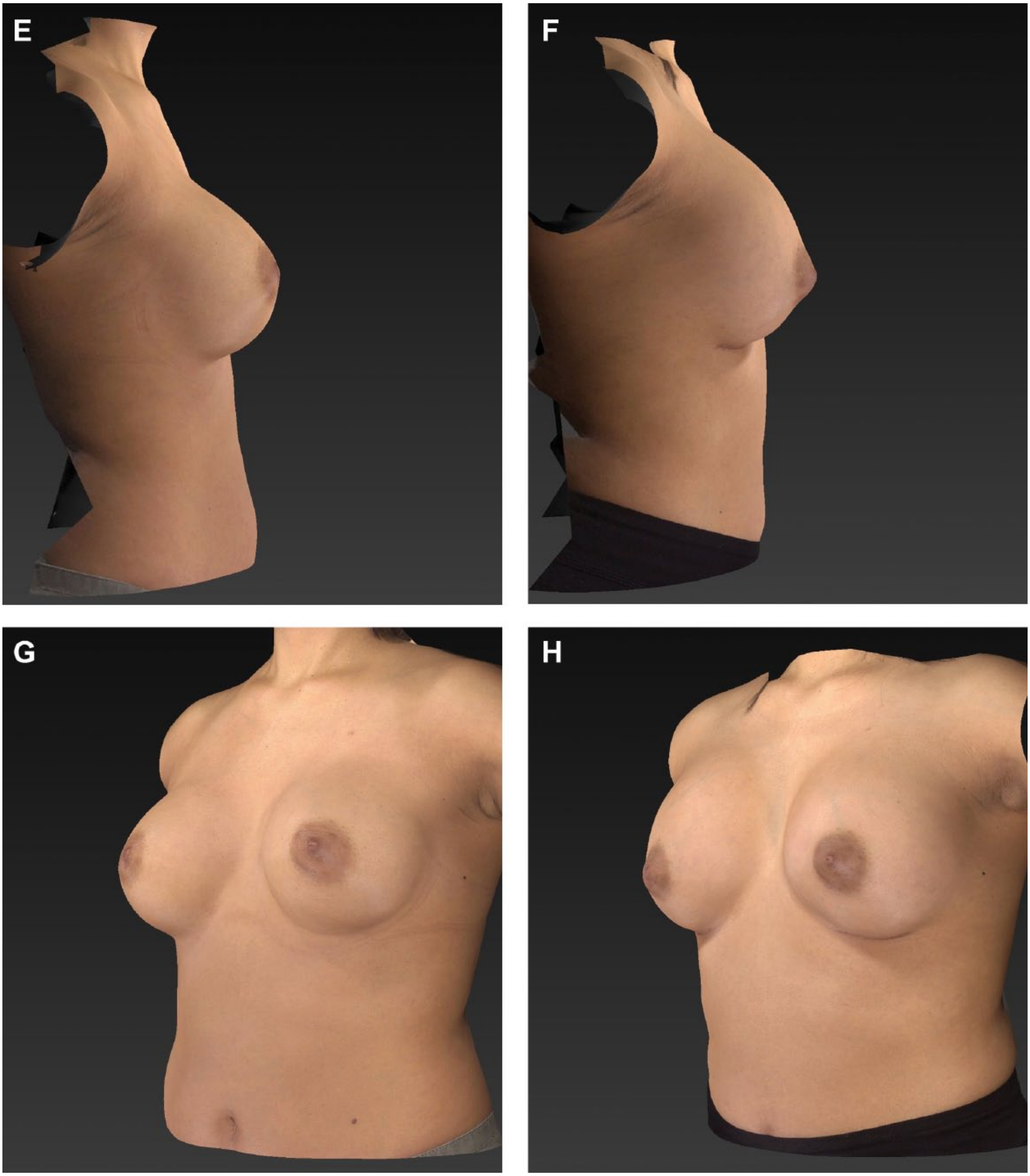

Figure 11. (continued) This 31-year-old woman (patient 17) underwent breast augmentation with 380-cc (right breast) and 410-cc (left breast) implants (Sientra MP, Santa Barbara, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This simulation was the least accurate in our series based on the greatest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

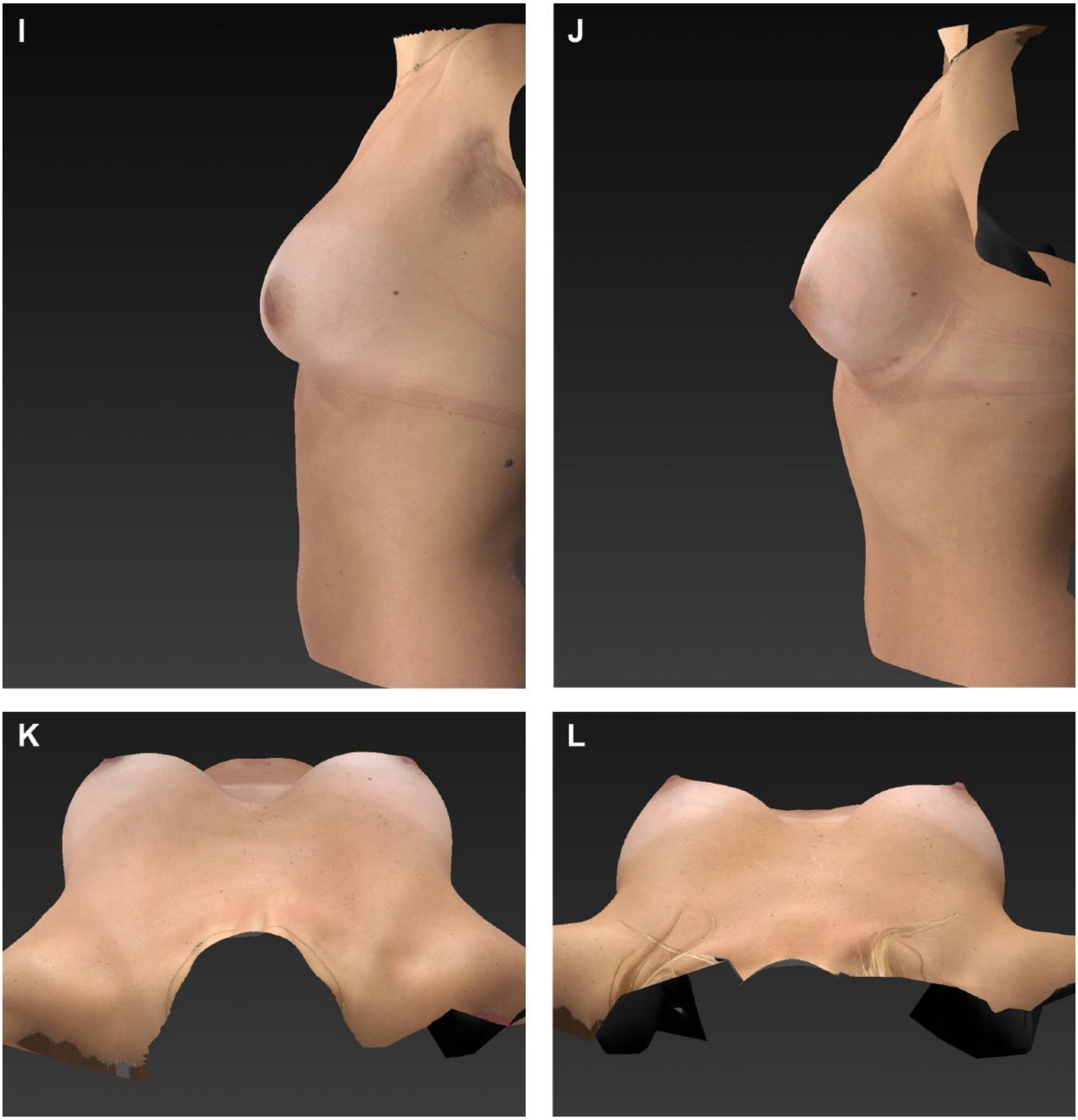

Figure 11. (continued) This 31-year-old woman (patient 17) underwent breast augmentation with 380-cc (right breast) and 410-cc (left breast) implants (Sientra MP, Santa Barbara, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This simulation was the least accurate in our series based on the greatest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

Although our data represent a single surgeon's experience with dual-plane placement of silicone implants through an inframammary approach, this is likely the most common breast augmentation procedure. The lack of predictable patterns of contour differences in our series patients could be attributable to the small sample size (N = 20). Larger studies may help determine whether contour differences occur more frequently in specific areas of the breast.

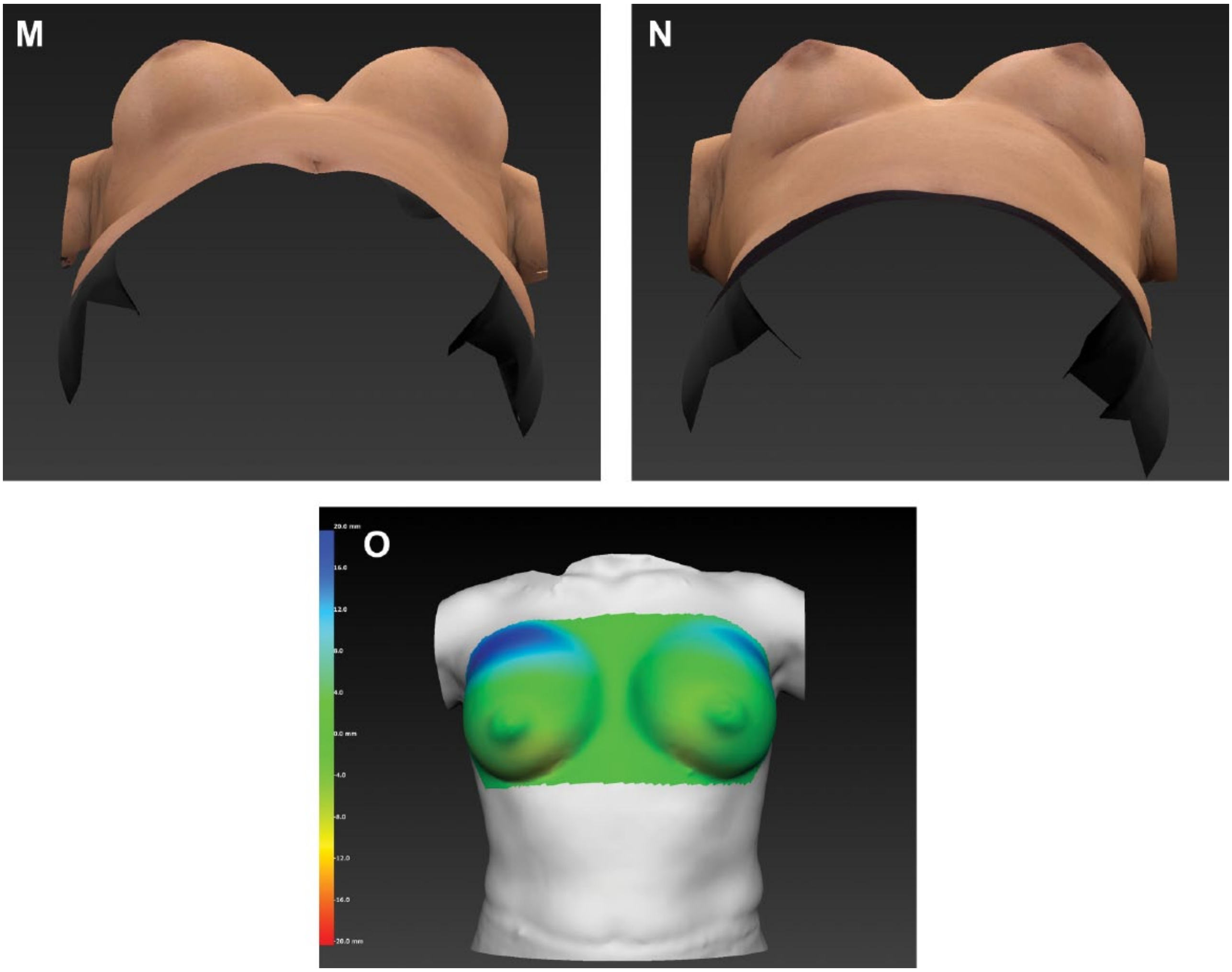

Figure 11. (continued) This 31-year-old woman (patient 17) underwent breast augmentation with 380-cc (right breast) and 410-cc (left breast) implants (Sientra MP, Santa Barbara, California) and 3-dimensional imaging. Views of the preoperative simulation: (A) front, (C) right oblique, (E) right lateral, (G) left oblique, (I) left lateral, (K) superior, and (M) inferior. Views of the actual 3-month postoperative result: (B) front, (D) right oblique, (F) right lateral, (H) left oblique, (J) left lateral, (L) superior, and (N) inferior. (O) The superimposed color map comparing A and B. This simulation was the least accurate in our series based on the greatest differences in root mean square and volume. (Refer to Table 1 for patient and implant details.)

CONCLUSIONS

Although the many proposed benefits of 3D imaging are apparent, it is essential to validate the reliability and accuracy of the information provided by this imaging. It is important to understand how closely simulations resemble actual postoperative results and to communicate this to patients considering breast surgery. In this study, the simulations generated by the Vectra M3 Imaging System provided a high degree of accuracy for breast volume (90%) and contour (98.4%). We believe that this technology has the potential to significantly enhance the surgeon-patient relationship.

Acknowledgment

The authors thank Rollin Read for his assistance with data analysis.

Disclosures

Dr Adams is an unpaid scientific advisor to Canfield Scientific, Inc (Fairfield, New Jersey). Dr Roostaeian declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

REFERENCES

1. Adams WP Jr. The process of breast augmentation: four sequential steps for optimizing outcomes for patients. *Plast Reconstr Surg*. 2008;122(6):1892-1900.
2. Tebbetts JB, Adams WP. Five critical decisions in breast augmentation using five measurements in 5 minutes: the high five decision support process. *Plast Reconstr Surg*. 2006;118(7)(suppl):35S-45S.
3. Mailey B, Freel A, Wong R, et al. Clinical accuracy and reproducibility of Portrait 3D Surgical Simulation Platform in breast augmentation. *Aesthetic Surg J*. 2013;33(1):84-92.
4. Losken A, Seify H, Denson DD, Paredes AA Jr, Carlson GW. Validating three-dimensional imaging of the breast. *Ann Plast Surg*. 2005;54(5):471-478.
5. Creasman CN, Mordaunt D, Liolios T, Chiu C, Gabriel A, Maxwell GP. Four-dimensional breast imaging, part I: introduction of a technology-driven, evidence-based approach to breast augmentation planning. *Aesthetic Surg J*. 2011;31(8):914-924.
6. Creasman CN, Mordaunt D, Liolios T, Chiu C, Gabriel A, Maxwell GP. Four-dimensional breast imaging, part II: clinical implementation and validation of a computer imaging system for breast augmentation planning. *Aesthetic Surg J*. 2011;31(8):925-938.
7. Eder M, Schneider A, Feussner H, et al. Breast volume assessment based on 3D surface geometry: verification of the method using MR imaging. *Biomed Tech*. 2008;53:112-121.
8. Kovacs L, Yassouridis A, Zimmermann A, et al. Optimization of 3-dimensional imaging of the breast region with 3-dimensionallaser scanners. *Ann Plast Surg*. 2006;56:229-336.
9. Losken A, Fishman I, Denson DD, Moyer HR, Carlson GW. An objective evaluation of breast symmetry and shape differences using 3-dimensional images. *Ann Plast Surg*. 2005;55:571-575.
10. Small KH, Tepper OM, Unger JG, et al. Re-defining pseudoptosis from a 3D perspective after short scar-medial pedicle reduction mammaplasty. *J Plast Reconstr Aesthetic Surg*. 2010;63:346-353.
11. Eder M, Waldenfels F, Sichtermann M, et al. Three-dimensional evaluation of breast contour and volume changes following subpectoral augmentation mammaplasty over 6 months. *J Plast Reconstr Aesthetic Surg*. 2011;64(9):1152-1160.