Design for Natural Breast Augmentation: The ICE Principle

Patrick Mallucci, M.B.Ch.B., M.D.
Olivier Alexandre Branford, M.A., M.B.B.S., Ph.D.

London, United Kingdom

Background: The authors' published studies have helped define breast beauty in outlining key parameters that contribute to breast attractiveness. The "ICE" principle puts design into practice. It is a simplified formula for inframammary fold incision planning as part of the process for determining implant selection and placement to reproduce the 45:55 ratio previously described as fundamental to natural breast appearance. The formula is as follows: implant dimensions (I) − capacity of the breast (C) = excess tissue required (E). The aim of this study was to test the accuracy of the ICE principle for producing consistent natural beautiful results in breast augmentation.

Methods: A prospective analysis of 50 consecutive women undergoing primary breast augmentation by means of an inframammary fold incision with anatomical or round implants was performed. The ICE principle was applied to all cases to determine implant selection, placement, and incision position. Changes in parameters between preoperative and postoperative digital clinical photographs were analyzed.

Results: The mean upper pole–to–lower pole ratio changed from 52:48 preoperatively to 45:55 postoperatively ($p < 0.0001$). Mean nipple angulation was also statistically significantly elevated from 11 degrees to 19 degrees skyward ($p \leq 0.0005$). Accuracy of incision placement in the fold was 99.7 percent on the right and 99.6 percent on the left, with a standard error of only 0.2 percent. There was a reduction in variability for all key parameters.

Conclusion: The authors have shown using the simple ICE principle for surgical planning in breast augmentation that attractive natural breasts may be achieved consistently and with precision. (*Plast. Reconstr. Surg.* 137: 1728, 2016.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Tissue-based planning for breast augmentation has contributed greatly to improved outcomes.[1–5] The negative consequences of volumetric approaches and oversized implants are well documented with higher complication and reoperation rates.[4] Dimensional planning has assisted in implant selection, respecting individual anatomy and using this as a basis for optimal guidance in customized implant choice.[1,6] The planning process involves not only specifics of implant selection but also positioning and incision placement. Methods for implant selection and placement vary considerably, such as the "number Y" technique by del Yerro and colleagues,[6] the "high five decision support process" by Tebbetts and Adams,[1] and the unpublished Akademikliniken method described by Hedén, but none has correlated these with aesthetic

From the Cadogan Clinic; the Department of Plastic Surgery, Royal Free Hampstead NHS Trust; and the Royal Marsden Hospital.
Received for publication October 1, 2015; accepted January 29, 2016.
Presented at the Akademikliniken's Beauty Through Science 11th International Annual Aesthetic Symposium, in Stockholm, Sweden, June 4 through 6, 2015; and the Aesthetic Surgery of the Breast, Milano Breast Meeting, Scuola di Oncologia Chirurgica Riconstruttiva, Sixth European Symposium, in Milan, Italy, December 10 through 13, 2014.

DOI: 10.1097/PRS.0000000000002230

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

Supplemental digital content is available for this article. Direct URL citations appear in the text; simply type the URL address into any Web browser to access this content. Clickable links to the material are provided in the HTML text of this article on the *Journal*'s Web site (www.PRSJournal.com).

Table 1. Critical Ideals of Beautiful Natural Breasts

Key Parameter	Ideal
Upper pole–to–lower pole ratio	45:55% = the "45:55 breast"
Nipple angulation	20 degrees skyward
Upper pole slope	Straight/mildly concave
Lower pole convexity	Tight convex curve

outcome. These methods are often not straightforward and are difficult to put into practice as a result of their complexity.

More recently, we have defined key parameters consistent with natural breast beauty in an observational analysis of 100 models with natural breasts and a population analysis with 1315 respondents (Table 1 and Fig. 1).[7,8] The "ICE" principle—where implant dimensions (I) – capacity of the breast (C) = excess tissue required (E)—is a simplified approach for implant selection and placement designed as a guide for reproducing aesthetically "ideal" breasts through a tissue-based approach. It is a simplification of more complex methods for calculating the inframammary fold incision, reducing the number of measurements required, and aiming to reproduce the 45:55 ratio[7,8] template accurately and consistently. It uses the inframammary fold incision as a key part of the planning process, placing the incision in the resulting neo–inframammary fold in such a way as to preserve the upper pole–to–lower pole proportion. The aim of this study was to test the accuracy of the ICE principle in terms of being able to achieve the above (i.e., prediction of inframammary fold incision placement for a given implant and its ability to reproduce a breast with the 45:55 ratio).

PATIENTS AND METHODS

Study Design

A prospective level IV analysis of all consecutive patients undergoing primary breast augmentation by means of an inframammary incision was performed. Inclusion criteria were women having anatomical or round implants by means of the inframammary approach. This incision is a key part of the planning process, which helps determine implant position through precise control of the lower pole of the breast. Exclusion criteria were those women with greater than grade I ptosis or having simultaneous mastopexy. The authors complied with the principles outlined in the Declaration of Helsinki.

Fifty consecutive patients were included in the study. The ICE principle (described below) was applied to all cases to calculate the position of the neo–inframammary fold. Patients were

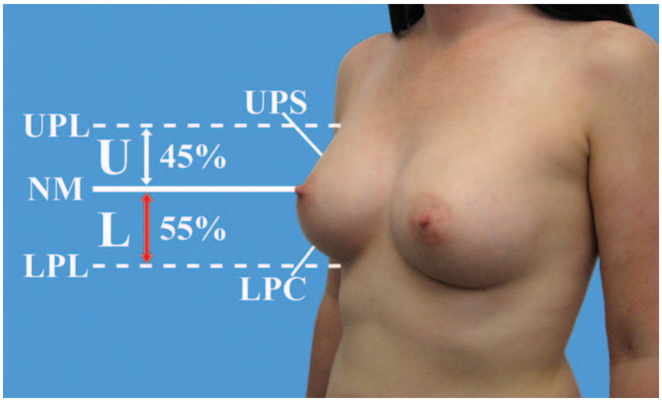

Fig. 1. Representative three-quarters profile view with standard breast parameters as used in the survey: upper pole–to–lower pole ratio, nipple angulation, and contour of upper and lower poles. The breast shown has an upper pole–to–lower pole ratio of 45:55, straight upper pole, skyward pointing nipple, and convex lower pole. *U*, upper pole; *L*, lower pole; *UPL*, upper pole line; *LPL*, lower pole line; *NM*, nipple meridian; *UPS*, upper pole slope; *LPC*, lower pole convexity. (From Mallucci P, Branford OA. Population analysis of the perfect breast: A morphometric analysis. *Plast Reconstr Surg*. 2014;134:436–437; with permission. Copyright © 2014 by Plastic and Reconstructive Surgery).

photographed preoperatively and postoperatively at final review in standardized three-quarters profile views using high-resolution digital photography.

Implant Selection

We use the base width of the breast as the primary determinant for implant selection, ideally selecting an implant whose diameter lies within the base width of the breast by at least 0.5 cm. The shape of the implant will depend on existing breast anatomy and patient desire in terms of appearance. For each implant width, variation can be found in projection and height (the latter for anatomical implants only, as width and height are the same for round implants). The ICE principle is then used to formulate ideal implant height and projection for a given breast.

Definition of the ICE Principle

The placement of an implant into a breast has an impact on the soft tissue and skin envelope. If the implant dimensions exceed the natural capacity of the breast, skin will be recruited mostly from the abdomen onto the lower pole of the breast. It is important to understand how much skin is required for a given implant. This is determined by the relationship between the implant dimensions and the natural capacity of the breast: the difference between these two measurements is the excess skin required (which will be recruited from the abdomen onto the lower pole) (Fig. 2). This is the fundamental basis of the ICE principle, with E being the distance below the existing fold that the incision needs to be placed for the selected implant (Fig. 2). If the implant characteristics do not exceed the natural capacity of the breast, no skin is recruited and therefore the incision is placed in the existing fold.

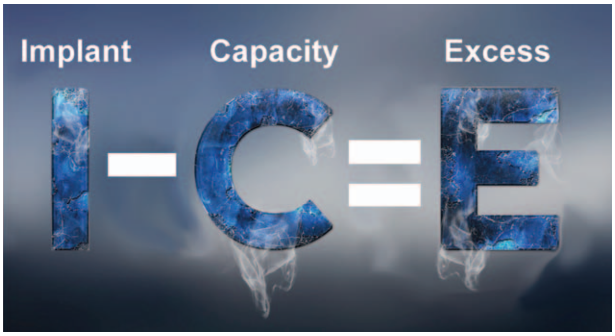

Fig. 2. The ICE principle, where *I* = implant dimensions, *C* = capacity of the breast lower pole, and *E* = excess skin required.

Implant dimension (I) is defined as height plus projection. The inframammary fold position and skin required in the lower pole is determined by the height of the implant relative to the nipple-areola complex (Akademikliniken method described by Hedén) and the projection of the implant: the more projected an implant is, the more skin it recruits from the abdomen into the lower pole. The capacity of the lower pole (C) is defined as the distance from the nipple to the inframammary fold on stretch.

Anatomical versus Round Implants

For an anatomical implant, the implant is placed at the mid-height point, reflecting the greater volume in the lower half with respect to the upper half of the implant (Fig. 3). This mirrors the 45:55 principle in that the lower pole is more loaded than the upper pole. For a round implant, this proportion is created by placing the implant slightly below the mid-height point (55 percent of the vertical height of the implant below it) to artificially load the lower pole of the breast (Fig. 3).

Primary Outcome Measures

Photographs were uploaded into Adobe Photoshop CS4 (Adobe Systems, Inc., San Jose, Calif.) and the preoperative and postoperative measurements were obtained using the ruler function according to the four key parameters identified previously (Table 1).[7,8] In addition, the position of

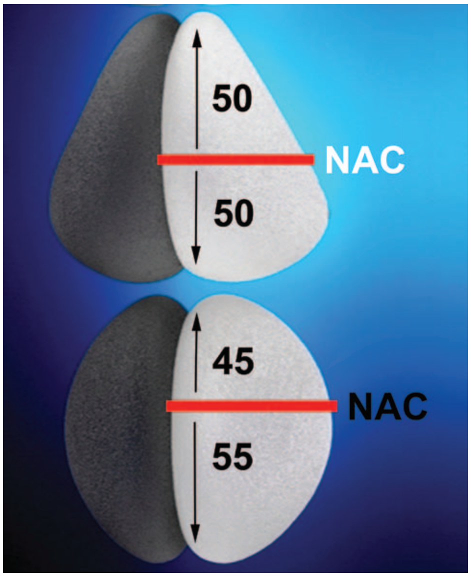

Fig. 3. Diagram showing position of implant meridian relative to the nipple-areola complex (*NAC*) in the ICE principle for an anatomical implant at the 50:50 position (*above*) and a round implant at the 45:55 position (*below*).

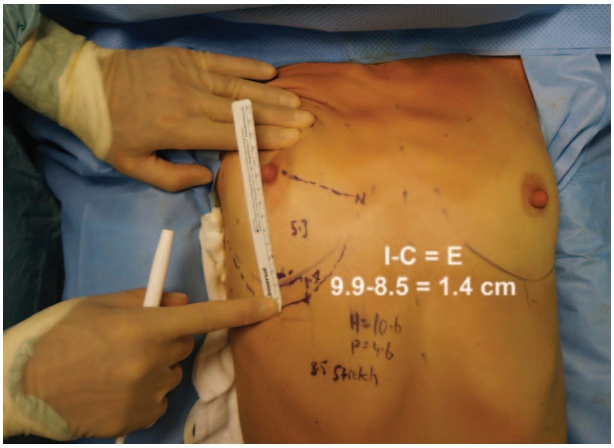

Fig. 4. Intraoperative planning using the ICE principle. Here the *I* – *C* = *E* calculation is shown corresponding to the ICE principle calculation shown in the main text.

the inframammary fold scar, as a marker of the overall precision of surgical planning, was measured as a percentage of the distance from the center of the nipple to the new inframammary fold.

Example ICE Principle Calculation for Anatomical Implant

A clinical example is shown in Figures 4 through 7. The ICE principle calculations are shown in Figure 5. For the patient demonstrated, an anatomical implant was used with a height of 10.6 cm and a projection of 4.6 cm. This gives an implant meridian to the lowest aspect of implant height of 5.3 cm (as described above, anatomical implants are loaded in the lower pole and thus are placed at 50:50). The nipple-to–inframammary fold distance under stretch was 8.5 cm, so in this case:

I = 9.9 cm (i.e., ½ of implant height – 5.3 cm + 4.6 cm of implant projection)

C = 8.5 cm (nipple-to–inframammary fold distance on stretch)

I – C = E

9.9 cm – 8.5 cm = 1.4 cm

Therefore, the inframammary fold was lowered by 1.4 cm. It is clear from the intraoperative (Fig. 5) and postoperative photographs (Figs. 6 and 7) that the scar was located precisely in the inframammary fold.

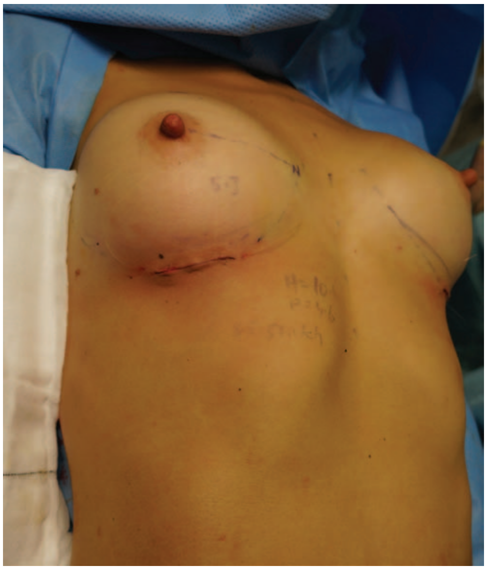

Fig. 5. Intraoperative result using ICE principle on same patient as in Figures 4, 6, and 7. This photograph shows that the incision ends up precisely in the inframammary fold.

Example ICE Principle Calculation for Round Implant

For the purposes of clarity, an example calculation for a patient with the same tissue and skin dimensions as in the example calculation above are shown below where a round implant is selected with a height of 10.6 cm and a projection of 4.6 cm. As stated above, the mid-height point for a round implant is with 55 percent of the vertical height of the implant below it. This gives an implant meridian to lowest aspect of implant height of 5.8 cm (from the calculation 10.6 cm × 55/100). The nipple-to–inframammary fold distance under stretch was 8.5 cm, so in this case:

I = 10.4 cm [(10.6 cm × 55/100) + 4.6 cm of implant projection]

C = 8.5 cm (nipple to inframammary fold on stretch)

I – C = E

10.4 cm – 8.5 cm = 1.9 cm

Therefore, the inframammary fold in this case would be lowered by 1.9 cm.

Statistical Analysis

Data for groups A and group B were compared using the paired *t* test. Data are shown as mean ± SE, median and quartiles, or as number (percent), as appropriate.

RESULTS

Fifty consecutive women undergoing bilateral breast augmentation by means of an inframammary approach were included in this study. Mean follow-up was 5.4 ± 1.8 months.

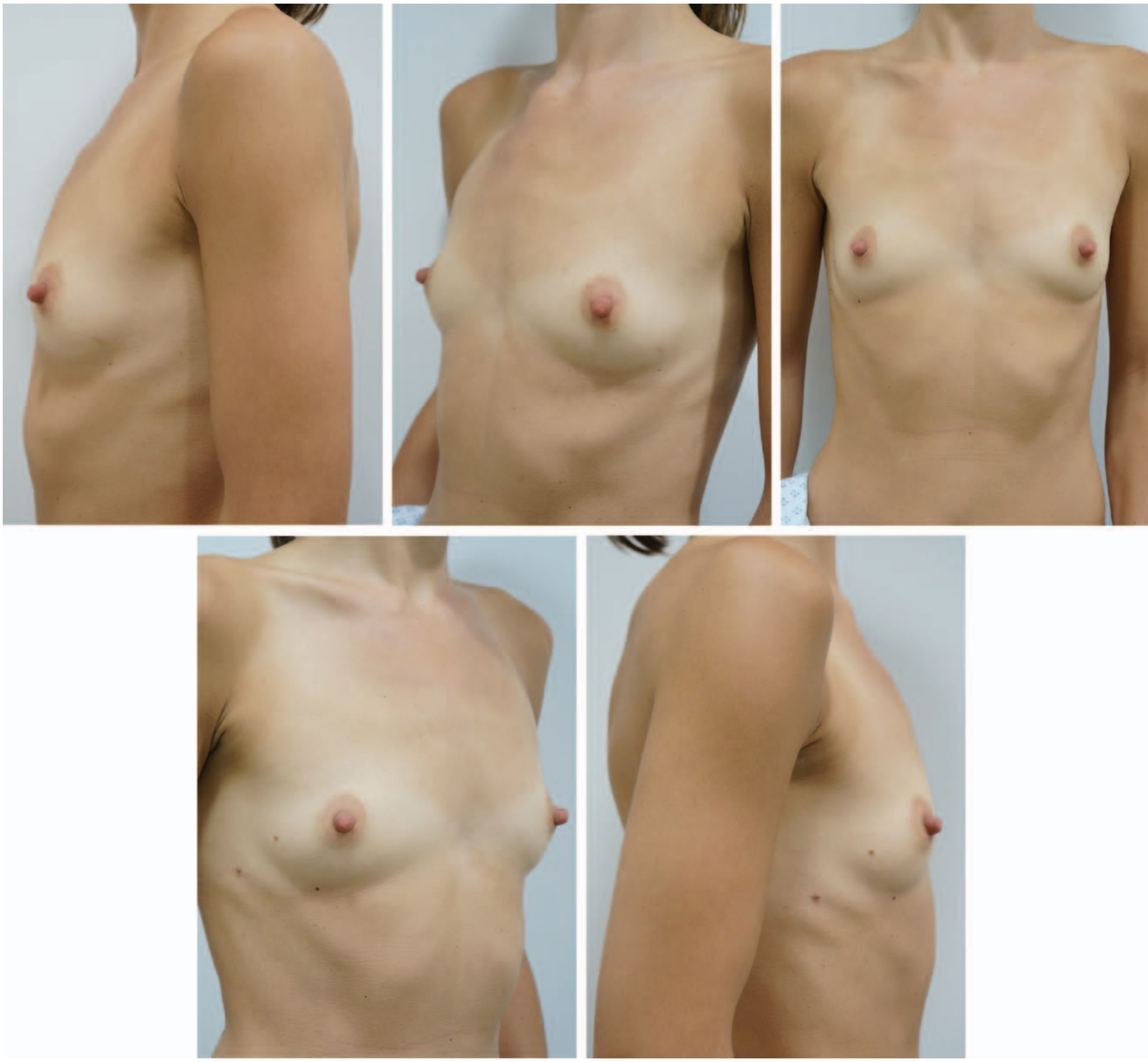

Fig. 6. Preoperative photographs of breast augmentation patient seen in Figures 4, 5, and 7.

Upper Pole–to–Lower Pole Ratio

Results are shown in Table 2 and Figure 8. Comparing the change in upper pole–to–lower pole ratios for both left and right sides combined, patients improved from mean preoperative right and left upper pole–to–lower pole ratios of 52:48 and 53:47, respectively, to mean postoperative right and left upper pole–to–lower pole ratios of 45:55 and 46:54, respectively. This corresponds to a highly statistically significant 6 percent elevation of nipple position on the breast mound ($n = 50$; $p < 0.0001$) on the right side and 7 percent elevation ($n = 50$; $p < 0.0001$) on the left side relative to the height of the breasts. It should be noted that these patients had not undergone any form of mastopexy.

Nipple Angulation

Results are listed in Table 3 and Figure 9. There was elevation in nipple angulation for both left and right sides combined from a mean of 11 degrees skyward preoperatively to 19 degrees skyward postoperatively. This corresponds to a highly statistically significant 7 degrees' elevation of nipple angulation ($n = 50$; $p < 0.0001$) on the right side and 7 degrees' elevation of nipple position ($n = 50$; $p = 0.0005$) on the left side relative to the horizontal plane.

Upper Pole Slope

Results are shown in Table 4. There was marked asymmetry in upper pole curvature

Fig. 7. Postoperative photographs of breast augmentation patient shown in Figure 6.

before breast augmentation, with half of women having concave upper poles on the left breast and one-third of women having concave upper poles on the right. Following breast augmentation using the ICE principle, symmetry was improved, with 90 percent of women having straight upper poles bilaterally.

Lower Pole Convexity

All patients had lower pole convexity postoperatively. Figure 10 shows a clinical example of the attractive tight lower pole curvature produced with this aesthetic template (and elevation of the nipple position on the breast mound) following breast augmentation.

Neo–Inframammary Fold Incision Placement

It was possible to visualize the neo–inframammary fold in all cases postoperatively on the digital

Table 2. Mean Preoperative and Postoperative Upper Pole–to–Lower Pole Ratio for Right and Left Sides for 50 Consecutive Breast Augmentation Patients Treated with the ICE Principle

Side	U:L Ratio	SE (%)
Preoperative		
Right	51.5:48.5	1.5
Left	52.6:47.4	1.4
Postoperative		
Right	45.3:54.7	0.4
Left	45.5:54.5	0.3

U:L, upper pole–to lower pole.

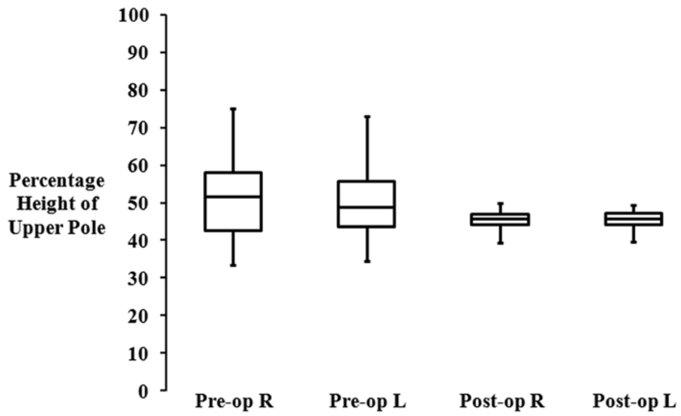

Fig. 8. Box-and-whisker plots of change in percentage of breast attributed to the upper pole for left and right sides showing close approximation to the 45:55 ratio and reduced spread of data postoperatively ($n = 50$). Minimum, maximum, median, and quartiles are shown. *Pre-op*, preoperative; *Post-op*, postoperative; *R*, right; *L*, left.

photographs. For the majority of women (42 of 50 on the left and 38 of 50 on the right), the incision was located exactly in the neo–inframammary fold. The mean accuracy of incision placement relative to the inframammary fold was 99.7 percent on the right and 99.6 percent on the left, with a standard error of only 0.2 percent on both sides.

Reduced Variability in Outcomes

We observed that by using the ICE principle, postoperative patients conformed much more closely to the key parameters we described previously.[7,8] The box-and-whisker charts of the results also show that the spread of data was greatly narrowed postoperatively (Figs. 8 and 9). This indicates that using the ICE principle reduces variability in outcomes.

Complications

There were no significant complications or returns to the operating room for any of the 50 patients.

Table 3. Mean Preoperative and Postoperative Nipple Angulation in Degrees for Right and Left Sides for 50 Consecutive Breast Augmentation Patients Treated with the ICE Principle*

Side	Angulation (deg)
Preoperative	
Right	11.7 ± 1.8
Left	11.2 ± 2.1
Postoperative	
Right	18.7 ± 0.9
Left	18.3 ± 0.7

*Values are given as mean ± SE.

DISCUSSION

Tebbetts and Adams have determined the position of the inframammary fold based on implant volume.[1] They have also shown using five measurements that a biodimensional approach to implant selection is crucial for reducing reoperation rates.[1] Hedén has detailed the Akademikliniken method in surgical planning. The ICE principle is a simplification of existing techniques, taking into consideration two implant parameters (height and projection) and two breast parameters (base width and nipple-to–inframammary fold distance on stretch). We have shown using a simple formula for surgical planning in breast augmentation that an ideal breast may be achieved with high levels of consistency.

It is important to note that the breast width can give rise to a selection of implants all of the same width but differing in projection or height (or both). It is precisely these latter two parameters that will then determine the most suitable of these implants for a given lower pole capacity. It is also vital to understand that not all inframammary folds are the same and that some can be lowered more easily than others without risking a double bubble. A tight, very well-defined fold will not tolerate lowering, whereas an "open," shallow, or less well-defined fold can be lowered much more significantly without adverse consequence. The ICE principle can therefore be used to work "backward" to reselect the implant if the excess is considered too great for a particular fold to tolerate: by lowering implant height or reducing projection, the excess required (E) is less, and therefore less disruption of the inframammary fold will

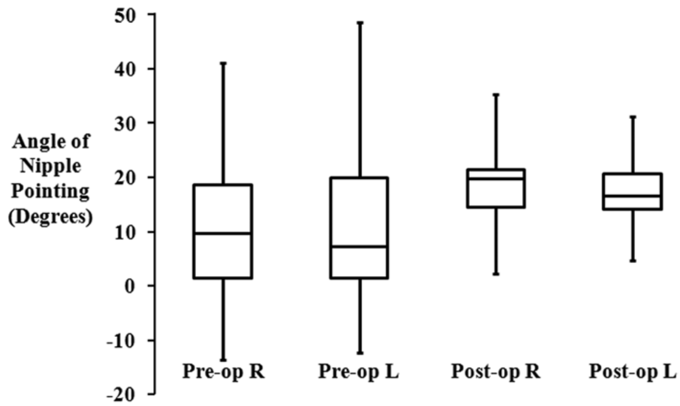

Fig. 9. Box-and-whisker plots of angle of nipple pointing for left and right sides showing approximation to the 20-degree skyward nipple angulation and reduced spread of results postoperatively. Minimum, maximum, median, and quartiles are shown. *Pre-op*, preoperative; *Post-op*, postoperative; *R*, right; *L*, left.

occur. In such cases, patients need to be "talked down" in volume and need to be made aware of the limitation of their anatomy and the negative consequences of an implant that is too large.

Precise location of the incision in the inframammary fold is critical—it is the defining marker of the lower pole of the breast. Poor incision placement affects not only implant position but the entire aesthetic of the breast. Incision fixation to the deep fascia at the level of the new lowered fold is a critical step to avoid bottoming-out and to ensure that the incision remains precisely in the fold. We routinely use a barbed 3-0 Stratafix suture (Ethicon, Inc., Somerville, N.J.) for this purpose. (**See Video, Supplemental Digital Content 1**, which demonstrates final fine tuning and fixation of the fixation of the incision, ***http://links.lww.com/PRS/B715***.)

The ICE principle can be applied equally to both round and anatomical implants. With the round implant, an adjustment is made in the vertical positioning of the implant around the nipple-areola complex by placing it slightly farther below the nipple than above in a 45:55 distribution. To create a natural appearance with round implants, the natural anatomy and aesthetic of the existing breast has to be appropriate. In such cases, the implant is not being used to create shape or proportion but simply to enhance an existing favorable situation without distorting it. In most cases, however, the creation of the natural appearance with a 45:55 outcome lends itself more to anatomical implants because of their natural volume distribution. The increasing availability of anatomical implants in the United States following U.S. Food and Drug Administration approval may signal a tide change in approaches to breast augmentation.

Table 4. Preoperative and Postoperative Upper Pole Curvature for 50 Consecutive Breast Augmentation Patients Treated with the ICE Principle

Side	Concave (%)	Straight (%)	Convex (%)
Preoperative			
Right	36	64	0
Left	48	52	0
Postoperative			
Right	4	90	6
Left	4	90	6

CONCLUSIONS

Understanding what constitutes breast beauty is essential for those carrying out aesthetic breast surgery. Historically, there has been little published in the plastic surgery literature on specific definitions of breast attractiveness or practical guidance on achieving beautiful results. Our previously published work challenges some preconceived ideas about breast attractiveness: A beautiful breast is beautiful in its lower pole.[7,8] This is the appearance of a perfectly formed youthful but natural breast—unspoiled by time, pregnancy, weight fluctuation, or iatrogenic distortion. It is the basis of the 45:55 principle and is universally recognized as attractive.[7] The development of the ICE principle is the practical extension and application of these aesthetic principles. It can be used as a practical basis for design in breast augmentation surgery to achieve consistently more natural and beautiful breasts. The principle of natural breast augmentation is one

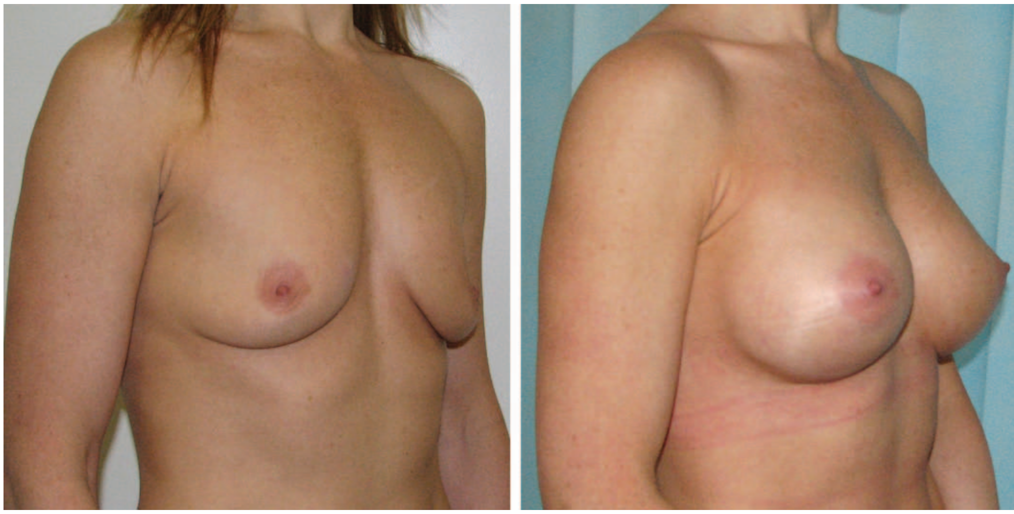

Fig. 10. Representative clinical example of breast augmentation patient demonstrating attractive tight lower pole curvature of the breast seen on three-quarters profile view. (*Left*) Preoperative view. (*Right*) Postoperative view.

Video. Supplemental Digital Content 1 demonstrates final fine tuning and fixation of the incision, ***http://links.lww.com/PRS/B715***.

that seeks to enhance shape without distorting it by adhering to the principles of tissue-based planning and focusing on aesthetic outcome.

The ICE principle embraces a new era of breast augmentation in which the vast majority of women increasingly understand that beauty is qualitative and not quantitative. Excessive volume is not only destructive to the local breast environment but is attractive to very few in the naked breast. The desire for a full cleavage is an appearance that relates largely to the clothed breast only. Today, women increasingly request a "natural" appearance in a bid to restore confidence and femininity without feeling they have become part of a stereotypical subset. It is our belief that the concept of natural breast augmentation through adherence to tissue-based principles will become the gold standard representing the patient's best interests not only from an aesthetic standpoint but also in terms of longevity and patient safety.

Patrick Mallucci, M.B.Ch.B., M.D.
Cadogan Clinic
120 Sloane Street
London SW1X 9BW, United Kingdom
pat.mallucci@googlemail.com

REFERENCES

1. 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.* 2005;116:2005–2016.
2. Tebbetts JB, Teitelbaum S. High- and extra-high-projection breast implants: Potential consequences for patients. *Plast Reconstr Surg.* 2010;126:2150–2159.

3. Tebbetts JB. Patient evaluation, operative planning, and surgical techniques to increase control and reduce morbidity and reoperations in breast augmentation. *Clin Plast Surg.* 2001;28:501–521.
4. Adams WP Jr. The process of breast augmentation: Four sequential steps for optimizing outcomes for patients. *Plast Reconstr Surg.* 2008;122:1892–1900.
5. Tebbetts JB. Achieving a zero percent reoperation rate at 3 years in a 50-consecutive-case augmentation mammaplasty premarket approval study. *Plast Reconstr Surg.* 2006;118:1453–1457.
6. del Yerro JL, Vegas MR, Fernandez V, et al. Selecting the implant height in breast augmentation with anatomical prosthesis: The "number Y". *Plast Reconstr Surg.* 2013;131:1404–1412.
7. Mallucci P, Branford OA. Population analysis of the perfect breast: A morphometric analysis. *Plast Reconstr Surg.* 2014;134:436–447.
8. Mallucci P, Branford OA. Concepts in aesthetic breast dimensions: Analysis of the ideal breast. *J Plast Reconstr Aesthet Surg.* 2012;65:8–16.