

Observations Concerning the Match between Breast Implant Dimensions, Breast Morphometry, and a Patient-reported Outcome

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Background: Outcome studies in breast augmentation do not assess how an implant has been matched to the soft tissue envelope. The study hypothesis is that there is a relationship between breast and implant dimensions and the subjective outcome of patient satisfaction.

Methods: In a study of patients undergoing subfascial breast augmentation (n = 341), morphometric measurements and a postsurgical survey of satisfaction with breast size were performed 3 months postoperatively. A ratio empirically derived from breast width, implant width, and projection (Rib) was calculated in patients who wished to have smaller, bigger, or no change in their implant size.

Results: 76% were content with breast size, 16.7% wished to be larger, and 7.3% wished to be smaller. Rib differed between groups who did not want to change size (n = 259, mean = 5.8, SD = 0.9), those who wished to be bigger (n = 57, mean = 5.6, SD = 1.1), and those who wished to be smaller (n = 25, mean = 5.3, SD = 1.3, H(341) = 14.0, $P < 0.01$). Rib differed between groups whose result was as expected (mean = 5.6, SD = 0.9), compared with those who expected to be bigger (mean = 5.4, SD = 1.2) or who expected a smaller outcome (mean = 5.6 SD = 1.0, H(341) = 18.3, $P < 0.01$).

Conclusions: These data provide an objective measurement by which studies concerning breast augmentation can be reported and compared. The method may guide standardization of clinical research regarding breast implant surgery. (*Plast Reconstr Surg Glob Open* 2021;9:e3370; doi: [10.1097/GOX.0000000000003370](https://doi.org/10.1097/GOX.0000000000003370); Published online 25 January 2021.)

INTRODUCTION

Determining a satisfactory patient outcome following breast augmentation is a multi-faceted process involving patient education, informed consent process, surgical technique, and postoperative care.¹ Within the operative process, there are many variables that can influence outcome such as plane of implant, implant selection, and surgical technique.²

Selection of an implant is based on numerous patient and surgical preferences and biases, and often the decision is a complex mix of patient requests, measurements, experience, and assessment by the surgeon of what they believe that a particular patient is requesting. Given the

degree of subjectivity in the process, it is surprising that breast augmentation has such a high satisfaction rate.³ Attempts to develop soft-tissue-based planning systems to rigorously define implant choice can result in patient dissatisfaction (the “engineers” approach), whereas pure patient preference can give rise to long-term complications (the “artists” approach).^{4,5}

When comparing studies that have “patient satisfaction” or other outcome measures, there has been no objective quantification of how a particular implant is chosen to fit an individual’s unique morphometry. Consequently, results are difficult to compare across studies. Similarly, outcome studies that examine complication rates that may be due to a mismatch between an implant and the soft tissue envelope are confounded by not addressing the match between an implant and the breast.

This study considered objective measurements of patient and implant, and the relationship to a simple reported patient outcome concerning size and expectation. The described ratio has been developed empirically, based on a hypothesis that implant width and projection

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should in some manner relate to the breast width to produce a pleasing result. It is the first study to examine whether there is any association between the match of an implant to a breast and patient satisfaction. Development of similar measurement-based matches may form a basis of a sizing system that objectively matches an implant to breast measurements.

MATERIALS AND METHODS

Study Design

Between February 2008 and February 2018, 341 patients underwent primary subfascial breast augmentation as a consecutive series by a technique previously described.⁶ Previous breast implant surgery or the requirement for an associated mastopexy were exclusion criteria. Patients provided written consent to the study under the guiding principles outlined in the WMA Declaration of Helsinki concerning ethical principles for medical research involving human subjects.

Round textured implants were used from a single manufacturer (Nagor Ltd, Cumbernauld, UK), and surgery was undertaken by a single surgeon. Patients were suitable for subfascial implant placement if a minimum of 10 mm of soft tissue was measurable at the lateral sternal margin (LSM) with a caliper designed for assessing percentage body fat at the level of the 4th rib, as previously described.⁷

Measurements

Breast width and LSM were measured preoperatively. The technique has been previously described and has good inter- and intra-observer reproducibility.⁸ Implant size was determined by a method employing breast base width, BMI, and breast thickness at the LSM as the primary indicators.^{3,6}

A ratio of breast implant dimension to breast width (R_{ib}) was calculated as $R_{ib} = W \times (P_i / W_i)$, where W is the measured breast width, W_i is the width of the implant, and P_i is the projection of the implant. Three months after surgery, in a patient-reported outcome measure (PROM), patients were asked to assess whether their breast size was as expected, larger or smaller. They were also asked that if given their time again, they would choose a smaller or larger implant or keep the same size.

Statistical Analysis

Data were assessed for normality and outliers (Shapiro-Wilk test, $P < 0.01$). Because data did not follow a normal distribution for breast width or LSM, Kruskal-Wallis (1-way ANOVA) test was used to examine differences among the group who did no desire change, those wished to be bigger, and those wishing to be smaller. In all tests, differences were considered significant with $P < 0.01$.

RESULTS

Population

An estimated 341 patients were recruited into the study. With regard to preoperative breast shape, there was no difference in the breast width (mean = 14.1 cm,

SD = 1.5, $H(341) = 1.6$, $P = 0.46$) or LSM measurement (mean = 2.1 cm, SD = 5.8, $H(341) = 2.6$, $P = 0.28$) between in-patients who did not want to change compared with those who wished to be larger or smaller. The 3 groups differed only in that patients who were content with their breast size 12 weeks after surgery were older (mean = 34.9 years, SD = 9.6) compared with those who wished to be bigger (mean = 31.1 years, SD = 9.8) or smaller (mean = 32.4 years, SD = 9.0, $H(341) = 9.1$, $P = 0.01$) at the time of surgery.

Implants

When comparing the 3 groups, there was a no difference between the size of implant used in patients who did not want to change compared with those who wished to be larger or smaller (mean = 429 cm³, SD = 83, $H(341) = 2.0$, $P = 0.036$). Regarding the profile of the implants employed, 45% were classified as moderate profile and 55% as high profile. There was no difference in the R_{ib} between “high” and “moderate” profile implants (“high profile” R_{ib} mean = 5.9, SD = 1.1, “moderate profile” R_{ib} mean = 5.7, SD = 0.72, $H(341) = 3.8$, $P = 0.97$).

Desire to Change (Fig. 1)

In total, 259 patients (76%) were content with the size of breast 3 months post-surgery, whereas 57 (16.7%) wished to be larger and 25 (7.3%) wished to have a smaller implant.

R_{ib} was significantly different among groups who did not want to change size ($n = 259$, mean = 5.8, SD = 0.9), those who wished to be bigger ($n = 57$, mean = 5.6, SD = 1.1), and those who wished to be smaller ($n = 25$, mean = 5.3, SD = 1.3, $H(341) = 14.0$, $P < 0.01$).

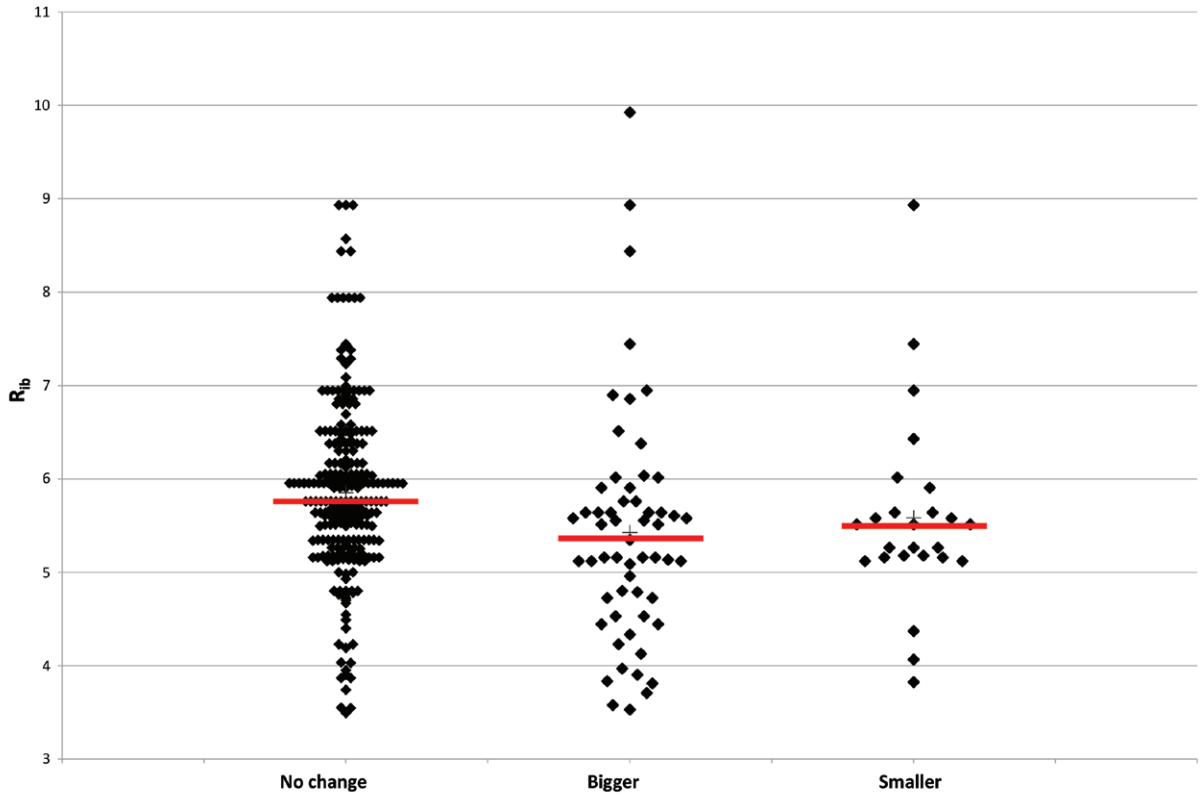
When taken as 2 groups (either “bigger” or “smaller”), there is no difference in the R_{ib} value (“bigger” mean = 5.4, SD 1.2, “smaller” mean = 5.6, SD = 1.0), $H(82) = 0.6$, $P = 0.43$). When a binary decision of “change” or “no change” is given, there is a significant difference in the R_{ib} value (“no change” mean = 5.9, SD = 0.9, “change” mean = 5.5, SD = 1.2, $H(341) = 18.1$, $P < 0.01$).

Expectations (Fig. 2)

R_{ib} was significantly different between groups whose resultant size was as expected (mean = 5.6, SD = 0.9), compared with those who expected to be bigger (mean = 5.4, SD = 1.2) or smaller (mean = 5.6, SD = 1.0, $H(341) = 18.3$, $P < 0.01$). When taken as 2 groups (either “bigger” or “smaller”), there is no difference in the R_{ib} value (“bigger” mean = 5.6, SD = 1.1, “smaller” mean = 5.3, SD = 1.3, $H(64) = 0.94$, $P = 0.33$). When a binary decision of “expected” ($n = 277$) or “not as expected” ($n = 64$) is given, there is a difference in the R_{ib} value (“expected” mean = 5.8, SD = 0.9, “not as expected” mean = 5.4, SD = 1.2, $H(341) = 13.6$, $P < 0.01$).

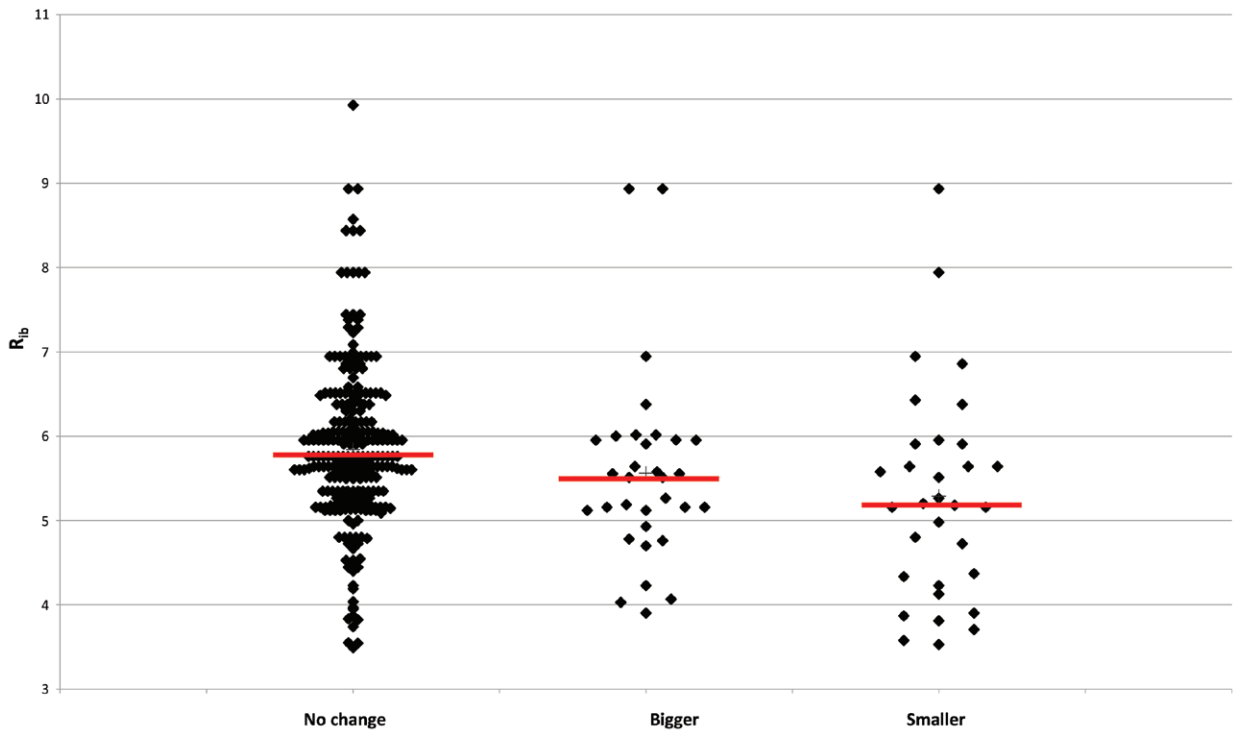
DISCUSSION

When evaluating reports of outcome measures, it is important to be able to compare like with like across different studies. One great weakness of breast-implant-based studies is that there is no measure of how a particular implant is matched to a particular breast morphometry. Development of a “language” by which researchers could



$H(341) = 14.0, P < 0.01$

Fig. 1. Scatter plot illustrating the difference between the R_{ib} value in the 3 study groups in those patients desiring a change in implant size.



$H(341) = 18.3, P < 0.01$

Fig. 2. Scatter plot illustrating the difference between the R_{ib} value in the 3 study groups in patient expectations of their breast size.

communicate such a match would be an invaluable adjunct to the science of breast augmentation. This study suggests a measure of match, which could potentially be adopted for such a purpose. It is not designed as a definitive tool for a surgeon to employ on a daily basis, but is a proof of concept that an objective match between prosthesis and soft tissue envelope can be used when reporting outcomes.

There are many different sizing systems that have been described using a combination of measurements, bra fitting, and increasingly computer imaging to assist in a conversation with patients about their desired outcome.^{9,10} A systemic review by Drs Adams and Mckee⁴ summarizes the pros and cons of 33 selection systems, of which only 3 were regarded as high quality with a MINORS (methodological Index for Non-Randomized Studies) Scale of 7.^{3,11,12} This study is an extension to one of those 3 studies³ and correlates PROMs with morphometric data that matches an implant's dimensions with that of the patient.

The described ratio has been developed empirically, based on a hypothesis that implant width and projection should in some manner relate to the breast width to produce a pleasing result. A simple ratio of implant width to breast width did not demonstrate a difference between groups that were satisfied with their outcomes and those who were not, yet the addition of implant projection produced a statistical difference. It is likely that other ratios that include facets of implant shape when compared with breast morphometrics will also be valuable as a similar descriptive tool, particularly if elements relating to parenchymal thickness were included.

Given the large number of variables that come together to produce an outcome following breast augmentation, it is unlikely that this study will produce similar data for another surgeon's practice. Its value lies in providing a framework for replication within a surgeon's own patient population, and to communicate that method of matching an implant to a breast in an objective manner. Most surgeons utilize breast width as a primary measure in determining implants size, and a simple satisfaction survey 3 months postoperatively would allow these data to be replicated with little additional effort.

It is generally accepted that patient satisfaction with their surgical outcome can vary over time for a variety of reasons not connected with the decisions and choices made preoperatively with the surgeon. Consequently, the study should not be viewed as a formulaic match of implant dimensions to those of the breast with the aim of predicting long-term patient satisfaction. It does however provide a meaningful measure at a single time point when post-surgical swelling and breast shape have developed to an endpoint by which a surgeon can gauge whether elements of their sizing system require adjustment in an objective manner.

The strength of the study is that it is a series of patients who are morphometrically the same who have undergone subfascial breast augmentation by a single surgeon using a single breast implant type that are matched in the 3 study groups. Given that the range of implant volumes were of the same size in all 3 study groups and that the

patient morphometrics were the same, the only variable over which a surgeon has control in effecting a good outcome with regard to size was the match between the implant and the patient.

Intuitively, a good patient outcome following surgery might relate to matching an implant's dimensions to those of the patient. Arguably the chosen measure (R_{ib}) producing a standard variable that describes breast implant shape is empirical rather than based on an aesthetic or geometrical hypothesis, but unlike a simple ratio of breast width to implant width, it correlates significantly with patient outcome. The ratio of implant projection to width varied from 0.41 to 0.48 for moderate profile implants to 0.47–0.55 for high profile products. However, there was no effect of profile on the R_{ib} . Whilst this would negate the ratios' use as a predictive tool when discussing an implant in terms of categorical shapes ("low," "moderate," or "high" profile), the observations are nevertheless valid in describing a match between an implant and breast when discussing patient-reported outcomes.

Expectations

Managing patient expectations is arguably the most important aspect of achieving a good surgical result. It is a multifaceted process involving a combination of providing accurate information in which both the patient and surgeon feel confident and transmitting that in a meaningful manner. This is the first study that attempts to match patient expectations to soft tissue measurements and provide an additional tool in that process. The R_{ib} value differed in groups in whom their postoperative size was as expected compared with those whose expectations were not met. However, the R_{ib} value could not distinguish between those patients who expected to be bigger or smaller but may be a useful tool in distinguishing which patients are unlikely to have their expectations met. Whilst reviewing any sizing tool a practitioner might care to employ, the R_{ib} can add an objective measure by which adjustments can be assessed in the future.

Desire to Change

A previous study has demonstrated similar percentages regarding those patients who might not be content with their breast size following implant surgery (no change 76%, bigger 16.7%, smaller 7.3%).³ As with expectation, the desire to change can be distinguished using the R_{ib} value, but it is not a sensitive tool for determining which patients are likely to wish to have a bigger or smaller implant. BMI and other body ratio measurements¹² can be of value in distinguishing between groups.

The debate regarding implant selection lies somewhere between the "engineer" and the "artist,"⁴ and as such a purely measurement-based system is likely to produce as poor an outcome as an intuitive, patient-lead approach if not provided with boundaries.⁵ However, implementing some form of tissue-based planning is associated with low reoperation rates (2.8%–3%)^{1,9,11} compared with industry standards of 15%–30%.^{13–18} Rigid adherence to tissue-based planning can lead to underestimation of implant

size, leaving up to 20% patients with breast smaller than they desire.¹⁹ However, a mixed approach can also produce a similar number of patients wishing for larger breasts.³ The weakness of all prospective studies examining implant selection is that they do not intentionally create patients who have had a poor outcome and are dissatisfied. As such, we can only learn from adverse outcomes after the fact,^{14,20} and any tool that has a predictive element is worthy of consideration.

The Value of the Study

It may seem at first reading that this study is of limited value in that it does not provide a simple set of parameters relating breast and implant dimensions to patient satisfaction. To produce such a tool with robust statistical power would require a collaborative effort by many surgeons using different techniques and over many thousands of procedures. However, this initial study is the first that demonstrates a difference between outcomes in satisfied patients compared with those whose expectations have not been met, and that it can be related to the match of a breast to an implant.

One of the most problematic issues when reporting outcomes following breast augmentation is that comparisons between series are difficult, given no indication as to how the implant has been matched to the soft tissue envelope in which it is placed. Consequently, there is no objectivity in the selection criteria by which, on the one hand, good results are created, and, on the other, adverse outcomes. By including the R_{ib} ratio in results data, it is possible for that assessment to be considered when comparing outcomes.

CONCLUSIONS

Matching a breast implant dimensions to a patient is one important facet in ensuring patient satisfaction with the size of their breast postoperatively. These data provide a framework by which a surgeon can develop a PROM and relate it to the match of implant-to-breast width within their own surgical practice. Although it should not be relied upon for application in everyday clinical life, the method may guide improved standardization of future clinical research regarding breast implant aesthetics.

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