Nipple-Areola Complex Sensitivity after Primary Breast Augmentation: A Comparison of Periareolar and Inframammary Incision Approaches

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Background: The body of literature documenting normative breast sensation and postoperative changes in sensation after reduction mammaplasty has grown considerably over the last several years. Despite this, only two studies have ever been published on the subject of postaugmentation mammaplasty sensory outcomes. The purpose of this study was to precisely measure sensory thresholds at the nipple-areola complex in women who have undergone augmentation mammaplasty by either the inframammary or periareolar approach.
Methods: Twenty women underwent primary augmentation mammaplasty by either the periareolar or inframammary approach at an average follow-up of 1.12 years. Sensory testing was performed using the Pressure-Specified Sensory Device by comparing moving and static sensory thresholds at the upper and lower areola and nipple. Nine women served as size-matched, nonoperated controls in the study.
Results: Primary augmentation mammaplasty was found to have a statistically significant negative effect on sensory outcomes when nonoperated controls were compared with women who had undergone augmentation mammaplasty via either the periareolar or inframammary approach. No differences in sensory outcomes were found between the two approaches used. Implant volume was found to be highly predictive of sensory outcomes, with an inverse relationship between implant size and the degree of sensitivity within the nipple-areola complex.
Conclusions: Plastic surgeons should feel comfortable counseling patients that augmentation mammaplasty by either the inframammary or periareolar approach results in no discernible differences in sensory outcomes. Furthermore, women who choose very large implants relative to their breast skin envelopes should be warned about potential adverse sensory sequelae within the nipple-areola complex. (*Plast. Reconstr. Surg.* 117: 1694, 2006.)

The body of literature documenting normative breast sensation and postoperative changes in sensation has grown considerably over the last several years. This is especially true in women following reduction mammaplasty. In addition to anatomic studies that have outlined the innervation of the nipple-areola complex, precise sensory measurements have been performed on patients who have undergone reduction mammaplasty by several different techniques, including the inferior pedicle, medial pedicle, and breast amputation–free nipple graft approaches.[1–6] Despite the expanding knowledge base on this subject, only one study has been published since 1976 on the comparably larger subset of patients who have undergone augmentation mammaplasty.[7]

As previous studies have demonstrated, women with macromastia are considerably less sensate in the region of the nipple-areola complex than age-matched controls with small to normal-sized breasts.[6,8,9] The causal relationship

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of this finding has been speculative and is thought to be related to nerve traction injury and decreased innervation density in patients with gigantomastia. Although evidence is anecdotal, women with macromastia who present for reduction mammaplasty are primarily motivated by chronic symptoms of pain and discomfort, the inability to engage in vigorous physical activity, and intertriginous infections. Concerns regarding sensory outcomes are usually secondary and frequently inconsequential, since preoperative sensation is diminished.

In contrast, women who present for augmentation mammaplasty are highly sensate in the region of the nipple-areola complex, and in the course of the preoperative consultation there are frequently questions about postoperative sensory outcomes. In women with micromastia, sensation of the nipple-areola complex is often of paramount importance and, in some women, an important source of stimulation during intimacy. Until now, informed consent regarding this issue has been achieved by the operative plastic surgeon by suggesting that sensory loss is a potential outcome, but that sensory outcomes are uncertain and variable. It is also the practice of some plastic surgeons to discourage the periareolar approach of implant placement in women who voice concerns about the loss of sensitivity, because of the risk of transection of nerve fibers leading directly to the nipple-areola complex.

Although other techniques of performing augmentation mammaplasty, such as the transumbilical and the endoscopically assisted transaxillary techniques, have gained popularity over the last several years, the vast majority of breast augmentations today are performed via either the inframammary approach or the periareolar approach. Unlike the two previous studies on the subject of sensory changes associated with augmentation mammaplasty,[7,10] we utilized the Pressure-Specified Sensory Device (Sensory Management Services, Baltimore, Md.). Previous studies have employed modalities such as light touch, pain perception to electrical currents, vibratory stimulus, and Semmes-Weinstein nylon monofilaments. Relative to the technologically advanced sensory testing modalities available today, the techniques used in the two previous studies on this subject are considered unreliable and inaccurate.[11] Thus, the purpose of this study was to quantify the sensation of the nipple-areola complex following breast augmentation using the Pressure-Specified Sensory Device and to compare the inframammary and periareolar approaches with respect to sensory outcomes.

PATIENTS AND METHODS

A total of 29 women were included in this study; nine of them were nonoperative controls (group 1), 13 had undergone breast augmentation through an inframammary approach (group 2), and seven had undergone augmentation via a periareolar approach (group 3). All women agreed to a 1-hour sensory examination that was performed in the presence of a female chaperone. No financial or other compensation was provided for enrollment in the study. The breast sensory testing protocol was accepted by our institutional review board, and all study subjects gave informed consent for sensory testing to be performed. No woman enrolled in this study reported a history of diabetes mellitus, thyroid disorders, collagen vascular disease, alcoholism, pernicious anemia, known neurological impairment, or history of previous breast surgery. Sensory evaluation was performed in all 29 women (58 breasts) by one examiner using the sensory device. Women were seated in a reclining chair with one breast exposed for testing and the other draped with a sheet. Women were asked to close their eyes so that the computer screen or the breast being tested could not be seen. A button linked to the computer was placed in the hand opposite to the breast being tested and the women were instructed to press the button to indicate perception of the test stimulus.

The nipple and upper and lower halves of the areola were selected as testing sites. At each test site, five readings were recorded. The highest and lowest values were discarded to eliminate outliers, and the mean of the remaining three was reported as the pressure threshold in grams per square millimeter. One-point static and moving pressure perception threshold was measured within a continuous range of 0.1 g/mm^2 to 100 g/mm^2. Data were entered into an Excel spreadsheet (Microsoft Corp., Redmond, Wash.). Statistical analyses were performed to compare the one-point moving and static sensibility measurements among groups 1, 2, and 3 using the Mann-Whitney nonparametric test between each group. Data for each of a subject's breasts were averaged for each woman, since the left and right sides are highly correlated.

Group 1: Normative Controls

Nine women served as nonoperative controls. The average age of the participants was 28 years (range, 19 to 38 years; SD, 6 years). Breast size

among participants ranged from 34A to 36C. A total of 18 breasts were tested and the results were averaged. Data on these patients have previously been published.[6]

Group 2: Inframammary Approach and Group 3: Periareolar Approach

A total of 20 women underwent augmentation mammaplasty by either the inframammary incisional approach (13 patients; 26 breasts) or the periareolar incisional approach (seven patients; 14 breasts). In study participants in whom the periareolar approach was utilized, the incision was designed from the 4 o'clock to the 8 o'clock position at the inferior border of the areola. Implants in both groups were placed in either the subglandular or submuscular plane. Study group participants were not further subdivided according to the plane of implant insertion, because study cells would suffer from small sample size and inadequacy for statistical analysis. Preoperative breast sizes ranged from 32B to 36C among study participants. The average duration between surgery and sensory evaluation was 1.12 years (range, 102 to 1512 days). The average age of participants at the time of testing was 33 years (range, 20 to 47 years; SD, 7 years). There were no significant differences in age at time of testing or in the interval between surgery and testing between the groups of women who underwent augmentation mammaplasty by either approach. The average implant size used was 375 cc (range, 340 to 475 cc) in the periareolar incisional approach group and 428 cc (range, 315 to 700 cc) in the inframammary incisional approach group; this was not statistically different ($p > 0.05$).

RESULTS

Cutaneous pressure threshold values for the nipple-areola complex were determined for study participants in all groups (Tables 1 and 2). There were no statistically significant differences ($p > 0.20$) in values between the upper and lower halves of the areola for each group for one-point moving and static tests; therefore, values for the upper and lower halves of the areola were pooled.

Sensory measurements for both nipple-areola complexes of each participant were averaged for each participant (left and right nipple-areola complex), and the nonparametric Mann-Whitney test for two independent groups was performed (Tables 1 and 2).

No statistically significant differences were found between women who underwent augmentation mammaplasty by the inframammary approach and those who had the periareolar approach ($p > 0.51$ for each test, nonparametric Mann-Whitney test) (Table 1). Groups 2 and 3 were therefore pooled and compared as a single group ($n = 20$) to normative controls (group 1, $n = 9$) (Table 2). Significant differences were found, with $p \leq 0.03$ for each test. Mean cutaneous sensory thresholds were nearly 10 times greater in women who underwent augmentation mammaplasty by any approach compared with unoperated controls with breast cup sizes ranging from 34A to 36C.

Groups 2 and 3 were pooled and then subgrouped into two categories by length of time from the date of surgery to testing. Six study participants were found to have a follow-up time of between 3 and 6 months. Fourteen study participants had a follow-up time of between 6 months and 4.1 years. No statistically significant differences were found, with $p \geq 0.50$ for each test (nonparametric Mann-Whitney test).

In comparing sensory threshold variations by age at surgery, incision type, and preoperative cup size, a regression analysis was performed and in each case was found to have a p value greater than 0.05. Once each of the nonsignificant variables was dropped from the statistical model, regression analysis revealed that 50 percent of the variation in sensation was found to be attributable to implant volume ($p < 0.02$).

DISCUSSION

The postoperative sensation of the nipple-areola complex after operative procedures on the

Table 1. Groups 2 (Inframammary Approach) and 3 (Peri-areolar Approach) Mean Cutaneous Pressure Threshold Measurements (g/mm²) of the Nipple-Areola Complex

Site/Type of Examination	Group II ($n = 13$) Inframammary Incision	Group III ($n = 7$) Peri-Areolar Incision	p*
Nipple: 1-point moving	3.5 (3.2)	2.7 (2.4)	0.51
Nipple: 1-point static	8.7 (11.5)	7.0 (7.9)	0.57
Areola: 1-point moving	5.1 (5.2)	4.9 (5.2)	0.95
Areola: 1-point static	13.6 (12.7)	12.8 (15.0)	0.92

*The p values were computed on averages (13 inframammary incision subjects, 7 peri-areolar incision subjects).

Table 2. Groups 1 and 2/3 (Combined Group of All Augmented Subjects) Mean (SD) Cutaneous Pressure Threshold Measurements in g/mm² of the Nipple-Areola Complex

Site/Type of Examination	Group 1 (n = 9): Normative/Unoperated Control	Groups 2/3 (n = 20): Augmented Subjects	p*
Nipple			
1-point moving	0.4	3.2	0.04
1-point static	0.7	8.1	<0.01
Areola			
1-point moving	0.8	5.0	<0.01
1-point static	2.0	13.3	0.02

*The p values were computed on averages (nine normative controls, 20 augmented subjects).

breast is being investigated with increasing frequency. Despite an increasing body of knowledge on this subject following reduction mammaplasty, there is a paucity of information about sensation after augmentation mammaplasty. No studies, before this one, have compared sensory outcomes utilizing different incisional approaches or sensory outcomes based on differences in implant volume.

Although there are a variety of ways to assess sensation, computer-assisted quantitative neurosensory testing represents a significant advance in our ability to perform continuous measurements. The Pressure-Specified Sensory Device is a computer-assisted instrument that uses a hemispheric probe attached to a force transducer to make continuous measurements of cutaneous pressure possible. It allows for one-point static (Merkel cell-neurite complexes, Ruffini complexes), one-point moving (Pacinian and Meissner corpuscles), and moving and static two-point (innervation density) discrimination.[12] Unlike nylon monofilaments, which provide only an estimate of the logarithmic range of cutaneous pressure thresholds that cannot be intuitively assessed without advanced statistical transformations, the Pressure-Specified Sensory Device provides continuous measurements of cutaneous pressure, making such statistical analyses and comparisons possible. Normative data for breast sensibility of the nipple-areola complex obtained using the device have been previously published.[6]

This study represents the first quantitative sensibility analysis that compares postoperative sensation of the nipple-areola complex after augmentation mammaplasty via the inframammary and periareolar approaches. Precise anatomic studies have previously elucidated the dual innervation of the nipple-areola complex medially and laterally from cutaneous branches of the third through sixth intercostal nerves.[13,14] It has always been a theoretical risk that transareolar techniques of augmentation mammaplasty place the sensory outcome of the nipple-areola complex at risk, because of the direct disruption of nerve fibers traversing the inferior pole of the areola. This study has demonstrated that there is no statistically significant difference in sensory outcomes when augmentation mammaplasty is performed via the periareolar or inframammary incisional approach. In the design of this study, women were not subdivided based on plane of dissection (submuscular versus subglandular pocket position). This was because the number of women within each subgroup was not large enough for a statistically valid comparison. The neural anatomy of the nipple-areola complex has been well described, so there is no reason to suspect that implant position, either above or below the pectoralis muscle, would affect sensory outcomes.[13,14]

Our study design was also limited by the lack of preoperative and postoperative sensibility data on the same patients. A preoperative study, in which study participants serve as their own preoperative controls, is planned.

Since the first published report on sensory outcomes after augmentation mammaplasty, a great deal has been learned. This study disputes the conclusions of the 1976 landmark article by Courtiss and Goldwyn[10] that demonstrated a return to normal nipple-areola complex sensation by 6 months after augmentation mammaplasty. Utilizing a far more sensitive testing apparatus than crude touch and pinprick, this study has demonstrated a nearly 10-fold decrease in sensory thresholds after primary augmentation mammaplasty.

It was interesting to find that there was no progressive diminution of sensory loss when study participants with an interval of between 3 and 6 months from surgery to testing were compared with participants with a follow-up of 6 months to 4.1 years. One might have expected to find some amelioration of sensory loss with time as the skin envelope of the breast stretches to accommodate

the implant, but no discernible differences were recognized. This suggests that sensory impairments found at 3 to 6 months are not likely to improve with time.

The relationship between implant volume and sensory outcome was another primary focus of this study. There was demonstrated to be a strong inverse relationship between implant volume and sensory outcomes. Although this relationship was found to be linear, implant sizes from 315 to 475 cc were found to have the least variability with respect to sensibility outcome. Sensibility outcomes were most variable with implant sizes greater than 475 cc.

The relationship found between implant volume and sensory outcome is perhaps best explained by the same forces that act on large pendulous breasts in cases of gigantomastia. In an earlier study, it was demonstrated that control women with relative micromastia (34A to 36C cup size) were far more sensate than control women with gigantomastia (36DD to 46EE cup size).[6] It was purported that volumetric differences in the breast were likely related to sensory outcomes because of nerve traction and innervation density, both of which are highly predictive of sensitivity. There are additional factors to consider, however, with respect to skin tension and the size of the skin envelope relative to the size of the implant. It would be expected that a large implant in a breast with a substantial skin envelope would create less tension than a large implant in a breast with a smaller and tighter skin envelope, which would consequently cause more nerve traction.

In the vast majority of women who choose to undergo breast augmentation, there is an improvement in overall body image.[7] Despite the fact that significant statistical differences have been found between women who have undergone augmentation mammaplasty and those who have not, it is not clear whether there is any clinical significance to these findings. Erogenous sensation is a cortical transfer function and is not necessarily correlated to sensory thresholds. The provision of this information regarding sensory outcomes to our patients is only one facet of the informed consent process that patients should undergo before having augmentation mammaplasty. Plastic surgeons should feel comfortable counseling patients that augmentation mammaplasty by either the inframammary or periareolar approach results in no discernable differences in sensory outcomes. Furthermore, women who choose very large implants relative to their breast skin envelopes should be warned about potential adverse sensory sequelae within the nipple-areola complex.

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