



Patient Preferences and Satisfaction of Nipple Areola Reconstruction with Three-Dimensional Tattoo in the Setting of Bilateral Implant Based Breast Reconstruction

Les préférences et la satisfaction des patientes lors de la reconstruction aréolo-mamelonnaire par tatouage tridimensionnel dans le contexte d'une reconstruction mammaire bilatérale par implants

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Abstract

Background: Patients undergoing mastectomy for breast cancer treatment can have three-dimensional nipple areola complex (NAC) tattoos as part of their reconstructive journey. The generally accepted size and position of the NAC is noted in the literature, however, patients may have different preferences. **Methods:** All patients undergoing NAC tattoos were given the option to pick the size of the tattoo and location on their chest. Post-procedure measurements were obtained as well as BREAST-Q surveys to examine patient satisfaction. **Results:** In 104 patients, average NAC tattoo diameter was 3.62 cm (± 0.45), average sternal notch to nipple was 19.53 cm (± 2.66) and average nipple to inframammary fold was 8.59 cm (± 2.64). On multivariable analysis, areola tattoo diameter was found to be significantly larger in patients with larger size implants ($P = .02$), and Asian women ($P = .04$). On multivariable analysis, sternal notch to nipple was significantly greater in patients with higher BMI ($P = .04$). In patients with pre-operative photos for comparison, post-tattoo size and position of the NAC reconstruction, was significantly smaller and higher on the chest compared to their pre-operative values with an average NAC diameter of 3.60 cm (± 0.46) ($P < .001$), sternal notch to nipple of 19.45 cm (± 2.87) ($P < .001$), and nipple to inframammary fold of 8.89 cm (± 2.80) ($P < .001$). Sexual well-being significantly improved with an average score of 53 (± 25) after micropigmentation. **Conclusions:** This study shows women prefer small areola size with a higher position compared to classic values, and these values may be influenced by race, BMI and implant size. Additionally, sexual well-being is improved after NAC reconstruction.

Résumé

Introduction : Les patientes qui subissent une mastectomie pour traiter un cancer du sein peuvent se faire tatouer le complexe aréolo-mamelonnaire (CAM) en trois dimensions dans le cadre de leur parcours de reconstruction. La dimension et la position

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généralement acceptées du CAM sont précisées dans les publications, mais les patientes peuvent avoir d'autres préférences. **Méthodologie** : Toutes les patientes qui se font tatouer le CAM ont pu choisir la dimension et l'emplacement du tatouage sur leur poitrine. Les mesures après l'intervention ont été colligées, de même que les réponses au questionnaire BREAST-Q, afin d'examiner la satisfaction des patientes. **Résultats** : Chez 104 patientes, le tatouage du CAM avait un diamètre moyen de 3,62 cm ($\pm 0,45$), la distance moyenne entre la fourchette sternale et l'aréole était de 19,53 cm ($\pm 2,66$) et la distance moyenne entre l'aréole et le pli inframammaire, de 8,59 cm ($\pm 2,64$). À l'analyse multivariable, le diamètre du tatouage de l'aréole était considérablement plus gros chez les patientes ayant des implants de plus grande dimension ($P = ,02$) et chez les femmes asiatiques ($P = ,04$). À l'analyse multivariable, la distance moyenne entre la fourchette sternale et l'aréole était également beaucoup plus grande chez les patientes ayant un IMC plus élevé ($P = ,04$). Chez les patientes qui disposaient de photos préopératoires aux fins de comparaison, la dimension et la position de la reconstruction du CAM après le tatouage étaient beaucoup plus petites et plus élevées sur la poitrine que leurs valeurs préopératoires, pour un diamètre moyen du CAM de 3,60 cm ($\pm 0,46$) ($P < 001$), une distance entre la fourchette sternale et l'aréole de 19,45 cm ($\pm 2,87$) ($P < 001$) et une distance entre l'aréole et le pli inframammaire de 8,89 cm ($\pm 2,80$) ($P < 001$). Le bien-être sexuel s'est beaucoup amélioré, pour un score moyen de 53 (± 25) après la micropigmentation. **Conclusions** : La présente étude démontre que les femmes préfèrent de petites aréoles, placées plus haut que ce qu'indiquent les valeurs classiques, et que ces valeurs peuvent être influencées par la race, l'IMC et la dimension des implants. De plus, le bien-être sexuel s'améliore après la reconstruction du CAM.

Keywords

Tattoo nipple areola reconstruction

Mots-clés

reconstruction aréolo-mamelonnaire, reconstruction mammaire, tatouage

Introduction

The ideal location and size of the nipple areola complex (NAC) on a native breast has been widely accepted as a standard areola diameter of 38 to 45 mm, and sternal notch to nipple distance of 22 cm.^{1,2} When patients undergo total mastectomy for breast cancer or genetic predisposition to breast cancer, the NAC is typically removed. On completion of breast reconstruction with implants or autologous tissue, patients have the opportunity for 3D nipple areola micropigmentation or tattoo. In 2013, Perez-Guisado et al³ looked at the size and placement nipple areola reconstruction, using a local flap nipple reconstruction followed by areola tattoo several months later. They reported that the sternal notch to nipple distance was smaller at 19 cm, compared to the classically accepted distance; as well as areola diameter of tattoo at 3.65 cm.

However, given in this study patients underwent nipple reconstruction with local flap followed by a tattoo 3 to 6 months later, patients selected areola size, but the nipple reconstruction location was selected by the surgeon. Therefore, the study is limited in that patients did not select NAC reconstruction location. Prior studies have also not examined patient satisfaction.

In the ideal setting, patients would select the nipple areola size and location on the chest at the time of the 3D nipple areola tattoo. In comparison to the preoperative native breast, it is predicted that the patients' view of esthetic placement and size of the NAC are typically smaller areola size placed higher on the chest. Further, the 3D micropigmentation technique provides detailing and shading for the appearance of a

projected nipple, which may improve patient satisfaction with breast reconstruction.

Methods

This study looked at nipple areola reconstruction with 3D micropigmentation in all patients with tattoo procedures by physician assistants between April 2020 through December 2022. Patients included in the study were those who underwent bilateral implant based breast reconstruction and had no previous nipple reconstruction or nipple areola tattoos. Patients were excluded if they had nipple sparing mastectomy, unilateral breast reconstruction, autologous breast reconstruction, or a nipple reconstruction by local flap or otherwise prior to the tattoo. All breast reconstructions occurred in two steps. First, placement of a tissue expander was performed at the time of mastectomy in either the pre-pectoral or submuscular plain, and this decision was made based on surgeon preference. Acellular dermal matrix was used to wrap the anterior surface of the tissue expander in pre-pectoral reconstructions. Use of acellular dermal matrix in submuscular breast reconstruction was based on surgeon preference. In a second stage, the tissue expander was exchanged to permanent implant. The choice of silicone versus saline implants was made by the patient. Three-dimensional tattoos were performed at a minimum of 3 months after exchange to permanent implant, to allow the implant reconstruction to settle and the incisions to heal.

At the time of nipple areola micropigmentation procedure, the patient was shown a circle template with various circle diameters ranging from 2.54 cm to 5.715 cm. The patient was

asked to hold the template up to the reconstructed breast in front of a mirror to select the preferred areola diameter. The patient was also encouraged to place the template in the location on the breast that was most esthetically pleasing to the patient. After patient selected location and size, the physician assistant (PA) took the following measurements in cm with a tape measure: left breast sternal notch to nipple, left nipple to inframammary fold (IMF), left breast width, right breast sternal notch to nipple, right nipple to IMF, right breast base width. The patient's height and weight were reported by patient on the day of the tattoo procedure. The nipple areola micropigmentation procedure was performed by trained physician assistants with NYC tattoo licenses. This is standard clinical practice for nipple areola micropigmentation and all clinical information was reviewed retrospectively.

Breast Q scores:

This study also reviewed patient satisfaction using Breast-Q scores pre-tattoo procedure and post-tattoo procedure. Scores on satisfaction with breasts, psychosocial well-being and sexual well-being were recorded from the BREAST-Q survey closest to the tattoo appointment, both before and after micropigmentation.

3D surface imaging:

The VECTRA XT 3D imaging system (Canfield Scientific, Parsippany, NJ, USA) was used to take preoperative images of patient's breasts in standing position with arms partially abducted. The system consists of six unique high-resolution color cameras used to capture anterior and posterior 180-degree images that are then processed and combined to create 3D images for detailed measurements. Vectra analysis module (VAM) software was used to measure the position and size of the nipple-areola complex (NAC) and breast relative to chest landmarks in preoperative patient photos. Seventeen markers in total were placed at several landmarks including the sternal notch, center of each nipple, borders of both areolas, and along the IMF. These markers were used to calculate the direct-line distance from the sternal notch to each nipple, the length and width of the areolas, and the width of each breast. They were also used to calculate the over-surface distance from the nipple straight down to the IMF. These lengths were exported as millimeters (mm) to Microsoft Excel.

Statistics

Patient demographics, implant and NAC tattoo characteristics, and BREAST-Q scores were summarized descriptively using means and standard deviations (SD) for continuous variables and frequencies and percentages for categorical variables. Univariable and multivariable linear regression models were fit for areola diameter and sternal notch to nipple. Age, BMI, race, implant size, and implant width were included as covariates in both models, selected a priori based on a hypothesized association with the outcome. NAC measurements and BREAST-Q scores were compared pre-tattoo and post-tattoo using the paired *t*-test for patients with available data at both time points. *P*-value <0.05 was used to denote statistical

significance. All statistical analyses were conducted in R, version 4.3.2.

Results

One hundred and four patients received NAC tattoos after completing bilateral implant based breast reconstruction during the study time period (Table 1). No complications occurred as a result of the tattoos. Average age was 49.1 years (± 9.4), average BMI was 24.8 (± 4.4). Average base width of the implant used for reconstruction was 12.49 cm (± 1.16) and average volume of the implant was 454 cc (± 140). Most patients had silicone implants (85.6% of patients, compared to 14.4% with saline implants) in the submuscular position (76% of patients, compared to 24% in the pre-pectoral position). The mastectomy incision type was as follows: 6 wise (5.8%), 1 vertical (0.96%), and 97 transverse (93.3%). Three-dimensional tattoos were performed on average 15 months after exchange to permanent implant (range 3-112 months). As chosen by the patient, average NAC tattoo diameter was 3.62 cm (± 0.45), average sternal notch to nipple was 19.53 cm (± 2.66), and average nipple to IMF was 8.59 cm (± 2.64). On multivariable analysis, areola tattoo diameter was found to be significantly larger in patients with larger size implants ($P = .02$), and Asian women ($P = .04$) (Table 2). On multivariable analysis, sternal notch to nipple was significantly greater in patients with higher BMI ($P = .04$) (Table 3).

Given this finding, BMI was more closely evaluated examining the ratio of sternal notch to nipple and nipple to IMF distance to determine if patients truly desired a lower nipple position or whether the lower position reflects a similar ratio of the distances across all BMI categories. BMI categories were broken down using standard groupings of underweight (<18.5), healthy weight (18.5-25), overweight (25-30), class 1 obesity (30-35), class 2 obesity (35-40), and class 3 obesity (>40). The ratio of sternal notch to nipple and nipple to IMF was 2.3, 2.4, 2.4, 2.3, 1.8, and 2.0, respectively, $P = .6$.

Table 1. Patient Demographics.

Characteristic	N = 104 ^a
Age, years	49.1 (9.4)
BMI	24.8 (4.4)
Race	
African American/Black	9 (8.7%)
Asian	2 (1.9%)
Caucasian	89 (86%)
Hispanic	2 (1.9%)
Unknown	2 (1.9%)
Volume of implant, cc	454 (140)
Width of implant, cm	12.49 (1.16)
Areola diameter, cm	3.62 (0.45)
Sternal notch to nipple, cm	19.53 (2.66)
Nipple to IMF, cm	8.59 (2.64)

^aMean (SD); n (%).

Table 2. Univariable and Multivariable Linear Regression Models for Areola Diameter (cm).

Characteristic	N	Univariable			Multivariable		
		Beta	95% CI ^a	P-value	Beta	95% CI ^a	P-value
Age (years)	104	0.01	0.00, 0.02	.075	0.01	0.00, 0.02	.08
BMI	104	0.04	0.02, 0.06	<.001	0.01	-0.02, 0.04	.5
Race	104						
Caucasian		—	—	—	—	—	—
African American/Black		0.16	-0.16, 0.47	.3	0.12	-0.18, 0.42	.4
Asian		0.54	-0.10, 1.2	.10	0.60	0.03, 1.2	.04
Hispanic		0.23	-0.41, 0.87	.5	-0.58	-1.4, 0.23	.2
Unknown		0.06	-0.58, 0.70	.8	0.06	-0.52, 0.63	.8
Size of implant, cc	104	0.001	0.001, 0.002	<.001	0.002	0.00, 0.005	.02
Width of implant, cm	98	0.15	0.08, 0.22	<.001	-0.15	-0.39, 0.09	.2

^aCI = Confidence Interval.

Table 3. Univariable and Multivariable Linear Regression Models for Sternal Notch to Nipple (cm).

Characteristic	N	Univariable			Multivariable		
		Beta	95% CI ^a	P-value	Beta	95% CI ^a	P-value
Age (years)	104	0.03	-0.03, 0.09	.3	0.01	-0.05, 0.06	.8
BMI	104	0.27	0.16, 0.38	<.001	0.18	0.01, 0.35	.04
Race	104						
Caucasian		—	—	—	—	—	—
African American/Black		-0.32	-2.2, 1.5	0.7	-0.59	-2.4, 1.3	.5
Asian		-0.52	-4.3, 3.3	.8	0.14	-3.4, 3.7	>.9
Hispanic		2.0	-1.8, 5.8	.3	0.85	-4.2, 5.9	.7
Unknown		0.61	-3.2, 4.4	.8	1.2	-2.3, 4.8	.5
Size of implant, cc	104	0.007	0.004, 0.011	<.001	-0.002	-0.014, 0.011	.8
Width of implant, cm	98	0.94	0.51, 1.4	<.001	0.69	-0.79, 2.2	.4

^aCI = Confidence Interval.

Table 4. Pre- and Post- Tattoo NAC Measurements.

Characteristic	Post, N = 52 ^a	Pre, N = 52 ^a	P-value ^b
Areola diameter, cm	3.60 (0.46)	4.35 (1.29)	<.001
Sternal notch to nipple, cm	19.45 (2.87)	21.93 (3.00)	<.001
Nipple to IMF, cm	8.89 (2.80)	7.31 (1.74)	<.001

^aMean (SD).

^bPaired t-test.

A subgroup of 52 patients had pre-operative Vectra imaging (Table 4). In these patients average pre-operative NAC diameter was 4.35 cm (± 1.29), average sternal notch to nipple was 21.93 cm (± 3.00), and average nipple to IMF was 7.31 cm (± 1.74). Post-tattoo size and position of the NAC reconstruction, as chosen by the patients, was significantly smaller and higher on the chest compared to their pre-operative NAC size and position with an average NAC diameter of 3.60 cm (± 0.46) ($P < .001$), sternal notch to nipple of 19.45 cm (± 2.87) ($P < .001$), and nipple to IMF of 8.89 cm (± 2.80) ($P < .001$).

Table 5. Pre- and Post- Tattoo BREAST-Q Scores.

Characteristic	Post, N = 40 ^a	Pre, N = 40 ^a	P-value ^b
Psychosocial Well-Being Score	73 (20)	70 (21)	.3
Satisfaction With Breasts Score	66 (19)	67 (17)	.8
Sexual Well-Being Score	53 (25)	46 (27)	.01

^aMean (SD).

^bPaired t-test.

Forty patients had both pre-tattoo and post-tattoo BREAST-Q surveys available (Table 5). Pre-tattoo surveys were filled out on average 10 days (± 7) prior to tattoo. Post-tattoo surveys were filled out on average 197 days (± 131) after the tattoo (range 2 weeks to 1 year). Average pre-tattoo scores in satisfaction with breasts was 67 (± 17), psychosocial well-being was 70 (± 21), and sexual well-being was 46 (± 27). Average post-tattoo scores in satisfaction with breasts 66 (± 19) and psychosocial well-being 73 (± 20) were not significantly changed. However, sexual well-being significantly

improved with an average score of 53 (± 25) after micropigmentation which is clinically significant (greater than the minimally important difference (MID)) ($P = .01$).

Discussion

This study shows that when patients can choose both the size of their NAC as well as the position on their chest, patients will choose a smaller diameter and a higher position than what is thought to be the standard values and/or what patients had preoperatively. Traditionally the proposed ideal NAC position based on sternal notch to nipple is 21 to 21.5 cm, the standard accepted nipple areola diameter is 38 to 45 mm, with a nipple-areola-breast proportion of approximately 1:3.^{1,4} Most reports of NAC reconstruction include creation of a projected nipple, the location of which is determined by the surgeon.⁵⁻⁷ Perez-Guisado investigated size and placement of nipple reconstruction and tattoo but did not allow patients to select location.³ They reported that the sternal notch to nipple distance was 19 cm, and the areola diameter of tattoo was 3.65 cm, both of which are smaller compared to the classically accepted distance. In this study, we see when patients are given the choice of location and size of NAC reconstruction, they chose an average NAC size of 3.62 cm (± 0.45), sternal notch to nipple of 19.53 cm (± 2.66) and nipple to IMF of 8.59 cm (± 2.64). This information is important to consider in the setting where clinicians are choosing the size and position of the NAC. For example, when surgeons are performing a formal nipple reconstruction, the position may be higher than previously thought. Extending outside of implant-based breast reconstruction, clinicians may want to consider making the skin paddle of autologous reconstructions smaller for eventual NAC reconstruction or placing the NAC higher and smaller in mastopexy or breast reduction surgery.

In this study, certain patient factors were found to influence size and position of the NAC. Two factors associated with patient preference for larger areola size was larger size implants, and Asian ethnicity. Intuitively, larger size NAC would be desired in women with larger size implants to be proportional. To our knowledge this is the first study to elucidate ethnicity as a factor in NAC size. This is important for the clinician to be aware of in that not all patients desire the same NAC size and ethnicity may play a role. Additionally, patients with a higher BMI desired a lower placement of the areola. However, when further examining the ratio of sternal notch to nipple and nipple to IMF, we see the ratio is not significantly different across BMI groups. Therefore, the lower placement is likely a function of the patients' overall body habitus and not that patients with higher BMI truly desire a lower NAC.

NAC reconstruction including 3D tattooing has been shown to increase patient satisfaction.^{6,8-10} Additionally, 3D tattoo NAC reconstruction can in some cases result in better satisfaction than other reconstruction options.¹¹ Bykowski et al found in their group of 107 patients who underwent NAC using local flaps, psychosocial well-being and sexual well-being improved after NAC reconstruction with no change in

satisfaction with breasts.¹² Similarly in this study of NAC using 3D tattoos, sexual well-being was significantly improved after NAC tattoo reconstruction. Average scores of sexual well-being improved from 46 ± 27 to 53 ± 25 . While the improvement in score may be multifactorial, the placement of a NAC tattoo seems to play at least some part. While patients may be largely satisfied with their breasts prior to NAC reconstruction, they may still feel uncomfortable without clothes on when the absent NAC is more in the forefront of patient's minds. The BREAST-Q satisfaction with breasts module has only one question, "How you look in the mirror unclothed" which examines this. However, questions in the BREAST-Q sexual well-being module examine confidence, comfort, attractiveness, and satisfaction with sex, with three questions specific to feelings when unclothed. Therefore, NAC reconstruction may play a larger and more positive role in sexual well-being.

This study is the first to examine patient preferences for NAC reconstruction when using 3D tattoo in 100 consecutive patients with bilateral implant-based breast reconstruction. However, there are some limitations. Autologous reconstruction patients were not included in this study to limit influence of the skin paddle of the reconstruction on position and size of NAC reconstruction. Similar, unilateral reconstruction patients were not included to limit influence of the contralateral breast. Finally, radiation and its effect on satisfaction was not examined as this was outside the scope of this paper.

Conclusion

When given the choice, most women prefer small areola size with a higher position on their chest compared to classic values. While overall satisfaction with the appearance of the breast is unchanged, sexual well-being is improved after NAC reconstruction.

Author Contributions

Jones, Giles, Davis, Bruce, Costigan—performed all NAC tattoos and collected data.

Jones, Giles, Davis, Bruce, Costigan, Boe, White, Smith-Montes, McCarthy, Coriddi—collected and analyzed data.

Jones, Giles, McCarthy, Coriddi—wrote and edited manuscript.

Declaration of Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: This research was funded in part by the NIH/NCI Cancer Center Support Grant P30 CA008748, which supports Memorial Sloan Kettering Cancer Center's research infrastructure.


Ethical Approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. This study was approved under Memorial Sloan Kettering Cancer Center IRB 18-202. Informed consent was waived.

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