Defining Normal Parameters for the Male Nipple-Areola Complex: A Prospective Observational Study and Recommendations for Placement on the Chest Wall

Aesthetic Surgery Journal
2018, Vol 38(7) 742–748

DOI: 10.1093/asj/sjx245
www.aestheticsurgeryjournal.com
OXFORD
UNIVERSITY PRESS

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Abstract

Background: The nipple-areola complex (NAC) is important aesthetically and functionally for both sexes. Methods for positioning the NAC in males are less well established in the literature compared to females but are just as important.

Objectives: This study aims to determine the normal parameters for the male NAC, to review literature, and to present a reliable method for preoperative placement.

Methods: Normal male patients, with no prior chest wall conditions, were prospectively recruited to participate. General demographics and chest wall dimensions were recorded–sternal notch to nipple (SNND), internipple (IND), anterior axillary folds distances (AFD), NAC, and chest circumference were measured. Comparisons were made using *t* test and ANOVA.

Results: One hundred and fifty-eight patients were recruited (age range, 18-90 years); mostly (86.7%) with normal or overweight BMI. The IND averaged 249.4 mm, the SNND averaged 204.2 mm, and the AFD averaged 383.8 mm. Areola diameter averaged 26.6 mm and for the nipple, 6.9 mm. The IND:AFD ratio was 0.65. There was no statistical difference in the IND:AFD ratio, SNND, or NAC parameters comparing different ethnic groups. The SNND increased with greater BMI ($P \leq 0.001$). Using these data, we suggest ideal NAC dimensions and devised a simple method for positioning of the NAC on the male chest wall.

Conclusions: This is the largest study, with the widest range in age and BMI, to date on this topic. Although fewer men than women undergo surgery to the breast, there is a growing awareness for enhancing the appearance of the male chest wall.

Level of Evidence: 4

Editorial Decision date: November 10, 2017; online publish-ahead-of-print January 10, 2018.

The nipple-areola complex (NAC) is an important aesthetic component of the chest wall for both sexes. It is necessary for breastfeeding and is also an erogenous zone. Its morphology can be affected by variations in development and by abnormal processes, which may be congenital or acquired. Situations that can affect the appearance or position of the NAC include; surgery to the breast, massive weight loss, trauma, gender reassignment, and gynecomastia. Final placement of the NAC is an important factor

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in determining the aesthetic outcomes after surgery to the female breast.[1] However, it is becoming increasingly apparent that the position and appearance of the NAC is similarly important in males.[2]

The majority of studies defining NAC placement and proportions have been directed at the female breast since they remain the most common group requiring treatment of this anatomical area. Consequently, there are a number of reliable methods to assist in the reconstruction of the female NAC which can be used to achieve the correct symmetry, size, shape, texture, pigmentation, and projection. These studies have determined that the ideal female NAC is situated at the point of highest projection on the breast mound.[3] To determine the ideal position for the NAC in relation to the rest of the chest, Penn described an equilateral triangle with sides of 21 centimeters, where the nipples would be placed at the two basal points.[4] As this was defined in a young patient group, Khan updated this method by using an isosceles triangle (ie, longer sides) that was reported as placing the NAC in a more natural position for an older population.[5] Normal average parameters (diameter and projection) for the NAC have also been reported. In a series of 600 female breasts—mean areola diameter was 40 mm, nipple diameter was 13 mm, and nipple projection was 9 mm.[6] Other studies have produced various ratios between the breast, nipple, and areola dimensions to define the ideal position for the NAC.[7] In one study, patients were asked to swing a disposable electrocardiogram (ECG) lead from side to side to allow them to self-mark the best position for the NAC. This method was reported as leading to a good aesthetic outcome.[8] Significant interrater variation in NAC placement has been reported.[9]

The situation with the male breast is different. The average NAC in males has different dimensions to the female and the NAC does not (normally) sit on a breast mound. Therefore, it is not possible to use the same methods used in females to determine the ideal position for the NAC in the male population. In fact, there are no universally established and accepted criteria for NAC placement in men.[10] Previous studies have suggested using unreproducible methods such as finger breadths,[11] whilst others (with smaller patient numbers) have only looked at the geometric dimensions of "aesthetically ideal" males.[12] An anatomical study described the male NAC position in relation to the edges of the pectoral muscles, which can be challenging to palpate accurately, especially in those with greater adiposity.[13] Most studies in males have reported fixed dimensions and relative positions for the NAC,[10,14] and mostly in a younger male population.[2,15] There is no consensus in the literature as to whether or not BMI is associated with a greater sternal notch to nipple distance. Therefore, with increasing BMI or height, the NAC positioned using these methods may end up being placed too high on the chest wall.[2,16]

Understanding the range of parameters for the normal male NAC is important in several situations. Gynecomastia is identified in 55% of male autopsies, and occurs in up to 70% of older, hospitalized men.[17] Those men with the most severe gynecomastia (grade III disease) may account for up to 26% of cases.[18] It is also important in cases of complete loss of the male NAC which may occur after trauma, burns,[19] or some gender reassignment procedures.[20-22] There is also a growing awareness of male breast aesthetics amongst patients and surgeons, and male patients of all ages often seek a surgical solution to achieve their aesthetic goals.[9,12] Men with breast disease often experience feelings of anxiety, embarrassment, emasculation, and depression.[23] However, it is not known whether self-consciousness of gynecomastia varies according to severity (using Simon's classification).[24]

Furthermore, there are no studies examining differences in the male NAC amongst the different ethnic groups, according to body mass index (BMI) or with differing age. Therefore, we hoped to identify and define the normal parameters for the male NAC. In so doing, we hoped to produce a reliable method for preoperative NAC placement on the male chest wall and to determine the ideal dimensions for the male NAC.

METHODS

Hospitalized male patients in a London teaching hospital were approached and asked to participate in the study over a one year period, between November 2013 and October 2014. Patients who consented to participate in the study had their chest wall and NAC parameters measured. The inclusion criterion for the study was; any adult male patient. The exclusion criteria were; previous history of chest trauma or surgery, preexisting chest wall conditions, previous hormonal therapy, and previous diagnosis of gynecomastia. We placed no restrictions on the ethnicity, age, or BMI of our patients with the intention of capturing as broad a cross-section of the normal male population as possible. The parameters for the NAC were measured using calipers and a flexible measuring tape was used to measure chest dimensions. No data were collected on NAC shape. All measurements were performed with the patient standing upright, at room temperature, with the chest exposed for one minute prior to performing the measurements.

General demographics, body mass index, and ethnicity were recorded. NAC parameters and the sternal notch to nipple distances (SNND) were taken. In cases of a noncircular (eg, oval) NAC, the horizontal diameter across the middle of the NAC was measured. Internipple distances (IND) were measured by placing the measuring tape taut between the centers of each nipple. On the anterior chest, the distance between the anterior axillary folds (AFD) was measured. The

palpable lateral edge of pectoralis major was used as the landmark for the anterior axillary fold and measurements were taken from the top of the axillary fold when viewed anteriorly (patients' arms fully relaxed against the chest sides). The chest circumference (CC) was measured at the level of the nipple. Ratios of the IND against the AFD and CC were then calculated. These are the two most commonly reported ratios in previous publications and this allowed us to make some comparisons with previously reported data. The key outcome measure was the IND:AFD ratio. Not only is the horizontal placement of the nipples more important visually (compared to the vertical) in the author's opinion, but also clinically, this ratio (using only the anterior chest parameters) is simpler to use in a routine clinical setting. We did not use measurements using the midclavicular position as a fixed landmark because it is difficult to define this position.

Ethics approval was attained for this study (National Research Ethics Service Committee East Midlands, Derby, U.K.). The study was performed in accordance with the Declaration of Helsinki. All data collection was performed using a Microsoft Excel spreadsheet and the SPSS package was used for data analysis.

Sample Size

To ensure adequate power for the study, the required sample size was calculated from a pilot analysis of the first 20 patients. Our final sample size was based on a calculation of 95% of the normal range for the key outcome; the IND:AFD ratio. When extrapolated from the pilot data, we expected that these measurements would have a standard deviation of 0.074. Arbitrarily, we estimated that our normal range would be within 0.020 of the true population value. Based on this assumption, and based on a 95% confidence level, we calculated that we would need a minimum of 158 patients for this study.

Literature Review Process

The literature search for previous similar studies in the English language was performed by the first (D.Y.) and second (L.C.) authors independently using the PubMed database in September 2017. There was no time frame applied to the search. To minimize the omission of potentially relevant studies, reference lists at the end of identified studies were also reviewed for possible related articles. The broad term used was "nipple (male OR men) (placement OR position OR location)." There were no disagreements between the researchers with regards to the outcome of the literature review. Any study that reported on positioning or dimensions of the adult male NAC was included in our review.

Statistical Methods

Demographic characteristics are presented as frequency and percentage (%). Important structural measures are described using means and normal ranges. Key ratios are summarized using mean and standard deviation (SD). Comparisons of key measures and ratios, by ethnicity (Caucasian vs others), age group, and BMI category, were conducted using *t* test and analysis of variance (ANOVA) as appropriate. Resulting *P* values are presented unadjusted for multiple comparisons. Using a Bonferonni correction, unadjusted *P*-values of <0.003 would be considered statistically significant. Stata version 13 was used for all analyses (Stata Statistical Software: Release 13; StataCorp LP, College Station, TX).

RESULTS

A total of 158 male patients were recruited for this study, representing 316 individual nipples. The average age was 57 years (range, 18-90 years). Most patients were Caucasian (British and Western European). Most patients had a BMI in the normal or overweight categories. The mean BMI was 25.3 kg/m^2 (range, 14.5-37.8 kg/m^2). These data are summarized in Table 1. Height ranged from 142 cm to 200 cm with an average of 176 cm.

Our data are presented in millimeters (mm), accurate to 1 decimal place. The average NAC diameter was 26.6 mm (range, 10.3-42.9 mm). Average nipple diameter was 6.9 mm (range, 3.2-10.7 mm). There were no statistically significant differences in these measurements comparing left and right sides. The average ratio of the diameters of the nipple to areola was 0.28. The average internipple distance measured (taut) across the chest was 249.4 mm. The ratio between this distance and the average chest circumference was, on average, 0.24. The ratio between the internipple distance and the distance between the anterior axillary folds was 0.65. These data are summarized in Tables 2 and 3.

There were statistically significant differences in the IND:AFD ratio with regards to age. This ranged from 0.62 in the 18-35 age group to 0.71 in the over 80 age group. The average IND:AFD was 0.65 and removing the >80 group did not affect this value when analyzing the data to two decimal places (Table 4). We found no statistical significance in the IND:AFD ratio, SNND, nipple, and areola diameters when comparing between different ethnic groups. There were statistically significant differences in the SNND between the three BMI subgroups, with increasing BMI displaying greater SNND values.

Table 1. General Demographics (n = 158)

Ethnicity	Frequency	Percentage (%)
Caucasian	112	70.9
Others	46	29.1
Indian	19	12.0
Afro-Caribbean	10	6.3
Eastern European	6	8.2
South American	2	1.3
Middle Eastern	1	0.6
Oriental	1	0.6
Age (years)		
18-35	29	18.4
36-50	25	15.8
51-65	42	26.6
66-80	45	28.5
>80	17	10.8
Body mass index (kg/m^2)		
<18.5	7	4.4
18.5-25 (normal)	74	46.8
25.1-30 (overweight)	56	35.4
30.1-35 (moderately obese)	18	11.4
35.1-40 (severely obese)	3	1.9
Mean, range	25.3, 14.5-37.8	

Table 2. General Measurements (n = 158; normal range ± 1.96 standard deviation)

Structure	Mean (mm)	Range (mm)
NAC diameter right	26.6	9.2-44.1
NAC diameter left	26.6	11.0-42.1
NAC diameter Av	26.6	10.3-42.9
Nipple diameter right	6.9	2.9-10.8
Nipple diameter left	7.0	3.2-10.8
Nipple diameter Av	6.9	3.2-10.7
Inter-nipple distance (IND)	249.4	187.4-311.4
Sternal-notch to nipple distance right (SNND)	202.2	158.1-246.3
Sternal-notch to nipple distance left	206.2	164.5-248.0
Distance between anterior axillary folds (AFD)	383.8	302.5-465.1
Chest circumference (CC)	1019.4	838.5-1200.2

Table 3. Ratios

Ratio	Mean (SD)
Internipple to chest circumference ratio (IND:CC)	0.24 (0.02)
Internipple to anterior axillary fold ratio (IND:AFD)	0.65 (0.07)
Nipple to areola ratio	0.28 (0.10)

DISCUSSION

Although fewer men than women undergo surgery to the breast, there is a growing awareness of the opportunities for enhancing the appearance of the male chest wall. With the ever-increasing availability of information on surgical solutions to aesthetic issues, male patients are likely to become ever more critical about the outcomes.

Placing the NAC in the correct position on the chest wall is important to ensure a satisfactory outcome after surgery to the male chest wall. Moreover, the NAC must be within the "normal range" for areola and nipple diameter in order to appear aesthetically acceptable. Therefore, defining the normal parameters for the adult male is likely to become increasingly relevant in future. The main aim of this study was to look at how surgeons can place the NAC correctly after surgery to address gross preexisting malposition or absence. In our opinion, trying to achieve minor aesthetic corrections as part of patient choice or after mild malpositioning requires the surgeon to juggle many factors, such as an individual's preference, expectations, and surgical risk, and is outside of this study's remit.

We were able to identify nine previous studies that examined aspects of the normal parameters of the male NAC or made recommendations about the ideal position for the NAC. Most of these included only small numbers of young males—the oldest patient in these studies was 54 years. By comparison, our study includes the largest number of normal male patients and the widest range in age.

For example, Kornstein and Cinelli[11] reported a position for the NAC which is 1 to 2 finger breadths cephalad to the intersection of the breast meridian line with the inferolateral border of pectoralis major muscle. They also recommended a NAC diameter of between 25 and 35 mm. We feel that the use of finger breadths and a wide range in NAC diameter is too imprecise leaving too much to experience and an "artistic eye" for many surgeons. In contrast,

Table 4. Mean (SD) Values of Key Parameters and Comparison Between Groups

	IND:AFD ratio		Average SNND		Average NAC		Nipple:areola ratio	
	Mean (SD)	*P*-value	Mean (SD)	*P*-value	Mean (SD)	*P*-value	Mean (SD)	*P*-value
Ethnicity								
Caucasian	0.66 (0.07)	0.01	206 (22)	0.10	26 (9)	0.76	0.28 (0.10)	0.07
Others	0.63 (0.06)		199 (20)		27 (7)		0.26 (0.08)	
Age (years)								
18-35	0.62 (0.07)	<0.001	200 (19)	0.65	26 (6)	0.88	0.28 (0.09)	0.94
36-50	0.63 (0.08)		207 (24)		26 (7)		0.27 (0.08)	
51-65	0.66 (0.07)		203 (26)		27 (7)		0.28 (0.10)	
66-80	0.66 (0.06)		207 (16)		27 (12)		0.28 (0.10)	
>80	0.71 (0.07)		205 (22)		27 (6)		0.29 (0.11)	
BMI (kg/m^2)								
18.5-25 (normal)	0.64 (0.07)	0.32	196 (22)	<0.001	25 (7)	0.06	0.27 (0.09)	0.03
25.1-30 (overweight)	0.66 (0.07)		212 (16)		28 (7)		0.30 (0.10)	
>30 (obese)	0.66 (0.08)		216 (17)		30 (10)		0.24 (0.08)	

BMI, body mass index.

Murphy et al[12] assessed the chest walls of 20, "aesthetically perfect," men and used a similar approach to Penn's 21 cm equilateral triangle. They suggested that the male internipple distance should be 22 cm and sternal notch to nipple to be 21 cm. Murphy also noted that Coleman had measured the chests of a number of US army recruits' and found that the sternal notch to nipple measurement was 19 cm. Beckenstein et al recommended a SNND of 20 cm and commented that earlier suggestions for placement of the NAC created nipples that were too inferior and medial. Beer et al[2] suggested a SNND of 20 cm and a midsternal line to nipple distance of 11.2 cm. Shulman et al[10] reported a SNND of 18.4 cm and IND distance 20.6 cm. All of these measurements lie within the range obtained for our own study suggesting that our own results are broadly correct. Importantly, analysis of our results according to age and ethnic group showed that the sternal-notch to nipple distances do not change with either age or ethnic group. All measurements were taken with the patient upright and it was felt that this position was most relevant in terms of day-to-day appearance. In addition, most surgery to the breast is performed with the patient head up to some degree and therefore outcomes would not be significantly affected by using only measurements obtained with the patient in the upright position.

In terms of NAC dimensions. Previous studies have reported NAC diameters of between 23 mm and 28 mm. Our own study found an average NAC diameter of 26.6 mm. Previous studies have also reported nipple diameters of between 5 mm and 6.9 mm. Our study found an average nipple diameter of 6.9 mm. We compared these NAC dimensions according to age, ethnic origin, and BMI. There was no significant change in NAC dimension with age. Similarly, there were no differences in NAC dimensions comparing the different ethnic groups or different BMI. This suggests that surgeons can be confident in selecting a specific NAC and nipple diameter for all their male patients—regardless of age and ethnic origin. From our own study, we recommend a NAC diameter of approximately 26.6 mm with a nipple diameter of approximately 6.9 mm.

Unfortunately, selection of the ideal position for the NAC is more complicated. Most previous studies have recommended using fixed values to place the NAC in the correct position (eg, Penn's triangle) because it is often easier for surgeons to understand and remember a few fixed dimensions. However, we feel that using ratios may be better since this helps to accommodate differences in the diameter of the chest. A few previous studies have used a similar approach. For example, Shulman used the number 0.213 as a multiplier applied to CC to obtain the IND, combining it with the patient's total height to estimate the vertical position of the NAC. Similarly, Murphy suggested using 0.23 as the multiplier. Interestingly, using the same calculations to obtain the multiplier, our study found a ratio of 0.22—which is similar to Murphy's.

Table 5. BMI Subgroups With Suggested SNND

Body mass index (kg/m^2)	Suggested SNND (cm)
18.5-25 (normal)	20
25.1-30 (overweight)	21
>30 (obese)	22

Others, such as Atiyeh et al,[15] used reverse calculations based on the measurement of the distances between the umbilicus, axillary folds, and sternal notch to deduce the IND and vertical position of the NAC. While elegant, we felt that the use of such coordinates adds a layer of unnecessary complexity. Moreover, we feel that relying on the umbilicus as a marker can introduce significant inaccuracies—especially with the increasing incidence of obesity. Therefore, use of their technique should really be limited to young, fit, nonobese individuals—who are the group least likely to request surgery to the NAC.

Our results reveal statistically significant differences in the IND:AFD ratio in regard to age. The >80 group had a particularly higher ratio, but there were only 17 individuals who fell into the latter group. The overall average IND:AFD was 0.65 and removing the >80 group did not affect this value when analyzing to two decimal places. Placing this into a clinical perspective, if the average IND:AFD ratio of 0.65 were to be applied to the average AFD in our dataset, the IND would be 249.5 mm. Using the highest age subgroup (>80) average, the IND would be 272.5, a difference of 23 mm, or only 11.5 mm each side. In fact, the main age groups in our study (18-80 years) showed little difference in the ratio (0.62 to 0.66), and this would also represent the most common age group presenting for treatment. We therefore suggest that the ratio of 0.65 is a realistic multiplier to use for the vast majority of patients requiring surgery to the chest wall.

Through the authors' experience of measuring the chest dimensions as accurately as possible, it was felt that the AFD was by far the easiest measurement to perform. Measurement of the chest circumference frequently required two persons to ensure that the measuring tape remained in a horizontal plane circumferentially rather than slipping at the back. In addition, in the operating room, with the patient under general anesthetic, it would be impractical to measure the circumference of the chest. Therefore, a simple, defined, anterior chest dimension is preferable.

There was a statistically significant increase in the average SNND with increasing BMI, but not increasing height. Intuitively, this would be expected since these individuals are more likely to experience pseudo-gynecomastia due to increased adiposity. As the "breast" sags, this is likely to influence the vertical component of the SNND. Therefore, we suggest that the ideal SNND should be stratified according to the patient's BMI—to the nearest centimeter (Table 5).

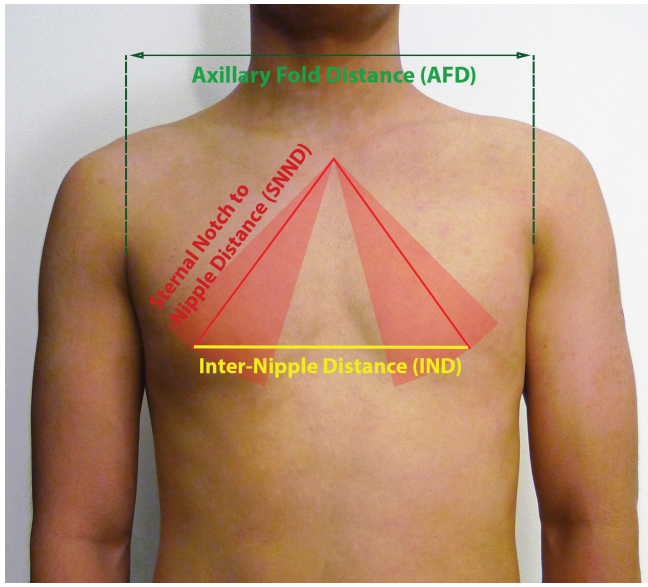

Figure 1. Chest wall of a 26-year-old male patient. SNND arc is first drawn (red). AFD (green) measured and using a ratio of 0.65, the IND is calculated. This is then moved into a central position on the chest (yellow), with the ends intersecting the SNND arc.

We also recommend using the sternal notch as the landmark from which to construct a system for placing the NAC. We do not recommend using the midclavicular point since this point is often difficult to locate accurately—especially in an obese individual. Our method creates one triangle with its apex at the sternal notch, but whose base length varies according to chest dimensions. We begin at the sternal notch by drawing an arc over the pectoral region with a radius of 20 to 22 cm depending on the BMI, as per Table 5. We then apply the multiplier of 0.65 to the AFD to obtain the IND. This length is superimposed onto the arc until it lies equidistant on either side of the sternum and intersects with the arc previously drawn on the chest. The point of intersection is where the NAC should be placed. The areola should be close to 27 mm in diameter and the nipple, 7 mm (Figure 1).

Limitations

The findings of our study were limited in a number of ways. To begin with, our study population was composed of patients attending a large city hospital who might not be representative of the normal population. The study population was also composed of several ethnic groups, which may have made a difference. However, the key ratios were very similar in the two main ethnic groups in our study. Finally, although we have been able to suggest a method

for selecting NAC dimension and placement, this should only be considered as a guide.

CONCLUSIONS

This paper provides defined values for the parameters of the normal NAC in males, which are likely to reflect that of the majority of the general population. We also describe a systematic method for selecting the ideal position for placement of the NAC on the chest wall of males. Although our descriptions (providing exact sizes and locations down to the millimeter) may seem overly precise, we feel that any guide or anatomical reference should always have a defined value as a starting point. Regardless of these exact values, patients and surgeons should always reach a consensus about where the NAC should be placed—before surgery is performed. Therefore, being able to document the method for selecting the size and position of the NAC in the operative notes before surgery, may prove useful in the future. However, the final decision on the size and position for the NAC should always rest with the patient—guided by the surgeon.

Acknowledgements

We thank Mr Saif Ramman, MRCS, for his contributions in the ethics approval process and initial study design.

Disclosures

The authors 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.

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