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ORIGINAL ARTICLE BREAST SURGERY

Nipple-Areolar Complex Position in Female-to-Male Transsexuals After Non-skin-excisional Mastectomy: A Case–Control Study in Japan

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Abstract
Background Mastectomy is performed in female-to-male transsexual (FTM TS) patients as a surgical treatment to make a female thorax resemble a male thorax; however, no studies have examined the nipple-areolar complex (NAC) position in FTM TS patients after mastectomy.
Patients and Methods The NAC position in 41 FTM TS patients before and after non-skin-excisional mastectomy was examined and compared with that in 50 age- and BMI-matched biologically male subjects as controls. The factors affecting the NAC position after the operation were also examined and verified by multiple regression analysis.
Results and Conclusions After non-skin-excisional mastectomy, the NAC in the FTM TS patients was positioned significantly more medially (horizontal NAC position ratio {('internipple distance'/'width of thorax') × 100} [HNPR]: preoperatively, 70.07% ± 4.19%; postoperatively, 63.28% ± 3.79%) and cranially (vertical NAC position ratio {('distance from sternal notch to nipple height'/'distance from sternal notch to umbilicus') × 100} [VNPR]: preoperatively, 43.87% ± 3.68%; postoperatively, 41.37% ± 3.15%). Postoperatively, the NAC in the FTM TS patients was located significantly more medially than that in the control subjects (HNPR: 63.28% ± 3.79% to 66.79% ± 4.82%), although the height of the NAC was the same. Multiple regression analysis revealed that the NAC position on breasts characterized by ptosis, a high projection, and lateral leaning (low skin elasticity and a substantial amount of skin between the nipples) tended to be positioned more medially after non-skin-excisional mastectomy. Laterally deviated eccentric circular type mastectomy may be a good option for FTM TS patients who have moderately sized breasts with such features.
Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Gender incongruence · Gender dysphoria · Female-to-male transsexual (FTM TS) · Mastectomy · Nipple-areolar complex (NAC) position

Introduction

Gender incongruence in ICD-11 [1], or gender dysphoria in DSM-5 [2], is a conflict between a person's biological sex and the gender as which they identify. Psychological, surgical, and hormonal treatments are available. Mastectomy is performed in female-to-male transsexual (FTM TS) patients with gender incongruence or gender dysphoria as a surgical treatment to make a female thorax resemble a male thorax, allowing the patient to present physically as the man they feel they are inside.

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Mastectomy techniques have been developed as surgical treatments for patients with gynecomastia or breast hypertrophy [3–13] and have been applied and improved as surgical options for FTM TS patients [14–21]. At our institution, we use a modified method (Fig. 1) as an improved version of that reported by members of Gent University Hospital, Belgium, in 2008 [18]. One of four surgical approaches was selected based on the breast shape of the patient: a semicircular type, concentric circular type, subcutaneous type, or nipple-areolar complex (NAC) graft type approach (Fig. 1).

The breasts of FTM TS patients in Japan tend to be small and have little ptosis, so in most cases, mastectomy involves little or no skin excision (semicircular or concentric circular type); however, the position of the NAC cannot be adjusted with these surgical approaches. In skin-excisional mastectomy (subcutaneous or NAC graft type), the NAC position can be adjusted and is usually determined by the surgeon's personal opinion. There are few standard criteria for the NAC position in men at present, and the position is not usually modified unless it appears obviously abnormal. However, the NAC position on the thorax after mastectomy sometimes looks strange compared to that on the thorax of non-FTM TS men. Several studies have reported on the male NAC position [22–26], but none have examined the NAC position in FTM TS patients after mastectomy.

In the present study, we compared the pre- and postoperative NAC positions of 41 with available postoperative data among 64 consecutive FTM TS patients after non-skin-excisional mastectomy (semicircular type); 50 age- and body mass index (BMI)-matched healthy biological males were included as controls. Factors affecting the NAC position after the operation were also examined and verified.

Patients and Methods

This case–control study was approved by the institutional review board of the participating institutions and conducted in accordance with the Declaration of Helsinki on investigations involving humans. Although informed consent was obtained in the form of an opt-out option on the Web site, for the two patients whose photographs were used in the present article, informed consent was obtained from each patient on an individual basis.

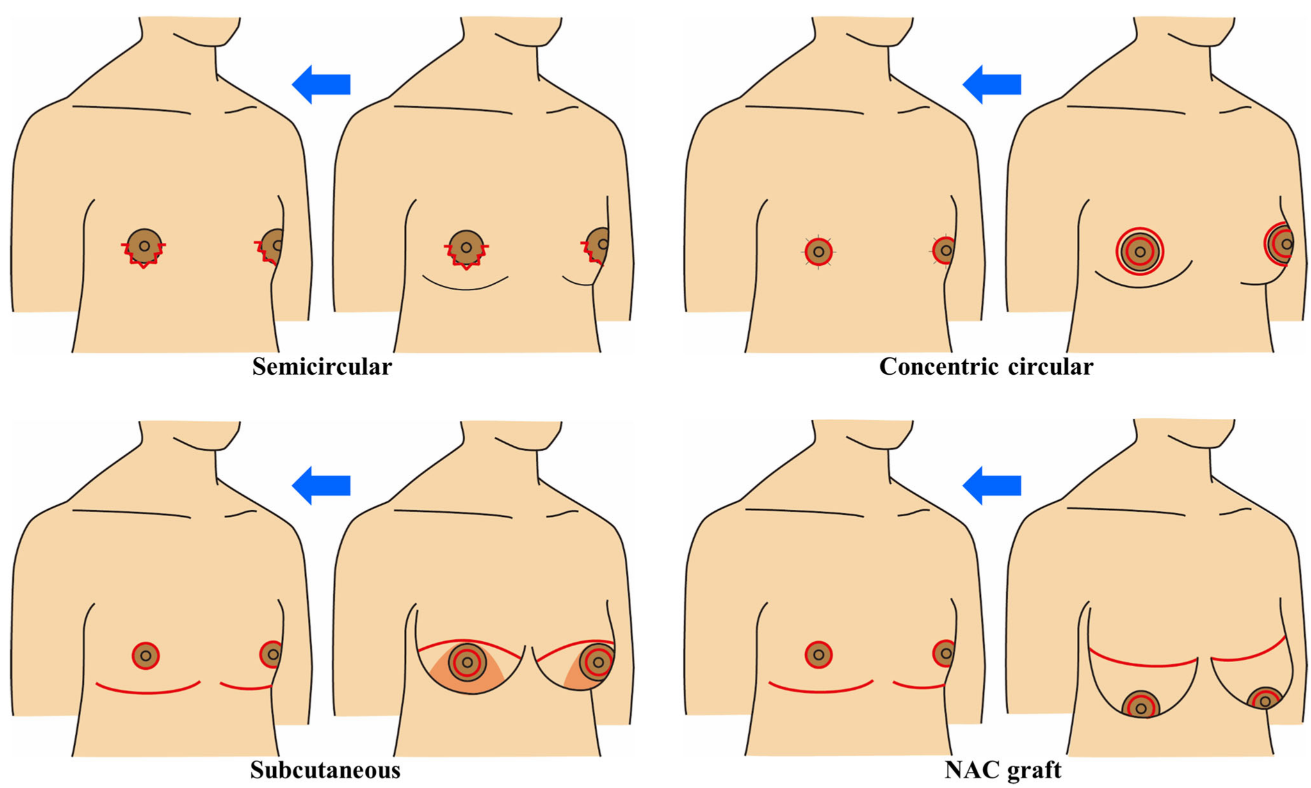


Fig. 1 Four types of surgical procedures for mastectomy. The type of surgical approach (semicircular type, concentric circular type, subcutaneous type, NAC graft type) was selected based on the breast shape of the patient

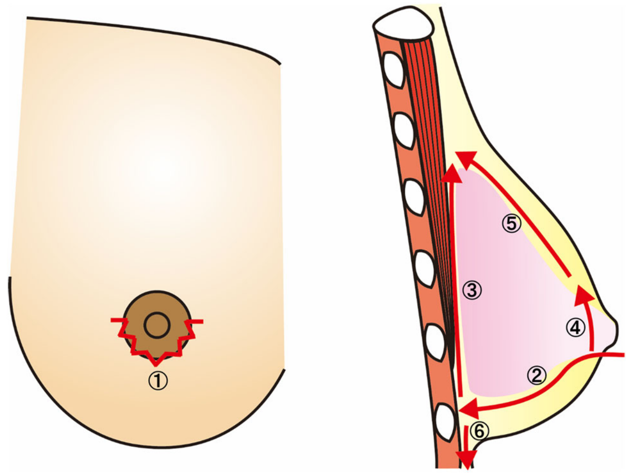
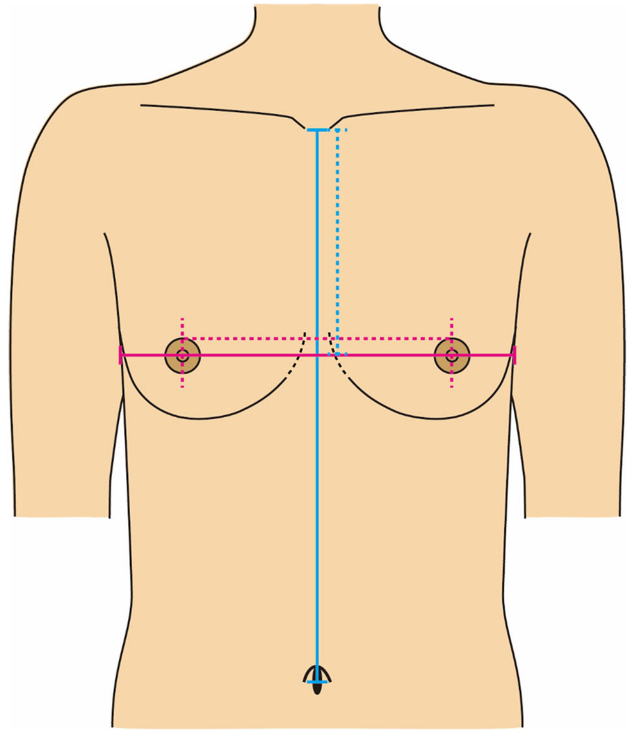


Fig. 2 Detailed description of the surgical procedure for semicircular mastectomy. A zigzag incision was used to prevent contracture after surgery (1). After the skin incision, dissection was performed along the mammary gland, usually from the lower half of the circumference, until reaching the fascia of the pectoralis major muscle (2). After dissecting the superficial fascia layer as far as possible from the lower half of the view (3), the mammary gland under the NAC was dissected, with care being taken not to resect too much tissue under the NAC to prevent recession and vascular insufficiency of the NAC (4). Next, the upper half of the mammary gland was dissected in the same way as the lower half (5), and then the mammary gland was resected. After resection of the mammary gland and the attached adipose tissue, subcutaneous dissection under the inframammary fold (IMF) point was performed, and the structure of the IMF was disrupted (6). Temporary wound closure was performed, checking for ptosis and sagging in the sitting position, and additional fat resection was performed if needed. After washing, achieving hemostasis and placing a drainage tube, wound closure was performed using 5-0 absorbable sutures and 6-0 non-absorbable sutures



HNPR (Horizontal NAC Position Ratio)

= Internipple distance / Width of thorax × 100

VNPR (Vertical NAC Position Ratio)

= Sternal notch to Nipple height / Sternal notch to Umbilicus × 100

Fig. 3 Definition of the HNPR and VNPR. The horizontal NAC position ratio (HNPR) was calculated as (‘internipple distance’/‘width of thorax’) × 100 (%). If the lateral margin of the breast exceeded the edge of the thorax, the breast width was used for the calculation. The vertical NAC position ratio (VNRP) was calculated as (‘distance from sternal notch to nipple height’/‘distance from sternal notch to umbilicus’) × 100 (%)

Subjects

Forty-one FTM TS patients with available postoperative data were selected from among 64 consecutive patients who underwent non-skin-excisional mastectomy (semicircular type) at either of two medical institutions (Yamanashi University Hospital, Kofu-Showa Plastic Surgery Clinic) from 2012 to 2017. The inclusion criteria were the existence of postoperative photographs obtained at least 3 months after the operation. The same doctor was in charge at both institutions (Akira Momosawa), and the same surgical procedures were performed. In addition, 50 age- and BMI-matched biological male volunteers were included as controls.

Surgical Indications and Procedures

The surgical indications for semicircular mastectomy in the present study were as follows: little to moderate breast tissue, little ptosis of the breast, and no skin excess predicted after surgery. The indications were rather vague and not considered to be objective according to the findings of past reports [18, 21]; however, the final surgical procedure was determined by the surgeon in charge, with comprehensive considerations, including the intentions of each individual patient. Details of the surgical procedure are shown in Fig. 2. The mammary gland and attached adipose tissue were removed from only the semicircular incision along the lower edge of the NAC.

NAC Position Analysis

The NAC position was assessed using photographs. Frontal and lateral photographs were obtained at the outpatient clinic at a distance of three meters away from the patient in

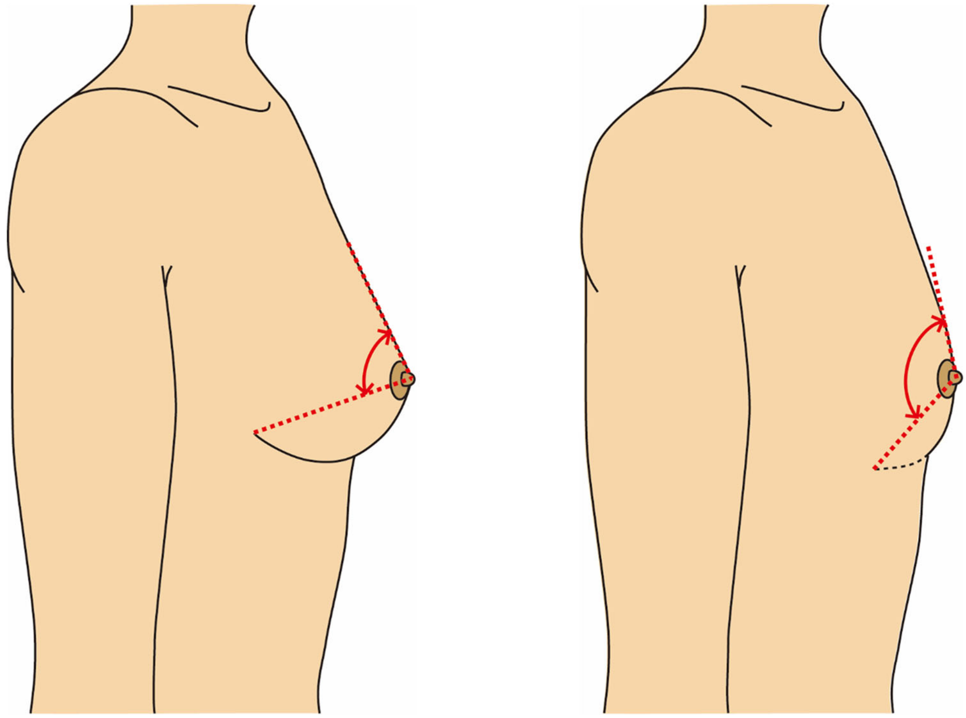


Fig. 4 Definition of the breast angle (BA). The BA is the angle made with the nipple being the apex between the line tangent to the breast mound above the nipple and a straight line from the nipple to the lateral edge of the inframammary fold. The average of the right and left sides was calculated and used for analyses

the standing position with the arms hanging naturally alongside the body (EOS Kiss®, Canon, Inc., Tokyo).

The original indices of the horizontal NAC position ratio (HNPR) and vertical NAC position ratio (VNPR) were used to assess the NAC position (Fig. 3). From the frontal photograph, the HNPR was calculated as (‘internipple distance’/‘width of thorax’) × 100. The VNPR was calculated as (‘distance from sternal notch to nipple height’/‘distance from sternal notch to umbilicus’) × 100. Frontal photographs of the controls were obtained in the same manner, and the HNPR and VNPR were calculated for comparison. Similar indices have already been utilized to assess the NAC position in a previous study [25]; however, our indices are slightly different because they were determined using photographs.

The pre- and postoperative HNPR and VNPR values were compared both among the patients and between the patients and controls. We also calculated the change in the HNPR and VNPR after the operation and examined the factors affecting this change by multiple regression analysis. The following four influential factors were selected for the HNPR assessment: age, BMI, breast angle (BA), and internal breast mound ratio (IBMR). For the VNPR assessment, the same factors were used, except for the IBMR, which was switched to the preoperative VNPR. The BA and IBMR are original indices developed for the present study (Figs. 4 and 5). The BA was defined as the angle made with the nipple being the apex between the line tangent to the breast mound above the nipple and a straight line from the nipple to the lateral edge of the inframammary fold (average of the right and left sides) (Fig. 4). The value was measured from lateral photographs. The BA was considered to be a factor that reflects breast ptosis or volume; breasts with ptosis or a high projection tend to have a small BA. The IBMR was calculated using the following formula: (‘distance of internal breast mound’/‘width of thorax’) × 100 (Fig. 5), where the ‘distance of internal breast mound’ is the sum of the right and left distances from the internal edge of the breast mound to the nipple; therefore, the distance between the right and left breast mounds is not included. The IBMR was considered to be a factor that reflects the size of the breast mound between the nipples. Breasts with a large width and lateral leaning or a laterally deviated NAC position tend to have a large IBMR.

Statistical Analyses

To compare the pre- and postoperative HNPR and VNPR values of the patients and the HNPR and VNPR values of the patients postoperatively and the controls, the Mann–Whitney U test was used. To assess the change in the HNPR and VNPR after the operation, multiple regression analysis was conducted. For both tests, the free software ‘R’ was used, and a P value < 0.05 was regarded as statistically significant.

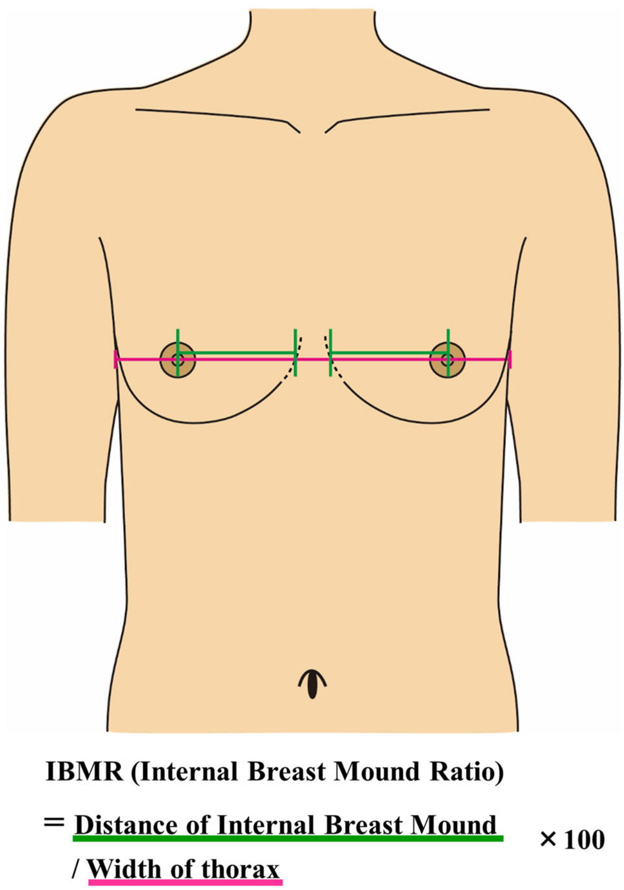


Fig. 5 Definition of the internal breast mound ratio (IBMR). The IBMR was calculated using the following formula: ('distance of internal breast mound'/'width of thorax') × 100 (%), where the 'distance of internal breast mound' is the sum of the right and left distances from the internal edge of the breast mound to the nipple

Results

Table 1 shows the results of each item for the patients and controls. The mean ± standard deviation (SD) age was 26.98 ± 5.46 (range 18–42) years in the patient group and 25.36 ± 5.00 (range 19–39) years in the control group. The mean ± SD BMI (kg/m^2) was 21.66 ± 1.88 (range 18.59–27.70) in the patient group and 21.45 ± 2.61 (range 16.65–30.69) in the control group. No statistically significant differences between the patients and controls were noted in these data (Table 1). The mean ± SD time at which the postoperative photographs were obtained was 240 ± 108 (range 114–654) days after the day of the operation.

The mean ± SD preoperative HNPR in the patient group was 70.07% ± 4.19% (range 56.97–81.37%), the mean ± SD postoperative HNPR in the patient group was 63.28% ± 3.79% (range 51.65–71.41%), and the mean ± SD HNPR in the control group was 66.79% ± 4.82% (range 55.23–79.81%). A significant difference was observed between the pre- and postoperative HNPR values in the patient group (change in the HNPR after the operation: 6.78% ± 2.63% medially), as well as between the postoperative HNPR in the patient group and that in the control group (Table 1).

The mean ± SD preoperative VNPR in the patient group was 43.87% ± 3.68% (range 36.21–52.63%), the mean ± SD postoperative VNPR in the patient group was 41.37% ± 3.15% (range 36.02–47.34%), and the mean ± SD VNPR in the control group was 40.04% ± 3.77% (range 32.01–46.54%). A significant difference was observed between the pre- and postoperative VNPR values in the patient group (change in the VNPR after the operation: 2.51% ± 2.14% cranially), but no significant difference was noted between the postoperative VNPR values in the patient and control groups (Table 1).

These results show that the NAC in FTM TS patients is positioned more medially and cranially after non-skin-excisional mastectomy, and NAC in FTM TS patients postoperatively is positioned more medially than that in biologically male controls, although the height of the NAC was similar. Typical examples are shown in Fig. 6.

The mean BA ± SD of the patients was 118.83° ± 14.11° (range 86.95°–150.51°), and the mean IBMR ± SD of the patients was 61.94% ± 5.64% (range 50.47–73.15%) (Table 1).

Factors affecting the postoperative NAC position

(a) HNPR (horizontal change)

The multiple regression analysis results are shown in Table 2: change in the HNPR = 0.558 + 0.125 × (age) − 0.009 × (BMI) − 0.110 × (BA) + 0.260 × (IBMR). The R-squared value was 0.752, indicating that 75.2% of the change in the HNPR could be attributed to the four factors (age, BMI, BA, and IBMR). The items judged to be significant were age, BA, and IBMR. A more advanced age or a larger IBMR and a smaller BA were revealed to be significant factors of the medial change in the horizontal NAC position.

(b) VNPR (vertical change)

The multiple regression analysis results are shown in Table 3: change in the VNPR = 1.112 + 0.021 × (age) − 0.033 × (BMI) − 0.058 × (BA) + 0.191 × (preoperative VNPR). The R-squared value was 0.389, indicating that 38.9% of the change in the VNPR could be attributed to the four factors (age, BMI, BA, and preoperative VNPR); this result is inferior to the result obtained for the HNPR. The items judged to be significant were the BA and preoperative VNPR. A smaller BA and a larger preoperative VNPR were revealed to be significant factors of the cranial change in the vertical NAC position; however,

Table 1 The results of each item for the patients and controls

	Patient	Control	*P*
Age	26.98 ± 5.46 (18 ~ 42)	25.36 ± 5.00 (19 ~ 39)	0.0952
BMI (kg/m^2)	21.66 ± 1.88 (18.59 ~ 27.70)	21.45 ± 2.61 (16.65 ~ 30.69)	0.325
HNPR (%)	Post-OPE: 63.28 ± 3.79 (51.65 ~ 71.41)	66.79 ± 4.82 (55.23 ~ 79.81)	***4.76 × 10^{-4}**
	Pre-OPE: 70.07 ± 4.19 (56.97 ~ 81.37)		–
Change of HNPR (pre-OPE to post-OPE) (%)	6.78 ± 2.63 (medially) (1.87 ~ 12.39)	–	***4.60 × 10^{-10}**
VNPR (%)	Post-OPE: 41.37 ± 3.15 (36.02 ~ 47.34)	40.04 ± 3.77 (32.01 ~ 46.54)	0.108
	Pre-OPE: 43.87 ± 3.68 (36.21 ~ 52.63)		–
Change of VNPR (pre-OPE to post-OPE) (%)	2.51 ± 2.14 (cranially) (–1.79 ~ 7.92)	–	***3.09 × 10^{-3}**
BA (°)	118.83 ± 14.11 (86.95 ~ 150.51)	–	–
IBMR (%)	61.94 ± 5.64 (50.47 ~ 73.15)	–	–

HNPR horizontal NAC position ratio (Fig. 3); *VNPR* vertical NAC position ratio (Fig. 3); *BA* breast angle (Fig. 4); *IBMR* internal breast mound ratio (Fig. 5)

*Statistically significant

the results suggest that other factors also contribute substantially to this change.

Discussion

The NAC position varies among biological males, and several studies [22–26] have reported on the NAC position in this population. Kasai et al. [25] examined the nipple position in Asian men and studied the influences of body shape on the nipple position. In the study by Kasai et al., almost the same indexes as the HNPR and VNPR were used to assess the NAC position, and the mean HNPR in the standing position was 67% ± 4.1% in the lean group (mean BMI, 20.0) and 67% ± 4.6% in the overweight group (mean BMI, 25.2). The mean VNPR in the standing position was 40% ± 2.3% in the lean group and 43% ± 3.7% in the overweight group. In the present study, the mean HNPR ± SD was 66.79% ± 4.82% and the mean VNPR ± SD was 40.04% ± 3.77% in the control group, which are not markedly different from the previously reported values. Yue et al. [26] also examined the NAC position in normal men. A different standard for measurement was set to assess the NAC position in that study, but an index similar to the HNPR was used to assess the horizontal NAC position, i.e., the 'internipple distance/axillary fold distance,' and the average was approximately 0.65. Although the subjects in that study were primarily Caucasian and had a higher BMI than those in our study, the horizontal NAC position was almost the same as in our present and the previous study, considering that the denominator (axillary fold distance) of the index was slightly larger than that of the HNPR (width of the thorax). These data may serve as useful references for standard NAC positions in biological males and can be used to determine the appropriate NAC position after breast mastectomy in FTM TS patients or gynecomastia and breast hypertrophy patients.

For breast mastectomy in FTM TS patients, the surgical method is usually selected according to the breast size, degree of ptosis, and skin elasticity [18, 21]. Realistically, these factors are impossible to present using numerical

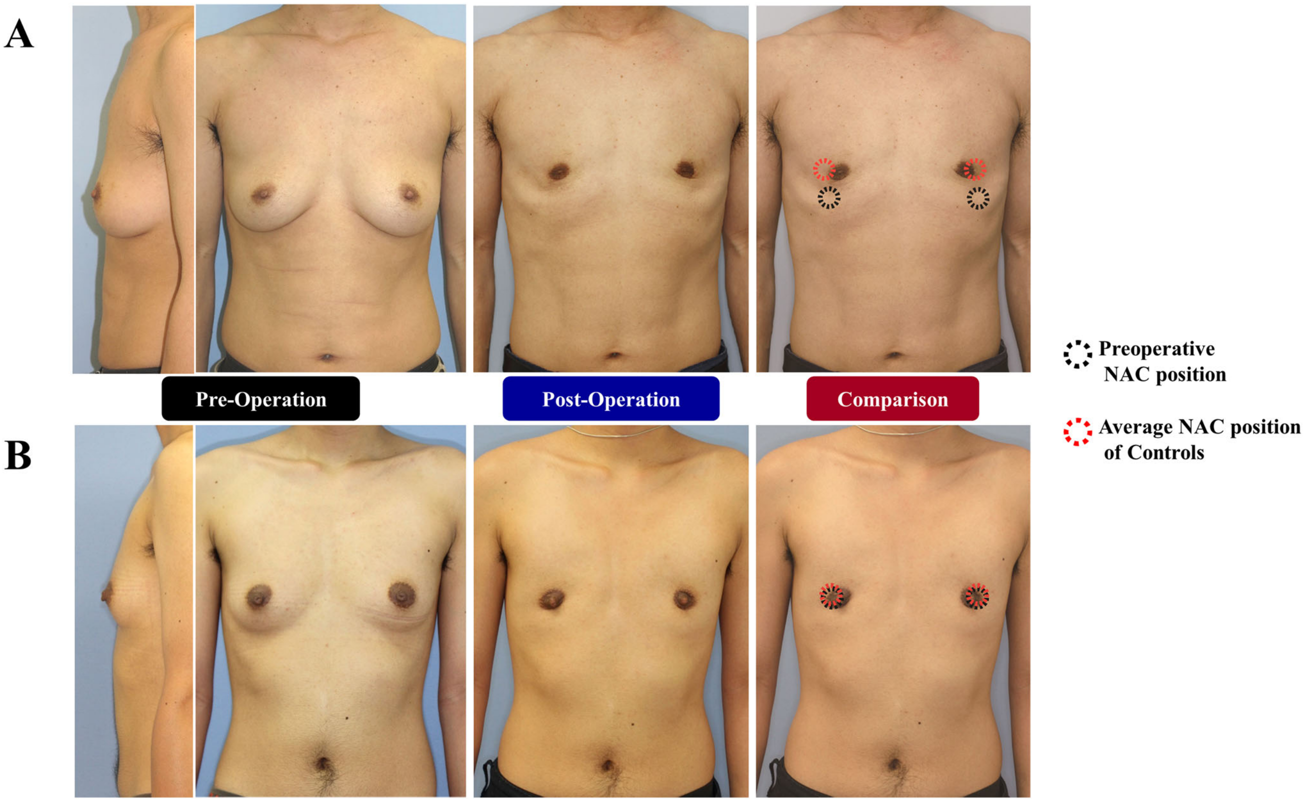


Fig. 6 A typical example of a patient before and after the operation and a comparison with the age- and BMI-matched male controls. **a** A 41-year-old patient with ptotic breasts of moderate volume. Other preoperative data were HNPR, 67.37%; VNPR, 47.76%; BMI, 20.20; BA, 86.95°; and IBMR, 56.68%. The changes in the HNPR and VNPR after the operation were 12.39% medially and 6.46% cranially, respectively, both of which are above the average. The postoperative NAC position (postoperative day 263) was more medial (HNPR 54.99%) than the average NAC position in the control group, although the height of the NAC was roughly the same (VNPR 41.30%). **b** A 24-year-old patient with non-ptotic breasts of small volume. Other preoperative data were HNPR, 66.10%; VNPR, 42.72%; BMI, 20.70; BA, 123.12°; and IBMR, 55.64%. The changes in the HNPR and VNPR after the operation were 5.16% medially and 0.81% cranially, respectively, both of which are below the average. The postoperative NAC position (postoperative day 654) was more medial (HNPR: 60.95%) than the average NAC position in the control group, although the height of the NAC was roughly the same (VNPR: 41.91%)

Table 2 The result of multiple regression analysis for the change in the HNPR

	Coefficient	95% CI	*P* value
Intercept	0.558	− 10.329, 11.445	0.918
Age	0.125	0.037, 0.214	**$*6.95 \times 10^{-3}$**
BMI	− 0.009	− 0.260, 0.241	0.940
BA	− 0.110	− 0.144, − 0.076	**$*1.27 \times 10^{-7}$**
IBMR	0.260	0.179, 0.341	**$*1.42 \times 10^{-7}$**

Multiple R-squared: 0.752

BA breast angle (Fig. 4); *IBMR* internal breast mound ratio (Fig. 5)

*Statistically significant

Table 3 The result of multiple regression analysis for the change in the VNPR

	Coefficient	95% CI	*P* value
Intercept	1.112	− 13.905, 16.129	0.882
Age	0.021	− 0.089, 0.131	0.702
BMI	− 0.033	− 0.350, 0.285	0.835
BA	− 0.058	− 0.106, − 0.009	***0.0210**
Pre-OPE VNPR	0.191	0.015, 0.367	***0.0342**

Multiple R-squared: 0.389

BA breast angle (Fig. 4); *IBMR* internal breast mound ratio (Fig. 5)

*Statistically significant

values; therefore, the surgical indications were determined not only by objective standards but also by various clinical judgments that were made on an individual basis for each patient. At our institution, after considering the likelihood and amount of skin shrinkage after surgery and the intentions of each individual patient, we tended to select the surgical procedure associated with the smallest possible skin incision; as a result, almost 70% of mastectomies in

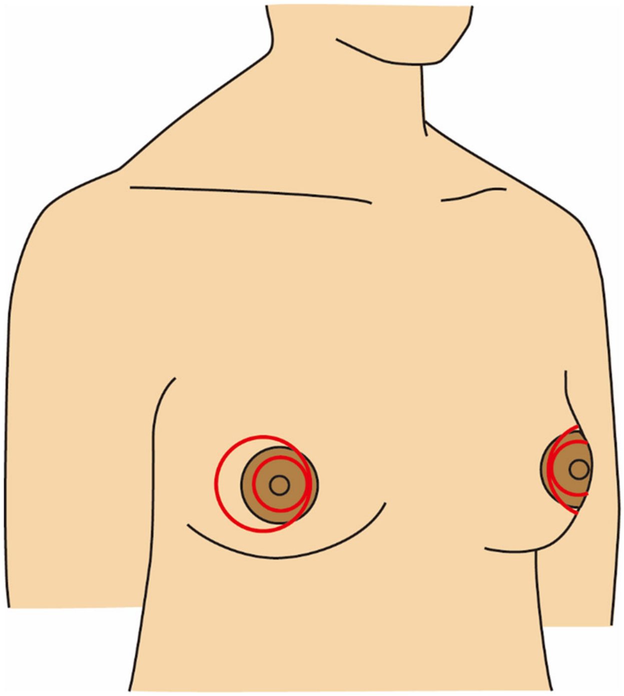


Fig. 7 Laterally deviated eccentric circular type mastectomy. This is a proposed surgical approach for adjusting the NAC position. The basic approach is the same as that of the concentric circular type, but the outer round skin incision is deviated more laterally to adjust the NAC position to lateral side

FTM TS patients have been the semicircular type, and 20% have been the concentric circular type. In a retrospective study reported by Monstrey et al. [18], the prevalence of the semicircular type was 16.3%, while that of the concentric circular type was 38.1%, indicating that surgeries with a greater extent of skin excision than those performed at our institution tended to be selected. This tendency was also noted in other retrospective studies reported later by Cregten-Escobar et al. [20] and Top and Balta [21]. The difference in the prevalence of these surgeries between these two studies and ours was considered to be mostly due to differences in the breast size by race. It may also be due to cultures differences regarding whether the contour is prioritized over scarring (i.e., a longer scar may be preferred if the contour is better). Japanese patients tend to prioritize a smaller scar over all other outcomes.

In terms of the horizontal change in the NAC position, the NAC was positioned significantly more medially after mastectomy than it was before and was located significantly more medially than that in the age- and BMI-matched controls. Furthermore, the NAC did not move laterally in any subject. The factors affecting the medial movement of the NAC after mastectomy were a more advance age, a larger IBMR, and a smaller BA. The characteristics shared by these factors are ptosis, a high projection, and lateral leaning, reflecting low skin elasticity and a substantial amount of skin between the nipples. The NAC may also be positioned more medially both pre- and postoperatively due to underlying rib abnormalities, such as pectus excavatum [27, 28], although such cases were not included in the present study.

In terms of the vertical change in the NAC position, the NAC was positioned significantly more cranially after mastectomy than before; however, the vertical position after mastectomy did not markedly differ from that in the age- and BMI-matched controls. The factors affecting the cranial movement of the NAC after mastectomy were a smaller BA and a larger preoperative VNPR. The characteristic shared by these factors was breast ptosis. However, this factor contributes relatively little to the vertical change in the NAC position, according to the multiple regression analysis results. The vertical change in the NAC position may therefore be related to a combination of factors that are difficult to predict.

Adjusting the NAC position in the first operation is considered possible if a concentric circular surgical approach is selected and the location of the round skin excision is deviated to either side. The present findings suggest that laterally deviated eccentric circular type mastectomy (Fig. 7) may be a good option for patients with moderately sized breasts with a tendency toward ptosis, a high projection, or lateral leaning, as this method is considered to inhibit medial positioning of the NAC after surgery. Concentric (eccentric) circular type mastectomy is considered a good option not only for adjusting the NAC position but also for adjusting the NAC size or facilitating the procedure itself, as this surgical approach enables a better view than the semicircular approach. The NAC position varied among the subjects and may sometimes vary between the right and left sides of an individual subject. Khan [29] described the horizontal position of the NAC in females and its medialized or lateralized variations. Laterally deviated eccentric circular procedures would be advantageous for patients with a discrepancy in the NAC size or location between the right and left sides by allowing adjustment of the circular skin incision.

Conclusions

The NAC position in 41 FTM TS patients pre- and post-non-skin-excisional mastectomy was examined and compared to that of 50 age- and BMI-matched biologically male subjects as controls. Factors affecting the NAC position after mastectomy in these patients were also evaluated. The NAC in the FTM TS patients was positioned more medially and cranially after the surgery, and the NAC was positioned more medially in the patients postoperatively than in the controls. The NAC position on breasts characterized by ptosis, a high projection, and lateral leaning (low skin elasticity and a substantial amount of skin between the nipples) tended to be positioned more medially after non-skin-excisional mastectomy. Laterally deviated eccentric circular type mastectomy may be a good option for FTM TS patients with moderately sized breasts with such features. The results of the present study will be useful as basic data for determining, adjusting, and predicting the NAC position in FTM TS patients or gynecomastia and breast hypertrophy patients after mastectomy.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose:

Ethical Approval This case–control study was approved by the institutional review board of the participating institutions and conducted in accordance with the Declaration of Helsinki on investigations involving humans.

Informed Consent Although informed consent was obtained in the form of an opt-out option on the Web site, for the two patients whose photographs were used in the present article, informed consent was obtained from each patient on an individual basis.

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