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Anthropometric Outcomes, Complications, and Patient Satisfaction Following Masculinizing Chest Surgery in Transgender Men

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ABSTRACT

Objective: To evaluate anthropometric, clinical, and patient-reported outcomes following masculinizing chest surgery in transgender men using Vietnamese male chest anthropometric reference standards.

Methods: A prospective study was conducted in 32 transgender men undergoing masculinizing chest surgery between 2022 and 2025. Preoperative and postoperative chest anthropometric measurements were compared with Vietnamese male reference values. Surgical outcomes, complications, sensory recovery, scar quality, and patient satisfaction were assessed.

Results: Surgical technique selection was significantly associated with preoperative chest classification ($p < 0.001$). Resected glandular tissue volume differed significantly among techniques ($p < 0.001$). Significant postoperative improvements were observed in chest circumference, nipple position, nipple-to-inframammary fold distance, areolar diameter, and anthropometric ratios (all $p < 0.05$). Postoperative thoracic width, areolar diameter, and NH/TL ratio were comparable to male reference values. Overall complication rate was 28.1%, with nipple–areola ischemia and seroma being the most common complications. Most patients demonstrated partial sensory recovery at >3 months postoperatively. Satisfaction was high for chest contour (92.2%), nipple–areola position (96.9–100%), scar appearance (90.6%), and overall surgical outcome (87.5%). Acceptable or aesthetically favorable scars were observed in 87.5% of breasts.

Conclusion: Masculinizing chest surgery achieved favorable anthropometric, clinical, and aesthetic outcomes with acceptable complication rates. Vietnamese male anthropometric reference standards provided a useful framework for objective postoperative evaluation.

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1. Introduction

Masculinizing chest surgery is one of the most important gender-affirming procedures for transgender men and is frequently the first, and sometimes the only, surgical intervention pursued during gender transition [1-3]. Consequently, achieving a masculine chest contour has substantial implications for gender affirmation, psychosocial well-being, and quality of life. The demand for masculinizing chest surgery has increased dramatically over the past decade. In the United States, the number of gender-affirming surgical procedures increased more than 150-fold between 2010 and 2018, while chest procedures accounted for approximately 60% of all gender-affirming surgeries performed between 2019 and 2021 [4, 5]. Similarly, survey-based studies have shown that nearly all transmasculine individuals either have undergone or desire masculinizing chest surgery at some point during their transition process [1, 6].

Numerous studies have demonstrated that masculinizing chest surgery is generally safe and effective across different surgical techniques. A recent systematic review and meta-analysis including 3,055 patients reported favorable outcomes across free nipple grafting, periareolar, and pedicled nipple techniques, although complication profiles and satisfaction rates varied between approaches [7]. Large database studies have likewise shown low short-term complication rates regardless of whether mastectomy, breast reduction, or free nipple grafting techniques were used [8]. From the patient perspective, postoperative satisfaction is consistently high, with pooled estimates approaching 92% overall [1]. Improvements have also been reported in quality of life, body image, sexual confidence, and gender dysphoria-related mental health outcomes following surgery [9]. However, patient satisfaction depends not only on chest flatness but also on aesthetic characteristics such as chest contour, scar appearance, symmetry, and particularly the size and position of the nipple–areola complex [2].

Despite the growing body of literature, most outcome studies focus primarily on complications, revision rates, or global satisfaction

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scores and rarely evaluate postoperative chest morphology using objective anthropometric standards [6, 9, 10]. This limitation is important because surgical planning and aesthetic assessment are fundamentally based on anatomical proportions, including chest dimensions and nipple–areola complex positioning [1, 11]. Furthermore, anthropometric characteristics differ substantially across populations, and previous Vietnamese studies have highlighted the importance of establishing population-specific reference values rather than relying solely on Western standards [12, 13]. Therefore, the development and application of Vietnamese male chest anthropometric reference standards may provide a more objective framework for evaluating surgical outcomes. The present study was conducted to assess anthropometric, clinical, and patient-reported outcomes following masculinizing chest surgery in transgender men using Vietnamese male chest anthropometric reference values as the benchmark for postoperative evaluation.

2. Materials And Method

Study design and participants

This study consisted of two complementary components. First, a cross-sectional anthropometric survey was conducted among healthy Vietnamese men to establish reference values for masculine chest morphology. Second, a prospective observational study was performed to evaluate outcomes of masculinizing chest surgery in transgender men using these anthropometric reference standards.

The reference cohort included 152 healthy Vietnamese men aged 18–40 years recruited by convenience sampling at Bach Mai Hospital and Hanoi Medical University between August 2022 and January 2023. Participants with a history of chest surgery, chest wall deformities, or conditions affecting thoracic morphology were excluded.

The surgical cohort comprised 32 transgender men who underwent masculinizing chest surgery at the Department of Plastic Surgery, Hoe Nhai Hospital, or the Department of Plastic and Reconstructive Surgery, Bach Mai Hospital, between July 2022 and May 2025. Eligible participants had complete medical records, consented to participate, and completed postoperative follow-up evaluations. Patients who developed severe systemic illness during follow-up or underwent subsequent chest surgery affecting postoperative morphology were excluded.

Surgical Technique Selection

Preoperative chest morphology was classified into four categories (Types A–D) according to breast size and degree of ptosis. Surgical technique selection was based on this classification.

Type A breasts were managed using the hemi-periareolar technique. Type B breasts underwent the circumareolar technique. Type C breasts were treated using either a pedicled nipple–areola complex (NAC) flap or circumareolar technique. Type D breasts were managed using either a pedicled NAC flap or free nipple graft technique.

For pedicled NAC flap and free nipple graft procedures, postoperative NAC positioning was planned according to anthropometric reference values derived from the male reference cohort.

Anthropometric Measurements

Anthropometric measurements were performed preoperatively and at postoperative follow-up by the same investigator using standardized techniques. Measurements included chest circumference (CC), thoracic width (TW), thoracic length (TL), inter-nipple distance (IND), sternal notch–to–nipple distance (SN–N), nipple height (NH), nipple-to-inframammary fold distance (NIMF), and areolar diameter (DA).

Two proportional indices were also calculated: nipple height/thoracic length ratio (NH/TL) and inter-nipple distance/thoracic width ratio (IND/TW).

CC, TW, and IND were analyzed at the patient level (N = 32), whereas SN–N, NH, NIMF, DA, and NH/TL were analyzed at the breast level (N = 64 breasts).

Outcome Assessment

The primary outcomes were changes in chest anthropometric measurements following surgery and comparison of postoperative values with male reference standards.

Secondary outcomes included resected breast glandular tissue volume, postoperative complications, nipple–areola complex sensory recovery, scar quality, and patient satisfaction.

Postoperative complications included nipple–areola ischemia and seroma. Sensory recovery was assessed more than three months after surgery using the Medical Research Council (MRC) sensory recovery scale, ranging from S0 (no sensation) to S4 (complete sensory recovery).

Scar quality was categorized as acceptable/good scar or hypertrophic/keloid scar. Patient satisfaction was evaluated regarding chest contour, NAC appearance, scar appearance, sensation preservation, overall surgical satisfaction, and satisfaction with NAC position in both horizontal and vertical dimensions.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Stata version 13.1 (StataCorp, College Station, TX, USA). Continuous variables were summarized as mean and standard deviation (SD), whereas categorical variables were presented as frequencies and

percentages. Differences in resected glandular tissue volume among surgical techniques were analyzed using one-way analysis of variance (ANOVA). Preoperative and postoperative anthropometric measurements were compared using paired t-tests. Postoperative measurements were compared with male reference values using independent-samples t-tests. Associations between chest classification and surgical technique, as well as complication rates across techniques, were analyzed using Fisher's exact test. A two-sided p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Review Board of Hanoi Medical University (Approval No. 1069/GCN-HMUIRB). Written informed consent was obtained from all participants prior to enrollment. All procedures were conducted in accordance with the principles of the Declaration of Helsinki.

3. Results

The surgical cohort included 32 transgender men with a mean age of 26.60 ± 4.30 years (range: 18–34 years), most of whom were between 21 and 30 years old. Mean height, weight, and BMI were 160.80 ± 5.50 cm, 58.40 ± 9.60 kg, and 22.60 ± 3.40 kg/m², respectively, with the majority having a normal BMI and no cases of class II or III obesity. Chest classification showed that type D was the most common, followed by types B and A, whereas type C was the least frequent. Regarding surgical management, the pedicled nipple–areola complex technique was the most frequently used approach, followed by circumareolar and hemi-periareolar techniques, while free nipple grafting was performed least often.

The choice of surgical technique differed significantly across chest classification groups ($p < 0.05$). All Type A breasts were treated using the hemi-periareolar technique, whereas all Type B breasts underwent the circumareolar approach. In Type C breasts, the pedicled nipple–areola complex flap was the predominant technique (66.7%), with the remaining cases managed using the circumareolar approach (33.3%). Among Type D breasts, most were treated with a pedicled nipple–areola complex flap (69.2%), while the remainder underwent free nipple grafting (30.8%). These findings demonstrate a significant association between preoperative chest classification and the selected surgical technique. (Table 1)

Table 1. Surgical techniques according to chest classification (N = 64 breasts)

Surgical technique	Type A	Type B	Type C	Type D	p-value
	n (%)	n (%)	n (%)	n (%)	
Free nipple graft	0 (0.0)	0 (0.0)	0 (0.0)	8 (30.77)	<0.01[f]*
Pedicled nipple–areola complex flap	0 (0.0)	0 (0.0)	4 (66.67)	18 (69.23)	
Circumareolar technique	0 (0.0)	18 (100.0)	2 (33.33)	0 (0.0)	
Hemi-periareolar technique	14 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Total	14 (100.0)	18 (100.0)	6 (100.0)	26 (100.0)	

*[f] Fisher's exact test; * statistically significant at p < 0.05; The unit of analysis was the breast; each patient contributed two observations corresponding to the right and left breasts.*

The volume of resected breast glandular tissue differed significantly among surgical techniques when analyzed at the breast level. The free nipple–areola complex graft technique yielded the largest mean resection volume, followed by the pedicled nipple–areola complex flap technique, whereas the semiperiareolar technique was associated with the smallest resection volume. These differences were statistically significant ($p < 0.05$).

Table 2. Resected breast glandular tissue volume by surgical technique (N = 64 breasts)

Surgical technique	Resected breast glandular tissue volume (g), Mean (SD)
Free nipple–areola complex graft	783.75 (259.90)
Pedicled nipple–areola complex flap	430.45 (94.38)
Periareolar technique	201.25 (64.29)
Semiperiareolar technique	117.00 (40.74)
p-value	<0.01*

**Unit of analysis: breast. ANOVA test. Statistically significant at p < 0.05.*

Significant reductions were observed after masculinizing chest surgery in chest circumference, inter-nipple distance, sternal notch–to–nipple distance, nipple height, nipple-to-inframammary fold distance, areolar diameter, and the NH/TL and IND/TW ratios (all $p < 0.05$). In contrast, thoracic width remained unchanged after surgery ($p > 0.05$). Compared with male reference values, postoperative thoracic width, areolar diameter, and NH/TL ratio were comparable to those of cisgender males ($p > 0.05$), whereas chest circumference, inter-nipple distance, sternal notch–to–nipple distance, nipple height, nipple-to-inframammary fold distance, and IND/TW ratio remained significantly different ($p < 0.05$). (Table 3)

Table 3.Changes in chest and nipple–areola anthropometric measurements before and after masculinizing chest surgery

Parameter	Unit	Preoperative Mean (SD)	Postoperative Mean (SD)	p-value†	Male Reference Mean (SD)	p-value‡
Chest circumference (CC)	cm	87.42 (7.63)	82.52 (7.16)	<0.01*	92.00 (6.50)	<0.01*
Thoracic width (TW)	cm	28.50 (2.30)	28.10 (2.20)	0.103	29.04 (3.91)	>0.05
Inter-nipple distance (IND)	cm	19.73 (1.94)	18.10 (2.27)	<0.01*	19.54 (1.87)	<0.01*
Sternal notch–to–nipple distance (SN–N)	cm	21.52 (3.79)	17.77 (1.35)	<0.01*	19.10 (1.79)	<0.01*
Nipple height (NH)	cm	19.67 (4.62)	15.29 (1.37)	<0.01*	16.22 (1.34)	<0.01*
Nipple-to-inframammary fold distance (NIMF)	cm	7.62 (2.40)	4.14 (0.72)	<0.01*	3.35 (0.80)	<0.01*
Areolar diameter (DA)	cm	3.85 (0.93)	2.47 (0.57)	<0.01*	2.49 (0.45)	>0.05
Nipple height/thoracic length ratio (NH/TL)	–	0.54 (0.12)	0.42 (0.04)	<0.01*	0.43 (0.03)	>0.05
Inter-nipple distance/thoracic width ratio (IND/TW)	–	0.70 (0.06)	0.65 (0.06)	<0.01*	0.68 (0.07)	<0.05*

† Comparison between preoperative and postoperative measurements; ‡ Comparison between postoperative measurements and male reference values; Statistically significant at p < 0.05; Note: CC, TW, and IND were analyzed at the patient level (N = 32). SN–N, NH, NIMF, DA, and NH/TL were analyzed at the breast level (N = 64 breasts). Each patient contributed two breast observations.

Among 32 patients, postoperative complications occurred in 28.1%, all of which were unilateral. The most common complications were nipple–areola ischemia and seroma (12.5% each). Complication rates did not differ significantly among surgical techniques (p = 0.369). At more than 3 months postoperatively, sensory recovery of the nipple–areola complex varied substantially. Most breasts demonstrated partial sensory recovery (S0+ to S2+), whereas advanced recovery (S3) was uncommon and no breast achieved complete sensory recovery (S4). The semiperiareolar technique showed the best preservation of sensation, followed by the periareolar technique, pedicled NAC flap, and free nipple graft. (Table 4)

Table 4. Postoperative outcomes following masculinizing chest surgery

Outcome	n (%)
Overall postoperative complications (N = 32 patients)	
No complications	23 (71.88)
Any complication	9 (28.12)
└ Nipple–areola ischemia (unilateral)	4 (12.50)
└ Seroma (unilateral)	4 (12.50)
└ Combined nipple–areola ischemia and seroma (unilateral)	1 (3.13)
Complications by surgical technique (N = 64 breasts)	
Free nipple graft	1/8 (12.50)
Pedicled NAC flap	5/22 (22.73)
Periareolar technique	1/20 (5.00)
Semiperiareolar technique	2/14 (14.29)
p-value (Fisher's exact test)	0.369
Sensory recovery of the nipple–areola complex (MRC grade, N = 64 breasts)	
S0 (No sensation)	9 (14.06)
S0+ (Dysesthesia/paresthesia)	17 (26.56)
S1 (Recovery of deep cutaneous pain sensation)	7 (10.94)
S2 (Touch sensation with paresthesia)	12 (18.75)
S2+ (Touch and pain sensation recovered, residual paresthesia)	11 (17.19)
S3 (Recovery of touch and pain sensation, no paresthesia)	2 (3.13)
S3+ (Two-point discrimination 7–15 mm)	0 (0.00)
S4 (Complete sensory recovery)	0 (0.00)

Abbreviations: NAC, nipple–areola complex; MRC, Medical Research Council sensory recovery scale.

Postoperative satisfaction was generally high. Almost all patients were satisfied with the position of the nipple–areola complex, with 96.9% reporting satisfaction with horizontal positioning and 100% with vertical positioning. Acceptable or aesthetically favorable scars were observed in 87.5% of breasts. Satisfaction was highest for chest flatness and contour (92.2%), followed by scar appearance (90.6%) and overall surgical satisfaction (87.5%). Satisfaction with areolar appearance reached 76.6%, whereas sensory satisfaction was the

lowest-rated outcome (12.5%). Despite the limited sensory recovery, overall satisfaction with the surgical results remained high. (Table 5)

Table 5. Aesthetic outcomes and patient satisfaction following masculinizing chest surgery

Outcome	n (%)
Satisfaction with nipple–areola complex position (N = 32 patients)	
Horizontal position satisfied	31 (96.88)
Horizontal position dissatisfied	1 (3.12)
Vertical position satisfied	32 (100.00)
Vertical position dissatisfied	0 (0.00)
Scar assessment (N = 64 breasts)	
Acceptable/good scar	56 (87.50)
Hypertrophic or keloid scar	8 (12.50)
Satisfaction with surgical outcomes (N = 64 breasts)	
Chest flatness/chest contour	59 (92.19)
Areolar appearance	49 (76.56)
Scar appearance	58 (90.63)
Sensation preservation	8 (12.50)
Overall surgical satisfaction	56 (87.50)

Note: Satisfaction data for nipple–areola complex position were analyzed at the patient level (N = 32), whereas scar assessment and postoperative satisfaction outcomes were analyzed at the breast level (N = 64 breasts).

4. Discussion

The present study demonstrates that masculinizing chest surgery effectively reshaped the female chest toward a more masculine morphology through both reduction of breast volume and repositioning of the nipple–areola complex (NAC). Consistent with previous reports, objective anthropometric measurements provided quantitative evidence of surgical success rather than relying solely on subjective aesthetic assessment **[14-16].** Furthermore, comparison with male reference data allowed evaluation of how closely postoperative chest morphology approached that of cisgender Vietnamese men, an approach increasingly recommended in contemporary gender-affirming surgery literature **[17, 18].**

Selection of surgical technique was strongly associated with preoperative chest classification. Smaller breasts (Types A and B) were managed using hemi-periareolar and circumareolar techniques, whereas larger and more ptotic breasts (Types C and D) required pedicled NAC flaps or free nipple grafting. This distribution is consistent with the algorithm proposed by Monstrey et al., which recommends limited-incision techniques for smaller breasts and techniques allowing greater skin excision and NAC repositioning for larger or ptotic breasts [19]. The significantly greater volume of glandular tissue removed in the free nipple graft and pedicled flap groups further reflects the more advanced breast morphology encountered in these patients.

Regarding overall chest morphology, chest circumference decreased significantly after surgery while thoracic width remained unchanged. These findings indicate that masculinization was achieved through removal of glandular tissue, redistribution of soft tissue, and management of redundant skin rather than alteration of the underlying thoracic skeleton. Similar observations have been reported by Monstrey et al. (2008) [19], Morselli et al. (2019) *[17]*, and Colombo et al. *(2015)[16]*, who emphasized that successful masculinizing chest surgery primarily targets breast projection and contour while preserving native thoracic dimensions. The stability of thoracic width also confirms that baseline chest skeletal anatomy in this cohort was compatible with the creation of a masculine chest contour.

Horizontal positioning of the NAC remains one of the most challenging aesthetic components of masculinizing chest surgery. Although inter-nipple distance (IND) decreased significantly after surgery, the postoperative value remained lower than the male reference standard. This reduction was most pronounced in the circumareolar and hemi-periareolar groups, likely reflecting postoperative skin contraction and the limited ability of these techniques to reposition the NAC laterally *[17, 20]* In contrast, free nipple grafting and pedicled flap techniques achieved postoperative IND/TW ratios closer to the male reference value (approximately 0.68), supporting previous anthropometric studies demonstrating that proportional indices are more reliable indicators of masculine NAC positioning than absolute measurements alone *[18, 21]*. The high rate of patient satisfaction with horizontal NAC position further suggests that proportional harmony may be more clinically relevant than exact anthropometric equivalence.

Vertical NAC positioning also improved substantially following surgery. Significant reductions were observed in both nipple height and sternal notch–to–nipple distance, indicating successful elevation of the NAC toward a more masculine position. Although postoperative absolute measurements remained lower than male reference values, the NH/TL ratio became nearly identical to that observed in cisgender Vietnamese men. These findings support the concept that proportional rather than absolute positioning should guide NAC placement, particularly in populations where thoracic dimensions differ between sexes *[18, 21]*. The fact that all patients expressed satisfaction with vertical NAC position further reinforces the clinical relevance of ratio-based planning methods.

Additional improvements were observed in the lower pole contour and NAC dimensions. Nipple-to-inframammary fold distance

decreased significantly, reflecting effective elimination of feminine lower pole fullness and inframammary fold prominence. However, postoperative values remained slightly greater than male reference measurements, suggesting that complete normalization of lower pole morphology remains difficult, particularly in larger breasts *[17, 20].* By contrast, areolar diameter was successfully reduced to values comparable with male anthropometric standards, demonstrating that NAC size is a highly controllable surgical parameter. Similar target diameters of approximately 2–3 cm have been recommended in previous studies of masculinizing chest surgery and male chest anthropometry *[18, 20, 21]*.

The safety profile observed in this cohort was acceptable and consistent with contemporary literature. Overall complication rates were relatively low, with nipple–areola ischemia and seroma representing the most common adverse events. Importantly, no significant differences in complication rates were observed among surgical techniques, suggesting that patient selection, extent of dissection, tissue characteristics, and perioperative management may be more important determinants of complications than the specific surgical technique itself [19, 20, 22]. Sensory recovery remained incomplete at 3 months postoperatively, particularly among patients undergoing free nipple grafting, whereas the hemi-periareolar technique demonstrated superior preservation of sensation. This finding reflects the trade-off frequently described in the literature between optimal contour correction and preservation of NAC innervation *[19, 23].*

Patient-reported outcomes were highly favorable overall. Satisfaction with chest contour exceeded 90%, while overall surgical satisfaction reached 87.5%. These findings are comparable to previous studies reporting satisfaction rates between 85% and 92% following masculinizing chest surgery [24, 25]. Satisfaction with NAC appearance was also relatively high and exceeded that reported in several earlier studies [26]. In addition, satisfaction with scar appearance was high (90.6%), consistent with the finding that 87.5% of breasts demonstrated acceptable or aesthetically favorable scars. Notably, satisfaction with sensation was low, yet this appeared to have limited impact on overall satisfaction, suggesting that chest contour, NAC position, scar quality, and aesthetic appearance are more influential determinants of patient-perceived success. Collectively, these findings support the effectiveness and safety of individualized technique selection guided by preoperative breast morphology and anthropometric principles, while highlighting the importance of NAC positioning and favorable scar outcomes as key determinants of aesthetic outcomes and patient satisfaction.

5. Conclusion

Masculinizing chest surgery effectively transformed chest morphology toward a male chest appearance, with significant improvements in chest contour, nipple–areola complex position, and anthropometric proportions. Surgical technique selection was strongly associated with preoperative chest classification, and techniques allowing active nipple–areola complex repositioning achieved postoperative proportions closest to male reference standards. The procedure demonstrated an acceptable safety profile, high overall patient satisfaction, and favorable aesthetic outcomes, supporting the use of anthropometric-based planning to optimize chest masculinization surgery in transgender men.

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