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Rhinoplasty

Quantitative Analysis of Morphometric Changes in Feminization Rhinoplasty Utilizing a Standardized Forehead-Rhinoplasty Technique

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Abstract

Background: Rhinoplasty is one of the most commonly performed facial gender-affirming surgeries (FGASs) for transgender females, but well-established morphometric parameters describing feminizing nasal changes do not exist.

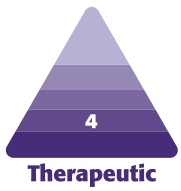
Objectives: Describe the author's technique for feminization rhinoplasty, analyze the changes in 3-dimensional nasal anthropomorphic parameters, and describe patient-reported outcomes.

Methods: Three-dimensional photogrammetric evaluation was performed both preoperatively and postoperatively in transgender female patients who underwent FGAS. Measurements assessed included the nasofrontal angle, nasolabial angle, dorsal height, mid-dorsal width, alar width, nasal tip width, and tip projection. Patients were surveyed preoperatively and postoperatively using the FACE-Q Nose module. Paired *t*-tests were utilized to assess changes in postoperative measurements and FACE-Q Nose satisfaction scores.

Results: Twenty patients underwent FGAS during the study period. The average time between surgery and postoperative 3-dimensional images was 13.6 ± 6.8 months. The nasofrontal angle increased by 8.2° (148.0 ± 7.4° to 156.1 ± 6.7°, $P < .001$) and tip projection increased by 0.017 (0.58 ± 0.03 to 0.60 ± 0.04, $P < .01$). Dorsal height, mid-dorsal width, and tip width all decreased significantly ($P < .05$). There were significant improvements in patients' "Satisfaction with Nose," "Satisfaction with Facial Appearance Overall," "Psychological Function," and "Social Function" on FACE-Q. One revision rhinoplasty was performed, and no documented surgical complications were reported.

Conclusions: There were statistically significant changes in the nasofrontal angle, tip projection, dorsal height, mid-dorsal width, and tip width in patients receiving feminization rhinoplasty. These data may help surgeons with preoperative planning and intraoperative decision making.

Level of Evidence: 4



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Facial feminization surgery (FFS) plays a critical role in gender affirmation and has repeatedly shown improvement in patients' quality of life metrics.[1-6] As the central structure of the midface, the nose is highly influential to gender perception.[7-9] Compared with cis-female noses, cis-male noses are characteristically wider, longer, and straighter, with limited supratip break, a broader and less rotated nasal tip, and a more acute nasolabial angle (NLA).[10-17] Importantly, however, the nasofrontal junction and glabella are also important contributors to the appearance of the upper nose. The cis-male nasofrontal angle is usually more acute in male patients.[18] Indeed, previous work has strongly indicated the importance of the upper third of the face for social identification,[9,19] and nasion position specifically has been identified as one of the main factors in gender-related differences in nasal shape.[20] Thus, a more comprehensive approach to feminization rhinoplasty should address not only the nose, but simultaneously the glabella and nasofrontal junction. Aesthetic rhinoplasty in cis-gender patients addresses the radix, but rarely includes the nasion or facial upper third creating an important distinction.

In addition to the nasofrontal transition, there are several other distinct differences between a more aesthetic cis-female nose and a more feminine gender–affirming rhinoplasty. In general, cis-gender aesthetic rhinoplasty aims to improve facial harmony by addressing relative imbalances between the nose and the face.[21-23] For example, augmentation of the radix can commonly be performed to lessen the relative prominence of a dorsal hump, or tip projection can be performed in patients with increased facial height and nasal length. Feminizing rhinoplasty, in contrast, most commonly calls for a significant reduction of the nose in all dimensions.[24]

Given that the mean cis-male facial bony proportions are larger than a cis-female's, and other facial feminization features simultaneously reduce these anatomic features of the face, including the forehead, brow, jaw, chin, and thyroid cartilage, the relative size of the nose after other feminizing procedures becomes exaggerated. Often, there exists a need to reduce the nasal dorsum to achieve a more subtle gently sloped dorsum and supratip break.[22,25] Finally, feminizing rhinoplasty requires paying special attention to creating a round nostril appearance because cis-male nostrils can be more elongated.[24]

The purpose of this study was to describe the author's standardized technique for feminization rhinoplasty, 3-dimensionally analyze the concurrent changes in facial and nasal anthropomorphic parameters, and describe clinical and patient-reported outcomes.

METHODS

Patient Population

Patients who underwent a rhinoplasty for gender-affirming facial surgery at a large academic medical center between January 2019 and November 2022 were enrolled in the study. Associated facial feminization procedures included frontal sinus setback/forehead contouring, suprabrow contouring, hairline advancement, genioplasty, mandibular contouring, malar implants, lip lift, and/or chondrolaryngoplasty. Patients needed to have a complete panel of 3-dimensional (3D) imaging (VECTRA; Canfield Scientific, Parsippany, NJ) preoperatively and postoperatively in order to be included in this study. Patients without facial feminization surgery as the underlying condition and complete 3D imaging were excluded.

All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this retrospective study, formal consent was not required. Photographic consent was included for the 2 patients who appear in the figures.

Operative Technique

Patients received an open rhinoplasty through traditional columellar and infracartilaginous access incisions. Most patients required and received dorsal cartilaginous and nasal bone reduction using a combination of rasps, sharp scissors, and ultrasonic dorsal reduction (Sonopet System, Stryker, Inc., Kalamazoo, MI). Patient profiles were modified from convex or straight to slightly concave. The caudal septum was routinely inspected, and in the presence of deviation, separated from the maxillary surface and repositioned using a suture through a hole drilled through the anterior nasal spine. Cartilaginous septum was harvested, taking care to preserve a 1 cm dorsal and caudal septal strut. Prominent bony spurs were removed. Cephalic trim of the lower lateral cartilages was performed, with care taken to leave at least 8 mm of cartilage width. The upper lateral cartilages were reapproximated in conjunction with either spreader grafts or upper lateral cartilage autospreader grafts for internal nasal valve patency. In the majority of cases, a caudal septal extension graft was fashioned from the harvested septum and used to control nasal tip projection, rotation, supratip break, and NLA. Cephalic intradomal and caudal transdomal sutures were placed for tip refinement and tip narrowing, and the domes were then affixed in an appropriate position to the septal extension graft. Bilateral inferior turbinate outfractures were routinely performed. A 2 mm osteotome was used for percutaneous osteotomies to infracture and reduce the nasal width. Alar rim grafts were placed to support the external nasal valve. Tip grafts and/or crushed cartilage were used when necessary for final refinement and to address any contour irregularities. Lastly, the alar bases were inspected and alar base resection was performed if indicated to reduce alar base width.

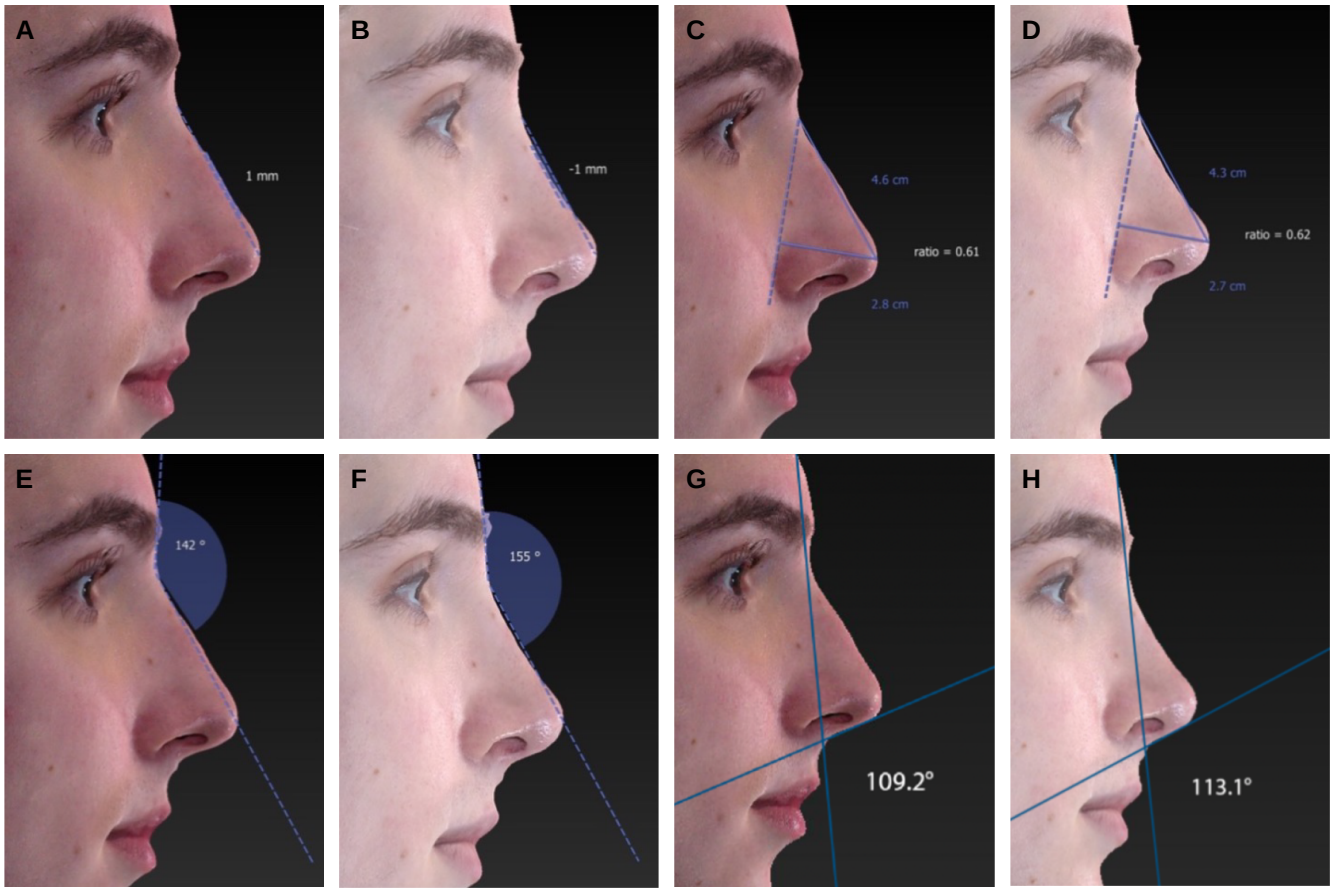

Figure 1. Example of three-dimensional (3D) photographic analysis on (A, C, E, G) a preoperative and (B, D, F, H) postoperative patient: (A, B) dorsal height, (C, D) tip projection, (E, F) nasofrontal angle, and (G, H) nasolabial angle. The patient is a 22-year-old transgender female, and the postoperative photograph was taken 10 months after surgery.

At the conclusion of the rhinoplasty, a trichophytic incision was made in the scalp to access the frontal sinus and nasofrontal junction. The frontal sinus and frontal bone were reduced with an osteotomy and setback or burring alone in the presence of a thick anterior table or minimally pneumatized frontal sinus. Importantly, attention was paid to the nasofrontal angle with significant burring in the glabellar region to adjust the nasofrontal angle.

Three-Dimensional Analysis

Three-dimensional photogrammetric evaluation of the nose was performed preoperatively and postoperatively. Standard anthropometric points were placed and measured by 2 separate observers in a blinded fashion. Variables assessed included alar width, nasal tip width, dorsal height, mid-dorsal width, tip projection, nasofrontal angle, and NLA. The alar width was defined as the distance between the alar points or the most lateral points of each ala. Tip projection was assessed using the Goode ratio, defined as the ratio of nasal projection to nasal length (Figure 1). The nasofrontal angle was defined as the angle formed by the glabella, nasion, and midpoint of the 2 medial canthi overlying the nasal

Table 1. Patient Demographics and Operative Details

Characteristics	Value (%)
n	18
Average age at surgery (years)	34.8 ± 11.6
Average time between surgery and postoperative 3D images (months)	9.4 ± 6.7
Procedure performed	%
Frontal sinus setback/brow contouring	100.0
Genioplasty	94.4
Mandibular contouring	83.3
Chondrolaryngoplasty	33.3
Rhinoplasty revision rate	0.0

3D, 3-dimensional.

Table 2. Three-Dimensional Analysis: Preoperative and Postoperative

Characteristics	Preoperative Mean (SD)	Postoperative Mean (SD)	Change	*P*-value
Alar width (mm)	35.1 (3.6)	33.8 (3.5)	−1.3	.01
Tip width (mm)	9.0 (0.9)	8.7 (1.2)	−0.3	.06
Dorsal height (mm)	1.7 (1.3)	0.1 (1.6)	1.6	.002
Dorsal width (mm)	10.5 (1.2)	10.1 (1.4)	−0.4	.06
Mid-dorsal width (mm)	10.4 (1.2)	10.1 (1.3)	−0.3	.02
Tip projection	0.6 (0.04)	0.7 (0.1)	0.1	.07
Nasofrontal angle (°)	142.5 (8.1)	145.9 (7.0)	3.4	.01
Nasolabial angle (°)	107.4 (7.8)	111.7 (8.2)	4.3	.01

SD, standard deviation.

dorsum. The NLA was defined as the angle formed between a line from the columella to the subnasale and a line perpendicular to the Frankfort horizontal. This measurement is used in the setting of variation in the soft tissue of the lip (as in our patient cohort, which often received upper lip fat grafting).[26,27] The Frankfort horizontal was defined as a line from the upper tragus to the infraorbital rim, as originally described by Guyuron for soft tissue cephalometric analysis.[28] Intraclass correlation coefficient (ICC) was used to measure interrater reliability for each variable.

Patient Satisfaction

Patient satisfaction was assessed preoperatively and postoperatively using the FACE-Q, a patient-reported outcome measure used in patients undergoing facial aesthetic procedures. The completed FACE-Q modules included: "Satisfaction with Nose," "Satisfaction with Facial Appearance Overall," "Psychological Function," "Social Function," and "Satisfaction with Decision." Each question consisted of a 4-point Likert scale from 1 ("very dissatisfied/definitely disagree") to 4 ("very satisfied/definitely agree"). The modules were scored individually, and Rasch-transformed scores (range 0 to 100) were calculated from raw scores. In addition, patient charts were reviewed to assess for unsatisfactory results and revision rates.

Statistical Analysis

Patient demographic data, operative details, and preoperative and postoperative variables measured were compared using paired *t* tests. The significance value was set at <.05, and all statistical analyses were completed in R (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Patient Characteristics and Operative Details

Twenty transgender female patients met the inclusion criteria after patients were excluded because of incomplete follow-up or unavailable 3D imaging. The average age at surgery was 36.9 ± 12.1 years old, ranging from 22 to 63 years of age. The average time between surgery and postoperative 3D images was 13.6 ± 6.8 months, ranging from 5 to 26 months. Rhinoplasty, in combination with forehead reconstruction (frontal sinus setback and brow contouring), was performed in 90% ($n = 18/20$) of patients (Table 1).

Morphometric Changes

The nasofrontal angle increased by a mean of 8.2° (148.0 ± 7.4° to 156.1 ± 6.7°, $P < .001$). The dorsal height decreased by 1.9 mm (1.7 ± 1.1 to −0.3 ± 1.2 mm, $P < .001$), the mid-dorsal width decreased by 1.2 mm (27.5 ± 2.6 to 26.3 ± 2.4 mm, $P = .01$), and tip projection increased by 0.017 (0.58 ± 0.03 preoperatively to 0.60 ± 0.04 postoperatively, $P < .01$). Changes to the alar width (34.8 ± 3.8 mm preoperatively to 34.3 ± 3.7 mm postoperatively, $P = .26$) and the NLA (104.6 ± 11.3° to 104.4 ± 6.2°, $P = .90$) were not statistically significant (Table 2).

Patient-Reported Outcomes

Sixty percent ($n = 12/20$) of included patients completed the FACE-Q both preoperatively and postoperatively. The average time from surgery to completion of the survey was 8.1 months (range = [5.6, 15.8]). The mean score for Satisfaction with Nose increased by 40.6 (35.6 ± 12.2 preoperatively to 76.2 ± 19.0 postoperatively, $P < .001$, Table 3).

Table 3. FACE-Q Scores: Preoperative and Postoperative

Characteristics	Preoperative Mean (SD)	Postoperative Mean (SD)	Change	*P*-value
FACE Q scale (range, 0-100)				
Satisfaction with nose	36.4 (13.0)	79.4 (17.2)	43.0	<.001
Satisfaction with facial appearance overall	33.7 (10.9)	71.4 (19.4)	37.7	<.001
Psychological function	39.3 (11.6)	69.5 (30.6)	30.2	.01
Social function	32.2 (20.2)	73.7 (22.8)	41.5	<.001
Satisfaction with decision	—	84.2 (19.9)	—	—

SD, standard deviation.

The mean score for Satisfaction with Facial Appearance Overall increased by 33.8 (32.5 ± 9.2 preoperatively to 66.3 ± 20.9 postoperatively, $P < .001$). The mean score for Psychological Function increased by 35.5 (37.3 ± 15.4 preoperatively to 65.9 ± 23.6 postoperatively, $P < .001$). The mean score for Social Function increased by 28.6 (29.3 ± 17.7 preoperatively to 64.8 ± 21.2 postoperatively, $P < .001$). Intraclass correlation coefficients ranged from 0.56 to 0.97 for the variables assessed (Supplemental Table 1).

DISCUSSION

In this study, we detail a surgical approach to feminizing rhinoplasty with an objective 3D analysis of the facial and nasal changes as well as subjective patient-reported outcomes. The rhinoplasties in this patient population were associated with a significant increase in the nasofrontal angle and tip projection as well as statistically significant decreases in dorsal height, mid-dorsal width, and tip width. There were also trends toward decreased alar width and decreased NLA, but they did not reach statistical significance. There were significant improvements in patients' Satisfaction with Nose, Satisfaction with Facial Appearance Overall, Psychological Function, and Social Function on FACE-Q. Only 1 revision rhinoplasty was performed, and there were no documented surgical complications.

Previously published studies examining feminization rhinoplasty have not included a comprehensive quantitative analysis of the subsequent changes in facial and nasal proportions.[25,29-31] Thus, well-established anthropometric parameters for surgeons to use as references for feminization rhinoplasty do not exist. Noureai et al published a significantly smaller series of feminization rhinoplasties,[17] but the operative technique was limited to conventional rhinoplasty only without any surgical maneuvers to address the frontal bone and nasofrontal transition. Also, the small series had a heterogeneous rhinoplasty technique with open and endonasal approaches used at roughly similar proportions. Additionally, their anthropomorphic analysis was performed on 2-dimensional (2D) photographs that limited their evaluation of the nasal profile to the nasofrontal angle, NLA, and supratip angle and analyzed surgical results immediately after surgery instead of >6 months postoperatively. As such, the analysis evaluated only a few nasal parameters on profile view and did not include any data describing nasal/alar/tip width that are critical to the overall aesthetic outcome and are apparent on frontal, lateral, oblique, basal, and half-basal views. Lastly, because the "after" analysis was performed in the immediate postoperative window instead of at a later follow-up, the postoperative changes/measurements that the authors described are unlikely to accurately reflect the final rhinoplasty outcomes.[32]

More recently, Bellinga et al published a larger series of facial feminization rhinoplasties.[31] However, their described forehead reconstruction consisted only of utilizing a burr to address the frontonasal transition without any mention of frontal bone osteotomy and setback. The anthropomorphic assessment included only a 2D assessment of the nasofrontal angle without assessment of any other facial or nasal parameters. The authors also did not mention when the postoperative anthropomorphic assessment was performed, and whether postoperative analysis was done at a later follow-up. They reported a 4% revision rate due to infection, dorsal irregularities, or dissatisfaction with the nasal tip.

In contrast, in this study, we described outcomes in a series of patients who underwent feminization rhinoplasty utilizing our standardized combined forehead-rhinoplasty technique. Notably, this is the first study in which a 3D morphometric analysis for quantitative evaluation of feminization rhinoplasty was used, and analysis was performed both preoperatively and at intermediate follow-up. A complete set of anthropomorphic parameters were examined in order to provide a more comprehensive analysis of nasal changes. Finally, patient-reported outcome measures were included, in addition to the analysis of clinical outcomes.

Overall, our findings are consistent with those of previous studies[17,31] and demonstrated statistically significant

Figure 2. Example of (A, C, E, G) preoperative and (B, D, F, H) postoperative patient Vectra (Canfield Scientific, Parsippany, NJ) photographs. The patient is a 22-year-old transgender female, and the postoperative photograph was taken 10 months after surgery.

increases in the nasofrontal angle, significant decreases in dorsal height, and high levels of patient satisfaction. In addition, we noted significant decreases in mid-dorsal width and tip width, as well as trends toward decreased alar width. Our findings provide objective data to quantitatively describe many of the widely touted but subjective aesthetic goals of feminizing rhinoplasty, including lowering and softening the nasofrontal junction, modifying the nasal profile/supratip break to slightly concave, narrowing the nose and nasal tip width, and refining and rotating the nasal tip (Figures 2, 3). We demonstrate that these operations can be performed safely and with low

Figure 3. Example (A, C, E, G) preoperative and (B, D, F, H) postoperative patient Vectra (Canfield Scientific, Parsippany, NJ) photographs. The patient is a 23-year-old transgender female, and the postoperative photograph was taken 8 months after surgery.

complication rates, high patient satisfaction rates, and low surgical revision rates.

Because this was a retrospective review, it is subject to the limitations inherent to this type of study design. The sample size limits the power of the findings. Nevertheless, statistically significant morphometric changes were observed and patients underwent a similar standardized forehead-rhinoplasty technique, which may increase the generalizability of the findings compared with other studies in which multiple different surgical approaches were used. Morphometric analysis is subject to a certain degree of inherent measuring variance, but 3D photogrammetry allows for more accurate measurements than 2D photographs[33-36] and was specifically utilized in this study in an effort to quantify anthropomorphic changes

with a higher degree of fidelity. Additionally, measurements were performed by 2 separate observers in a blinded fashion to mitigate operator error, and ICC was indicative of good-to-excellent interrater reliability.

Interestingly, patient satisfaction was not directly related to the degree of nasal changes, but the degree of aesthetic modification was carefully balanced to achieve facial harmony. Patients underwent additional procedures simultaneously, making it a challenge to isolate patient-reported outcomes relative to the forehead-rhinoplasty procedure alone. Nonetheless, the presented data are still useful to demonstrate that these procedures as a whole are beneficial for patients' gender affirmation. Furthermore, recent studies have suggested that postoperative isotretinoin can improve scarring and tip definition following rhinoplasty in patients with thick skin.[37-39] Although none of this patient cohort was given isotretinoin postoperatively, future studies should include investigation of this regimen's efficacy in the transgender female population. Future directions include examining a larger series of patients, comparing the aesthetic preferences of transgender female patients against the typical "ideal female nose," and assessing nose-specific patient-reported functional outcomes using instruments such as the Nasal Obstruction Symptom Evaluation Survey.[40]

CONCLUSIONS

This study represents the first investigation to date of 3D quantitative morphometric changes following feminization rhinoplasty using a standardized forehead-rhinoplasty technique. There were statistically significant changes in the nasofrontal angle, dorsal height, mid-dorsal width, tip width, and tip projection. Although it is important to optimize the surgical plan for each individual patient, these data may assist surgeons performing feminization rhinoplasty with preoperative planning and intraoperative decision making.

Supplemental Material

This article contains supplemental material located online at www.asjopenforum.com.

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