



Original Research Article

Morphometric analysis of pre and post operative facial angles following rhinoplasty

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ABSTRACT

Introduction: Facial aesthetic surgery requires a thorough preoperative analysis of face and identification of problems to frame a comprehensive surgical plan. The conceptions of an attractive face must be analyzed beforehand. Powell and Humphrey had defined facial angles and had formulated range which would be perceived as attractive.

Objective: To compare the change in pre- and post-operative nasolabial, nasofrontal and nasofacial angles in patients undergoing Rhinoplasty.

Materials and Methods: A prospective observational study was conducted from October 2014 to October 2019 in ENT department of a tertiary care hospital. Twenty-one patients undergoing Rhinoplasty and fulfilling the inclusion criteria were considered as study population. Their pre- and post-operative profile photographs were taken for morphometric analysis. The nasolabial, nasofrontal and nasofacial angles were measured and compared, before and one month after the surgery in profile pictures.

Results: A significant change in the nasolabial and nasofacial angles were seen following Rhinoplasty. The mean nasofrontal angle showed an increase following Rhinoplasty but was not found significant.

Conclusions: Rhinoplasty results in significant change in nasofacial and nasolabial angles and in expert hands, is expected to restore the various facial angles to their acceptable range.

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1. Introduction

The nose is the most prominent structure in facial profile and plays an important role in perception of beauty. Deviated nose can result in aesthetic, functional as well as psychological problems, leading the individuals to seek treatment. Rhinoplasty is one of the most frequently performed aesthetic surgical procedures in the world which can achieve a more balanced facial appearance and also improve nasal airway when combined with Septoplasty. At the same time, it is also one of the most challenging surgical

procedures and may lead to patient dissatisfaction. It has been described as an easy surgery to do badly and a difficult surgery to do perfectly.¹

Facial morphometry has been used to analyze the face objectively. The face has been divided into various proportions, and the various angles that the nose makes with the rest of the face have been studied for identification of the ideal angles that are perceived as most beautiful by the population.² For a successful Rhinoplasty, a comprehensive preoperative analysis of nasofacial proportions is of utmost importance to help the operating surgeon to establish definite surgical goals and adopt the optimum surgical technique. Making of a surgical plan that would yield

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harmonious Rhinoplasty results for patients necessitates a detailed analysis of the patients' angular and proportional profiles prior to surgery. Attractive faces are deemed to have ideal measurements and angles which have been described by Powell and Humphrey. They described ideal angles of the facial aesthetic triangle and gave the accepted dimensions of the facial angles: Nasolabial angle: 90 to 95° in males and 95 to 105° in females, Nasofacial angle: 30 to 40° degrees and Nasofrontal angle: 115 to 135°.³ These facial proportions act as a guide and are helpful in planning a procedure, though they cannot be taken as absolute values.

Studies have been done to evaluate the normal values of various facial angles and proportions using cephalometry, anthropometry, and photogrammetry. An accurate documentation of pre-operative appearance of patient is required for medico-legal documentation, to aid in explanation of surgical procedure to patient and obtain informed consent for same, planning of surgical technique and digital image manipulation to forecast expected surgical outcome.⁴ There is a lack of literature on the changes in facial angles in relation to nose following rhinoplasty. This study was conducted with aim to compare the pre- and post-operative nasofrontal, nasofacial and nasolabial angles using facial morphometric measurements and to observe if they fall in the ideal range as previously described in literature.

2. Materials and Methods

A prospective observational study was conducted from October 2014 to October 2019 in the Otorhinolaryngology department of an academic tertiary care hospital. A sample size comprising of 21 patients undergoing Rhinoplasty in the age group of 18 to 40 years of both genders consenting to participate in the study were included. Patients below 18 years or those who had any previous septal or nasal surgery, systemic diseases like tuberculosis, syphilis, sarcoidosis, wegner's granulomatosis, immunodeficiency, or psychological disorders were not included in the study. All surgeries were performed under general anesthesia by a single surgeon with experience in performing Rhinoplasties.

All the patients had their photographs taken in various views as per standard protocol for Rhinoplasty.⁴ Post-operatively, the patients were photographed similarly one month after the surgery. The evaluation was made from profile photographs of the patients taken pre-operatively and one-month post-operatively. The angles studied were nasofacial, nasofrontal and nasolabial angles (Figure 1). Nasofacial angle is formed by the intersection of two lines, one drawn from nasion to pronasalae and another drawn from glabella to pogonion.⁵ Nasolabial angle is the angle formed between the plane of columella and upper lip as seen on profile view.⁶ The nasofrontal angle is the angle between the plane of nasal dorsum and a plane joining the nasion to glabella.² Morphometric analysis of the images

was performed using software (GNU Image Manipulation Program version 2.10.20). The data was tabulated and stored in a Microsoft Excel sheet. Statistical analysis was done using IBM SPSS version 20. Wilcoxon signed-rank test was used to compare the pre- and post-operative angles as measured on the photographs.

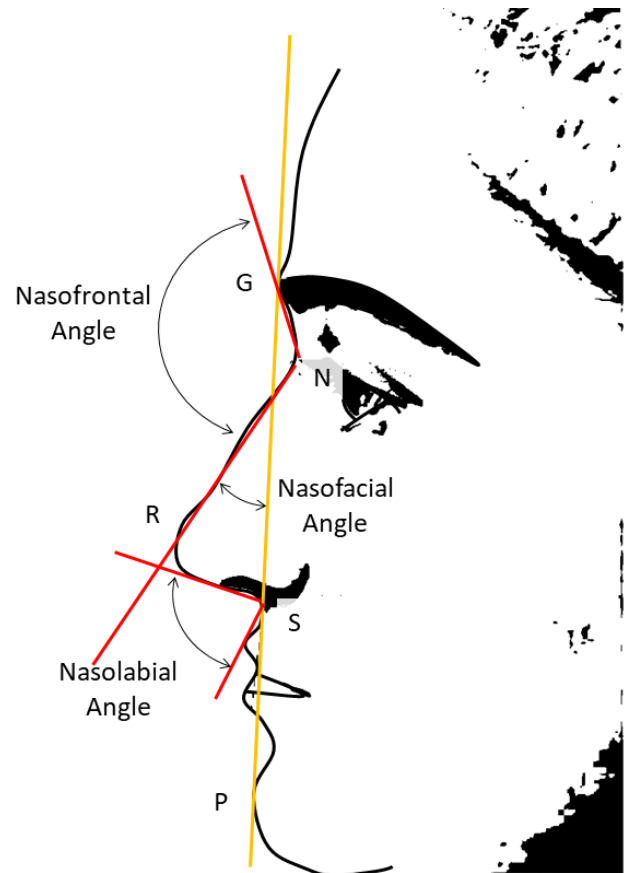


Fig. 1: Illustration of various cephalometric angles on facial profile. [G: Glabella (most prominent midline point between eyebrows); N: Nasion (deepest point of nasofrontal angle); R: Rhinion (midline point at junction of nasal bones and upper lateral cartilages); S: Subnasale (midline point of junction of columella with upper lip); P: Pogonion (anterior-most point of chin)]

3. Results

A prospective observational study was conducted in the Otorhinolaryngology department of a tertiary care hospital from October 2014 to October 2019. A total of 21 patients meeting the inclusion criteria and having undergone surgery was included in the study. The mean age of study participants was 28.4 ± 6.1 years. The gender distribution was M:F = 13:8. No patients were lost to follow-up.

The patients' facial angles were computed from profile photographs and the angles were compared pre- and post-operatively (Figure 2). The mean nasofrontal angle measured pre-operatively in the study population was

127.5±8.4° while post-operatively it was 130.5±5.7°. The mean nasofacial angle pre-operatively was 27.4±3.9° while post-operatively it was 30.0±3.5°. The mean nasolabial angle pre-operatively was 96.4±7.9° while post-operatively it was 101.6±4.2°.

Wilcoxon signed-rank test was used to compare the pre- and post-operative values of various facial angles. From the above data it was seen that there was an increase in the nasofrontal, nasofacial and nasolabial angles post-operatively following Rhinoplasty as compared to the pre-operative measurements. Following the surgery, the mean increase in nasofrontal angle was 2.9±7.0° (p=0.085), the nasofacial angle increased by 2.6±3.9° (p=0.015) while the nasolabial angle increased by 5.2±9.3° (p=0.010) (Table 1). Thus, there was a significant increase in the nasofacial and nasolabial angles, while there was no significant change in nasofrontal angle post-operatively.

4. Discussion

The perceived improvement in facial profile post Rhinoplasty can be assessed by measurement of various cephalometric angles. The angles studied most commonly include the nasolabial, nasofacial and nasofrontal angles. Out of these, the nasofrontal angle is said to be of the least importance in terms of subjective assessment for aesthetic improvement.⁷

Pasinato R et al studied the changes in various angles measured on nose following Rhinoplasty. They found a significant increase in nasolabial and nasofrontal angles, and a reduction in the nasofacial angle following rhinoplasty.⁸ In our study, we find an increase in all the three angles measured on face with relation to the nose. This seems to be due to the pre-op facial morphometry of patients and the patients in our study requiring mostly reduction rhinoplasty that is expected to have an increase in the nasolabial and nasofrontal angles post operatively.

Shahbazi Z et al studied the changes in nasolabial angles in patients undergoing Rhinoplasty. They observed that the mean nasolabial angle in men was 92.4° and in women was 97.12°, which increased post-operatively to 111.28° in men and 111.81° in women.⁹ The results of our study are similar to theirs as our data shows a mean increase of 5.2±9.3° following rhinoplasty.

Gräber I et al. studied the changes in cephalometric angles in patients undergoing Rhinoplasty and compared the subjective and objective outcomes. They found that nasofrontal angle was not within the normal range in 85% of all cases pre-operatively, and post-operative normalization was achieved in 10% of additional cases. The nasofacial angle was beyond the normal range in 35% of all cases and successful correction to normal range was observed in 70% of such cases. Nasolabial angle was outside the normal range in 36% of all cases and was corrected to normal range in 71% of such cases. On comparison of objective with

subjective parameters, they found that objective evaluation matches subjective evaluation in 70% of all cases, while in remainder, the objective rating was found to be better than the subjective evaluation. They concluded that the nasolabial and nasofacial angles are of greater importance for subjective aesthetic correction of nasal deformities than the nasofrontal angle which seems to be of minor importance.⁷

Naini FB et al. studied the aesthetics of nasal dorsum, with aim to identify the range of nasofrontal angle deemed most acceptable to the patients, clinicians and the general population. They found that a nasofrontal angle of 127-142° was deemed acceptable by most people, and an angle of 130° was regarded as ideal. Additionally, they found that nasofrontal angle of less than 118° or greater than 145° was regarded as highly unacceptable.² The results of our study also show that the mean nasofrontal angle was 127.5±8.4° preoperatively and 130.5±5.7° post operatively. It is also seen that pre-operatively, two patients had a nasofrontal angle > 142° (unacceptable), while one of them had a nasofrontal angle of >145° (highly unacceptable). Post-operatively, their nasofrontal angle was reduced to the acceptable range of 127-142°. Additionally, a total of 10 patients had nasofrontal angle of <127° (with two of them <118°). Nine out of these ten patients had an increase in nasofrontal angle post operatively, and five of these nine had nasofrontal angle restored to normal range of 127-142°.

Siddapur KR et al. studied the angulations of nose using photographic techniques in a sample of medical students representing the south Indian population. They found a mean nasofrontal angle of 131.9±8.1° (Males 126.2±8.8° and females 135.1±5.5°).¹⁰ In our study, none of the patients have a nasofacial angle beyond mean±2SD as determined by Siddapur KR et al.

The nasolabial angle has been regarded as a key aesthetic parameter not just by regards of plastic surgeons but also by the orthodontic surgeons.¹¹ Estimates regarding the ideal desirable value of nasolabial angle vary in literature and are affected by multiple factors including race and gender. Sinno HH et al studied the preference of people regarding the optimum value of nasolabial angle to find the ideal value. They found that the most preferable nasolabial angle was 97.0±6.3° in males and 104.9±4.0° in females. Therefore, the ideal range of nasolabial angle was estimated by them to range from 90.7 to 103.3° in males and 100.9 to 108.9° in females.⁶ Armijo BS et al. studied the nasolabial angles perceived to be most aesthetically pleasing by plastic surgeons, residents, nurses and other office staff. They found an angle of 95.96±2.57° and 97.7±2.32° most suitable for males and females respectively.¹²

Studies regarding the normal range of nasolabial angle in the Indian population have reported a varying range of observed normal nasolabial angles. As observed by Dua V et al., the normal range of nasolabial angle in the



Fig. 2: Pre- and post-operative measurements of facial angles on profile photographs illustrated for four study patients

Table 1: Observed values of Nasofrontal, Nasofacial and Nasolabial angles in study subjects pre and post Rhinoplasty

S No	Age	Sex (M/F)	Nasofrontal angle (°)			Nasofacial angle (°)			Nasolabial Angle (°)		
			Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
1	28	M	130.2	137.3	7.1	30.2	32.4	2.2	92.0	106.2	14.2
2	34	M	129.8	136.9	7.1	23.1	27.7	4.6	94.9	104.1	9.2
3	29	F	119.1	121.3	2.2	22.4	25.4	3.0	93.8	100.1	6.3
4	36	M	124.0	127.1	3.1	28.8	31.2	2.4	91.2	97.8	6.6
5	18	M	130.2	135.7	5.5	29.3	36.1	6.8	95.7	102.5	6.8
6	22	M	127.8	133.4	5.6	22.7	29.2	6.5	92.4	99.2	6.8
7	21	F	134.1	129.2	-4.9	23.6	28.7	5.1	93.3	96.9	3.6
8	33	M	126.2	135.6	9.4	32.2	35.4	3.2	95.5	105.1	9.6
9	25	F	121.3	127.5	6.2	25.4	27.8	2.4	87.9	92.4	4.5
10	38	M	127.8	134.2	6.4	32.5	34.8	2.3	94.2	104.8	10.6
11	37	F	117.4	130.7	13.3	22.7	25.9	3.2	89.7	98.6	8.9
13	26	F	118.8	131.6	12.8	23.9	28.6	4.7	93.2	98.2	5.0
13	26	F	118.8	131.6	12.8	23.9	28.6	4.7	93.2	98.2	5.0
14	19	F	119.2	123.9	4.7	27.6	32.8	5.2	95.4	101.5	6.1
15	22	M	120.1	119.5	-0.6	28.2	32.5	4.4	98.8	108.8	10.0
16	24	F	147.7	134.1	-13.6	22.2	31.2	9.0	94.9	104.9	10.0
17	28	M	129.3	120.6	-8.7	34.2	27.3	-6.9	119.7	96.5	-23.2
18	32	M	142.1	136.3	-5.8	27.6	23.2	-4.4	92.8	105.2	12.5
19	26	M	123.0	126.4	3.4	29.3	28.2	-1.1	97.7	107.1	9.4
20	33	M	117.7	126.5	8.8	32.4	27.7	-4.7	118.0	98.4	-19.6
21	35	F	140.8	135.0	-5.8	25.6	30.4	4.8	94.5	104.4	9.9
Mean	28.4		127.5	130.4	2.9	27.4	30.0	2.6	96.4	101.6	5.2
SD	6.1		8.4	5.7	7.0	3.9	3.5	3.9	7.9	4.2	9.3
p				0.085			0.015			0.010	

Indian population is $96.1 \pm 9.7^\circ$ with no significant gender variation.¹¹ Kommi PB et al. found the normal nasolabial angle in the South Indian population to be $101.73 \pm 12.57^\circ$ in males and $99.76 \pm 15.35^\circ$ in females (overall mean of $99.76 \pm 15.35^\circ$, with no statistical differences between the two genders).¹³ Siddapur KR et al found the nasolabial angle in south Indian population to be $88.6 \pm 9.3^\circ$ in males and $104.0 \pm 8.1^\circ$ in females (overall mean of $98.4 \pm 11.3^\circ$).¹⁰

In our study, it is seen that pre-operatively, two male patients have nasolabial angle greater than the normal range as reported by Dua V et al. Post-operatively, these patients had the nasolabial angles restored to the ideal range. However, it is seen that three of the other patients had nasolabial angles greater than the normal range post operatively. This can be related to alteration of nasal tip and columella as deemed appropriate by the surgeon for nasal aesthetics.

Naini FB et al. studied the preferred nasofacial angle in the Caucasian population. They found an angle of about 30° to be ideal, and an acceptable range of $27-36^\circ$. Angles less than 21° or more than 42° were found to be very unattractive. The threshold for nasofacial angle beyond which the study participants seek Rhinoplasty was found to be $\leq 24^\circ$ and $\geq 39^\circ$.⁵ In our data, a total of nine patients were pre-operatively found to have nasofacial angles beyond the acceptable range stated above. Out of these nine, seven patients had nasofacial angles beyond the threshold for seeking Rhinoplasty. Post-operatively, only four out of nine patients had nasofacial angles beyond the acceptable range. Overall, the patients had a mean increased in nasofacial angle as compared to the pre-op measurements.

Siddapur KR et al. found the mean nasofacial angle in a south Indian population to be $35.2 \pm 3.3^\circ$, with no significant gender variation.¹⁰ In our study, it is seen that pre-operatively, 12 of the patients had nasofacial angle beyond mean $\pm 2SD$ as determined by Siddapur KR et al. Post operatively, the number of such persons reduced to eight.

The strengths of this study lie in the objective assessment of facial angles in relation to the nose and studying their changes post rhinoplasty. There are some weaknesses in the current study, including lack of subjective assessment and patient perception of the changes in facial appearance following the rhinoplasty. Addition of same would have helped in understanding patient perceptions of facial features and their correlation to the changes in nasal angles.

5. Conclusion

From the results of our study, it can be concluded that a significant change is observed in nasofacial and nasolabial angles following Rhinoplasty. The change in nasofrontal angle was not found to be significant in our study. In expert hands, Rhinoplasty is expected to restore the various facial angles to their acceptable range in a majority of the patients.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare no conflict of interest.

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