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Preoperative Facial Analysis for Corrective Rhinoplasty

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Abstract

Background: Cosmetic Rhinoplasty now transcends all age, gender, socioeconomic, and ethnic classes, and is no longer considered an indulgence reserved only for the wealthy. As Indian society continues to strive for facial beauty, cosmetic Rhinoplasty ranks among the most commonly performed cosmetic surgical procedures in India. **Aim & Objective:** This study was aimed at developing a soft tissue facial analysis with special emphasis on nose morphology. This can be used for evaluation of nasal deformity, treatment planning for the correction achieved during Rhinoplasty, with the objectives to establish anthropometric norms and composite index of facial outcome. **Subjects and Methods:** All the maxillofacial anthropometric parameters were studied on standardized digital photographs in a sample population of 40 males and 40 females of age 18-22 years. Statistically, all the anthropometric parameters were assessed for their theoretical distribution using normal (Gaussian) distribution. Their Goodness of fit was tested by Chi Square Test. Composite Index was established by factor analysis. Their inter-relationship was studied by factor analysis. The pre- and post- comparisons were made using paired't' test. **Results:** All the anthropometric norms followed normal (Gaussian) distribution pattern. The component matrix analysis showed that the male and female anthropometric norms followed a definite pattern to form a component index. **Conclusion:** The study needs to be continued as a multicentric study with regards to graft material and its acceptability by recipient site. Another parameter that needs to be considered is the degree of patient satisfaction.

Keywords: Anthropometric Norms, Nose Morphology, Orthognathic Surgery, Plastic Surgery, Rhinoplasty.

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Introduction

As Indian society continues to strive for facial beauty, it is not surprising thatcosmetic Rhinoplasty ranks among the most commonly performed cosmetic surgicalprocedures in India. Fuelled by a growing acceptance of cosmetic surgery, ever morefavorable cosmetic outcomes and widespread media attention, cosmetic nasal surgerycontinues to grow in popularity at an unprecedented rate.[1] Cosmetic Rhinoplasty nowtranscends all age, gender, socioeconomic, and ethnic classes, and is no longerconsidered an indulgence reserved only for the wealthy. Indeed, cosmetic Rhinoplastyis becoming increasingly prevalent worldwide, with growing popularity in Asia,America and Europe. It appears that cosmetic nasal surgery has come of age andfurther expansion of its popularity seems inevitable.[2]

The anthropometric methods andsurgical practice intersect at a point to treat congenital or post traumatic facial disfigurements in various racial or ethnic groups. Surgeons performing Rhinoplastyrequire access to facial databases based on accurate anthropometric measurements toperform optimum correction in both sexes. Though technically Rhinoplasty is similarfor men and women, certain points should be considered during the cosmetic nasalsurgery, asexpectations from surgery are different in both the sexes.[3] This study is away to clarify these important points which should be considered during Rhinoplasty. This can also be a basis for further clinical studies to enhance the planning andoutcome of corrective surgery.

Septal cartilage, conchal cartilage from pinna, autogenous rib cartilage, iliac crest,ethmoid bone graft, vomer and parietal bone are the different autogenous tissues usedfor Rhinoplasty.[4]

Rhinoplasty is the most difficult of all cosmetic operations for three reasons: (1) nasal anatomy is highly variable, (2) the procedure must correct form and function, and (3) the final result must meet the patient's expectations.

As one enters practice and begins to learn Rhinoplasty surgery in the real world, decisions have to be made and their consequences must be accepted. Hopefully, these principles will guide the younger surgeon through the challenges of learning Rhinoplasty surgery.[5]

Form without function is a disaster. Most postoperative nasal obstruction reflects a failure to diagnose and treat a preoperative subclinical condition. One must identify and correct preexisting anatomical deformities of the septum, nasal valves, and turbinates. There is no excuse for not doing a thorough preoperative internal exam and recording a specific operative plan.[6] One must accept in advance that

there is no magic operation that guarantees perfect results. Each surgical maneuver within an operation has its learning curve. Within an operative sequence, the individual maneuvers are additive, but their interactions and potential complications are geometric.[7]The field of Orthodontics is not only restricted to correction of dento-facial deformities, but it also encompasses Orthognathic surgery and plastic surgery, which includes Rhinoplasty.[8,9]

Therefore this study was undertaken to broaden the understanding of anthropometric norms of pleasing male and female faces/ facial features, and to utilize these norms for establishing an index as well as to check the outcome of facial surgeries.There is a need to study the distribution of facial anthropometric measurements, so that surgeons can use the set norms during Rhinoplasty in choosing an acceptable (appropriate) combination to arrive at or achieve a desired outcome.

The study is aimed to develop a soft tissue facial analysis for young population of the Indian subcontinent with special emphasis on nose morphology, which can be used for evaluation of nasal deformity for the treatment planning of Rhinoplasty.

Subjects and Methods

40 males and 40 females within the age group of 18-22 years were chosen after screening 200 subjects to participate in the study for obtaining photographic records. 40 photographs of each gender were selected using simple random sampling to study the distribution of anthropometric norms. The study was conducted in Department Of Otorhinolaryngology, BKL Walwalkar Medical College, Chiplun, Ratnagiri (M.S.) in the period of two months from March 2019 to May 2019.

Inclusion criteria were pleasing facial appearance (Subjective) and pleasing facial profile. (Subjective), exclusion criteria were gross facial asymmetry and previous history of facial surgery including Orthognathic surgery.

Photographic setup and recording of measurements

The photographic setup consisted of Nikon D70 Digital SLR Camera. All the pictures were taken in the aperture priority mode of camera with aperture at 16 and built in flashlight was used for uniform or constant illumination. The center of the camera lens was kept at 5 ft. away from the subject. This distance was a standard to obtain sharp image. In order to obtain records in natural head position (NHP), the subjects were positioned on a line marked on the floor and were asked to stand in relaxed position and to look straight into the mirror at the eye level, which was kept 5 feet away from the subject.

Following landmarks were marked on the photographs

- Trichion: Anterior hairline in the midline
- Glabella: Most prominent midline point of forehead, well appreciated on lateral view
- Nasion: Most posterior midline point of forehead corresponding to nasofrontal suture (root of the nose)
- Tip: Most anteriorly projecting aspect of the nose
- Subnasale: Junction of columella and upper lip
- Pogonion: Most anterior soft tissue point on chin in the midline
- Menton: Most inferior point on chin
- Cervical point: Point of intersection between the line tangent to the neck and the line tangent to the submental region.
- Canthus: The angle formed by the upper and lower eyelids at the nasal (inner or medial canthus) or temporal (outer or lateral canthus) end. Outermost border of the pinna/ auricle visible on the frontal photograph, on right and left side.
- Ala: the flaring cartilaginous expansion forming the outer side of each of the nares.

Male and female anthropometric parameters were assessed for their theoretical distribution using normal (Gaussian) distribution. Their Goodness of fit was tested by Chi Square Test. The differences between expected and observed distribution were not significant. ($p > 0.8$)

All the graphs exhibited fairly good fitness with normal curve ($p > 0.8$). The anthropometric parameters studied behaved in a similar manner. The parameters followed the normal distribution pattern.

Results

Following parameters showed fairly good fitness with normal curve in males and females.

- Trichion to Glabella,
- Glabella to Subnasale,
- Subnasale to Menton,
- Intercanthal width
- Nasofrontal Angle
- Nasofacial angle,
- Mentocervical angle,
- Facial Convexity Angle
- Nasolabial Angle
- Nasal width,
- Nasal height,
- Right side of Nasal triangle,
- Left side of Nasal triangle,
- Base of Nasal triangle,
- Apex angle of Nasal triangle,
- Inter Alar distance.

Mean and standard daviation of all the parameters were described in Table 1. This shows that the above mentioned parameters of the pleasing face followed the normal distribution pattern, with 68% of the readings falling in mean + 1SD, 95% falling in mean + 2SD and 99% falling in mean + 3SD. Intercanthal width also followed the normal distribution pattern with Mean: 43.29 mm and SD: 3.45. The range of observations was with mean -1SD to +2SD. Nasofrontal angle with Mean: 134.60º and SD: 7.66 showed the normal distribution pattern and all the readings were observed within mean + 1SD. The normal distribution of Nasomental angle with Mean: 129.66º and SD: 4.14 showed a range from -2SD to +1SD. Nasomental line to Upper lip distance with Mean: 5.18mm and SD: 3.08. Nasomental line to Lower lip distance with Mean: 2.70 mm and SD: 3.08 followed normal distribution pattern. Normal distribution

pattern was observed with Facial Convexity Angle Mean: 12.03º and SD: 5.56. Nasolabial Angle with Mean: 96.99º and SD: 15.40. Left side of nasal triangle also followed the normal distribution pattern, but there was a slight variation as compared to right side (Rt. Side of Nasal triangle Mean: 40.40 mm, SD: 3.23 and Left Side of Nasal triangle Mean: 40.13 mm, SD: 3.01); Intercanthal width also followed the normal distribution pattern with Mean: 40.03 mm, SD: 3.28 and Nasofrontal angle with Mean: 140.91º and SD: 6.94 showed the normal distribution pattern. The normal distribution of Nasomental angle with Mean: 129.17º and SD: 5.08. Nasomental line to Upper lip distance with Mean: 4.31mm and SD: 2.36. Nasomental line to Lower lip distance with Mean: 2.05mm and SD: 2.70. Normal distribution pattern was observed with Facial Convexity Angle with Mean: 14.68º and SD: 5.39.

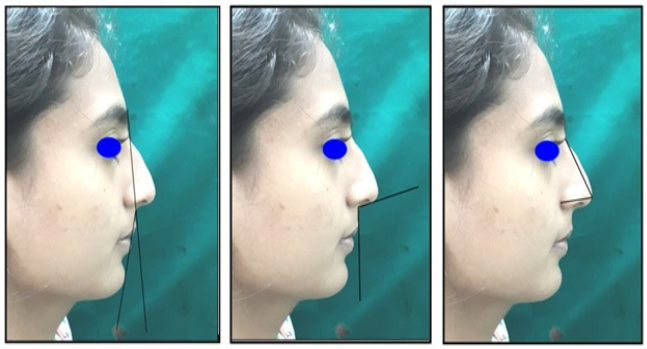
Nasolabial Angle with Mean: 104.04º, SD: 10.74. Left side of nasal triangle also followed the normal distribution pattern, but there was a slight variation as compared to right side (Rt. Side of Nasal triangle Mean: 35.63 mm, SD: 2.68 and Lt. Side of Nasal triangle Mean: 35.10 mm, SD: 2.79); Right Side angle of Nasal triangle and left Side angle of Nasal triangle also followed the normal distribution pattern, but there was a slight variation as compared to right side (Rt. Side angle of Nasal triangle Mean 55.28o, SD: 4.50 and Lt. Side angle of Nasal triangle Mean: 56.12o, SD: 4.66); Base of nasal triangle with Mean: 39.36 mm and SD: 3.39.

Table 1:Male &Female sample mean and standard deviation

Anthropometric parameter	Male		Female		Total	
	SD	Mean	SD	Mean	SD	Mean
Trichion to Glabella distance	68.00	5.90	62.88	5.69	65.44	6.32
Glabella to Subnasale distance	75.53	6.62	74.39	5.07	74.96	5.89
Subnasale to Menton distance	89.06	8.63	72.82	4.92	80.94	10.74
Intercanthal width	43.29	3.45	40.03	3.28	41.66	3.73
Nasofrontal Angle	134.60	7.66	140.91	6.94	137.75	7.93
Nasofacial Angle	32.28	3.12	31.47	3.26	31.87	3.20
Nasomental Angle	129.66	4.14	129.17	5.08	129.41	4.62
Mento Cervical Angle	103.05	9.29	98.42	7.48	100.73	8.70
Facial Convexity Angle	12.03	5.56	14.68	5.39	13.36	5.61
Nasolabial Angle	96.99	15.40	104.04	10.74	100.51	13.68
Nasal Width	33.81	2.74	28.63	3.56	31.22	4.09
Nasal Height	55.58	5.59	50.46	3.38	53.02	5.27
Rt. Side of Nasal triangle	40.40	3.23	35.63	2.68	38.02	3.80
Lt. Side of Nasal triangle	40.13	3.01	35.10	2.79	37.62	3.84
Base of Nasal triangle	44.72	3.45	39.36	3.39	42.04	4.34
Apex of Nasal triangle	67.77	5.99	67.86	6.31	67.82	6.12
Inter Alar distance	50.99	4.28	43.94	3.62	47.47	5.30

Table 2:Anthropometric Facial ratios by sex

Parameter	Males	Females
Trichion to Glabella: Glabella to Subnasale	1:1.11	1:1.18
Trichion to Glabella: Subnasale to Menton	1:1.30	1:1.15
Inter medial canthal distance: eye (medial to lateral canthus)	1:0.86	1:0.87
Inter medial canthal distance: outer border of ear to lateral canthus	1:1.12	1:1.07
Inter medial canthal distance: ala-ala (outer border of rt. & lt. ala)	1:1.17	1:1.09



A. Angle of facial convexity B. Nasolabial angle C. Nasal width and height

Figure 1:ATLAS

Discussion

Anthropometric norms and normal distribution in males

All the mentioned parameters of the pleasing face followed the normal distribution pattern, with 68% of the readings falling in mean + 1SD, 95% falling in mean + 2SD and 99% falling in mean + 3SD. These findings are in accordance with the studies done earlier.[10-15], [22-24]

Left Ear width also followed the normal distribution pattern, but there was a slight variation when compared to right ear width (Right Ear Width Mean: 48.00 mm, SD: 6.54 and Left ear width Mean: 49.14 mm, SD: 5.61); for practical purpose, as the pleasing face is supposed to be symmetrical, the combined width of right side and left side divided by two can be taken as reference for soft tissue facial analysis. Intercanthal width also followed the normal distribution pattern with Mean: 43.29 mm and SD: 3.45. The range of observations was with mean -1SD to +2SD. This showed that the distance in the positive range of SD is considered as pleasing in case of males.

Naso-frontal angle with Mean: 134.60º and SD: 7.66 showed the normal distribution pattern and all the readings were observed within mean + 1SD. This can be attributed to the fact that in pleasing faces, the nasofrontal angle is considered pleasing over a short range.

The normal distribution of Nasomental angle with Mean: 129.66º and SD: 4.14 showed a range from -2SD to +1SD. This showed that the angle in the negative range of SD is considered as pleasing in case of males.

Nasomental line to Upper lip distance with Mean: 5.18mm and SD: 3.08 followed thenormal distribution pattern, with mean -1SD to +2SD; again showing that the distance in positive range of SD is considered as pleasing in case of males.

Nasomental line to Lower lip distance with Mean: 2.70 mm

and SD: 3.08 followednormal distribution pattern. Here, the distribution of subjects was within mean -2SD and +1SD, demonstrating that the distance in the negative range of the SD is more pleasing in males.

Normal distribution pattern was observed with Facial Convexity Angle Mean: 12.03º and SD: 5.56. However, the graph shows that the range of observations was within mean -2SD to +1SD. This observation signifies that a smaller facial convexity angle is considered more pleasing in case of males.

Nasolabial Angle with Mean: 96.99º and SD: 15.40 followed normal distribution pattern. The distribution was observed with mean -2SD to + 1SD. This observation signifies that a smaller nasolabial angle is considered more pleasing in case of males.

Left side of nasal triangle also followed the normal distribution pattern, but there wasa slight variation as compared to right side (Rt. Side of Nasal triangle Mean: 40.40 mm, SD: 3.23 and Left Side of Nasal triangle Mean: 40.13 mm, SD: 3.01); for practical purposes as the pleasing face is supposed to be symmetrical, the combined length of right side and left side divided by two can be taken as reference for soft tissue facial analysis.

Right Side angle of Nasal triangle and Left Side angle of Nasal triangle also followed the normal distribution pattern, but there was a slight variation as compared to rightside (Rt. Side angle of Nasal triangle Mean: 55.85o, SD: 3.04 and Lt. Side angle of Nasal triangle Mean: 56.47o, SD: 3.51); for practical purposes, as the pleasing face is supposed to be symmetrical the combined angle of right side and left side divided by two can be taken as reference for soft tissue facial analysis.

Anthropometric norms and normal distribution in females

All the above mentioned parameters of the pleasing face followed the normal distribution pattern with 68% of the readings falling in mean + 1SD, 95% falling in mean + 2SD and 99% falling in mean + 3SD. These findings are in accordance with the studies done earlier.[10-15,22-24]

Left Ear width also followed the normal distribution pattern but there was a slight variation as compared to Right Ear width (Right Ear width mean: 42.86 mm, SD: 4.06 and Left Ear width Mean: 43.43 mm, SD: 5.89); for practical purposes as the pleasing face is supposed to be symmetrical, the combined width of right side and left side divided by two can be taken as reference for soft tissue facial analysis.

Intercanthal width also followed the normal distribution pattern with Mean: 40.03 mm, SD: 3.28. The range of observations was with mean -1SD to +2SD, showing that the distance within the positive range of the SD is considered as pleasing in case of females. Nasofrontal angle with Mean: 140.91º and SD: 6.94 showed the normal distribution pattern and all the readings were observed within mean + 1SD. This can be attributed to the fact that in female faces the nasofrontal angle is considered pleasing in a short range.

The normal distribution of Nasomental angle with Mean: 129.17º and SD: 5.08 showed a range from -2SD to +1SD. This indicates that the angle within the negative range of the SD is considered as pleasing in female faces.

Nasomental line to Upper lip distance with Mean: 4.31mm and SD: 2.36 followed thenormal distribution pattern with mean -1SD to +2SD, again showing that the distance within the positive range of the SD is considered as pleasing in case of females. Nasomental line to Lower lip distance with Mean: 2.05mm and SD: 2.70 followed normal distribution pattern. Here, the distribution of subjects was within mean -2SD and +1SD, demonstrating that the lesser distance is more pleasing in females.

Normal distribution pattern was observed with Facial Convexity Angle with Mean: 14.68º and SD: 5.39. However, the graph shows that the range of observations was within mean -2SD to + 1SD. This observation signifies that a smaller facial convexity angle is considered more pleasing in case of females.

Nasolabial Angle with Mean: 104.04º, SD: 10.74 followed normal distributionpattern. The distribution was observed with mean -2SD to + 1SD. This observation signifies that a smaller nasolabial angle is considered more pleasing in case of females.

Left side of nasal triangle also followed the normal distribution pattern, but there was a slight variation as compared to right side (Rt. Side of Nasal triangle Mean: 35.63 mm, SD: 2.68 and Lt. Side of Nasal triangle Mean: 35.10 mm, SD: 2.79); for practical purposes, as the pleasing face is supposed to be symmetrical, the combined length ofright side and left side divided by two can be taken as reference for soft tissue facial analysis.

Right Side angle of Nasal triangle and left Side angle of Nasal triangle also followed the normal distribution pattern, but there was a slight variation as compared to right side (Rt. Side angle of Nasal triangle Mean 55.28o, SD: 4.50 and Lt. Side angle of Nasal triangle Mean: 56.12o, SD: 4.66); for practical purposes, as the pleasing face is supposed to be symmetrical, the combined angle of right side and left side divided by two can be taken as reference for soft tissue facial analysis.

Base of nasal triangle with Mean: 39.36 mm and SD: 3.39 followed the normal distribution pattern with mean -1SD to +2SD, again showing that the distance within the positive range of SD is considered as pleasing in case of females.

Conclusion

This study was aimed at developing a soft tissue facial analysis with special emphasis on nose morphology. This can be used for evaluation of nasal deformity, treatment planning and post-surgical evaluation of the correction achieved during Rhinoplasty, with the objectives to establish anthropometric norms and composite index of facial outcome, and to study pre- and post-Rhinoplasty measurements for desired facial outcome and comparison of surgical outcome with norms.

The following anthropometric parameters were studied on standardized digitalphotographs in a sample population of 50 males and 50 females:

Trichion to Glabella (distance), Glabella to Subnasale (distance), Subnasale to Menton (distance), Right Ear width, Left Ear width, Right Eye width, Left Eye width, Intercanthal width, Nasofrontal Angle, Nasofacial Angle, Nasomental Angle, Nasomental Line to Upper Lip,

Nasomental Line to Lower Lip, Subnasale-Pogonion to Upper lip, Subnasale-Pogonion to Lower lip, Mento Cervical Angle, Facial Convexity Angle, Nasolabial Angle, Nasal Width, Nasal Height, Right Side of Nasal triangle, Left Side of Nasal triangle, Base of Nasal triangle, Apex of Nasal triangle, Right side angle of Nasal triangle, Left side angle of Nasal triangle, Inter Alar distance.

Statistically, all the anthropometric parameters were assessed for their theoretical distribution using normal (Gaussian) distribution. Their Goodness of fit was tested by Chi Square Test. Composite Index was established by factor analysis. The pre- & post- comparisons were made using paired't' test, and pre- and post- relationship wasalso studied using correlation analysis. The surgical outcome was compared with the norms developed. All the anthropometric parameters were assessed for their theoretical distribution using normal distribution. Their inter-relationship was studiedby factor analysis.

All the anthropometric norms followed normal (Gaussian) distribution pattern. The component matrix analysis showed that the male and female anthropometric norms followed a definite pattern to form a component index. These indices have been discussed in detail previously. The pre- and post-Rhinoplasty comparison showed a definite positive change in the parameters. The pre- and post-Rhinoplasty change was statistically significant in few parameters.

The study needs to be continued as a multicentric study with regards to graft material and its acceptability by recipient site. Another parameter that needs to be considered is the degree of patient satisfaction.

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