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Original Article

Anatomy Section

Nasofaciometric Analysis: Baseline Study of Regional Population

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ABSTRACT

Background: The general population of any region has its specific nasofacial features which constitutes their regional identity. With the rapid advancement in techniques of correcting multiple facial anomalies, surgical planning has become more sophisticated and knowledge of the exact relationship between the various areas of head and face is now indispensable.A general baseline data for facial analysis would be helpful to plan orthodontic, otorhinolaryngological and cosmetic surgeries which can significantly enhance facial harmony and balance with regards to his regional morphology.Also,such data helps the forensic investigations ,such as,whether the deceased belonged to that region or not or if his face is destructed then finding nasofacial parameters with the linear regression equations and revealing his regional identity.

Aims: The purpose of this study is to obtain and correlate regional nasofacial parameters for aesthetic treatment and medicolegal purposes.

Settings and Design: This study was conducted on 200 persons in the regional area of Pune, Maharashtra.

Methods and Materials: Anthropometric measurements of 200 adult males and females with full developmental growth were included in the study. Persons with history of maxillofacial surgeries, dentures etc were excluded from study.

Statistical Analysis Used: SPSS software.

Results and Conclusions: Values were higher for males compared to females. Also, many parameters significantly correlate with each other and can be used for reconstructive and medicolegal purposes.

Key Words: Nasofaciometric analysis, Facial parameters

INTRODUCTION

Human face is a biological masterpiece of form and function. Its importance has been documented in arts and sciences since the beginning of modern civilisation. Face must confirm to stringent proportions in order for it to be aesthetically pleasing.

The identification of aesthetic facial qualities began with ancient civilisations such as Egyptians and Greeks who captured their ideas of beauty in art form[1[. Rules defining the relationships between various areas of head and face were formulated by scholars and artists of the renaissance based on classical Greek canons. In medicine, the use of these neoclassical formulas was propagated by the artist –anatomists of the seventeenth to nineteenth century [2].

The importance of seeing the face in proportions has been emphasized by many surgeons. Its application in reconstructive surgery is even more justified since the soft tissue morphology of the face cannot be studied reliably from cephalograms of the underlying skeleton in certain areas. With the rapid advancement in techniques of correcting multiple facial anomalies, surgical planning has become more sophisticated and knowledge of the exact relationship between the various areas of head and face is now indispensable [2]. Aesthetic requests of the patients undergoing orthognotic surgery have increased over time and represent now-a-days the leading subjective motivation for the patient and a major aim of the treatment for the surgeon. In this regard, anthropometric evaluation has considerably improved the diagnostic capacity of the orthodontist and of the surgeon [3]. For such an important task baseline records and an understanding of their interplay are essential [1].

The patient presenting to the rhinologic surgeon with a functional disorder of the nose is suffering in many respects from several different conditions. They are often also affected psychologically. A well planned and performed rhinologic procedure will not only improve the function of the nose, but in all probability give advantageous results in both the physical

appearance and in some cases also in their psychological balance. The nose should therefore be considered part of the physiognomy of the person and not as was the general tendency until recently, as an independent structure [4].

A general guideline for facial analysis would be helpful to individuals not totally familiar with facial deformities resulting from traumatic, neoplastic and developmental causes. [5]Preoperative planning can significantly enhance facial harmony and balance to correct underlying skeletal discrepancies in concert with or prior to cosmetic procedures.

Evaluation of face aesthetics facilitates planning of comprehensive treatment and to assess the results and efficacy of treatment modalities. Also, knowing the regional variations of nasofacial contours would help the forensic persons in medicolegal cases especially for personal identification.

Hence the current study is being undertaken to formulate a baseline record of the nasofacial contours of regional population in and around Pune, Maharashtra. The purpose of this study is to obtain average measurements of the soft tissue for aesthetic treatment and medicolegal purposes. Hence the aims of our study was:

1. To formulate a baseline record of nasal contours of regional population in and around Pune, Maharashtra.
2. To study the clinically important facial parameters.
3. To observe sex differences in facial parameters.
4. To compare with the similar studies done in the past.
5. To find the relationships among the measurements.

METHODS AND MATERIALS

Number of subjects in the present study was two hundred with one hundred males and one hundred females. These were adult individuals more than twenty five years of age belonging to the regions in and around Pune.

Criteria for selection:

1. Adult males and females with full developmental growth.
2. Individuals who had undergone maxillofacial surgery were not included.
3. Individuals with artificial dentures, prosthesis, edentate or having undergone any other dental procedures were not included.

For taking anthropometric measurements, subject was made to stand erect, barefoot on a level floor against the wall with his back and hips touching the wall. The head of the subject was made to rest without any strain in the eye-ear plane (Frankfurt plane). It was assured that subject was at rest, not breathless and was comfortable and stable (not changing the position) while taking measurements. Such technique was applied to all the two hundred subjects. For taking measurements sliding calipers and spreading calipers were used and following horizontal and vertical measurements were made:

Vertical measurements:

1. Morphological facial height (n-gn): It is the straight line distance between the point nasion and gnathion in the Frankfurt horizontal plane.
   Gnathion (gn): It is the lowest point on the lower margin of the lower jaw intersected by the mid-saggital plane [6].
   Nasion (n): It is the point on the nasal root intersected by mid-saggital plane [6].
2. Nasal length (n-sn): It measures the length of the nose. It is a straight line distance between nasion and subnasale.
   Subnasale (sn): It is the point where the lower margin of the nasal septum meets the integument of the upper lip.
3. Subnasomental length (sn-me): It is the straight line distance between subnasale and menton [6].
   Menton(me): It is the lowest point on the anterior wall of chin.
4. Nasal depth (prn-sn): It is the straight line distance between the points pronasale and subnasale.
   Pronasale(prn): It is the most anteriorly placed point on the tip of the nose when the head is held in Frankfurt horizontal plane [6].

Horizontal measurements:

1. Bizygomatic breadth (zy-zy): It is the maximum face breadth taken on the zygomatic arches between the two zygion points. The landmarks are not fixed but arrived at while taking the measurement.
   Zygion (zy): It is the most laterally placed point on the zygomatic arch.
2. Bigonial breadth (go-go): It is the distance of the lower jaw measured between two gonions.
   Gonion (go): It is the lowest posterior and most lateral point on the angle of the lower jaw. The point lies on the lateral side of the angle [6].
3. Biauricular breadth (Bitragal breadth) (t-t): It is the distance between two tragion.
   Tragion(t): It is the point on upper margin of tragus where tangents drawn to the anterior and upper margin of this cartilage cut each other.
   Nasal breadth: The maximum normal external breadth of the nasal alae determined without exertion or any pressure [6].
4. External orbital breadth (ec-ec): This measurement is the straight line distance between the two ectocanthions. It is also called as External biocular breadth or Ocular/ Biorbital breadth.
   Ectocanthion (ec): It is the point on the lateral side of the eye where the upper and lower lid-margins meet.

5. Internal orbital breadth (en-en): This measurement is the straight line distance between the two endocanthions. Endocanthion (en): It is the point on the medial side of the eye where the upper and lower lid-margins meet [6].

RESULTS

The data was analysed using SPSS software. The statistical methods used are as follows:

- Mean
- Standard deviation
- Correlation
- Linear regression analysis

The data was analysed separately for males & females.

The observations were done on hundred males and hundred females; total of two hundred individuals.

[Table/Fig-1] shows the mean values and standard deviation for all the parameters taken.

It is observed that except for nasal depth, internal ocular breadth, nasal length and external ocular breadth significant differences were noted amongst all other parameters in males and females. Morphological facial height of males (114.16) is higher than of females (108.36) and the difference is statistically significant (<0.05).

Similarly, subnasomental length in case of males (63.12) is higher than of females (57.61) and is statistically significant.

Also, bizygomatic breadth, bigonial breadth, biauricular breadth and nasal breadth of males is higher than that of females and is statistically significant.

The figures in the correlation matrix are the correlation coefficients(r). It is a measure of the strength of relationship between two variables. The range for 'r' is -1 to +1.

When 'r' is +1 it implies perfect direct correlation and when it is -1 it implies perfect inverse correlation and when it is 0 there is no correlation.

Examples of perfect positive or perfect negative correlation are rare in nature in which case there is no scatter and the graph will contain all the observations on a straight line.

Moderately positive or moderately negative correlation is more common. In case of moderately positive correlation value of 'r' lies between 0 & +1. In case of moderately negative correlation value of 'r' lies between 0 & -1.

[Table/Fig-2] shows correlation matrices for all two hundred volunteers. Moderately positive correlation is obtained between morphological facial height and nasal length, morphological facial height and subnasomental length, bizygomatic breadth and nasal breadth, bizygomatic breadth and biauricular breadth, bizygomatic breadth and bigonial breadth, biauricular breadth and bigonial breadth, external ocular breadth and bizygomatic breadth, external ocular breadth and biauricular breadth.

[Table/Fig-3] shows correlation matrices for both males and females.

There is moderately positive correlation between morphological facial height and subnasomental length and the two parameters are more correlated in males than in females. Biauricular breadth and bizygomatic breadth also show significant correlation in both the sexes. Bigonial breadth and bizygomatic breadth, internal ocular breadth and external ocular breadth show noticeable correlation only in males.

In case of females correlation coefficient (r) > 0.4 is also observed in case of:

1. Nasal breadth and bizygomatic breadth (r=0.521)
2. Biauricular breadth and bigonial breadth (r=0.518)
3. External ocular breadth and bizygomatic breadth (r=0.504)
4. External ocular breadth and biauricular breadth (r=0.486)
5. Nasal breadth and biauricular breadth (r=0.445)

[Table/Fig-4, 5, 6 and 7] show linear regression analysis which has provided the regression equations for predicting

Parameters	Sex	Mean	S.D	t	p
Morp. Facial Height	M	114.16	2.65	6.74	<0.0001
	F	108.36	5.86		
Nasal length	M	51.17	3.83	1.73	0.08
	F	50.24	3.75		
Subnasomental length	M	63.12	6.66	6.80	<0.0001
	F	57.61	4.58		
Nasal depth	M	16.26	2.53	0.01	0.99
	F	16.26	2.36		
BZB	M	116.98	5.54	5.74	<0.0001
	F	111.83	7.02		
BGB	M	106.38	5.27	8.48	<0.0001
	F	99.25	6.50		
BAB	M	129.81	5.97	5.27	<0.0001
	F	125.47	5.65		
Nasal breadth	M	33.45	3.38	3.45	3.45
	F	31.47	4.62		
EOB	M	94.46	4.74	1.76	1.76
	F	93.23	5.12		
IOB	M	30.55	3.25	0.64	0.64
	F	30.28	2.77		

[Table/Fig-1]: Mean and standard deviation

Parameters	MFL	NL	SNML	ND	NB	BZB	BAB	BGB	EOB	IOB
MFL	1									
NL	0.41*	1								
SNML	0.66	0.27	1							
ND	0.14	0.19	0.19	1						
NB	0.12	0.05	0.02	-0.09	1					
BZB	0.32	0.17	0.28	0.02	0.48*	1				
BAB	0.31	0.10	0.21	0.12	0.38	0.55*	1			
BGB	0.25	0.06	0.25	0.09	0.24	0.47*	0.47*	1		
EOB	0.23	0.25	0.20	0.08	0.37	0.46*	0.45*	0.25	1	
IOB	0.27	0.24	0.13	0.10	0.03	0.25	0.17	0.10	0.31	1

[Table/Fig-2]: Correlation matrices of 200 volunteers
*indicates r (correlation coefficient) > 0.4

Parameters	Sex	MFL	NL	SNML	ND	NB	BZB	BAB	BGB	EOB	IOB
MFL	M	1									
	F	1									
NL	M	0.45*	1								
	F	0.35	1								
SNML	M	0.65*	0.30	1							
	F	0.50*	0.18	1							
ND	M	0.18	0.25	0.30	1						
	F	0.21	0.13	0.10	1						
NB	M	0.07	0.18	-0.11	-0.16	1					
	F	-0.01	-0.08	-0.08	-0.04	1					
BZB	M	0.12	0.15	0.20	0.08	0.29	1				
	F	0.25	0.13	0.08	-0.02	0.52*	1				
BAB	M	0.26	0.12	0.10	0.05	0.19	0.48*	1			
	F	0.11	-0.00	0.01	0.22	0.44*	0.49	1			
BGB	M	0.03	0.11	0.09	0.08	-0.00	0.42*	0.18	1		
	F	0.05	-0.08	-0.03	0.12	0.23	0.31	0.51*	1		
EOB	M	0.17	0.25	0.16	-0.04	0.35	0.39	0.39	0.21	1	
	F	0.22	0.24	0.18	0.20	0.39	0.50*	0.48*	0.23	1	
IOB	M	0.17	0.27	0.08	0.12	0.14	0.36	0.32	0.10	0.43*	1
	F	0.41*	0.18	0.19	0.09	-0.07	0.16	-0.02	0.08	0.17	1

[Table/Fig-3]:-Correlation matrices for males and females
*indicates r (correlation coefficient) > 0.4.

nasal length and nasal breadth from vertical and horizontal measurements respectively, in either sex.

DISCUSSION

Face is a biological masterpiece of form and function. The importance of seeing the face in proportion has been emphasized since long. Attempts have always been made to use facial features to classify individuals into different groups so as to formulate a significant pattern of facial contours specific for that group and region. Physical anthropological methodology has been used as a tool for the same. With the advent of modern science use of somatometric study for reconstructive surgery and medicolegal purposes has acquired a great importance. So the main attempt of this study is to create a baseline record of various facial parameters for the local population; to understand the uniqueness of sex differences and also to check how far these measurements are related so as

to provide baseline data of nasofacial contours useful to clinicians and forensic persons.

The present study of two hundred subjects (hundred males and hundred females) showed higher mean value of all the parameters in males as compared to their female counterparts. This is in accordance with previous studies done by G M Kurulkar [7] and Iravati Karve [8] in different regions of Maharashtra. Most of the measurements showed statistically significant difference between males and females except nasal length, nasal depth, external ocular breadth & internal ocular breadth [Table/Fig-8]

Sr. No.	Parameters (x)(mm)	Nasal length (y) (mm) (y=mx+b)
1.	MFH	y=0.2753x+19.74
2.	SNML	y=0.1735x+40.22
3.	ND	y=0.3823x+44.95

[Table/Fig-4]: Regression equations to predict nasal length from various parameters in males

Sr. No.	Parameters(x)(mm)	Nasal breadth(y)(mm) (y=mx+b)
1.	BZB	y=0.1803x+12.37
2.	BAB	y=0.0048x+33.97
3.	BGB	y=0.1124x+18.86
4.	EOB	y=0.2277x+11.94
5.	IOB	y=0.1534x+28.77

[Table/Fig-5]: Regression equations to predict nasal breadth from various parameters in males

Sr. No	Parameters (x)(mm)	Nasal length (y)(mm) (y=mx+b)
1.	MFH	y=0.2296x+25.36
2.	SNML	y=0.1508x+41.55
3.	ND	y=0.2110x+46.81

[Table/Fig-6]: Regression equations to predict nasal length from various parameters in Females

Sr. No.	Parameters (x)(mm)	Nasal breadth (y)(mm) (y=mx+b)
1.	BZB	y=0.3432x-6.905
2.	BAB	y=0.1662x+14.97
3.	BGB	y=0.3533x-1.468
4.	EOB	y=-0.1209x+35.13
5.	IOB	y=0.1534x+28.77

[Table/Fig-7]: Regression equations to predict nasal breadth from various parameters in Females

Interpersonal variations leading to differences in observations taken by various researchers depend on:

- the type of instrument and its standardization
- spotting/locating the appropriate somatometric landmark
- ease at which the instrument is applied
- experience of the observer who takes the measurements

The correlation between morphological facial height – sub-nasomental length, morphological facial height – nasal length, bigonial breadth-biauricular breadth, external ocular breadth-bizygomatic breadth, external ocular breadth-biauricular breadth is very significant not considered in earlier studies.

Earlier due to lack of advanced computation techniques the data obtained could not be properly analyzed and also female participation was minimal .Such factors were overcome in this study and the data obtained is extremely useful in surgical, reconstructive cosmetologic and medicolegal fields. For e.g. given a body with very mutilated face if we know certain measurement, we can derive the rest of parameters with the help of linear regression equations and can roughly know the dimensions and contours of the face of that person which will definitely help for his personal identification. Cosmetologic and rhinologic surgeons who attempt to surgically reconstruct the face and nose may be benefited with the availability of the baseline faciometric data which will guide them about the regional facial dimension and trends and help in quantitative reconstruction of the face.

CONCLUSIONS

There is a significant difference between most of the parameters for either sex with the values being higher for males than for females. Only nasal length, nasal depth, external ocular breadth and internal ocular breadth showed similar values in both the sexes.

Parameters	G.M Kurulkar & Rajadhyaksha		Irawate karve		Present study	
	Male	Female	Male	Female	Male	Female
Nasal length	74.8±8.5	68.7±7.2	48.3±3.8	45.9±3.6	51.1±3.8	50.2±3.7
Nasal breadth	48.3±3.5	45.7±3.7	36.8±2.9	32.4±2.4	33.4±3.3	31.4±4.6
BZB	131.7±5.2	126±4.8	132±5.7	125±4.9	116±5.5	111.8±7.0
BGB	89.0±6.4	82.4±4.7	103.3±6.1	93.6±5.9	106.3±5.2	99.2±6.5
IOB	30.8±3.2	29.5±3.2	28.6±2.7	27.9±2.6	30.5±3.2	30.2±2.7

[Table/Fig-8]: Comparison of mean and standard deviations for males and females.

Most of the parameters show a significant correlation with each other. Correlation between nasal length and morphological facial height is especially significant in both sexes.

A comparison with previous studies shows the regional differences in the facial framework of the individuals although the trend of sexual dimorphism is similar.

The data obtained is useful for application into reconstructive and medicolegal cases. Special thanks to Dr. Bhanu, Dr. Simon & entire dept. of anatomy, B.J. Medical college, Pune.

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