

Craniofacial Anthropometry in Newborns and Infants

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Abstract

Objective: The face is involved in many syndromes of dysmorphogenesis. The soft tissue facial landmarks are known to be influenced by age, race and sex and it is imperative to identify a balance between them before reconstructive surgery. Further, with knowledge of standard facial traits, an individualized norm can be established to optimize facial attractiveness.

Material & Methods: Measurements were made on 60 infants (30 males and 30 females) aged between 1-4 months and 60 newborns (30 males and 30 females) with a view to establish the criterion of facial anthropometry for this age group in North Indians. A special emphasis was given in this study to sexual dimorphism.

Findings: The mean value and range for all the parameters was determined for the North Indian population. A statistically significant sexual dimorphism was noted to exist in ear length ($P<0.01$) and length of the philtrum ($P<0.05$). Philtral-commissural ratio was determined for North Indians, philtrum width=oral width/3.2.

Conclusion: The local values derived from well defined populations should be used as reference in the evaluation of a case with dimorphic features. This study demonstrates the existence of a partial positive correlation between philtral width and oral width, i.e. when one increases the other also increases and vice versa. The Philtral-commissural relationship is expected to assist in planning philtral construction in cleft lip patients.

Key Words: Dimorphism, North Indian, Philtral-Commissural Ratio, Anthropometry

Introduction

In recent years, craniofacial anthropometry has become an important tool used by clinical geneticists, forensic experts and reconstructive surgeons. Embryology of the face is responsible for its involvement in many syndromes of dysmorphogenesis. As the face is a complex

anatomic unit, it is best to evaluate each distinct region of the face separately taking care to relate the various parts to the whole.^[1]

The measurement of head circumference is an important screening procedure for detecting abnormalities of head growth. Intercanthal distance estimation has been used in calculating

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combined width of maxillary anterior teeth. Ear length is important in the evaluation of congenital anomaly syndrome such as Down's syndrome.

The philtrum of the upper lip has a unique configuration and is a landmark of individual distinction.^[2] Since it is frequently involved in disfiguring oro-facial malformations, it is important that a thorough understanding of its anatomical relationships be established so that functional and aesthetic surgical corrections can be accomplished^[3]. The commissural distance was found to have the best single correlation with the philtrum.^[4]

These soft tissue facial landmarks are known to be influenced by age, race and sex and it is imperative to identify a balance between them before reconstructive surgery. Further with a knowledge of standard facial traits and patients' soft tissue features, an individualized norm can be established to optimize facial attractiveness.^[5] As such a study was devised in which measurements were made on 60 cases (30 males, 30 females) aged between 1-4 months and 60 newborn cases (30 males, 30 females) with a view to establish the criterion of facial anthropometry for this age group in North Indians. A special emphasis was given in this study on sexual dimorphism.

Material & Methods

The present study was undertaken from July, 2004 to November, 2006 as a joint effort by the department of anatomy and department of pediatrics, Dayanand Medical College & Hospital, Ludhiana, Punjab, India. An approval from the ethical committee is needed for any research work at Dayanand Medical College and Hospital and was duly taken by the authors. This institution has a tertiary level advanced hospital and is considered to be the most prestigious medical college in North India. The measurements were taken after taking prior written permission from the parents (of newborns and those who attended the immunization clinic). The measurement technique was discussed with the clinician in charge of the nursery and his

consent was taken. Proper precautions like using new gloves, washing the instrument with dettol solution, and covering the tips of the instrument with disposable plastic were followed. All the measurements were taken in the presence of a resident pediatrician and during daytime, when the cases were sleeping. The data so obtained was subjected to extensive statistical analysis. Unpaired 't' test was utilized to compare the parameters as measured for males and females and the 't' distribution table was consulted. The coefficient of determination (R^2) and the coefficient of correlation (r value) was determined to calculate the impact of oral width on philtrum width in both the study groups. The correlation coefficient squared (r^2) equals the percentage of the variability (of the unknown variable) that can be predicted by the known variables. The data was also tabulated to derive constants for the prediction equation $Pw=a+b(Ow)$ where a, b are computed constants, Pw is the proposed philtrum width and Ow is the oral width.

Measurements of newborn babies were delayed for 48 hours to allow facial swelling and distortions to recede. Cases between 1-4 months showing normal development were considered to have normal faces. The following parameters were recorded (Fig 1):

Horizontal Parameters

- **Head Circumference:** The lower edge of measuring tape was placed just above the child's eyebrows, above the ears and around the occipital prominence with the objective of measuring the maximal head circumference^[6].
- **Intercanthal Distance:** was measured in mms between the median angles of the palpebral fissures^[7].
- **Philtrum Width:** Two points were marked at the base of the philtrum, i.e. at the junction of the vertical ridge of philtrum and vermilion border of upper lip. The width between these points was taken as the philtral width^[8]
- **Commissural distance:** was measured between the corners of the mouth^[4].

Vertical Parameters

- **Ear Length:** from superior to inferior aspects of the ear^[9].



Fig 1- From left to right

- Upper row: Head circumference, intercanthal distance, philtrum width, commissural distance
- Lower row: Nose Length, Ear Length, Philtrum length, Lower Lip to Chin

- **Philtrum length:** from base of columella to midline depression of the vermillion border^[10].
- **Lower Lip to Chin:** between junction of skin and mucous membrane of lower lip and the lowest point of the chin with mouth closed^[10].
- **Nose Length:** Nasion to a point at the tip of the nose in line with the upper edge of both nostrils^[10].

The head circumference was measured using a non stretchable measuring tape in centimeters. The remaining parameters were measured in millimeters using a vernier caliper (Least Count-0.02 mms) taking into account the error if any, in the instrument. All measurements were taken while the subjects were sleeping to avoid variation due to facial expression.

Findings

Morphometric Criteria for North Indian Population: The mean dimensions of the various parameters for both the age groups have been tabulated in tables 1 and 2.

Males v/s Females-‘The Sex Factor’

It is evident from table I and II that in both groups statistically significant sexual dimorphism was found in ear length ($P < 0.01$) and length of philtrum ($P < 0.05$). The remaining parameters as determined for each group when compared were found to be statistically insignificant.

From above, it can be concluded that there exists a definite statistically significant sexual dimorphism for ear and philtrum length in north Indian population.

Table III shows the Effect of oral width and philtrum width on each other in both groups in newborns and 1-4 month infants. For Newborns, with one unit change in oral width there is a change of 0.16 units in philtrum width. Otherwise with one unit change in philtrum width there is a change of 0.64 units in oral width. In 1-4 month age group one unit change in oral width there is a change of 0.21 units in philtrum width.

Otherwise with one unit change in philtrum width there is a change of 0.64 units in oral width. Table IV shows that for both groups a highly partial positive correlation exists between philtrum and oral widths. They significantly contribute towards each other ($P < 0.01$).

Table 1- Mean values (standard deviation) and Comparison in sexes for newborns

Parameter	Male	Female	T value	P value	Level of Significance
Head Circumference	33.23 (1.57)	33.19 (0.78)	0.12	>0.05	Not Significant
Intercanthal Distance	20.05 (1.43)	20.10 (1.56)	0.13	>0.05	Not Significant
Philtrum Width	7.80 (1.16)	7.35(0.73)	1.80	>0.05	Not Significant
Commisural Distance	24.87 (1.90)	24.53 (2.11)	0.66	>0.05	Not Significant
Nose Length	21.48 (2.06)	21.34 (2.03)	0.27	>0.10	Not Significant
Ear Length	37.55 (2.24)	35.21 (2.61)	3.73*	<0.01	Highly Significant
Philtrum Length	8.85 (0.88)	7.75 (2.89)	1.99 [†]	<0.05	Significant
Lower Lip to Chin	16.37 (2.20)	16.26 (2.44)	0.18	>0.05	Not Significant

According to t distribution table

*For T value 1.96-2.57; P<0.05

[†]For T value \geq 2.58; P<0.01

ie. Tabular value of t is 1.96 at 0.05 and 2.58 at 0.01 respectively.

Table 2- Mean values (standard deviation) and Comparison in sexes for 1-4 month group

Parameter	Male	Female	T value	P value	Level of Significance
Head Circumference	36.57 (0.86)	36.17 (0.91)	1.75	>0.05	Not Significant
Intercanthal Distance	23.02 (1.99)	22.18 (1.79)	1.72	>0.05	Not Significant
Philtrum Width	8.89 (1.12)	8.63 (1.22)	0.86	>0.05	Not Significant
Commisural Distance	28.75 (2.65)	28.34 (2.12)	0.66	>0.05	Not Significant
Nose Length	24.44 (2.34)	24.56 (2.20)	0.20	>0.10	Not Significant
Ear Length	42.74 (2.83)	40.86 (2.15)	2.90*	<0.01	Highly Significant
Philtrum Length	10.43 (0.92)	9.86 (1.09)	2.19 [†]	<0.05	Significant
Lower Lip to Chin	19.08 (1.78)	19.38 (2.29)	0.57	>0.05	Not Significant

According to t distribution table

*For T value 1.96-2.57; P<0.05

[†]For T value \geq 2.58; P<0.01

ie. tabular value of t is 1.96 at 0.05 and 2.58 at 0.01 respectively.

Table 3- Effect of oral width and philtrum width on each other in both groups

Groups	Parameter	Equation	Coefficient of Determination
Newborns	Philtrum width	$3.70 + 0.16^\dagger (Ow)$	0.10
	Oral width	$19.82 + 0.64^\dagger (Pw)$	0.10
One-Four Months	Philtrum width	$2.73 + 0.21^\dagger (Ow)$	0.19
	Oral width	$20.79 + 0.88^\dagger (Pw)$	0.19

† P<0.01

For newborns the coefficient of correlation (r) is 0.318. The contribution of one parameter towards the other (r^2) is about 10%. The coefficient of correlation (r) for 1-4 months group is 0.432. The contribution of one parameter towards the other (r^2) is about 19%.

Philtral Commissural Ratio (for North Indian population)

This ratio has been described for American population^[4] to provide the measurement of the proposed philtrum for assisting in planning philtral construction in cleft lip patients. Using the data obtained in the present study this ratio comes out to be:

$$\text{philtrum width} = \text{oral width}/3.20$$

(for North Indian population)

Discussion

The customs, traditions food habits and environmental conditions of North India are distinct from the rest of the country. As such the present study defines the morphometric criterion for the North Indian population. The developmental data and the normal values of these measurements in healthy subjects are expected to be useful for dysmorphologists in the early identification of some craniofacial syndromes and in planning intervention. The

values for the South Indian population^[10] are different while those in Nigerian neonates^[11] are markedly different. All these findings can be explained on the basis of the influence of genetic, cultural, environmental and racial factors on soft tissue facial landmarks. This implies that local values derived from well defined populations should be used as reference in the evaluation of a case with dimorphic features.

The results depict higher values for males in all the parameters measured. These can be explained on the basis the physical personality of the individual has a bearing on the craniofacial landmarks so the male characteristics are usually larger.^[12]

The sex difference in philtrum and ear length was found to be statistically significant. The values obtained are similar to those from western countries^[13-14] and from Jammu^[15] and from Hyderabad^[16]. This supports the assertion that the sexual dimorphism does not appear to the same extent in different parts of the face. A large part of male facial preponderance is known to exist in the lower third of the face.^[17]

The present study defines the standards for philtrum length and oral width. Both are important in syndrome diagnosis. Williams syndrome is characterized by a long philtrum while Di George and Cohen cases have short philtrum. Wide mouth is found in Goldenhar syndrome while short mouth accompanies

Table 4- Contribution of oral width and philtrum width on each other in both groups

Mean	Philtrum width	Oral width	r value	P value
Newborns	7.58	24.70	0.318	<0.01
One-Four Months	8.76	28.55	0.432	<0.01

Craniocarpotarsal Dysplasia. The clinical impression may be misleading and should be accompanied by quantitative criteria. This study demonstrates the existence of a partial positive correlation between philtral width and oral width i.e. when one increases the other also increases and vice versa.

The philtrum is considered to be one of the important facial landmarks in the restoration of esthetics^[18]. The philtral width and length standards are definitely invaluable as they express a mean which cannot be deviated from to more than a limited extent without transgressing the laws of nature and producing deformity.^[19] Philtral– commissural ratio was determined for North Indians Philtrum width = oral width/3.2. This relationship is expected to assist in planning philtral construction in cleft lip patients. The ratio for the American population came out to be Philtrum width= oral width/3.75.^[4]

The existence of a partial positive correlation between oral and philtral width indicates that when these two parameters are in harmonious coordination, It is bound to have a positive impact on the esthetic appearance. This physical attractiveness is known to have a statistically significant effect on self esteem and other measures of psychic well being as beauty is definitely not skin deep.

Conclusion

The local values derived from well defined populations are expected to be useful for dysmorphologists in the early identification of some craniofacial syndromes and in planning intervention. This study demonstrates the existence of a partial positive correlation between philtral width and oral width i.e. when one increases the other also increases and vice versa. A statistically significant sexual dimorphism was noted to exist in ear length and length of the philtrum. The Philtral– commissural ratio was determined for North Indians, Philtrum width = Oral width/3.2. This relationship is expected to assist in planning philtral construction in cleft lip patients.

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