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Original Research

Hard Tissue Cephalometric Norms for Orthognathic Surgery in Karnataka Population

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Abstract:

Background: The purpose of the study was to determine the soft tissue cephalometric norms for adult Karnataka population with well-balanced and pleasing faces, for diagnosis and treatment planning of orthognathic surgery, to determine variation in norms between Karnataka and the Caucasian population.

Materials and Methods: Lateral cephalograms of 100 adults (50 males and 50 females), with a mean age of 17-30 years were obtained from the Karnataka population. Standardized lateral radiographic head films in a natural head position were used. The radiographs were analyzed using cephalometrics for orthognathic surgery soft tissue analysis.

Results: Various angular and linear measurements for soft tissue showed increased convexity in males and increased throat angle in facial form and in lip position and form showed decreased the nasolabial angle, increased lower lip protrusion, and increased mentolabial Sulcus in Karnataka population.

Conclusion: Soft tissue analysis showed increased soft tissue convexity in males compared to females and increased throat angle in both sexes in facial forms, and in lip position and form, showed decreased the nasolabial angle, increased lower lip protrusion, and increased mentolabial Sulcus in Karnataka population.

Key Words: Surgical norms, orthognathic surgery, hard tissue

Introduction

Roentgenographic cephalometry was first introduced to the orthodontic speciality by Broadbent in 1931,[1] mainly as a tool to study cranio-facial growth and development. Gradually, it was used to study facial forms, development of norms, and assessment of treatment prognosis and growth prediction for the individual patients.

Various cephalometric analyzes have been evolved in an attempt to define the skeletal characteristics of a "balanced face" and a "good occlusion" in a precise and easy way. The successful treatment of the orthognathic surgical patient is dependent on careful diagnosis and planning.[2]

Cephalometric analysis can be an aid in the diagnosis of skeletal and dental problems and a tool for simulating surgery and orthodontics by the use of acetate overlays.[3]

The patients who require orthognathic surgery usually have facial bones as well as teeth positions that must be modified by combined orthodontic and surgical treatment.

For this reason, a specialized cephalometric appraisal system, called cephalometrics for orthognathic surgery (COGS), was developed at the University of Connecticut.[2]

This appraisal is based on a system of cephalometric analysis that was developed at Indiana University by Burstone and Legan.

In the literature, a number of investigators noticed the variation in the cranio-facial morphology, of different ethnic groups. Then with time, it became evident that cephalometric norms of one ethnic group need not necessarily, apply to another ethnic group.

Normal values for the COGS analysis of Karnataka population would be useful in providing racially specific values for diagnosis and treatment planning for orthognathic surgery.

Therefore, the present study was designed to determine what are the normal cephalometric values and measurements of adult Karnataka population with well-balanced and pleasing faces and develop surgically useful rectilinear cephalometric norms, for diagnosis and treatment planning of orthognathic surgery and to determine if, in fact, these measurements are statistically different from those of Caucasian population.

Materials and Methods

This study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, College Of Dental Sciences, Davangere. Ethical clearance was obtained from the institution.

Lateral cephalogram of 100 adults (50 males and 50 females) with age ranging from 17 to 30 years were obtained from Karnataka population. These lateral cephalograms were traced and analyzed manually twice by using Burstone's COGS Hard

tissue analysis. To avoid any errors in the identification of land marks, and analysis was carried out in the presence of two observers to avoid inter-observer variability.

Criteria for the selection of the sample

The subjects were selected for the present study based on the following criteria:

1. They were in the age group of 17-30 years
2. All exhibited Class I occlusion with acceptable profile
3. Full complement of permanent teeth in present proper intercuspation
4. Patients with normal over jet and overbite
5. Presence of only negligible crowding and rotations and spacings
6. No history of orthodontic, orthognathic, or plastic surgery treatment.

Standardization of the cephalometric technique

Standardized 8″ × 10″ Kodak T-mat™ E gold lateral radiographic head films with intensifying screen were used for each subject on Veraview md-cp, advanced panoramic and cephalometric equipment, Kyoto Japan, Model x102 md-cp 2902.

The X-ray source to subject distance was kept at a constant distance of 5 ft. The film was kept at a constant distance of 16 cm away from the midsagittal plan of the subject oriented in natural head position.

Cogs analysis

The analysis was done for all 100 lateral cephalograms with the following parameters.

Skeletal measurements

Cranial base (Figure 1)

1. Posterior cranial base: Measured parallel to HP from articulare to Ptm
2. Anterior cranial base: Measured parallel to HP from Ptm to Nasion.

Horizontal (skeletal) (Figure 2)

1. Angle of convexity: It is the angle formed between Nasion - Pont A and pogonion
2. Apical base of maxilla: Measured from Nasion to Point A parallel to HP
3. Apical base of mandible: Measured from Nasion to Point B parallel to HP
4. Chin prominence: Measured parallel to HP from Nasion to pogonion.

Vertical (skeletal, dental) (Figure 3)

Anterior component

1. Middle third facial height: Measured perpendicular to HP from Nasion to anterior nasal spine
2. Lower third facial height: Measured perpendicular to HP from ANS to gnathion.

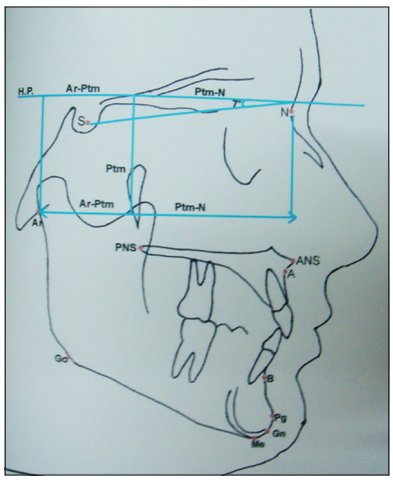

Figure 1: Cranial base measurements.

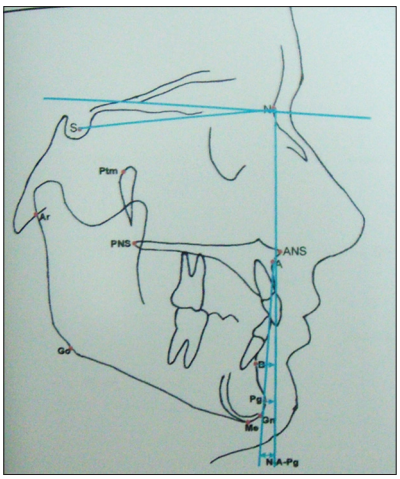

Figure 2: Horizontal measurements.

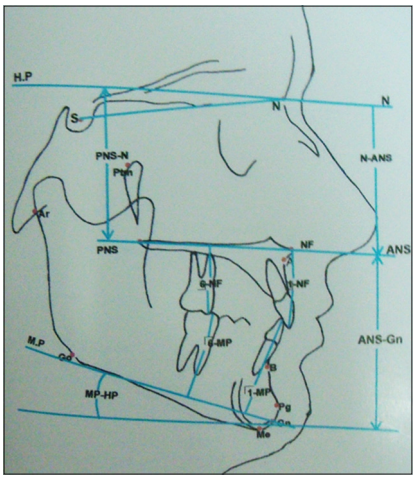

Figure 3: Vertical (skeletal and dental) measurements.

Posterior component

1. Posterior vertical height: Measured perpendicular to HP from PNS to Nasion
2. Posterior facial diversions: It is the angle formed between the mandibular plane (GO-GN) to HP.

Dental measurements (Figure 3)

Anterior component

1. Upper 1 to NF: Measured from a perpendicular line dropped from the incisal edge of upper central incisor to the nasal floor
2. Lower 1 to MP: Measured from incisal edge of mandibular anterior teeth to the mandibular plane.

Posterior component

1. Upper 6 to NF: Measured from the mesiobuccal cusp tip of the maxillary first molar to the nasal floor
2. Lower 6 to MP: Measured from the mesiobuccal cusp tip of mandibular first molar to the mandibular plane.

Maxilla and mandible

1. Maxillary length: Distance between ANS and PNS
2. Ramus length: Measured from articulare to gonion
3. Mandibular length: Measured from gonion to pogonion
4. Gonial angle: Angle formed between articulare gonion and gnathion
5. Chin position: Measured from point B to pogonion.

Dental

1. Occlusal plane angle: Angle between OP and HP
2. Relation of maxilla and mandible to OP: Measured from the distance Point A to Point B dropped perpendicularly to OP
3. Upper incisor position: Angle between the nasal floor and the long axis of upper central incisor
4. Lower incisor position: Angles between the mandibular plane and the long axis of the lower central incisor.

Statistical analysis

Results are presented as mean ± standard deviation (SD) values. A $P = 0.05$ or less was considered for statistical significance.

Results

100 lateral cephalograms were analyzed. The results were as follows:

Tables 1 and 2 show the changes in cranial base measurements in both males and female, which were not significant. Changes in horizontal measurements which showed more of convex profile with a mean of 5.08 and SD of ± 3.85 (males) and mean of 5.4 and SD ± 2.6 for females, with prognathic maxilla with a mean of 1.12 and SD of ± 3.00 (males) and a mean of 0.8 and SD ± 2.9, shows changes in vertical measurements (skeletal and dental) which showed a decreased lower anterior facial height with a mean of 66.34 and SD of ± 4.52 (males) and mean of 60.5 and SD ± 5.0. Vertical and dental measurements showed increase in lower incisor proclination with a mean of 99.62 and SD of ± 6.34 (males) and a mean of 98.2 and SD ± 5.01 for females.

Table 1: Hard tissue measurements for males.

Measurements	Mean	SD	95% confidence limits	
Cranial base				
Ar-Ptm (11 HP)	37.22	2.85	31.5	42.9
N-Ptm (11 HP)	55.82	3.69	48.4	63.2
N-A-Pg (angle)	5.08	3.85	−2.6	12.8
Horizontal (skeletal)				
N-A (11 HP)	1.12	3	−4.9	7.1
N-B (11 HP)	−0.68	6.7	−14.1	12.7
N-Pg (11 HP)	1.34	5.72	−10.1	12.8
N-ANS (HP)	53.8	3.86	46.1	611.5
ANS-Gn (HP)	66.34	4.52	57.3	75.4
PNS-N (HP)	54.92	4.52	45.9	64
Vertical (skeletal, dental)				
MP-HP (angle)	22.54	4.44	13.7	31.4
Upper l-NF (NF)	29.74	2.81	24.1	35.4
Lower 1 - MP (MP)	44.66	3.1	38.5	50.9
Upper 6-NF (NF)	26.68	6.45	13.8	39.6
Lower 6-MP (MP)	36.32	3.57	29.2	43.5
PNS-ANS (11 HP)	54.32	8 77	36.8	71.9
Ar-Go (linear)	53.26	3.44	46.4	60.1
Maxilla, mandible				
Go-Pg (linear)	82. 58	5.66	71.3	93.9
B-Pg (11 MP)	9.04	13.68	−18.3	36.4
Ar-Go-Gn (angle)	121.28	5.23	110.8	131.7
OP upper - HP (angle)	6.76	3.18	0.4	13.1
Dental				
A-B (11 OP)	2.68	1 25	0.2	5.2
Upper 1- NF (angle)	115 32	3.36	108 6	122
Lower 1-MP (angle)	99.62	6.34	86.9	112.3

SD: Standard deviation

Table 2: Hard tissue measurements for females.

Measurements	Mean	SD	95% confidence limits	
Cranial base				
Ar-Ptm (II HP)	33	3.4	26.1	39.8
N-Ptm (II HP)	51.5	2.7	46	57
Horizontal (skeletal)				
N-A-Pg (angle)	5.4	2.6	0.2	10.6
N-A (II HP)	0.8	2.9	−5.1	6.7
N-B (II HP)	−2.0	6	−14.1	10.1
N-Pg (II HP)	−1.3	4.8	−10.9	8.2
Vertical (skeletal, dental)				
N-ANS (HP)	50.2	2.9	44.5	55.9
AKS-Gn (HP)	60.5	5	50.5	70.4
PNS-N (HP)	47.2	5.2	36.7	57.7
MP-HP (angle)	26	8.1	9.8	42.2
Uppr 1-NF (NF)	27.1	3.2	20.6	33.6
Lower 1-MP (MP)	39.1	4.4	30.3	47.8
Upper 6-NF (NF)	22.3	1.9	18.5	26.1
Lower 6-MP (MP)	32.2	3.6	25	39.4
Maxilla, mandible				
PNS-ANS (II HP)	51.8	3.2	45.4	58.2
Ar-Go (linear)	45.7	4.4	36.8	54.6
Go-Pg (Linear)	74.6	3.2	68.1	81.1
B-Pg (II MP)	5	1.8	1.4	8.5
Ar-Go-Gn (angle)	121.3	3.8	113.8	128.9
Dental				
OP upper - HP (angle)	9.1	9.3	−9.5	27.8
A-B (II OP)	3.9	4.8	−5.8	13.6
Upper 1-NF (angle)	112.8	6.2	100.5	125.2
Lower 1-MP (angle)	98.2	5.1	87.9	108.4

SD: Standard deviation

Table 3: Burstone's cephalometric measurements.

Measurements	Mean±SD	
	Female	Male
Cranial base		
Ar-Ptm (II HP) (mm)	32.1±1.9	37.1±2.8
N-Ptm (II HP) (mm)	50.9±3	52.8±4.1
Horizontal (skeletal)		
N-A-Pog (angle)	2.6±5.1°	3.9±6.4°
N-A (IIHP) (mm)	−2±3.7	0.0±3.7
N-B (IIHP) (mm)	−6.9±4.3	−5.3±6.7
N-Pog (IIHP) (mm)	−6.5±5.1	−4.3±8.5
Vertical (skeletal an dental)		
N-ANS (HP) (mm)	50±2.4	54±3.2
ANS-Gn (HP) (mm)	61.3±3.3	68.6±3.8
N-PNS (mm)	50.6±2.2	53.9±1.7
MP-HP (angle)	24.2±5°	23°±5.9°
Upper 1-NF (NF) (mm)	27.5±1.7	30.5±2.1
Lower 1-MP (MP) (mm)	40.8±1.8	45±2.1
Upper 6-NF (NF) (mm)	23±1.3	26.2±2
Lower 6-MP (MP) (mm)	32±1.9	35.8±2.6
Maxillae and mandible		
PNS-ANS (II HP) (mm)	52.5±3.5	57.5±2.5
Ar-Go (linear) (mm)	46.8±2.5	52±4.2
Go-pg (linear) (mm)	74.3±5.8	83.7±4.6
B-Pg (II MP)	7.2±1.9	8.9±1.7
Ar-Go-Gn	122±6.9	119±6.5
Dental		
OP upper-HP (angle)	7.1±2.5°	6.1±5.1°
A-B (II OP)	0.4±2.5°	−1.1±2
Upper 1-NF (angle)	112±5.3°	111±4.7
Lower 1-MP (angle)	95.9±5.7°	95.9±5.7°

SD: Standard deviation

Discussion

Currently, norms for the COGS analysis were now available for white and black American adults only (Table 3). Having recognized the fact that, the norms prescribed for one ethnic group need not fit the other, an attempt was made in this study to set the cephalometric norms for COGS in the Karnataka population, so that it will be helpful to individualize the treatment protocols and for better results.

Some reports of cephalometric norms have methodological problems of sample size. The study by Cotton *et al.* was based on only 20 subjects.[4]

Altemus selected 80 adolescents with the most ideal dentitions from a group of 3,289.[5] Kowalski *et al.*, on the other hand, studied a large sample of 244 subjects.[6]

In the present study, 100 patients (50 males and 50 females) were chosen as a sample size, which was similar to most other studies.[1-14]

The COGS analysis uses linear dimensions to describe the size and position of facial bones. This is practical because the surgeon thinks in terms of millimeters in planning and accomplishing his procedures.

A note of caution should be observed. It is possible that all of the facial bones of the face may be large or small, particularly in the population with skeletal deformities. Therefore, the clinician should mentally proportion these measurements comparing them to similar proportions from the standards.

Conclusion

From the studies, following conclusions were drawn. Karnataka population showed:

- Greater maxillary skeletal prognathism
- Decreased skeletal lower anterior face height
- Greater upper posterior face height
- Greater proclination of the lower incisors
- Greater mandibular body length
- Greater skeletal facial convexity and greater upper and lower anterior dental heights as compared to Caucasian sample.

In concurrence with some other studies, statistically significant maxillary dental proclination was not observed, but there was an increase in mandibular incisor proclination.

The facial structures of Karnataka males, in general, were larger than that of Karnataka females.

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