Original Article

To Compare the Established Soft-Tissue Cephalometric Norms of COGS Analysis using Dolphin Software for the Chhattisgarh Population

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Abstract

Background: India, a varied country with many different ethnicities and cultural groups thus having different dentofacial patterns that necessitate specialized cephalometric evaluation for orthognathic surgery (COGS). Chhattisgarh is located in eastern part of Central India and is incredibly diverse as it comprises tribal community. **Materials and Methods:** One hundred pretreatment digital lateral cephalograms (DICOM format) of the patients reported to the Department of Orthodontics and Dentofacial Orthopedic, New Horizon Dental College and Research Institute, Sakri, Bilaspur, Chhattisgarh, were selected based on inclusion and exclusion criteria. Then, these digital lateral cephalogram were digitized using DOLPHIN software and landmarks were marked. Various linear and angular measurements were made; further, these values were compared to the standard analyses provided by Legan and Burstone for soft tissue. **Results:** There were significant changes between our research group's soft-tissue values and those of the Caucasians. With the exception of facial convexity, mandibular prognathism, and lower face throat angle, all parameters showed significant differences in the male Chhattisgarh population. **Conclusions:** This study determined COGS values in Chhattisgarh population which will aid in diagnosis and treatment planning.

Keywords: Cephalometric analysis, Chhattisgarh population, COGS analysis, COGS

Introduction

In the field of orthodontics today, when a patient needs both orthodontic therapy and orthognathic surgery, their treatment objectives are typically evaluated using lateral and anteroposterior cephalometrics.

This cephalometric analysis is important for several reasons, the first of which is that the identification of skeletal and dental abnormalities depends heavily on cephalometric study. In addition to its significance in mimicking orthognathic surgery through the use of "Surgical Treatment Objective," it enables clinicians to assess operative changes both during and after the treatment period. Research has been done to determine the standard values for human facial measurements. These standard measurements are used to track the outcomes of surgery, quantify the craniofacial dimensions, and evaluate face abnormalities.

The analysis standards derived by Legan and Burstone for the soft tissues, respectively, are the most easily accessible and commonly recognized.[1-3] This analysis is specially designed for patients who require orthognathic surgery and was developed by identifying various landmarks and measurements that can be altered by common surgical procedures. According to several research, typical measurements from one racial group should not be applied to other racial groups. It is crucial to create standards for diversed population since different ethnic groups should be addressed based on their unique characteristics. Because the developed Caucasian norms are used in many cephalometric analyses, they may not be applied to other racial groups.

The application of defined criteria for the Indian population may be inadequate because these studies were conducted on

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the Caucasian population. India, a varied country with many different ethnicities and cultural groups thus having different dentofacial patterns that necessitate specialized cephalometric evaluation for orthognathic surgery (COGS). Chhattisgarh is located in eastern part of Central India and is incredibly diverse as it comprises tribal community. The tribes include the Gonds of Bastar, the Abhuj Maria, the Bison Horn Maria, the Murias, the Halba, the Bhatra, and the Dhurva. The Gonds or Adivasi tribe, who are descended from the Indus valley culture, make up the majority of the tribal population.

This study was designed to establish norms using Burstone's cephalometric landmarks, dental measurements, and skeletal measurements. It will be used to calculate norms that can help in the diagnosis and treatment of dentofacial abnormalities for residents of the state of Chhattisgarh.

Materials and Methods

Source of data

One hundred pretreatment lateral cephalograms of the patients who reported to the Department of Orthodontics and Dentofacial Orthopedics, New Horizon Dental College and Research Institute, Sakri, Bilaspur, Chhattisgarh, were selected based on inclusion and exclusion criteria.

Inclusion criteria

1) Subjects belonging to the Chhattisgarhi Origin were selected
2) Subjects aged between 18 and 25 years were selected
3) Presence of all permanent dentition with proper intercuspation
4) Subjects with presence of only negligible crowding, rotations and spacing of teeth were selected
5) Good quality digital cephalometric file in DICOM FORMAT, with visible landmarks.

Exclusion criteria

1) No severe skeletal or dental deformities
2) No history of prior orthodontic treatment
3) No history of orthognathic interventions or plastic surgery of maxillofacial region.

Materials

1) Digital Lateral Cephalogram (DICOM format)
2) Desktop computer system having DOLPHIN SOFTWARE (11.95 PREMIUM).

Methods

One hundred pretreatment digital lateral cephalograms (DICOM format) of the patients reported to the Department of Orthodontics and Dentofacial Orthopedic, New Horizon Dental College and Research Institute, Sakri, Bilaspur, Chhattisgarh, were selected based on inclusion and exclusion criteria. Then, these digital lateral cephalograms were digitized using DOLPHIN software and landmarks mentioned below were marked. Various linear and angular measurements were made; further, these values were compared to the standard analyses provided by Legan and Burstone for soft tissue and Burstone *et al*. for hard tissue.

The following cephalometric landmarks were used for the study:

Facial form	
Facial convexity	A line dropped form Glabella "G" to Subnasale "Sn" and a line Sn to soft. increased +ve value=convex profile Increased –ve value=concave profile (class III skeletal and dental relationship).
MX prognathism	A line dropped perpendicular to horizontal plane from Glabella. Measure the distance from perpendicular line to Sn (parallel to HP). Describes the amount of maxillary excess/deficiency in anteroposterior dimension.
MD prognathism	A line dropped perpendicular line to HP from Glabella. Measure the position of the pogonion from this line parallel to HP. Increased –ve value indicated mandible is retrognathic.
Vertical height ratio	A line dropped perpendicular line to HP from Glabella, to this line drop a perpendicular line to Sn and M. Measure the distance from G-Sn and Sn-Me (all perpendicular to HP).
Lower face-throat angle	Formed by the intersection of lines Sn-Gn and Gn-C. Obtuse lower face neck angle indicates that any procedures that reduce the prominence of chin should not be done.
Lower face height-depth ratio	A line dropped from Sn to Gn and C to Gn. Measure the distance from Sn-Gn and C-Gn. If the ratio is more than 1=short neck.

Lip position and form	
Naso-labial angle	A line is drawn from Sn to Cm and drop a line from Sn to Ls.
Upper lip protrusion	A line is drawn from Sn to soft-tissue Pg the amount of lip protrusion/retrusion is measured with perpendicular linear distance from this line to the prominent point of the lip.
Lower lip protrusion	A line is drawn from Sn to Pg and the amount of lip protrusion/retrusion is measured with perpendicular linear distance from this line to the most prominent point of both lips.
Mentolabial sulcus	The perpendicular distance between deepest points on the mentolabial sulcus to Li-Pg' line.
Vertical lip-chin ratio	The ratio between these two measurements (Sn-Stms/ Stmi-Me), it's done to assess the lower third of the face.
U1 exposure	The distance between tip of upper central incisor and Stms.
Interlabial gap	It is the distance between Stms and Stmi, useful in assessing lip competence.

Statistical analysis

The data were tabulated in Microsoft excel and analyzed with the Statistical Package for the Social Sciences V.24 software. Variables were presented with mean and standard deviation. The level of significance was tested using independent *t*-test. $P < 0.05$ was considered statistically significant.

Error control

The reliability of the method was analyzed by calculating Dahlberg's formula: The error test was conducted on 25% of cephalometric radiographs that were randomly selected. The combination error for both types of measurement for any

given variable was relatively insignificant and within normal acceptable limits.

Results

There were significant changes between our research group's soft-tissue values and those of the Caucasians. With the exception of facial convexity, mandibular prognathism, and lower face throat angle, all parameters showed significant differences in the male Chhattisgarh population (Table 1).

However, all parameters indicated significant differences in the female Chhattisgarh population, with the exception of the nasolabial angle, lower face throat angle, and vertical lip chin ratio (Table 2).

Discussion

The ability to recognize the standard dentofacial patterns of individuals from different ethnic groups is crucial for clinical and scientific purposes, and clinicians may find it useful to use cephalometric norms to help them identify patient anomalies.

Several studies conducted over the years have demonstrated that people of different races do, in fact, exhibit significant differences both within and among themselves. The most widely accepted and easily accessible standards are those developed by *Legan and Burstone* for the soft tissues, respectively. Given that these studies were carried out on the Caucasian population. India is a diverse nation with numerous ethnic and cultural groups, which results in a range of dentofacial patterns that call for specific cephalometric examination for orthognathic surgery (COGS). Chhattisgarh is located in eastern part of Central India and is incredibly diverse as it comprises tribal community.

There were some notable differences in the soft-tissue parameters between the Chhattisgarh and Caucasian populations, yet there are also some parallels.

The soft tissue hides the skeletal hard tissues, such as the teeth and underlying bone; therefore, this discrepancy can result in unfavorable face features. Therefore, to reach normative criteria and a desirable face, soft-tissue considerations must be kept in mind before any planned orthognathic surgery. All soft-tissue parameters, with the exception of lower face throat angle, mandibular prognathism, and facial convexity, exhibited statistically significant alterations in the male population.

The nasolabial angle (84.64 ± 13.3), mentolabial sulcus (22.83 ± 8.09), upper lip protrusion (9.61 ± 3.54), and lower lip protrusion (11.27 ± 4.5) all showed statistically significant increases, as indicated in Table 1. This indicates that, in contrast to Caucasians, males tend to have protruding upper and lower lips. Similar findings were seen in study conducted by Yadav *et al*. on Central India population, they found that lower lip was more protrusive in relation to lower facial plane in Central India population.[11]

Table 1: Comparison of soft-tissue parameters between Caucasian and Chhattisgarh male population

Variables	Chhattisgarh's male		Caucasian's male		*t*-value	*P*-value
	Mean	SD	Mean	SD		
Facial convexity	12.34	11	12	4	0.24	0.811
Maxillary prognathism	3.03	4.07	6	3	5.65	0.001
Mandibular prognathism	−0.77	4.5	0	4	0.71	0.48 NS
L face-throat angle	101.55	11	100	7	1.09	0.28 NS
Nasolabial angle	84.64	13.3	102	8	10.11	0.001
Mentolabial sulcus	22.83	8.09	4	2	18.03	0.001
Upper lip protrusion	9.61	3.54	3	1	14.46	0.001
Lower lip protrusion	11.27	4.5	2	1	15.96	0.001
Vertical height ratio	0.87	0.11	1	1	9.15	0.001
L face ht-depth ratio	1.42	0.28	1.2	1	6.09	0.001
Vertical lip-chin ratio	0.53	0.05	0.5	2	4.65	0.001
U1 exposure	3.62	4.17	2	2	3.01	0.003
Interlabial gap	4.98	3.06	2	2	7.54	0.001

SD: Standard deviation

Table 2: Comparison of soft-tissue parameters between Caucasian and Chhattisgarh female population

Variables	Chhattisgarh's female		Caucasian's female		*t*-value	*P*-value
	Mean	SD	Mean	SD		
Facial convexity	16.3	7.04	12	4	4.73	0.001
Maxillary prognathism	1.31	4.02	6	3	9.04	0.001
Mandibular prognathism	-5.98	8.83	0	4	5.25	0.001
L face-throat angle	103.55	9.5	100	7	1.52	0.137 NS
Nasolabial angle	102.04	10.2	102	8	0.01	0.992 NS
Mentolabial sulcus	17.29	2.4	4	2	6.24	<0.001
Upper lip protrusion	8.73	7.6	3	1	5.84	0.001
Lower lip protrusion	10.83	2.9	2	1	5.21	0.001
Vertical height ratio	0.87	0.12	1	100	8.39	0.001
L face ht-depth ratio	1.54	0.47	1.2	120	5.6	0.001
Vertical lip-chin ratio	0.51	0.08	0.5	50	0.97	0.338 NS
U1 exposure	7.47	10.67	2	2	3.97	0.001
Interlabial gap	4.82	2.76	2	2	7.91	0.001

SD: Standard deviation

In addition, there was a statistically significant increase in the lower face height to depth ratio (1.42 ± 0.28), U1 exposure (3.62 ± 4.17), and interlabial gap (4.98 ± 3.06) among the male population of Chhattisgarh (Table 1). Similar results were observed in the study conducted by Yadav et.al on Central India population. All parameters indicated statistically significant difference in the female Chhattisgarh population, with the exception of the nasolabial angle, lower face throat angle, and vertical lip chin ratio. Other parameters such as mentolabial sulcus (17.29 ± 16.49), U1 exposure (7.47 ± 10.67), and interlabial gap (4.82 ± 2.76) showed statistically significant increase, that is, when compared to Caucasians female

population showed more convex profile and protrusive lips (Table 2). In addition to the statistically significant results mentioned above, the values for the inter-labial gap, maxillary incisor exposure, and upper and lower lip protrusion were all extremely important.

Each of these values was above the range provided by *Legan*. This indicates that male and female Chhattisgarh population have more protruded upper and lower lips which are also supported by the study on Central Indian population for different ethnicities.

Conclusions

It can be concluded that compared to Caucasians, Chhattisgarh male population showed:

- Prognathic maxilla and mandible as well as forward placement of chin in relation to nasion when compared to Caucasians male
- Increased nasolabial angle and mentolabial sulcus then Caucasians male
- Protrusive lips when compared with Caucasian male population
- Increased upper incisor exposure and interlabial gap when compared to Caucasians male.

However, compared to Caucasians, Chhattisgarh female population showed:

- Convex facial profile when compared to Caucasian female
- Protrusive lips when compared with Caucasian male population
- Increased upper incisor exposure and interlabial gap when compared to Caucasians male.

This study determined COGS values in Chhattisgarh population which will aid in diagnosis and treatment planning. Though further research might be required due to limitations of the study and diversed population.

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