Cephalometric norms for orthognathic surgery for North India (Eastern Uttar Pradesh)

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ABSTRACT

Aim: The present study was aimed at development of the cephalometric norms for orthognathic surgery for the population of eastern Uttar Pradesh in North India. Settings and design: This study was conducted at a dental college. Materials and Methods: The study sample consisted of 50 males and 50 females. Each lateral cephalogram was taken in occlusion and subsequently traced. All reference points, landmarks, and measurements were made according to cephalometrics for orthognathic surgery (COGS) system. Statistical analysis used: The statistical analysis involved calculation of mean and standard deviation for each of the 23 parameters assessed for each subject. The data was subsequently compared with COGS study by using Normal (Z) test. Results: The norms were derived for the purvanchal population of North India and these were found to be quite distinct compared to those obtained from COGS study with respect to specific parameters. Conclusion: Male subjects indicated greater prominence of chin relative to the face, decreased posterior divergence, infraeruption of upper and lower molar as well as lower incisors, decreased total effective length of the maxilla, tendency towards Class III occlusion, and procumbent lower incisors. Female subjects, however, indicated increased anterior cranial base length, greater prominence of chin relative to the face, prognathic maxilla and mandible, increased middle third facial height, infraerupted lower incisors, increased mandibular body length, and procumbent lower incisors.

Key words: Cephalometric norms, COGS System, North India, purvanchal

INTRODUCTION

In modern day practice, the treatment goals for any patient that requires combined orthodontic treatment and orthognathic surgery are determined systematically through cephalometrics, the importance of which can be elaborated as follows:

1. Cephalometric analysis aid in diagnosis of skeletal and dental problems.

2. It can help simulate orthognathic surgery through ‘Surgical Treatment Objective’ (STO).

3. It allows the clinician to evaluate the changes following the completion of the treatment.

In 1978, Burstone reported the cephalometric norms for the cases that required orthognathic surgery as per the cephalometrics for orthognathic surgery (COGS) System.[1] However, with time it became apparent that standards obtained from one ethnic group may not necessarily apply to the other ethnic groups.

Furthermore, no cephalometric guidelines for orthognathic surgery have been reported, previously, primarily for the natives of Purvanchal (Eastern Uttar Pradesh, (U.P.) region in North India.

It was, therefore, considered imperative to develop...
cephalometric norms for orthognathic surgery for the purvanchal population.

Aims and Objectives

The present study was aimed at achieving the following objectives:
1. To establish the cephalometric norms for Orthognathic surgery for North India (Eastern U.P.).
2. To compare these with the original norms as reported by Charles J Burstone and others.[2]

Materials and Methods

The study was conducted at a dental college in eastern Uttar Pradesh. The study sample consisted of hundred individuals. It comprised of 50 males and 50 females. The mean age of the sample was 24 and 21.5 years for males and females, respectively. The following criteria were used for patient selection:
1. The patient is a native of eastern Uttar Pradesh.
2. No previous orthodontic or orthognathic surgical treatment had been undertaken.
3. All individuals had esthetically pleasing facial appearance.
4. Full compliment of dentition except permanent third molars was present.
5. Angle’s Class I molar relationship, present bilaterally.
6. No crossbite in anterior and posterior segments.

An informed consent was taken from each of the selected subject for Lateral cephalogram.

The subject is first made to assume the natural head position (NHP). A plumb line is suspended on the right side of the subject and its shadow is seen on the right side of the subject’s face from an illuminated light source. Two markings, one near the outer canthus of eye and the other near the angle of mandible, are made on the face over the shadow of the plumb line. The whole procedure is repeated few more times to ensure that the two markings repeatedly fall on the shadow of the plum line. Thus, the accuracy of the recording of NHP is ascertained.[2] Then, the cephalogram is taken with the teeth in occlusion in a conventional manner. Cephalograms of all the subjects were traced, by a single examiner using acetate paper and 0.3-mm lead pencil and a tracing board.

All reference points, landmarks, and measurements were made according to COGS system [Figure 1]. Twenty three parameters were assessed for each individual [Tables 1 and 2]. Angular and linear measurements were taken to the nearest 0.05 and 0.05 mm, respectively. Subsequently, the data was subjected to statistical evaluation.

The statistical analysis involved calculation of mean and standard deviation for each of the 23 parameters assessed for each subject. The data was subsequently, compared with COGS study by using Normal (Z) test and denoting the significantly different values at 5%, 1%, and 0.1% level of significance by symbols *, **, ***, respectively. The summarized tables are given separately for males [Table 1] and for females [Table 2].

Results

Following the comparison between the data obtained from the present study and that from COGS study, it was found that for male subjects, 14 parameters did not differ significantly. Hence, for these 14 parameters, the norms, as obtained from the COGS study can be applied directly to the North Indian (purvanchal) males. The difference was, however, significant for ‘PNS-N’ and ‘PNS-ANS’ and highly significant for ‘upper molar-NF’ and ‘lower molar-MP’. For the remaining five parameters, i.e., ‘B-Pg’, ‘MP-HP’, ‘Lower incisor-MP’, ‘A-B II OP’, ‘Lower incisor-MP (Angle)’, the difference was found to be most highly significant. This means that for nine parameters, the norms, as obtained from the COGS study need to be modified in accordance with the results and the objectives of the present study [Table 1].

For female subjects, 14 parameters did not differ significantly. It means that for these 14 parameters, the norms, as obtained from the COGS study can be applied directly to the North Indian (purvanchal) females. The difference was, however, significant for four parameters, i.e. ‘N-A’, ‘N-B’, ‘B-Pg’, ‘N-ANS’, while it was highly significant only for a single parameter, i.e. ‘N-Pg’. The difference was found to be most highly

Figure 1: Points and landmarks used in the present study
Table 1: Comparison between the parameters of the present study and the similar cephalometrics for orthognathic surgery values for males

| Measurements                        | COGS study (mean ± Standard deviation) | Present study (mean ± Standard deviation) | Z value |
|-------------------------------------|----------------------------------------|-------------------------------------------|---------|
| Cranial base                        |                                        |                                            |         |
| Ar-PTM (II HP)                      | 37.1 ± 2.8                             | 37.8 ± 2.5                                | 0.85    |
| PTM-N (IIHP)                        | 52.8 ± 4.1                             | 54.6 ± 5.6                                | 1.33    |
| Horizontal (Skeletal)               |                                        |                                            |         |
| N-A-Pg (Angle)                      | 3.9° ± 6.4°                            | 6.0° ± 6.4°                               | 1.09    |
| N-A (IIHP)                          | 0.0 ± 3.7                              | 2 ± 4.8                                   | 1.67    |
| N-B (IIHP)                          | -5.3 ± 6.7                             | -3.5 ± 6.2                                | 0.90    |
| N-Pg (IIHP)                         | -4.3 ± 8.5                             | -1.4 ± 7.5                                | 1.16    |
| B-Pg (IIHP)                         | 8.9 ± 1.7                              | 6.1 ± 2                                   | 5.23*** |
| Vertical (Skeletal and Dental)      |                                        |                                            |         |
| N-ANS (⊥ HP)                        | 54.7 ± 3.2                             | 54 ± 3.8                                  | 0.70    |
| ANS-Gn (⊥ HP)                       | 68.6 ± 3.8                             | 68 ± 3.9                                  | 0.52    |
| PNS-N (⊥ HP)                        | 53.9 ± 1.7                             | 55.2 ± 2.6                                | 2.22*   |
| MP-HP (Angle)                       | 23.0° ± 5.9°                           | 17° ± 6.2°                                | 3.33*** |
| Upper Incisor-NF (⊥ NF)             | 30.5 ± 2.1                             | 30 ± 2.8                                  | 0.73    |
| Lower incisor-MP (⊥ MP)             | 45.0 ± 2.1                             | 41.3 ± 3.1                                | 5.20*** |
| Upper molar-NF (⊥ NF)               | 26.2 ± 2.0                             | 24.6 ± 1.9                                | 2.67**  |
| Lower molar-MP (⊥ MP)               | 35.8 ± 2.6                             | 33.5 ± 2.9                                | 2.85**  |
| Maxilla - mandible                  |                                        |                                            |         |
| PNS-ANS (IIHP)                      | 57.7 ± 2.5                             | 55.1 ± 7.6                                | 2.05*   |
| Ar-Go (Linear)                      | 52 ± 4.2                               | 53.3 ± 5.1                                | 0.97    |
| Go-Pg (Linear)                      | 83.7 ± 4.6                             | 83.4 ± 5.1                                | 0.21    |
| Ar-Go-Gn (Angle)                    | 119.1° ± 6.5°                          | 118° ± 7.2°                               | 0.55    |
| Dental                              |                                        |                                            |         |
| OP-HP (Angle)                       | 6.2° ± 5.1°                            | 5.7° ± 8.3°                               | 0.28    |
| A-B II OP                           | -1.1 ± 2.0                             | 1.7 ± 3.2                                 | 4.0***  |
| Upper Incisor-NF (⊥ NF)             | 111.0° ± 4.7°                          | 113° ± 6.5°                               | 1.28    |
| Lower incisor-MP (⊥ Angle)          | 95.9° ± 5.2°                           | 103° ± 6.7°                               | 4.22*** |

Disclaimer: Normal (Z) test denotes significantly different values at 5%, 1% and 0.1% level of significance by symbols *, **, ***; respectively. All reference points, landmarks and measurements were made according to ‘Cephalometrics for Orthognathic Surgery’ (COGS) system.

Table 2: Comparison between the parameters of the present study and the similar cephalometrics for orthognathic surgery values for females

| Measurements                        | COGS study (mean ± Standard deviation) | Present study (mean ± Standard deviation) | Z value |
|-------------------------------------|----------------------------------------|-------------------------------------------|---------|
| Cranial base                        |                                        |                                            |         |
| Ar-PTM (II HP)                      | 32.8 ± 1.8                             | 36.4 ± 2.9                                | 5.91*** |
| PTM-N (IIHP)                        | 50.9 ± 3.0                             | 52.4 ± 2.6                                | 1.80    |
| Horizontal (Skeletal)               |                                        |                                            |         |
| N-A-Pg (Angle)                      | 2.6° ± 5.1°                            | 4.8° ± 5.4°                               | 1.48    |
| N-A (IIHP)                          | -2.0 ± 3.7                             | 0.9 ± 3.7                                 | 2.10*   |
| N-B (IIHP)                          | -6.9 ± 4.3                             | -3.7 ± 6.5                                | 2.26*   |
| N-Pg (IIHP)                         | -6.5 ± 5.1                             | -1.9 ± 7.2                                | 2.82**  |
| B-Pg (IIHP)                         | 7.2 ± 1.9                              | 6.1 ± 1.7                                 | 2.07*   |
| Vertical (Skeletal and dental)      |                                        |                                            |         |
| N-ANS (⊥ HP)                        | 50.0 ± 2.4                             | 51.6 ± 3.4                                | 2.08*   |
| ANS-Gn (⊥ HP)                       | 61.3 ± 3.3                             | 62.3 ± 5.0                                | 0.92    |
| PNS-N (⊥ HP)                        | 50.6 ± 2.2                             | 51.8 ± 2.9                                | 1.75    |
| MP-HP (Angle)                       | 24.2° ± 5.0°                           | 21.4° ± 8.2°                              | 1.64    |
| Upper Incisor-NF (⊥ NF)             | 27.5 ± 1.7                             | 28.7 ± 3.4                                | 1.87    |
| Lower incisor-MP (⊥ MP)             | 40.8 ± 1.8                             | 36.1 ± 5.3                                | 5.38*** |
| Upper molar-NF (⊥ NF)               | 23.0 ± 1.3                             | 23.7 ± 3.9                                | 1.09    |
| Lower molar-MP (⊥ MP)               | 32.1 ± 1.9                             | 31.3 ± 6.1                                | 0.81    |
| Maxilla - mandible                  |                                        |                                            |         |
| PNS-ANS (IIHP)                      | 52.6 ± 3.5                             | 52.6 ± 3.1                                | 0.0     |
| Ar-Go (Linear)                      | 46.8 ± 2.5                             | 48.2 ± 8.7                                | 1.01    |
| Go-Pg (Linear)                      | 74.3 ± 5.8                             | 82.0 ± 8.4                                | 4.11*** |
| Ar-Go-Gn (Angle)                    | 122.0° ± 6.9°                          | 121.0° ± 5.5°                             | 0.55    |
| Dental                              |                                        |                                            |         |
| OP-HP (Angle)                       | 7.1° ± 2.5°                            | 6.1° ± 4.9°                               | 1.07    |
| A-B II OP                           | -0.4 ± 2.5                             | 0.7 ± 3.1                                 | 1.44    |
| Upper Incisor-NF (Angle)            | 112.5° ± 5.3°                          | 113.4° ± 8.0°                             | 0.52    |
| Lower incisor-MP (Angle)            | 95.9° ± 5.7°                           | 102.4° ± 6.5°                             | 3.83*** |

Disclaimer: Normal (Z) test denotes significantly different values at 5%, 1% and 0.1% level of significance by symbols *, **, ***; respectively. All reference points, landmarks and measurements were made according to ‘Cephalometrics for Orthognathic Surgery’ (COGS) system.
significant for the remaining four parameters, i.e. ‘Ar-PTM’, ‘Lower incisor-MP’ (angular and linear) and ‘Go-Pg’. Hence, for nine parameters, the norms, as obtained from the COGS study need to be modified in accordance with the objectives and the results of the present study [Table 2].

**Discussion**

Cephalometric norms have been established using various analysis such as McNamara’s, Steiner’s, Down’s etc, for the Indian population like for Gujaratis,[3] North Indians,[4] Maharashtrians,[5] Bunts,[6] Gurkhas.[7] These studies have established the differences between the different ethnic groups as far as the craniofacial characteristics are concerned. Burstone’s analysis used for orthognathic surgery provides cephalometric norms for the Caucasians. This led us to the development of similar cephalometric norms for the North Indian (purvanchal) population.

For the male subjects, the cranial base measurements as obtained in the present study matched with those from the COGS study. For females, however, ‘PTM-N’ matched but ‘Ar-PTM’, the horizontal distance between the posterior parts of the maxilla and mandible was found out to be more in the present study.

Compared to the COGS data, the horizontal (skeletal) measurements showed that both males and females had greater prominence of chin relative to face. The position of the maxillary and mandibular apical bases in relation to nasion, as determined by ‘N-A’ and ‘N-B’ measurements, was found out to be more prognathic in females. This was, however, not true for males.

With respect to the vertical skeletal measurements, posterior maxillary height, ‘PNS-N’, was found to be marginally increased and the mandibular plane angle, ‘MP-HP’, was found to be most significantly decreased, for males. The suggested decrease in the posterior divergence in the male subjects of the present study is in accordance with the study conducted by Valiathan[8] and Arunkumar and others.[9] For females, however, the decrease in posterior divergence was not statistically significant. Middle third facial height, ‘N-ANS’, was only marginally increased.

The vertical dental measurements proved that lower incisors, upper and lower molars were infraerupted in males, while only lower incisors were found to be infraerupted in females. This data should be correlated with the ‘ANS-Gn’ and ‘MP-HP’ to establish whether the origin of the maxillary and mandibular discrepancies is skeletal, dental, or a combination of both.

Maxilla-mandible measurements did not show any marked deviation for the male subjects, except that the total effective length of the maxilla, PNS-ANS, was found to be significantly decreased. On the other hand, it was mandibular body length, Go-Pg, that was found to be significantly increased for the female subjects.

Assessment of dental relationship showed that male subjects had a tendency towards denture base discrepancy that predisposes the individual to Class III occlusion. Both male and female group had markedly procumbent lower incisors. The latter finding is in accordance with the study conducted by Valiathan.[8]

**Summary and Conclusion**

In comparison to the COGS study, the norms for the male subjects indicated greater prominence of chin relative to the face, decreased posterior divergence, infraeruption of upper and lower molar as well as lower incisors, decreased total effective length of the maxilla, tendency towards Class III occlusion and procumbent lower incisors.

Female subjects, however, indicated increased anterior cranial base length, greater prominence of chin relative to the face, prognathic maxilla and mandible, increased middle third facial height, infraerupted lower incisors, increased mandibular body length and procumbent lower incisors.

Statistically significant differences were found between North Indian (Purvanchal) men and women when compared with Caucasians with respect to certain specific parameters. These differences need to be considered when analyzing the cephalogram for orthognathic surgical cases. The values derived from this study may help making the deformity assessment and surgical planning procedures more appropriate. This would help us achieve optimal results for purvanchal population of North India.

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