ORIGINAL ARTICLE

Establishing lateral cephalometric norms for Nalgonda children with mixed dentition

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ABSTRACT

Aim: The aim was to establish lateral cephalometric norms among Nalgonda children with mixed dentition and also to compare these norms with the established value of Caucasian norms. **Materials and Methods**: A total of 100 children (50 girls and 50 boys), aged between 8 and 12 years was selected based on the following inclusion criteria: Class I molar relationship without any crowding, no skeletal abnormality and no previous orthodontic treatment. A new custom made software was developed into which the subject's data were uploaded for cephalometric analysis of skeletal, dental angular and linear measurements. **Results:** Nalgonda children demonstrated forwardly placed maxillary and mandibular incisors in relation to NA and NB planes giving an acute interincisal angle of 116.1°. A statistical difference was observed between boys and girls in few variables which include ANB. Lower incisor-NB (linear), angle of convexity, occlusal cant and gonial angle. **Conclusion:** These children displayed horizontal growth pattern and Class II skeletal tendency with acute interincisal angle which varied from Caucasians. The values provided here would aid in the diagnosis and treatment planning for orthodontic interventions among Nalgonda children.

Key words: Children with mixed dentition, lateral cephalometric norms, software

Introduction

Growth changes in children are a continuous process with a predictable sequence, yet having a unique course for every child. These developmental changes would also influence the cephalometric standards. To accomplish facial esthetics and functional occlusion, it is important to know the normal skeletal and dental parameters of children in various populations. Lateral cephalometrics play a pivotal role in the analysis of dentofacial morphology, which is important in orthodontic diagnosis and treatment planning. Since its origin by Broadbent in 1931,[1] various diverse methods of analysis have been proposed in different populations.[2] Downs[3] Steiner and Tweed[4] and Bjork[5] were among the pioneers who established cephalometric norms to be used as guidance for treatment planning of various skeletal and dental malocclusions.

Though extensive studies have been carried out in the western population, there is limited information available on lateral cephalometric norms in Indian children. As no lateral cephalometric norms have been previously established in Nalgonda children with mixed dentition of Telangana region, the following study has been undertaken to derive normative values for selected lateral cephalometric variables.

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Materials and Methods

This cross-sectional radiographic study was designed and conducted in the Department of Pediatric and Preventive Dentistry, Kamineni Institute of Dental Sciences, Narketpally, Nalgonda (District). This study design was

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reviewed and approved by our institutional ethical committee. A total of 100 healthy school going children (50 boys, 50 girls) aged between 8 and 12 years (mixed dentition period) was randomly selected from various schools of Nalgonda District using the following inclusion criteria:

- Near normal occlusion with Class I molar relationship.
- Pleasant soft tissue profile with competent lips and without apparent skeletal deformity.
- Normal overbite and overjet.
- Minimum or no crowding.
- No previous orthodontic treatment.
- No history of trauma.
- Normal growth and facial symmetry.
- No significant medical history.

Radiographic Technique

An informed consent was obtained from the parents or guardians of each participant. All lateral cephalometric radiographs were taken in standardized manner using the same X-ray unit (Villa Sistemi Medicali S.P.A. Via Delle Azalee 3. 2009 Buccinasco [MI], Italy. Mfd. 2010) and by the same person, in natural head posture (Frankfort horizontal plane parallel to the floor), using a cephalostat to maintain the head with the teeth in centric occlusion, and with lips in relaxed position. Exposure was made at 74 kVp and 6 mA for 4.5 s. All radiographs were taken following proper precautionary measures using lead aprons, throat shields and eye mask.

Analysis of Radiographs

A modified custom made software (Pogonion Version 1.0) has been developed using Microsoft Dot Net framework 4.0 (NXS Inc., http://www.nxs.co.in) for the cephalometric analysis.

Each subject's information was entered into the software, and twenty landmarks were located, subsequently 14 angular and 2 linear measurements were analyzed. In order to eliminate the bias, each radiograph was analyzed by three examiners. All measurements were taken to the nearest 0.5 mm method error in identifying and locating the anatomical landmarks. The recorded data were tabulated and statistically analyzed using paired t-test.

Results

The cephalometric measurement data were categorized based on gender to obtain specific and useful cephalometric norms in Nalgonda children. The method errors for both linear and angular measurements were <1.5 mm and $0.5°$, respectively, for all variables. Considering the nonsignificant difference between the three examiners the data recorded by the examiners was averaged. The descriptive statistics (mean, standard deviation and range) of each variable for males, females, and the total sample are presented in Tables 1 and 2. The mean of skeletal angular measurements which include SNA, SNB, upper incisor (UI)-NA (angular) and lower incisor (LI)-NB (angular) were found

Table 1: Cephalometric norms for 8-12 years old boys and girls

Variable	Boys					Girls				
	Mean	SD	Median	Range		Mean	SD	Median	Range	
				Minimum	Maximum				Minimum	Maximum
Angular measurements										
SNA	81.8	3.2	82.0	73.1	90.6	82.62	3.48	82.4	71.7	89.2
SNB	78.3	3.0	78.5	72	86.6	76.98	8.7	78.5	81	85.8
ANB	3.5	1.6	3.3	1.1	4.9	10.85	46.78	4.35	1.2	6.5
UI-NA	26.0	5.5	26.1	11.9	40.5	23.12	5.98	22.9	17.4	36.5
LI-NB	31.2	4.9	31.5	19.8	43.6	26.6	29.51	31.5	25	44.6
I/I	122.2	28.2	119.5	102	140.2	120.8	34.18	120.9	107.8	132.2
IMPA	98.4	8.6	98.8	90.1	106	98.6	8.4	98.8	87.3	105.3
Facial angle	85.5	3.57	85.6	75.1	94.5	84.3	10.1	85.5	83	103.4
MP angle	22.5	5.1	22.2	15.1	34.4	22.9	6.9	22.6	15.7	30.7
Angle of convexity	8.4	3.5	8.7	1.4	9.2	7.9	4.9	7.2	1.1	8.9
Y-axis	59.1	5.9	59.5	51.9	66.7	59.2	3.9	59.3	52.9	62.2
Cant occlusal plane	12.1	4.61	10.9	3.3	17.0	13.28	10.2	12.0	3.3	22
Occlusal plane angle	20.6	29.8	22.2	13.2	29.3	13.6	53.7	23.5	23.5	32
Gonial angle	125.4	10.9	126	119.5	143.1	126.5	8.55	126.3	116.4	138.9
Linear measurements										
UI-NA	3.12	1.72	3.00	1.4	6.6	2.79	2.7	2.5	1.2	8.6
LI-NB	3.91	1.44	3.90	0.7	9.9	4.88	4.37	4.4	0.9	8.4

SD: Standard deviation, IMPA: Incisor mandibular plane angle, MP: Mandibular plane, UI: Upper incisor, LI: Lower incisor

Table 2: Cephalometric norms of the total sample

Variable	Total sample				
	Mean	SD	Median	Range	
				Minimum	Maximum
Angular measurements					
SNA	81.9	3.31	82.1	71.70	90.60
SNB	77.7	6.58	78.30	72	86.60
ANB	5.2	23.62	3.45	1.1	6.5
UI-NA	25.3	5.63	24.90	11.9	40.5
LI-NB	29.9	15.43	3.10	19.8	44.6
I/I	121.5	26.97	119.7	102	140.2
IMPA	98.5	8.57	98.8	87.3	106.3
Facial angle	84.9	7.59	85.6	75.1	103.4
MP angle	22.7	6.09	22.4	15.1	34.4
Angle of convexity	8.2	4.34	8.05	1.1	9.2
Y-axis	59.1	5.03	59.40	51.1	66.7
Occlusal plane angle	17.1	43.55	22.7	13.2	32
Gonial angle	126.0	9.81	126.1	116.4	143.1
Linear measurements					
UI-NA	3.19	2.04	3.10	1.2	8.6
LI-NB	4.32	2.71	4.05	0.7	9.9
Cant occlusal plane	12.7	7.96	11.7	3.3	22.00

SD: Standard deviation, IMPA: Incisor mandibular plane angle, MP: Mandibular plane, UI: Upper incisor, LI: Lower incisor

to be greater among boys, whereas angles ANB, LI-NB (linear), I/I angle, incisor mandibular plane angle (IMPA), facial angle, MP angle, angle of convexity, Y-axis, occlusal cant, I/occlusal plane angle, and gonial angle were found to be more among girls. From the obtained data, few variables such as ANB, LI-NB (linear), angle of convexity, occlusal cant, and gonial angle have shown statistically significant difference between males and females ($P < 0.05$).

Discussion

As there is diversity in the appearance of craniofacial features in different population, ethnicity, gender, and age, it was thought that establishing lateral cephalometric norms in children with mixed dentition is essential and would aid in orthodontic diagnosis and treatment planning. The values obtained in the present study were compared with Caucasian standards.

SNA

The mean value of SNA angle in the present study group (81.2 ± 2.2°) was similar to the Caucasian standards (82 ± 2°) indicating an analogous skeletal maxillary position in relation to the cranial base as Caucasians. But the mean SNA was found to be slightly less than South Kanara children[6] (82.5 ± 5.2°) and North Indian children (81.6°)[7] and slightly more than Mewari children[8] (81.06 ± 2.93°).

SNB

The mean value of SNB angle in the present study group children was lower (77.3 ± 2.7°) than Caucasian norms (80 ± 2) indicating retruded mandibular position relative to the cranial base. The mean SNB angle found in this study was in agreement with the studies done by Singh Rathore *et al*.,[8] (77.15 ± 2.52°), Chandranee *et al*. on North Indians (78.5°) and Kharabanda *et al*.[9] on Aryo-Dravidians (78.5°) and South Kanara children (78.9 ± 5.0°). In this study, SNB in males is slightly more than females in contrast to South Kanara children.

ANB

The combined mean value of ANB angle (3.9°) in the present study sample was found to be much greater than Caucasians (2°), South Kanara children (3.2 ± 2.1°), and Chandranee *et al*. (3.12°), indicating greater convexity and skeletal Class II tendency than these respective population. However, Anuradha *et al*.[10] reported a greater ANB value (4.95°) among North Indian preschool children than the present value.

Upper Incisor-NA (Angular and Linear)

The angular measurement of UIs to NA plane in the present study was 27.4 ± 4.2°, which was much higher than the Caucasian norms (22°) indicating more labial position of UIs with no significant sexual dimorphism. The present study results were in agreement with the studies done on Madras[11] population (23.5°) by Chandranee *et al*.; on North Indian children (24.9°); and Mewari children (23.9 ± 5.1°).

The linear measurement/relationship of UIs to NA plane was 3.2 ± 1.6 mm which was less than the Caucasian norms (4 mm) and also Mewari children (5.11 ± 2.39 mm) and North Indian children (4.9 mm).

Lower Incisor-NB (Angular and Linear)

The mean angular value of LIs to NB plane in the present study group was 30.7 ± 4.6° which was also much higher than the Caucasian norms indicating forward positioning of LIs. These results are in accordance with the study done on Madras population (26°) by Kannappan and Balasubramaniam,[11] North Indian children (27.8°) and also Mewari children (28.3 ± 4.1°).

The mean linear measurement of LIs to NB plane of the total sample was 4.7 ± 1.9 mm which was more when compared to the Caucasian norms (4 mm) with a significant difference between boys and girls ($P < 0.05$). However, LI-NB (linear) measurement was found to be more among Madras population (5.2 mm), North Indian children (6 mm) and Mewari children (5.34 ± 2.0 mm).

Interincisal Angle (I/I)

The interincisal angle (116.17 ± 14.5°) in the present study group was less when compared to the Caucasian norms (130–131°). The obtained results were consistent with the South Kanara children (117.6 ± 8.7°). In contrast, a higher interincisal angle was observed in North Indian children by Nanda and Nanda[12] and Mewari children of Rajasthan (123.63 ± 7.19°) by Singh Rathore *et al*. suggesting more vertical relation of incisors.

Incisor Mandibular Plane Angle

In the present study, the mean IMPA was greater (97.4°) in either of the gender. The obtained value was more when compared to Tweed's average of 90°, indicating a more forward position of LIs in relation to the MP.

Facial Angle (FH-N-Pg)

The mean facial angle for the combined sample in the present study group was less than Caucasian norms and South Kanara children, however, it was within the normal range.

Mandibular Plane Angle

The mean MP angle for the combined sample was 22.0 ± 4.2° similar to the Caucasian group, but within the normal range indicating normal mandibular growth pattern.

Angle of Convexity

The mean angle of convexity (8.12 ± 4.3°) for the total sample was within Down's Caucasian range (–8-10°).

Y-axis (FH-S-Gn)

The mean Y-axis of the present study group, 58.7 ± 3.6° was similar to the Down's Caucasian norms (59°) suggesting similar skeletal growth of the mandible. In contrast, South Kanara children exhibited increased vertical growth pattern (66.6 ± 4.4°) whereas North Indian children showed increased horizontal growth pattern. This difference could be due to the racial differences.

The mean occlusal cant and incisor occlusal plane angle for the present study group were 11.9 ± 4.6° and 23.1 ± 5.6°, respectively, which were found to be more than the Down's Caucasian norms indicating more forward position of the LIs than Caucasians.

Gonial Angle

The mean gonial angle for the present study group was 127.8° which was less than the Caucasian norms (130 ± 7°) indicating horizontal growth pattern.

Conclusion

Within the limitations of the present study, the selected cephalometric norms among Nalgonda children had shown some variations in both skeletal and dental parameters in comparison to Caucasians. Nalgonda children showed horizontal growth pattern with skeletal mandibular retrusion in relation to the cranial base. Maxillary and mandibular anterior teeth were forwardly positioned in relation to the NA and NB planes giving an acute interincisal angle. A statistically significant difference was observed between males and females in angles ANB, LI-NB (linear), angle of convexity, occlusal cant, and gonial angle. These differences should be taken into consideration to facilitate better orthodontic diagnosis and treatment planning. Further investigations need to be carried out on a large scale for a definitive conclusion.

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