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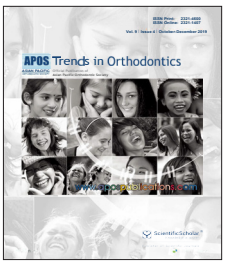

Original Article

Cephalometric norms for Sri Lankan Sinhalese adolescents with Class I malocclusion

Nishanthi Vithanaarachchi[1], L. S. Nawarathna[2]

[1]Department of Community Dental Health, Faculty of Dental Sciences, [2]Department of Statistics and Computer Sciences, Faculty of Science, University of Peradeniya, Sri Lanka.

***Corresponding author:**
Nishanthi Vithanaarachchi, Department of Community Dental Health, Faculty of Dental Sciences, University of Peradeniya, Sri Lanka.

nvithanaarachchi3@gmail.com

Received : 22 February 19
Accepted : 21 May 19
Published : 31 December 19

DOI
10.25259/APOS_14_2019

Quick Response Code:

ABSTRACT

Context: Comprehensive cephalometric analysis plays a significant role in orthodontic diagnosis and treatment planing and variety of cephalometric standards have been developed for different populations. It is important to develop standard cephalometric norms for different populations.

Aims: The aim of this study was to develop cephalometric standards for Sri Lankan Sinhalese adolescents with Class I malocclusion and to test the hypothesis that there are racial differences in cephalometric measurements between Sri Lankan and Caucasian norms.

Setting and Design: Cross sectional , hospital based, descriptive study.

Materials and Methods: Lateral cephalograms were obtained from 33 males (aged 15.7 ± 1.99 years) and 42 females (aged 15.6 ± 2.29 years). Inclusion criteria were healthy individuals with normal growth and development, straight facial profile, average vertical facial proportions, full complement of dentition (excluding third molars), normal overjet and overbite, Class I incisor, canine and molar relationship, and no crossbite in the anterior/posterior region. Eight angular and four linear measurements were analyzed in skeletal, dental, and soft-tissue assessment.

Statistical Analysis Used: Statistical analysis was performed using the statistical software R 3.5.0.

Results: In the dentoalveolar assessment, the Sri Lankan subjects had a significantly proclined upper (UI to N-A = 23.28) and lower incisor (LI to N-B = 6.56 mm and 28.3) inclinations compared with the Caucasian norms. In the assessment of soft-tissue profile, both upper (1.66 ± 2.7mm) and lower lip (2.8 ± 2.6mm) protrusions were slightly increased than the norms of the Steiner analysis, and these findings were clinically significant. There were no apparent differences in relation to anteroposterior and vertical skeletal relationship when compared with Caucasian norms.

Conclusions: The results of the present study suggested that Sri Lankan Sinhalese adolescents with Class I occlusion are likely to present greater incisor proclination than Caucasians.

Keywords: Cephalomertic norms, Class I malocclusion, Orthodontics, Sinhalese

Key Messages: The present study suggested that Sri Lankan Sinhalese adolescents are likely to present greater incisor proclination than Caucasians in Class 1 malocclusion.

INTRODUCTION

Comprehensive cephalometric analysis plays a significant role in orthodontic diagnosis, treatment planning, visualization of treatment objectives, assessment of prognosis, evaluation of treatment outcome, evaluation of treatment stability, assessment of growth changes and facilitates research endeavors. Cephalometric "norms" are established to evaluate the deviation

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of an individual's or a study population's craniofacial morphology from the average.

A large number of cephalometric standards have been developed for both adult and child populations in countries with Caucasian populations. The first cephalometric analysis was introduced by Down using twenty white American non-orthodontic subjects ranging in age from 12 to 17 years with facial harmony and ideal occlusion.[1] Steiner established Steiner cephalometric norms for the same ethnic group.[2] Later, Ricketts developed a computerized analysis intended for routine use by clinicians using a lateral and frontal cephalometric radiographs, but the sample was not specified properly.[3] McNamara analysis was derived from three sources such as lateral cephalograms of the children comprising the Bolton standards, selected values from a group of untreated children from Burlington Research Center, and a sample of young adults from Ann Arbor, Michigan, with good to excellent facial and dental configurations.[4] However, all these norms were based on samples of Caucasians only.

There is a proven ethnic variation in relation to craniofacial morphology including skeletal and dentoalveolar and soft-tissue components. Therefore, cephalometric measurements taken from one population may not be applicable for clinical use in a different population. Differences in the dentofacial relationship of various ethnic groups have been observed by many researches.[5-8] Furthermore, gender differences in cephalometric parameters have been observed in some studies.[9,10] Knowledge of the normal dentofacial pattern of each racial group will ensure improved treatment success and establishment of optimal facial harmony. Therefore, it is important to develop standard cephalometric norms for different populations as well as for gender variations. Sri Lanka has a diverse population. The ethnic groups include the Sinhalese, Tamils, Muslims, and Burghers. The Sinhalese are the predominant ethnic group in the country with over 70% of the total population. However, proper research has not been conducted in Sri Lanka to establish cephalometric standards for the predominant ethnic group previously.

This research was aimed to develop cephalometric standards for Sri Lankan Sinhalese adolescents with Class I occlusion and balanced facial proportions for both males and females with the intention of further improvement of treatment success and establishment of optimal facial harmony for our orthodontic patients with future orthodontic treatment.

SUBJECTS AND METHODS

This study was conducted at the University Dental Hospital, Faculty of Dental Sciences (FDS), University of Peradeniya in Sri Lanka. Ethical approval for the study was obtained from the Ethic Review Committee of the FDS, University of Peradeniya (FDS – FRC/2012/01). The subjects were in the age range of 13–17 years, and the material of this study consisted of lateral cephalograms of 75 Sri Lankan adolescents. The inclusion criteria used for selection of subjects were healthy individuals with normal growth and development, straight facial profile, average vertical facial proportions, full complement of dentition (excluding third molars), normal overjet and overbite, Class 1 incisor, canine and molar relationship, and no crossbite in the anterior/posterior region, born in Sri Lanka to Sinhalese parents. Patients who had previous orthodontic treatment, cleft lip/palate or other craniofacial syndromes, bimaxillary proclination, moderate and severe crowding, and positive mandibular displacement were excluded from the study in line with the exclusion criteria adopted by similar studies.

Written informed consent was obtained from parents/guardians of the study participants before taking standard lateral cephalogram with teeth in centric occlusion of each individual. The lateral cephalograms were scanned into digital format using an Epson Perfection V800 scan setting. Commonly used cephalometric hard- and soft-tissue landmarks and measurements were utilized in this study. NemoCeph software package version 2006 was used to perform digital cephalometry analysis that comprised eight angular and four linear measurements [Table 1, Figures 1 and 2].

Cephalometric analysis was repeated on ten lateral head films to assess the reliability. Analysis was repeated 2 weeks later on the same ten cephalograms. The results of the two testing phases were statistically compared using the Dahlberg reliability formula. Intraoperator error ranged from 0.0 to 0.68° for angular measurements and 0.0 to 0.47 mm for linear

Table 1: Linear and angular measurements used in cephalometry analysis and their abbreviations.

SNA	Maxillary apical base relationship to anterior cranial base
SNB	Mandibular apical base relationship to anterior cranial base
ANB	Apical base relationship
UI to N-A	Inclination of maxillary incisors in relation to nasion to maxillary plane
LI to N-B	Inclination of mandibular incisors in relation to nasion to mandibular plane
LI to UI	Inclination of maxillary incisors to mandibular incisors
GoGn to S-N	Inclination of mandibular plane to anterior cranial base
Occl to S-N	Inclination of functional occlusal plane to anterior cranial base
UL-Sn-Pog	Upper Lip Protrusion in relation to subnasale to pogonion plane
LL-Sn-Pog	Lower Lip Protrusion in relation to subnasale to pogonion plane

measurements. No differences were determined ($P > 0.05$), and intraoperator reliability was deemed satisfactorily.

All the computations in this study have been performed using the statistical software R 3.5.0. Descriptive statistics, including the mean and SD, were computed for each variable. The paired *t*-test was performed to compare the differences between males and females within the sample. Wilcoxon rank-sum test was carried out to assess the significance of the variables of the study sample when the population cannot be assumed to be normally distributed. Significant differences were determined at the 95% probability level.

RESULTS

The lateral cephalometric radiographs of Sri Lankan Sinhalese with Class I malocclusion were analyzed to assess and establish normative values. Lateral cephalometric radiographs of 33 males with an average age of 15.7 ± 1.99 years and 42 females with an average age of 15.6 ± 2.29 years were analyzed.

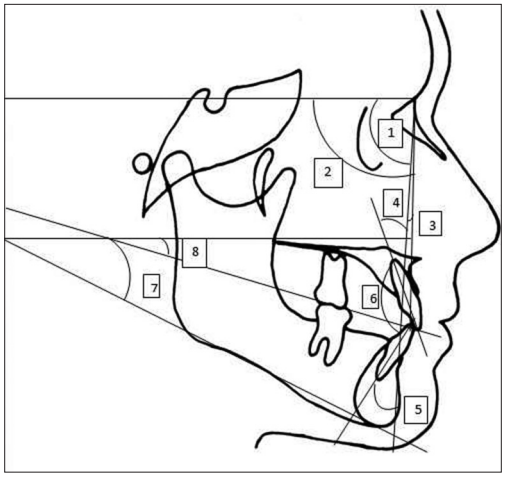

Figure 1: Angular measurements used in the cephalometric analysis. 1. SNA, 2. SNB, 3. ANB, 4. UI to N-A, 5. LI to N-B, 6. LI to UI, 7. GoGn to S-N, and 8. Occl to S-N.

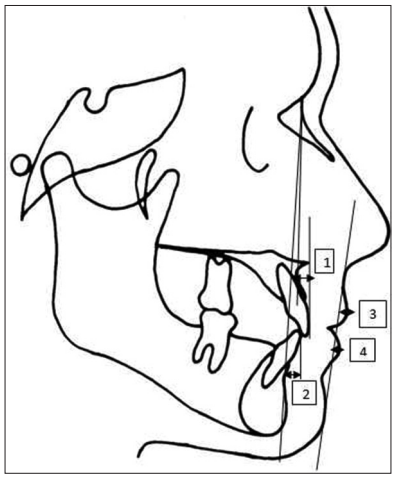

Figure 2: Linear measurements used in the cephalometric analysis. 1. UI to N-A, 2. LI to N-B, 3. UL-Sn-Pog, and 4. LL-Sn-Pog.

Dentally, slightly increased upper incisor inclination was identified in the study sample in comparison with the Caucasian sample (UI to N-A = 23.28°), and this increase was statistically significant ($P = 0.04$). Lower incisors were proclined compared to Caucasian sample in both linear and angular measurements (LI to N-B = 6.56 mm and 28.3°), and the lower incisor inclination was statistically significant ($P = 0.0003$). Interincisal angle between upper and lower incisors was reduced (123.8 ± 10.7°) when compared with the cephlometic norms of the Steiner analysis. However, this reduction was statistically insignificant ($P > 0.05$) [Table 2].

In the assessment of the soft-tissue profile, both upper (1.66 ± 2.7mm) and lower lip (2.8 ± 2.6 mm) protrusions were slightly increased than the norms of the Steiner analysis, and these findings were clinically significant [Table 2].

In the present study, the comparison demonstrated similarity in anteroposterior cephalometric angular measurements with normative values and no apparent differences were identified in angles such as sella-nasion–point A (SNA), sella-nasion–point B (SNB), and A point-nasion-B point (ANB). Considering the vertical relationship of mandiblar plane to the base of the skull (GoGn to S-N) and functional occlusal plane to the base of the skull (occl to S-N) of Sri Lankan patients showed no significant differences between the two groups when compared with Steiner norms.

The linear and angular measurements in both males and females were analyzed in the study and did not show any statistically significant differences ($P > 0.05$) [Table 3].

DISCUSSION

Considering the ethnic background of patients in planning treatment is an important requirement for successful outcome of orthodontic treatment. This can be achieved by establishing cephalometric norms for the specific racial group. Many studies related to cephalometric norms have been published for different ethnic groups from America, Europe, Japan, China, India, and Iran. Within these studies, few cephalometric normative studies have been focused on Class I malocclusion mainly from the countries of Middle East region. However, there are no cephalometric norms for Sri Lankan children, and this study was considered as a baseline study to establish norms for Sri Lankan Sinhalese. As Sinhalese are the predominant ethnic group of the diverse population in Sri Lanka, the sample was carefully selected to include Sinhalese born and living in Sri Lanka in the present study.

Table 2: A comparison of lateral cephalometric values for Sri Lankan Sinhalese sample with Class I malocclusion with Steiner normative values.

Variable	Standard Steiner mean value	Total				
		Sinhalese Mean value	Standard deviation	*t*-test	*P* value	Wilcoxon signed-rank test
						P value
SNA (°)	82	83.47	4.137	2.9942	0.003801	
SNB (°)	80	78.79	3.905	−2.607	0.01116	
ANB (°)	3	4.71	2.292	9.96	4.72E−15	
UI to N-A (mm)	4	4.12	2.869			0.3674
LI to N-B (mm)	4	6.56	3.405			7.74E−09
UI to N-A (°)	22	23.28	5.779	1.8603	0.06704	
LI to N-B (°)	25	28.3	7.368	3.7705	0.0003371	
LI to UI (°)	131	123.8	10.736	−5.6696	2.97E−07	
GoGn to S–N (°)	32	32.36	5.873	14.858	<2.2e−16	
Occl to S–N (°)	14	17.4	3.917	13.77	<2.2e−16	
UL–Sn-Pog (mm)	0	1.66	2.735	5.1366	2.41E−06	
LL–Sn-Pog (mm)	0	2.81	2.648	8.9439	3.35E−13	

Table 3: Comparison of cephalometric measurements of the Sri Lankan Sinhalese males and females using *t*-test.

Measurements	Sinhalese Male mean	Male-SD	Sinhalese Female mean	Female-SD	Two sample *t*-test		Wilcoxon rank-sum test	
					t-value	*P* value	w value	*P* value
SNA (°)	83.87	4.77	83.2	3.66	−0.665	0.507		
SNB (°)	79.4	4.51	78.37	3.41	−1.092	0.278		
ANB (°)	4.54	2.10	4.82	2.42	0	1		
UI to N-A (mm)	4.56	2.75	3.82	2.94			523	0.317
LI to N-B (mm)	7.46	4.31	5.94	2.47			492	0.172
UI to N-A (°)	24.54	5.48	22.4	5.88	−1.552	0.125		
LI to N-B (°)	28.98	7.84	27.82	7.07	−0.648	0.518		
LI to UI (°)	121.7	10.83	125.2	10.55	1.378	0.172		
GoGn to S–N (°)	31.22	6.17	33.14	5.59	1.366	0.176		
Occl to S–N (°)	19.4	4.32	21.1	3.49	1.825	0.072		
UL–Sn-Pog (mm)	1.82	3.11	1.56	2.47	−0.389	0.698		
LL–Sn-Pog (mm)	3.22	2.71	2.52	2.59	−1.102	0.274		

Results of the present study have shown that Sri Lankan Sinhalese children have statistically different dental features than Caucasian sample. When the dentoalvelolar relationships considered, both upper and lower incisors were proclined than the original Steiner's sample. Hassan observed greater proclination and protrusion of incisors in Saudi children compared to the Caucasian sample.[11] Further, Hamdan and Al-Jasser reported greater proclination and protrusion of incisors in an Arabic population than Caucasians.[12,13] Due to increase in both the upper and lower incisor inclinations, interincisal angle was reduced.

Sri Lankan norms were compared with Steiner SNA, SNB, and ANB values and showed no significant differences between the two groups. Tayseer reported similar results with the study conducted on an adult Emirati sample with Class I malocclusion.[14] Some of the other studies done in the Asian region are in agreement with this.[11] However, it is important to asses an error made by the change of vertical position of the sella point for further accuracy of the SNA, SNB, and ANB angles in future studies. While considering the vertical relationship, occlusal plane to S-N values between the study group and Steiner showed no apparent difference. More similar findings were observed with the study done in Martha ethnic population.[15] However, lower face height tends to increase with aging from childhood to adulthood due to the cephalocaudal gradient of growth of the facial bones.[16]

The current study with Sri Lankan Sinhalese showed upper and lower lip protrusions compared with Caucasians. Similarly greater upper and lower lip protrusions were observed with the study conducted with the Chinese population.[17] Further, more convex faces with protrusive lips and acute nasolabial angels were identified with the North Indian population.[18]

All the linear and angular measurements analyzed in the study were statistically not significant between both males

and females. Study done by Martina observed similar observations with the study conducted with the Slovenian children.[19]

CONCLUSIONS

The results of the present study suggested that Sri Lankan Sinhalese adolescents are likely to present greater incisor proclination than Caucasians in Class I malocclusion. Based on the results of the current study, it is important to conduct a similar study with normal occlusion to establish norms for Sri Lankans.

Acknowledgment

We extend our gratitude to B. M. S. C. Basnayake for her assistance in data analysis.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: Vithanaarachchi N, Nawarathna LS. Cephalometric norms for Sri Lankan Sinhalese adolescents with Class I malocclusion. APOS Trends Orthod 2019;9(4):230-4.