Craniofacial characteristics of Caucasian and Afro-Caucasian Brazilian subjects with normal occlusion

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ABSTRACT

Objective: The objective of this study was to compare the skeletal, dental and soft tissue characteristics of Caucasian and Afro-Caucasian Brazilian subjects with normal occlusion and to evaluate sexual dimorphism within the groups. Material and Methods: The sample comprised lateral cephalograms of untreated normal occlusion subjects, divided into 2 groups. Group 1 included 40 Caucasian subjects (20 of each sex), with a mean age of 13.02 years; group 2 included 40 Afro-Caucasian subjects (20 of each sex), with a mean age of 13.02 years. Groups 1 and 2 and males and females within each group were compared with t tests. Results: Afro-Caucasian subjects presented greater maxillary protrusion, smaller upper anterior face height and lower posterior face height, larger upper posterior face height, greater maxillary and mandibular dentoalveolar protrusion as well as soft tissue protrusion than Caucasian subjects. The Afro-Caucasian female subjects had less mandibular protrusion and smaller total posterior facial height and upper posterior facial height than males. Conclusions: Brazilian Afro-Caucasian subjects have greater dentoalveolar and soft tissue protrusion than Brazilian Caucasian subjects, with slight sexual dimorphism in some variables.

Key words: Ethnic groups. Cephalometry. Normal values.

INTRODUCTION

In the world's population it is possible to observe many variations of cephalometric patterns within homogeneous ethnic groups[9,18,24,25,27]. The 2000 Brazilian demographic census showed that 53.74% of the national population was Caucasian, 6.21% was composed by African subjects and 38.45% were Afro-Caucasian subjects. The interracial blending group of African and Caucasian is concentrated in large urban centers[21]. Therefore, it is necessary to recognize the differences between a homogeneous racial group and an interracial blending group to improve treatment planning and patient's individual expectations[1].

An interracial blending might not be a simple average of the facial characteristics of the two ancestors, but they might have unique characteristics that could play a role in orthodontic planning.

One of the most common interracial blending occurs between Caucasian and African subjects. Each one of these two basic ethnic groups has different facial characteristics. The most common difference is that African populations have greater bimaxillary protrusion than Caucasian

subjects[3,4,10,13,17,18]. Consequently, because of this large miscegenation between Caucasian and African subjects, a new cephalometric pattern has to be developed for the Afro-Caucasian descents to help establishing a correct treatment planning.

Due to the lack of reports on the cephalometric characteristics for Afro-Caucasian subjects, the aim of this study was to compare the skeletal, dental and soft tissue characteristics of Caucasian subjects and Afro-Caucasian descents with normal occlusion in order to comparatively determine their cephalometric traits. Sexual dimorphism was also evaluated within groups.

MATERIAL AND METHODS

The sample consisted of 80 lateral cephalograms from Brazilian Caucasian subjects and Brazilian Afro-Caucasian descents with normal occlusion, selected from the files of the Growth Center of the Department of Orthodontics at Dental School of Bauru, University of São Paulo, Brazil. Group 1 included 40 Caucasian subjects (20 males; 20 females), with a mean age of 13.02 (range from 11.89 to 15.03 years) and group 2 included 40 Afro-Caucasian subjects (20 males; 20 females), with a mean age of 13.02 (range from 12 to 14.30 years).

Group 1 was formed by subjects with Caucasian heritage. These subjects were from the same region in Brazil. The additional selection criteria was that the subjects should present all permanent teeth in occlusion, excepting the third molars, absence or a minimum crowding of as much as 3 mm, well-balanced faces and absence of previous orthodontic treatment. To be included in group 2, the ethnic and racial characteristics were evaluated by means of a questionnaire that provided information on the parents' racial background. In this questionnaire, the candidate had to mark which category his father and his mother belonged (Asian, African, Afro-Caucasian, Caucasian or Indian). To be included in the samples, one of the parents had to belong to the African category and the other had to belong to the Caucasian category, with no history of previous blending. In this way, only subjects that showed to be Afro-Caucasian descents from the same Brazilian region were included in the sample.

The lateral cephalograms were obtained in centric occlusion with the lips at rest. The anatomic tracings and location of the dentoskeletal landmarks were manually carried out by 1 investigator (CLQ) and digitized with a Numonics AccuGrid XNT, model A30TL.F (Numonics Corporation, Montgomeryville, PA, USA) digitizer connected to a computer (Figure 1). These data were analyzed with Dentofacial Planner 7.02 (Dentofacial Planner Software Inc., Toronto, ON, Canada) that corrected the magnification factor of the radiographic images, which was 6% for group 1 and 9.8% for group 2 (Figure 2).

Abbreviation	Cephalometric Variables
SNA	Angle formed by sella-nasion-A point
SNB	Angle formed by sella-nasion-B point
ANB angle	Angle formed by A point-nasion-B point
TAFH	Total anterior facial height: linear distance between nasion (N) and menton (Me)
UAFH	Upper anterior facial height: linear distance between N and ANS' (perpendicular projection of anterior nasal spine in line N-Me)
LAFH	Lower anterior facial height: linear distance between ANS' and Me
TPFH	Total posterior facial height: linear distance between sella (S) and gonion (Go)
UPFH	Upper posterior facial height: linear distance between S and Ar' -perpendicular projection of articulare (Ar) in line (SGo)
LPFH	Lower posterior facial height: linear distance between Ar' and Go
MxI.NA	Angle formed by maxillary incisors' long axis and line NA
MxI-NA	Linear distance from buccal surface of most protruded maxillary incisor to line NA
MdI.NB	Angle formed by mandibular incisors' long axis and line NB
MdI-NB	Linear distance from buccal surface of most protruded mandibular incisor to line NB
IMPA	Angle formed by mandibular incisors' long axis and mandibular plan (Go-Me)
Nasolabial angle	Angle formed by line from lower border of nose to line representing inclination of upper lip
Upper lip protrusion	Linear distance between upper lip anterior point and subnasale-pogonion line
Lower lip protrusion	Linear distance between lower lip anterior point and subnasale-pogonion line

Figure 1- Definitions and abbreviations of the cephalometric variables

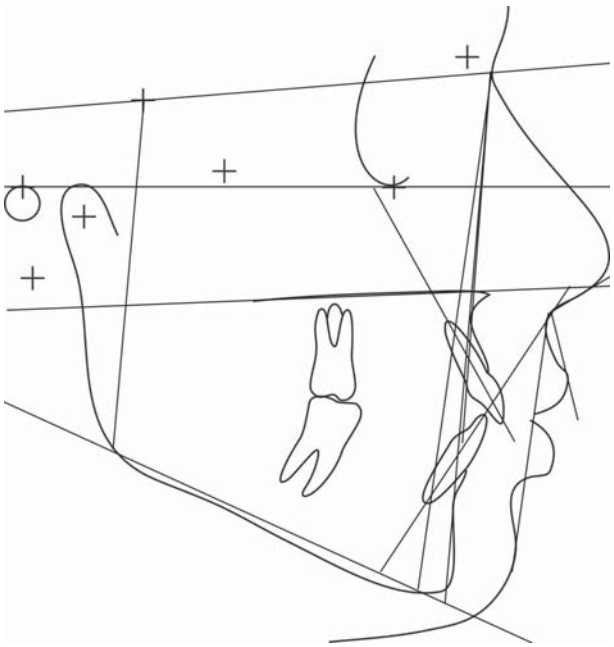

Figure 2- Lateral cephalogram with landmarks and measurements

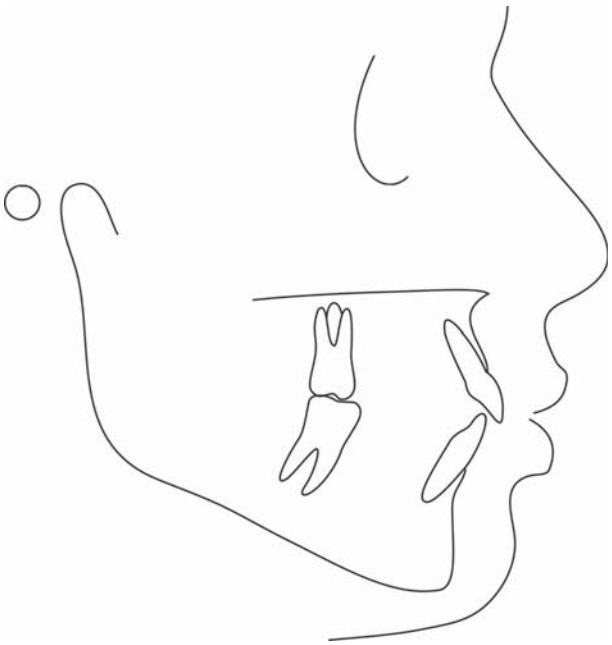

Figure 3- Cephalometric patterns of the Afro-Caucasian subjects

Table 1- Means and standard deviations (SD) of age and skeletal, dentoalveolar, soft-tissue and face height variables and results of t test for both groups

	Group 1 Caucasian subjects (n=40)		Group 2 Afro-Caucasian subjects (n=40)		
Variable	Mean	SD	Mean	SD	P
Age	13.02	0.78	13.02	0.67	0.978
Maxillary component					
SNA angle (º)	81.14	3.78	82.94	4.23	0.046*
Mandibular component					
SNB angle (º)	79.02	3.51	80.53	3.66	0.061
Maxillomandibular relationship					
ANB angle (º)	2.13	2.14	2.42	2.14	0.556
Facial Height					
TAFH (mm)	110.59	4.33	108.63	4.33	0.087
UAFH (mm)	50.61	2.03	48.14	2.65	0.000*
LAFH (mm)	59.97	4.89	60.49	3.89	0.603
TPFH (mm)	70.95	4.69	69.55	5.54	0.225
UPFH (mm)	28.19	2.80	29.77	3.36	0.025*
LPFH (mm)	42.76	4.34	39.78	4.29	0.002*
Maxillary dentoalveolar component					
MxI.NA (º)	22.60	5.38	26.78	5.28	0.000*
MxI-NA (mm)	5.73	2.01	7.27	2.17	0.001*
Mandibular dentoalveolar component					
MdI.NB (º)	24.52	3.69	31.97	4.57	0.000*
MdI-NB (mm)	3.81	1.95	5.50	2.01	0.000*
IMPA (mm)	90.38	5.45	97.78	4.95	0.000*
Soft tissue					
Nasolabial angle (º)	110.26	8.68	98.93	11.42	0.000*
Upper lip protrusion (mm)	3.40	1.03	5.76	1.73	0.000*
Lower lip protrusion (mm)	2.51	1.08	4.71	2.09	0.000*

* Statistically significant at P<.05

Error Study

A month after the first measurements, 16 randomly selected cephalograms were retraced and remeasured by the same examiner. The casual error was calculated according to Dahlberg´s formula[12] ($Se^2 = \sum d2/2n$), where Se^2 is the error variance and d is the difference between 2 determinations of the same variable. The systematic errors were evaluated with dependent t tests[19] at $P<.05$.

Statistical Analysis

Normal distribution was verified by the Kolmogorov-Smirnov test. The results of the tests were non significant for all variables. Therefore, *t* tests were used to compare the variables between the groups.

To evaluate sexual dimorphism, males and females were compared in each racial group with *t* tests. All statistical analyses were performed with the Statistica 6.0 software (Statsoft, Tulsa, OK, USA).

RESULTS

The means and standard deviations for each variable were calculated for both groups. Only 3 variables presented statistically significant systematic errors (MxI-NA, UAFH, LAFH). The range of casual errors varied from 0.37 mm to 1.48° for variables MdI-NB and Nasolabial angle, respectively.

Caucasian subjects had significantly less protruded maxilla, greater upper anterior face height and lower posterior facial height, smaller upper posterior face height, more retruded and retroclined maxillary and mandibular incisors, more obtuse nasolabial angle and more retruded lips than Afro-Caucasian subjects (Table 1).

Caucasian females and males did not have any statistically significant differences (Table 2).

Afro-Caucasian females had a significantly more retruded mandible, and smaller total and upper posterior face height than males (Table 3).

Table 2- Means and standard deviations (SD) of age and skeletal, dentoalveolar, and soft-tissue variables for Caucasian subjects and results of *t* test

	Caucasian females (n=20)		Caucasian males (n=20)		
Variable	Mean	SD	Mean	SD	P
Age	13.08	0.81	12.97	0.76	0.685
Maxillary component					
SNA angle (º)	81.20	4.16	81.08	3.35	0.920
Mandibular component					
SNB angle (º)	78.92	3.44	79.11	3.53	0.864
Maxillomandibular relationship					
ANB angle (º)	2.29	2.30	1.98	2.08	0.663
Facial Height					
TAFH (mm)	109.83	5.32	111.35	6.08	0.405
UAFH (mm)	50.28	2.07	50.95	1.98	0.303
LAFH (mm)	59.55	4.46	60.40	5.36	0.589
TPFH (mm)	70.09	4.18	71.82	5.11	0.247
UPFH (mm)	27.36	2.07	29.01	3.22	0.061
LPFH (mm)	42.72	3.83	42.81	4.89	0.951
Maxillary dentoalveolar component					
MxI.NA (º)	21.74	5.62	23.30	5.15	0.318
MxI-NA (mm)	5.59	2.01	5.73	2.01	0.673
Mandibular dentoalveolar component					
MdI.NB (º)	25.49	3.74	23.69	3.40	0.095
MdI-NB (mm)	4.23	2.09	3.43	1.78	0.188
IMPA (mm)	90.95	5.62	89.70	5.46	0.525
Soft tissue					
Nasolabial angle (º)	107.59	6.30	112.28	10.48	0.057
Upper lip protrusion (mm)	3.50	0.96	3.30	1.11	0.567
Lower lip protrusion (mm)	2.81	1.11	2.77	0.99	0.085

Table 3- Means and standard deviations (SD) of age and skeletal, dentoalveolar, and soft-tissue variables for Afro-Caucasian subjects and results of t test

	Afro-Caucasian females (n=20)		Afro-Caucasian males (n=20)		
Variable	Mean	SD	Mean	SD	P
Age	12.94	0.69	13.10	0.66	0.463
Maxillary component					
SNA angle (º)	81.85	3.80	84.04	4.17	0.102
Mandibular component					
SNB angle (º)	79.39	3.47	81.67	3.56	0.047*
Maxillomandibular relationship					
ANB angle (º)	2.46	2.16	2.38	2.18	0.913
Facial Height					
TAFH (mm)	107.43	3.84	109.83	4.54	0.079
UAFH (mm)	47.72	2.82	48.56	2.48	0.323
LAFH (mm)	59.71	3.42	61.27	4.25	0.208
TPFH (mm)	67.03	5.14	72.07	4.59	0.002*
UPFH (mm)	27.78	2.82	31.76	2.62	0.000*
LPFH (mm)	39.25	3.69	40.31	4.86	0.444
Maxillary dentoalveolar component					
MxI.NA (º)	27.17	5.07	26.40	5.60	0.653
MxI-NA (mm)	7.26	1.83	7.29	2.52	0.960
Mandibular dentoalveolar component					
MdI.NB (º)	32.02	4.15	31.93	5.07	0.954
MdI-NB (mm)	5.56	1.86	5.45	2.20	0.871
IMPA (mm)	97.18	4.55	98.38	5.38	0.451
Soft tissue					
Nasolabial angle (º)	97.69	10.48	100.17	12.44	0.498
Upper lip protrusion (mm)	5.58	1.63	5.95	1.86	0.514
Lower lip protrusion (mm)	4.65	2.25	4.78	1.97	0.841

* Statistically significant at P<.05

DISCUSSION

Currently, several racial cephalometric standards have been established for relatively homogeneous groups[1-3,5-8,10,11,13-18,27,30]. However, many populations have blended with others, producing mixed facial characteristics that have not yet been studied. In some countries, the Caucasian population has blended with the African population quite often, creating a new ethnic group: the Afro-Caucasian descents. Therefore, this investigation compared a Brazilian Caucasian sample to a Brazilian Afro-Caucasian group, both with normal occlusion, to determine the areas that differ significantly between them.

A cephalometric study of a specific group has difficulties concerning the selection criteria: the definitions of clinical normality; the definition of each group designation, as well as the geographic origins and the sample size and age[13,17,18,27,28]. In this study, sample selection criteria were: the Caucasian subjects should be as homogeneous as possible and the Afro-Caucasian subjects should descent from a Caucasian and an African parent; both groups should be from the same geographic area and compatible regarding age and sex distribution (Table 1). These restrictive criteria resulted in not very large groups. However, there are recent previous studies with similar sample sizes[6,14,18,20,27].

In this study, many variables showed significant differences between Caucasian and Afro-Caucasian subjects. Some variables were similar to the Caucasian ancestors and some to the African ancestors. These similarities demonstrate that the cephalometric patterns of the Afro-Caucasian subjects were not a simple average of all variables between these two patterns, but a singular pattern that has to be considered in treatment planning (Figure 3).

Afro-Caucasian subjects had more protruded maxilla than Caucasian subjects (Table 1). Even though the Afro-Caucasian showed greater maxillary protrusion than Caucasian subjects their SNA was 4° smaller than previous values found for African subjects[3,5,13,17,18].

The UAFH was significantly smaller in Afro-Caucasian subjects than in Caucasian subjects.

This characteristic was similar to the results found for African subjects that the UAFH showed to be significantly smaller for African subjects when compared with Caucasian subjects[18]. Even though the UAFH was statistically smaller, this variable is not as important as the LAFH in orthodontic treatment planning, because treatment changes are limited to the lower face[5,23]. In this study, the LAFH had no significant difference between Caucasian and Afro-Caucasian subjects. Therefore, it seems that the blended subjects inherited an increased LAFH from the Caucasians because African subjects usually have smaller LAFH than Caucasian subjects[3].

The upper posterior facial height (UPFH) was significantly smaller and the LPFH was significantly larger in Caucasian subjects than in Afro-Caucasian subjects which are similar to comparisons with African subjects[4,17,26].

Afro-Caucasian subjects had more proclined and protruded maxillary and mandibular incisors, more protruded upper and lower lips and smaller nasolabial angle than Caucasian subjects (Table 1). These characteristics show that Afro-Caucasian subjects have dental and soft tissue components similar to the African ancestors[3,4,7,10,13,17,18,22].

There was no sexual dimorphism for the Caucasian females and males (Table 2). The literature is not unanimous about sexual dimorphism in Caucasian subjects probably because the studied samples derived from different regions, cultures, and have different environmental influence[16,27,29]. Differences were found in other age ranges[16,27,29].

The Afro-Caucasian females had less mandibular protrusion and smaller TPFH and UPFH than males (Table 3). It is common for the African ancestors that males have greater mandibular protrusion than females[13,17,27]. The literature also shows that African female subjects have smaller posterior vertical dimensions in the face than males[17,18]. Therefore, these characteristics of the Afro-Caucasian were predominantly inherited from the African ancestors.

Treatment planning for Afro-Caucasian patients has to take the current results into consideration. Therefore, a more protruded dentition and facial profile can be accepted unless the amount of dental protrusion is causing lip incompetence, in which situation extractions can be recommended.

CONCLUSIONS

Brazilian Afro-Caucasian subjects presented greater maxillary protrusion, smaller upper anterior face height and lower posterior face height, larger upper posterior face height, greater maxillary and mandibular dentoalveolar protrusion as well as soft tissue protrusion than Caucasian subjects;

Brazilian Caucasian subjects presented no sexual dimorphism at the evaluated age range;

Brazilian Afro-Caucasian female subjects had less mandibular protrusion and smaller TPFH and UPFH than males.

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