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.
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 |
| Mxl.NA       | Angle formed by maxillary incisors’ long axis and line NA |
| Mxl-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
### 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

| Variable                        | Group 1 (n=40) | Group 2 (n=40) | P    |
|---------------------------------|----------------|----------------|------|
|                                  | Caucasian      | Afro-Caucasian |      |
| **Mean**                        | **SD**         | **Mean**       | **SD** | **P** |
| **Age**                         | 13.02          | 0.78           | 13.02 | 0.67  | 0.978 |
| **Maxillary component**         |                |                |      |
| SNA angle (°)                   | 81.14          | 3.78           | 82.94 | 4.23  | 0.046*|
| **Mandibular component**        |                |                |      |
| SNB angle (°)                   | 79.02          | 3.51           | 80.53 | 3.66  | 0.061 |
| **Maxillomandibular relationship** |            |                |      |
| ANB angle (°)                   | 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 | 3.92  | 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 (°)                      | 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 (°)                      | 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 (°)            | 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\(^2\) (\(\text{Se}^2 = \frac{\sum d^2}{2n}\)), where \(\text{Se}^2\) 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\(^18\) 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

| Variable                          | Caucasian females (n=20) | Caucasian males (n=20) | \(P\) |
|-----------------------------------|-------------------------|------------------------|------|
| **Age**                           |                         |                        |      |
| Mean SD                           | 13.08 0.81              | 12.97 0.76             | 0.685|
| **Maxillary component**           |                         |                        |      |
| SNA angle (°)                     | 81.20 4.16              | 81.08 3.35             | 0.920|
| **Mandibular component**          |                         |                        |      |
| SNB angle (°)                     | 78.92 3.44              | 79.11 3.53             | 0.864|
| **Maxillomandibular relationship**|                         |                        |      |
| ANB angle (°)                     | 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 (°)                        | 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 (°)                        | 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 (°)              | 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|
Currently, several racial cephalometric standards have been established for relatively homogeneous groups. 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 descendents. 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. 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. These restrictive criteria resulted in not very large groups. However, there are recent previous studies with similar sample sizes.

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.

Afro-Caucasian subjects had more protruded maxilla than Caucasian subjects, even though the Afro-Caucasian showed greater maxillary protrusion than Caucasian subjects their SNA was 4° smaller than previous values found for African subjects.

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

### 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

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

* Statistically significant at P<.05
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\(^6\). Even though the UAFH was statistically smaller, this variable was 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.

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