

# Cephalometric study of tooth position in young Afro-Caucasian Brazilian individuals with normal occlusion

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## Abstract

**Objective:** The purpose of this study was to achieve a specific cephalometric pattern for young Afro-Caucasian Brazilian individuals and verify the presence of dimorphism between sexes. **Methods:** The sample was composed of 40 lateral cephalograms of young Afro-Caucasian Brazilian individuals (mulattos), 20 males (mean age 13.25 years) and 20 females (mean age 13.10 years), with normal occlusion and no previous orthodontic treatment. The cephalometric variables were determined according to the analyses of Downs, Steiner, Riedel, Tweed, McNamara, Ricketts and Interlandi. Independent t test was applied to compare the variables between sexes. **Results:** The maxillary and mandibular incisors were protruded and buccally tipped. There was no statistically significant difference between sexes in all variables. **Conclusions:** It was observed that young Afro-Caucasian Brazilian individuals without skeletal alterations and with normal occlusion showed specific tooth position and facial features in relation to the other Brazilian ethnic groups.

**Keywords:** Ethnic groups. Cephalometrics. Incisors.

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## INTRODUCTION

Population context determines an intense variation in ethnic groups, especially in large urban centers, evidencing the need to acknowledge that a single pattern of facial esthetics may not be appropriate for diagnostic decisions and treatment planning for individuals of different ethnic backgrounds, who migrated to distinct geographic regions.<sup>12,16</sup>

In Brazil, the admixture between Portuguese settlers, Brazilian Amerindians and Africans led to the formation of a diversified population, and a significant part of the Brazilian population was originated from relationships between White-Black (Mulatto), White-Amerindian (Caboclo) and Black-Amerindian (Zambo). Each one of the three basic groups (Amerindian, White and Black) does not represent a pure ethnicity. It is important to identify the characteristics of the Brazilian population and to analyze the respective somatic aspects.<sup>36</sup>

The importance of investigating the skeletal and dentofacial components and relate them to normal and individual characteristics in the ethnic groups, with different cultural and social influences, is justified by orthodontic treatment limitations and its clinical implications, especially when the mechanics impairs the facial esthetics.<sup>7,8,13-16,20,22,27,28,42</sup> The normative values of cephalometric measurements, which are specific for different ethnic groups, should complement the diagnosis and treatment planning according to the individual needs and expectations of the patient.<sup>1,39</sup> The literature highlights the lack of cephalometric studies related to differences in facial morphology between ethnic groups.<sup>1,7,14,15,26,29</sup> The applicability of characteristics of facial, skeletal and soft tissue patterns should also be determined to establish the diagnosis and treatment planning of malocclusions, aiming to achieve occlusal, functional and skeletal ideal relationships. Therefore, the cephalometric and occlusal

studies aim to promote stable orthodontic corrections, with ideal tooth position.

Therefore, considering the lack of specific studies in Afro-Caucasian individuals, the present study aimed to determine the existing cephalometric variables for the ideal maxillary and mandibular incisors position in Mulatto individuals with balanced faces.

## ETHNICITY

Since the terms “racial” and “ethnic” may induce doubtful interpretations, it was used the classification of Cuvier (cited by Ávila<sup>5</sup>), which highlights the three main racial groups according to differentiation criteria related to the color of human skin, i.e.:

- » White race;
- » Yellow race;
- » Black race.

The meaning of each ethnic group is closely related to culture conditions and sociopolitical integration of members of each population, regarding the language, habits and way of life. Therefore, an ethnic group is a population among others that constitutes a racial group when collectively grouped, but maintain their physical and cultural differences by limiting mechanisms as geographic or social barriers.<sup>6,37</sup>

The skin color classification for Mulatto individuals is due to the miscegenation between Whites and Blacks.

In 1999, IBGE (Brazilian Institute for Geography and Statistics) published data revealing that Brazilian Black population was only 5.4%. However, with the increase of 39.9% of Mulattos, Brazil was mainly defined as a Black country, as it is currently considered by many Americans and Europeans.

Considering these aspects, it is extremely important to differentiate the variations of craniofacial skeletal structures (that are closed related to the maxillary and mandibular teeth position) in the Afro-Caucasian individuals,

since the normal relationship between skeletal and tooth position is different according to ethnic variations. Thus, studies should be conducted to support the diagnosis, especially in Afro-Caucasian individuals (Mulattos), because they constitute a large community within the Brazilian population.

### PROPOSITION

This study aimed to present an individual cephalometric pattern for tooth position in young Afro-Caucasian Brazilian individuals with

age ranging from 12 to 14 years, by means of:

- » Achieving mean values of normality for dental cephalometric measurements.
- » Identifying the presence or absence of dimorphism between sexes.

### MATERIAL AND METHODS

The study was conducted on forty lateral cephalograms of Afro-Caucasian Brazilian individuals with Angle normal occlusion (aged 12 to 14 years). The sample was selected by examining young individuals in public state schools of Bauru, Brazil.



FIGURE 1 - Extraoral photographs. Young Afro-Caucasian male individual.



FIGURE 2 - Intraoral photographs. Determination of occlusal characteristics in a young Afro-Caucasian individual, with normal occlusion.

The ethnic and racial characteristics were accurately evaluated by a questionnaire, which provided information to classify the skin color of the parents. Therefore, only young individuals of African descent were included in the sample. Adolescent clinical examinations were performed using a disposable spatula as an effective instrument for intraoral examination.

Additional inclusion criteria were: Presence of permanent teeth in occlusion, but third

molars; normal molar and premolar relationship; no previous orthodontic treatment; little or no crowding; no posterior crossbites; normal overjet and overbite; pleasant soft tissue profile with balanced facial pattern (Figs 1-4).

To determine the balance between facial thirds and absence of asymmetry, a subjective facial analysis was conducted to select only young individuals with balanced facial profile (Pattern I).<sup>12</sup>



FIGURE 3 - Extraoral photographs. Young Afro-Caucasian female individual.



FIGURE 4 - Intraoral photographs. Determination of occlusal characteristics in young female individual with normal occlusion.

The sample of Afro-Caucasian Brazilian subjects with normal occlusion was composed of 40 young individuals, being 20 males and 20 females, with mean age of 13.15 years (range, 12.0 – 14.30 years).

### Radiographs

All lateral cephalograms were obtained in maximum intercuspation with lips at rest, using a Broadbent<sup>11</sup> cephalostat to standardize the head positioning.

The magnification factor of the radiographic image was calculated and corrected to achieve greater accuracy. The X-ray machine showed a magnification factor of 9.8%.

### Tracing of cephalograms

Cephalograms were hand-traced and the landmarks were analyzed in a digitizing tablet (Numonics Corporation, Montgomeryville, PA, USA), connected to a microcomputer with processor AMD K6-2 500MHz, for achievement of cephalometric measurements.

The tracings and digitization of points were performed by the examiner using a customized analysis in the software Dentofacial Planner 7.02 (Dentofacial Planner Software Inc., Toronto, Ontario, Canada) for the measurements. Correction of the magnification factor (9.8%) was performed by the software (Fig 5).

### Dental cephalometric variables

Maxillary dentoalveolar component (Fig 6A)

1. Mx1.NA: Angle between the long axis of the maxillary central incisor and line NA, representing the degree of inclination of the maxillary central incisor in relation to the maxilla and nasion point.

2. Mx1.PP: Angle between the long axis of the maxillary central incisor and the palatal plane, representing the degree of inclination of the maxillary central incisor in relation to the maxilla.

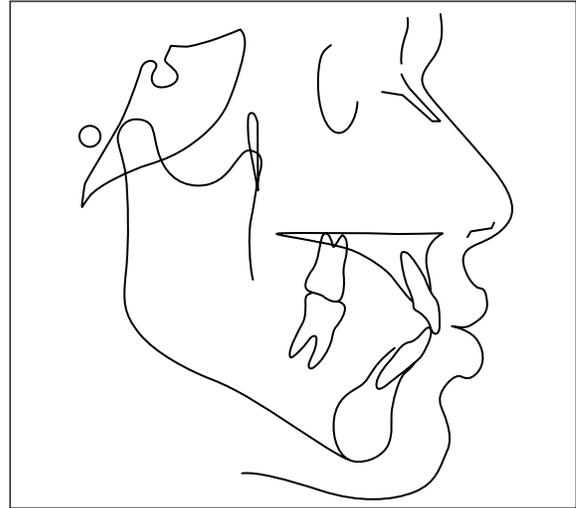


FIGURE 5 - Tracing of anatomical structures.

3. Mx1-NA: Distance between the most anterior point on the crown of the maxillary central incisor and line NA, representing the anteroposterior position of the maxillary incisor in relation to the maxilla and nasion.

4. Mx1-PP: Perpendicular distance between the incisal edge of the maxillary central incisor and the palatal plane, representing the vertical position of the permanent maxillary central incisor in the maxilla.

5. Mx1-Aperp: Distance between the EMxI point (incisal edge of maxillary central incisor) and line Aperp.

6. Mx1-PTV: Distance between the EMxI point to the pterygomaxillary vertical plane.

Mandibular dentoalveolar component (Fig 6B)

7. Md1.NB: Angle between the long axis of the mandibular central incisor and line NB, representing the degree of inclination of the mandibular central incisor in relation to the mandible and nasion point.

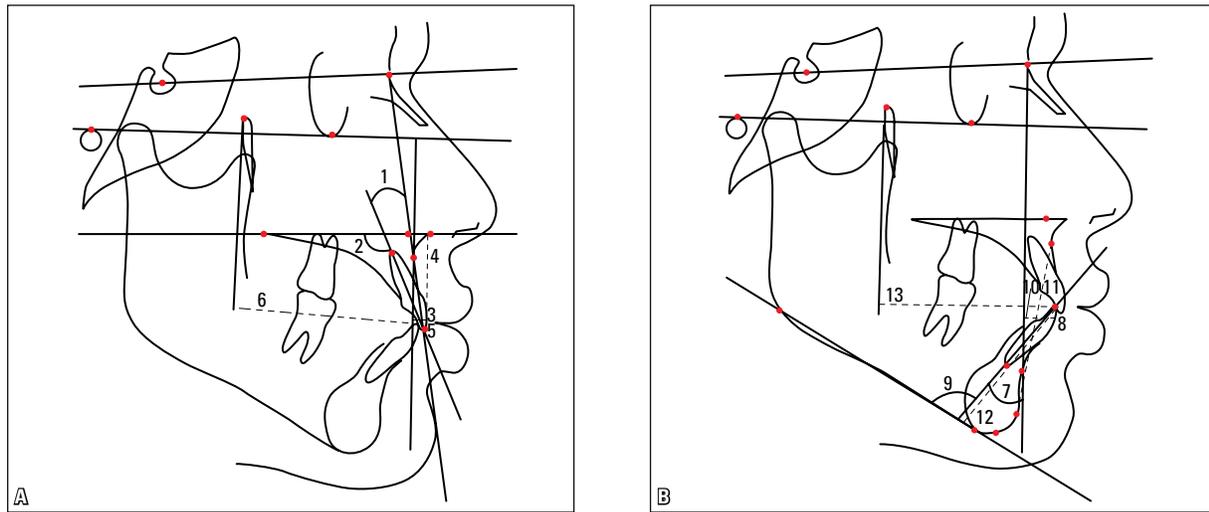


FIGURE 6 - Tracing of anatomical structures **A)** Maxillary anterior dentoalveolar component. **B)** Mandibular anterior dentoalveolar component.

8. Mdl-NB: Perpendicular distance between the most anterior point on the crown of the mandibular central incisor and line NB, representing the anteroposterior position of the mandibular incisor in relation to the mandible and nasion.

9. IMPA: Angle between the long axis of the mandibular central incisor and the mandibular plane (GoMe), representing the tooth inclination in relation to the mandible.

10. "I" line: Union of points P' and "E", traced in an extent of only 1 cm, at the crossing point with the occlusal plane, determining the degree of retrusion or protrusion of the mandibular central incisor.

11. Mdl-APog: Distance between the EMdI point (incisal edge of mandibular incisor) and the line A-Pog.

12. Mdl-PM: Perpendicular distance between the incisal edge of the mandibular central incisor and the mandibular plane, representing the vertical position of the permanent mandibular central incisor in the mandibular symphysis.

13. Mdl-PTV: distance between the EMdI point to the pterygomaxillary vertical plane (PTV).

### Statistical analysis

#### Method error

Cephalograms were retraced by the same examiner. To determine the reliability of results, fifteen randomly selected radiographs were traced and digitized by the same investigator, after a 20-day interval.

For each cephalometric measurement analyzed, the systematic and casual errors were independently evaluated. The systematic error was calculated by the paired t test, as suggested by Houston.<sup>25</sup> Application of the Dahlberg<sup>17</sup> formula ( $Se^2 = \sum d^2 / 2n$ ) allowed to estimate the result of casual errors, considering as significant errors greater than 1 millimeter for linear measurements and 1.5 degree for angular measurements.<sup>17</sup>

#### Descriptive and comparative analysis

The values were matched in relation to the chronological age of subjects and are presented

in Table 1. The descriptive evaluation of values achieved in relation to the dental cephalometric variables in the Brazilian Afro-Caucasian adolescents is shown in Table 2. Table 3 presents the results of the independent t test for comparison of cephalometric variables between males and females.

For statistical analysis of data, the independent t test was applied at a significance level of  $p < 0.05$ , for comparison of values of cephalometric variables between sexes. These tests were conducted on the software Statistica for

Windows 5.0 (Statistica for Windows. StatSoft, Inc., 1995, Tulsa, OK, USA).

### RESULTS

The mean age of subjects ( $n=40$ ) was 13.15 years, according to the t test. A descriptive evaluation of the dental cephalometric variables in Afro-Caucasian Brazilian adolescents is presented in Table 2.

Table 3 shows the absence of dimorphism between sexes. According to the results, no significant difference was observed for all analyzed variables.

### DISCUSSION

There is a lack of studies in the literature to determine the characteristics of facial, skeletal and dental normality, specifically addressing young Mulatto Brazilian individuals. Therefore, some cephalometric parameters for Black individuals

TABLE 1 - Statistical analysis of ages means for both sexes.

|             | Total (n=40) |      | Female (n=20) |      | Male (n=20) |      | p     |
|-------------|--------------|------|---------------|------|-------------|------|-------|
|             | X            | SD   | X             | SD   | X           | SD   |       |
| Age         | 13.15        | 0.61 | 13.10         | 0.78 | 13.25       | 1.04 | 0.560 |
| Minimum age | 12.00        |      | 12.00         |      | 12.20       |      |       |
| Maximum age | 14.30        |      | 14.21         |      | 14.30       |      |       |

Significant at  $p < 0.05$ .

TABLE 2 - Descriptive analysis of the sample, with mean values and standard deviations of young Afro-Caucasian Brazilian individuals.

| Variables  | n  | Mean   | Minimum | Maximum | SD   |
|--|----|--------|---------|---------|------|
| <b>Maxillary anterior dentoalveolar component</b>  |    |        |         |         |      |
| Mx1.NA   | 40 | 24.23  | 14.8    | 33.4    | 4.40 |
| Mx1.PP   | 40 | 113.61 | 101.4   | 124.1   | 4.68 |
| Mx1-NA   | 40 | 6.40   | 3       | 12.6    | 2.16 |
| Mx1-PP   | 40 | 26.58  | 21.2    | 30.3    | 2.26 |
| Mx1-PTV  | 40 | 52.95  | 42.3    | 66.3    | 4.78 |
| Mx1-Aperp  | 40 | 5.95   | 2       | 11.5    | 2.18 |
| <b>Mandibular anterior dentoalveolar component</b> |    |        |         |         |      |
| Md1.NB   | 40 | 28.10  | 13.1    | 36.8    | 5.23 |
| IMPA   | 40 | 94.63  | 80.5    | 105.3   | 5.58 |
| Md1-NB   | 40 | 5.23   | 1.2     | 9.2     | 2.00 |
| Md1-GoMe   | 40 | 38.82  | 34.9    | 43.8    | 2.26 |
| Md1-PTV  | 40 | 49.37  | 38.9    | 61.5    | 4.46 |
| Md1-APog   | 40 | 4.10   | 0.4     | 7.9     | 1.56 |
| "I" line   | 40 | -4.82  | -9.7    | -0.5    | 1.91 |

TABLE 3 - Statistical analysis of independent t test for the dimorphism between sexes, in young Afro-Caucasian Brazilian individuals

| Variables  | Male   |      | Female |      | p     |
|--|--------|------|--------|------|-------|
|  | Mean   | SD   | Mean   | SD   |       |
| <b>Maxillary anterior dentoalveolar component</b>  |        |      |        |      |       |
| Mx1.NA   | 24.44  | 4.46 | 24.01  | 4.43 | 0.762 |
| Mx1.PP   | 113.81 | 5.09 | 113.42 | 4.37 | 0.796 |
| Mx1-NA   | 6.53   | 2.28 | 6.26   | 2.08 | 0.698 |
| Mx1-PP   | 26.70  | 2.51 | 26.46  | 2.04 | 0.743 |
| Mx1-PTV  | 53.44  | 4.95 | 52.47  | 4.69 | 0.529 |
| Mx1-Aperp  | 5.82   | 2.29 | 6.09   | 2.13 | 0.697 |
| <b>Mandibular anterior dentoalveolar component</b> |        |      |        |      |       |
| Md1.NB   | 27.65  | 5.70 | 28.55  | 4.81 | 0.591 |
| IMPA   | 94.63  | 5.30 | 94.64  | 5.98 | 0.993 |
| Md1-PM   | 39.51  | 2.29 | 38.14  | 2.07 | 0.056 |
| Md1-PTV  | 49.90  | 4.62 | 48.84  | 4.34 | 0.462 |
| Md1-NB   | 4.96   | 2.15 | 5.49   | 1.85 | 0.410 |
| Md1-APog   | 4.00   | 1.73 | 4.20   | 1.42 | 0.700 |
| "I" line   | -4.69  | 2.19 | -4.95  | 1.62 | 0.667 |

Significant at  $p < 0.05$ .

were used to accomplish the present study, yet including young Afro-Caucasian individuals.<sup>8,36,38,51</sup>

Considering the face of young Afro-Caucasian Brazilian individuals as harmonic and pleasant, different classifications were found in the literature regarding the facial types.<sup>12,21</sup> The literature shows that the craniofacial features of the evaluated subjects may suffer alterations during the growth period due to heritage.<sup>9,12,52</sup>

The characteristic of Pattern I for Afro-Caucasian individuals slightly varied in relation to the classification proposed by Capelozza Filho.<sup>12</sup> The facial phenotype of male and female Mulattos presented facial convexity and a closed nasolabial, due to a slightly maxillary protrusion or incisors flaring. However, the thickness of the upper lip significantly influenced the nasolabial angle in most sample subjects, considering that the facial characteristics of these individuals exhibited peculiarities that were intermediate between Blacks and Whites.

The oblique line of nose insertion was significant in most sample subjects.

It was also observed that the mandible presented greater clockwise rotation, with compensation of mandibular incisors (buccal inclination),<sup>9,21</sup> significant increase of facial convexity and slight increase in the LAFH.

To certify the incisor positioning, 13 dental cephalometric variables were implemented due to the structure diversity of the craniofacial complex. Many cephalometric measurements are obtained considering the cranial base or maxillary and mandibular bone bases. However, there is large variation of the structural morphology involving the cranial base.<sup>7,21</sup> A short SN line may induce the orthodontist to a less accurate diagnosis, leading to an erroneous evidence of the protrusion or retrusion of bone and dental bases.<sup>41,53</sup>

Deflection of the cranial base may also lead to erroneous interpretations during the complementary diagnosis. However, many variations may be analyzed as typical characteristics of a certain ethnic group.<sup>21,41</sup>

Some variables suggested by Downs<sup>19</sup> and Steiner<sup>44</sup> are obtained from the cranial base. Conversely, Ricketts,<sup>43</sup> McNamara<sup>35</sup> and Tweed<sup>47,48</sup> did not use the cranial base as reference to evaluate the dental variables.

Therefore, analysis of the skeletal morphology of young Afro-Caucasian individuals on the cephalogram evidenced the great potential of tooth compensation because of the skeletal characteristics of the jaws. The maxilla exhibited slight protrusion in relation to the forehead, which therefore should be considered normal for this ethnic group. However, the mandible exhibited slight clockwise rotation with marked mandibular incisors flaring. This skeletal and dental characteristic may induce a false diagnosis of bimaxillary protrusion of the bone bases for Afro-Caucasian and Black individuals.<sup>21</sup>

In addition to the facial and morpho-differential diagnosis of the cephalogram, the main reference points for orthodontic treatment include the curve of Spee, anterior and posterior tooth crowding, inclination of maxillary and especially of mandibular incisors.<sup>19,27,32,44,47,48</sup> Therefore, when establishing these analyses, the specificity and applicability in different racial groups demonstrate evident craniofacial and dental differences. Thus, there should be a customized therapy to avoid interference on the phenotypic characteristics of the craniofacial complex.

### Maxillary and mandibular incisor position for the different ethnic groups

When comparing some linear and angular variables of the present study with the report of Medeiros<sup>36</sup> on Black individuals, it may be inferred that the variables I.NB, 1-NB and "I" line demonstrated significant differences. There was a greater protrusion and inclination, especially in mandibular incisors of young Afro-Brazilian individuals, which corroborates with some other studies.<sup>2,4,9,14,16,20,22,30</sup>

Analysis of studies that determine the protrusion of mandibular incisors by morpho-differential analysis ("I" line) evidences greater

protrusion of mandibular incisors in Afro-Caucasians and Black individuals,<sup>8,36</sup> compared to studies that analyzed this variable in Caucasians<sup>27,28</sup> and individuals of Asian descent.<sup>42</sup>

Another study with young Caucasian individuals assessed the craniofacial growth and development in young individuals aged 6 to 18 years.<sup>34</sup> The comparative analysis of values evidences that most dental variables exhibited great proximity or similarity with the present results. However, it was observed that the dental variables in young Afro-Caucasian Brazilian individuals revealed slight protrusion and inclination of incisors in relation to the Caucasians, except for the variable Mx1-PTV. For the variables Mdl-GoMe and Mx1-PP, which quantified the dental extrusion and stages of eruption of mandibular and maxillary molars, the value was slightly greater for young Caucasian individuals.

#### **Quantitative evaluation, in relation to mandibular incisor position, according to the Tweed variable (IMPA)**

The Afro-Caucasian individuals showed a mean value of 94.6° for the variable IMPA. In comparison, it was observed a mean of 92.3° for the IMPA in Brazilians with Japanese descent,<sup>46</sup> which was greater than the value of 90° observed by Margolis<sup>32</sup> and Tweed<sup>48</sup> in North American individuals, and also greater than the 91° observed by Martins et al,<sup>34</sup> in Caucasian individuals aged 12 to 14 years. Conversely, Harris, Kowalski and Walker<sup>24</sup> found a value of 95.6° for Black individuals.

#### **Comparison between male and female sexes**

Several studies<sup>14,18,23,30,40,42,46,51</sup> established patterns for different ethnic groups with standardized samples, correlating the presence or absence of dimorphism between sexes. However, other studies<sup>8,10,22,36</sup> individually evaluated the ideal values for young and adult Black individuals.

The comparative evaluation between sexes is important to identify differences in the growth and development process between young male and female individuals.<sup>41</sup> Martins et al<sup>34</sup> observed tendencies of earlier craniofacial development for young females compared to the males, at different ages.

The observation of numeric and statistical similarity in the analysis between male and female sexes indicates the absence of sexual dimorphism between young Afro-Caucasian Brazilian individuals (Tab. 3), assuming that the dentoalveolar variables may be applied for both sexes.

#### **Clinical application**

It should be highlighted to the clinician that, since this is a cephalometric study, measurements of other studies should also be evaluated and correlated to the current study. However, the variables are obtained by mean values that present large variation (standard deviation). The orthodontist should understand these variations to properly apply this knowledge, considering that facial analysis should be the main instrument to determine the final diagnosis with the secondary aid of cephalometric measurements and lateral cephalograms. The orthodontist should also consider the variations and limitation of the facial, skeletal and dental context in the different ethnic groups when selecting the best treatment plan.

#### **CONCLUSIONS**

The results showed the mean values of dental cephalometric variables in young Afro-Caucasian Brazilian individuals (Pattern I) with normal occlusion, which leads to the following conclusions:

» The distinct characteristic observed in cephalometric patterns of Afro-Caucasian individuals differs from values of other ethnic groups showed in the literature, indicating the need for a specific or differentiated analysis for diagnosis and orthodontic treatment planning.

» There was no dimorphism between sexes.  
 » Further studies should be conducted in Afro-Caucasian individuals with skeletal discrepancy (Pattern II, Pattern III, Short Face and Long Face).

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