

# Dental dimensions and Angle's molar classification in a group of Afro-descendants from a township of Cali, Colombia

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**ABSTRACT**

**Objective:** To analyze the permanent teeth through mesodistal and vestibulo-palatal (vestibulo-lingual) dental diameters and Angle's molar classification to determine mean, sexual dimorphism, bilateral symmetry and population biological similarities in a group of Afro-descendants from the township of El Hormiguero, in Cali, Colombia. **Materials and methods:** Descriptive study that analyzed the mesodistal and vestibulo-palatal (vestibulo-lingual) diameters of permanent teeth of 36 plaster models (21 females and 15 males) of a group of Afro-descendants from the township of El Hormiguero, Cali, Colombia. Parametric and nonparametric tests were used to estimate sexual dimorphism and bilateral symmetry, in addition to correlations with Angle's molar class. A  $p < 0.05$  was considered significant. **Results:** Minimal differences were found in the diameters of the right and left sides. Some lower arch teeth showed sexual dimorphism. No significant differences were observed between Angle molar class and sex, while bilateral symmetry showed a difference close to significance. The total summation of mesodistal diameters showed no relationship with Angle molar class. **Conclusions:** There is sexual dimorphism in the diameters in the lower arch. There was no relationship between the diameters and Angle's molar class, and there was no sexual dimorphism.

**Keywords:** odontometry; physical anthropology; permanent dentition; Angle malocclusion.

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## INTRODUCTION

Dental anthropology is an interdisciplinary field within biological anthropology, paleontology, biology and dentistry that focuses on the observation, recording, analysis, explanation and understanding of all information that can be obtained from human teeth based on their morphology, dimensions, pathologies, and cultural modifications (1).

Within this framework, odontometry refers to the measurement of various dimensions of the roots and crowns of deciduous and permanent teeth. These measurements are applied in the dental field to predict and clinically manage the space in maxillary and mandibular arches during orthopedic and orthodontic procedures. They are applied in the anthropological field to establish phylogenetic relationships of hominids, including the genus *Homo*, and to determine biological similarities between past and present human groups. And they are also applied in the forensic field to estimate ethnic patterns and determine sex as essential elements in the basic quartet of human identification during forensic dental procedures (2, 3).

The dental dimensions most studied worldwide, due to their usefulness and higher degree of preservation—as they are less exposed and affected by physiological or pathological wear—are the mesiodistal diameter, defined as the distance between the mesial and distal interproximal points of greater contour, and the buccopalatal diameter (buccolingual in lower teeth), defined as the distance between the maximum convexities of the buccal and palatal (lingual) surfaces (4). Additionally, Angle's molar relationship has been considered, which describes how the first upper and lower molars align during the occlusal contact of maximum intercuspation, based on the position of the mesiobuccal cusp in relation to the buccal developmental groove (5-7).

Research in dentistry, anthropology, and forensics on dental dimensions has allowed to understand how tooth size has evolved and varied among different human groups across the five continents. This variation is influenced by factors such as diet, food preparation methods, environmental conditions, and specific biological characteristics. Dental dimensions—especially the mesiodistal diameter of permanent teeth—the perimeter of the upper and lower dental arches, and the crown module of the upper first molar—mesiodistal diameter plus buccopalatal and buccolingual diameter divided by two—have been very useful for grouping human groups based

on their geographic distribution in a series of clusters according to tooth size: hypermicrodonts (<10.2 mm), microdonts (10.2-10.59 mm), mesodonts (10.6-10.99 mm), macrodonts (11.0-11.39 mm), and hypermacrodonts (>11.42 mm) (8).

Based on this, it has been inferred that Australian and Polynesian human groups have the largest dentition (macrodonts); European and African groups show no significant differences; Asian and American groups—significantly different from African groups—have medium-sized dentition (mesodonts); and some European groups have the smallest dentition (microdonts) (9, 10). Differences between past and present human groups follow microevolutionary trends of morphological simplification, slower individual growth rate, a reduction in tooth size, and the disappearance of sexual dimorphism (2).

Therefore, the objective of this study was to analyze the dimensions of permanent teeth through mesiodistal and buccopalatal (buccolingual) dental diameters and Angle's molar classification in a group of young Afro-descendants from the settlement of El Hormiguero in Cali, Colombia. This aims to generate population biological markers that allow us to compare the results obtained—averages, sexual dimorphism and bilateral symmetry—with different Colombian and global human groups, contributing to the microevolutionary reconstruction of biological similarities. This study provides valuable information, not only on ethnohistorical processes within the anthropological and forensic contexts, but also into the direct association between dental arch perimeter—sum of the mesiodistal diameters—and Angle's molar classification. In the dental context, this relationship may be associated with dental malocclusion, arch shape, and facial biotypes.

## MATERIALS AND METHODS

A cross-sectional, descriptive and observational study was conducted to analyze the dimensions of permanent teeth through the mesiodistal and buccopalatal (buccolingual) dental diameters and Angle's molar classification in a group of 36 young individuals—21 women and 15 men—from the settlement of El Hormiguero in Cali, Colombia. These participants were students from the Official Ethnoeducational Institution El Hormiguero, aged between 12 and 17 years, who self-identified as Afro-descendants, along with their parents and grandparents. According to the 2025 National Population and Housing Census (11) and Political Constitution of 1991 (12), the method of

self-identification with an ethnic group was employed, based on a multicultural and multiethnic approach.

In Colombia, 10.6% of the population self-identifies as Afro-descendant, in Valle del Cauca this percentage rises to 27.2%, and in Santiago de Cali, to 26.2%, with the highest concentration found in El Hormiguero. The sample was selected by convenience, based on the presence of 24 healthy permanent teeth in the mouth—excluding second and third molars as they had not reached the occlusal plane within the studied age range—and the assent and consent of students and parents, respectively. According to the central boundary theorem, a sample size of  $n > 30$  approaches a normal distribution. Therefore, the  $n = 36$  sample for the characterization of dental morphology meets the normality assumptions, so that appropriate statistical tests can be applied for this distribution.

Following approval of the Institutional Human Ethics Committee from the Universidad del Valle (code No 013-023), study models were obtained using type III WhipMix® dental stone from upper and lower impressions taken with Tropicalgin® and Zhermack® alginate, using Coe ID® plastic trays. At all times, manufacturers' indications on the properties and handling of biomaterials were followed.

Once the study models were obtained, the researchers standardized the criteria to measure the mesiodistal and buccopalatal (buccolingual) diameters using the methods described by Moorrees et al. (13) and Kieser et al. (14), respectively. Measurements were taken using a fine-tipped Ubermann® digital caliper with an accuracy of 0.1 mm, in accordance with the manufacturer's specifications. A standardization protocol and double blinding were used to control biases and ensure consistency in measurement criteria (caliper positioning). The degree of concordance was assessed using the concordance correlation coefficient in STATA 16® software. By measuring 10 models, results were obtained using the intraclass correlation coefficient for the interobserver criteria (observer vs. advisor) at 94%, 96%, 93% and 92% with standard measurement errors of 0.01 mm; and for intraobserver criteria (observer vs. observer) at 95%, 98%, 95% and 94% with standard measurement errors of 0.01 mm. To obtain the mesiodistal diameter of each tooth, the caliper was positioned parallel or vertical to the incisal or occlusal surface, ensuring that the plane of the tips

was in the maximum contour areas of the mesial and distal interproximal contact points. To obtain the buccopalatal (buccolingual) diameter of each tooth, the caliper was positioned parallel or vertical to the incisal or occlusal surface, ensuring that the plane of the tips was located at the maximum contour areas of the buccal and lingual surfaces.

Once the observers were standardized, all models were measured, and a database was created in Microsoft Excel®, which was then processed using the STATA 16® software. For the statistical normality analysis, when the Shapiro-Wilk test was significant, Student's t-test was used; otherwise, the Mann-Whitney U Test was applied. Using the univariate analysis (descriptive statistics) the average of diameters was obtained. With the bivariate analysis, sexual dimorphism (Student's t-test), bilateral symmetry (Pearson and Spearman correlation tests), the relationship between Angle molar class and sexual dimorphism, bilateral symmetry (chi-square test), and arc perimeter (Kruskal-Wallis test) were determined. A  $p < 0.05$  was considered statistically significant. Finally, the SPSS 21® software was used to determine biological similarity—based on the means, and their respective standard deviation of the mesiodistal diameter of central and lateral incisors, canines, first and second premolars, and first upper and lower molars—through a similarity matrix from hierarchical cluster classification using the squared Euclidean distance and its respective dendrogram obtained by Ward's method.

## RESULTS

After the statistical analysis and the calculation of the average dental dimensions (Table 1), sexual dimorphism was observed in the mesiodistal diameter of the lower left lateral incisor 3.2 ( $p = 0.05$ ; 0.26 mm) and the lower right first premolar 4.4 ( $p = 0.04$ ; 0.35 mm), with larger measurements in women.

Sexual dimorphism was observed in the buccolingual diameter of the upper left first molar 2.6 ( $p = 0.04$ ; 0.56 mm), lower left first premolar 3.4 ( $p = 0.03$ ; 0.18 mm), lower right canine 4.3 ( $p = 0.04$ ; 0.42 mm), and lower right second premolar 4.5 ( $p = 0.05$ ; 0.46 mm), with larger measurements in women (Table 2).

Another important finding is that there was bilateral symmetry in all teeth for both diameters (Table 3).

**Table 1.** Average dental dimensions of the Afro-descendant group from the settlement El Hormiguero (Cali, Colombia).

| Tooth | Mesiodistal diameter |      | Buccopalatal (buccolingual) diameter |      |
|-------|----------------------|------|--------------------------------------|------|
|       | Mean                 | SD   | Mean                                 | SD   |
| 11    | 8.80                 | 0.52 | 8.76                                 | 0.64 |
| 12    | 7.26                 | 0.60 | 7.29                                 | 0.60 |
| 13    | 7.91                 | 0.79 | 7.92                                 | 0.75 |
| 14    | 7.36                 | 0.59 | 7.40                                 | 0.60 |
| 15    | 6.44                 | 0.63 | 6.89                                 | 0.62 |
| 16    | 10.27                | 0.64 | 10.26                                | 0.64 |
| 21    | 8.75                 | 0.53 | 8.73                                 | 0.52 |
| 22    | 7.23                 | 0.64 | 7.18                                 | 0.61 |
| 23    | 7.77                 | 0.65 | 7.84                                 | 0.57 |
| 24    | 7.49                 | 0.40 | 7.53                                 | 0.40 |
| 25    | 6.87                 | 0.57 | 6.82                                 | 5.27 |
| 26    | 10.19                | 0.97 | 10.23                                | 0.83 |
| 31    | 5.33                 | 0.45 | 5.40                                 | 0.46 |
| 32    | 6.02                 | 0.40 | 6.09                                 | 0.48 |
| 33    | 7.03                 | 0.53 | 7.05                                 | 0.58 |
| 34    | 7.59                 | 0.65 | 7.59                                 | 0.53 |
| 35    | 7.40                 | 0.72 | 7.49                                 | 0.69 |
| 36    | 11.18                | 0.77 | 11.24                                | 0.67 |
| 41    | 5.38                 | 0.45 | 5.50                                 | 0.96 |
| 42    | 6.07                 | 0.48 | 6.11                                 | 0.57 |
| 43    | 7.02                 | 0.57 | 7.08                                 | 0.59 |
| 44    | 7.57                 | 0.51 | 7.54                                 | 0.55 |
| 45    | 7.48                 | 0.73 | 7.32                                 | 0.69 |
| 46    | 11.14                | 0.79 | 11.05                                | 0.89 |

SD: standard deviation.

**Table 2.** Sexual dimorphisms of dental dimensions in the Afro-descendant group from the settlement of El Hormiguero (Cali, Colombia).

| Tooth | Sex   | Mesiodistal diameter |      |                              | Buccopalatal (buccolingual) diameter |      |                              |
|-------|-------|----------------------|------|------------------------------|--------------------------------------|------|------------------------------|
|       |       | Mean                 | SD   | Sexual dimorphism (p < 0.05) | Mean                                 | SD   | Sexual dimorphism (p < 0.05) |
| 11    | Men   | 8.73                 | 0.57 | 0.36*                        | 7.31                                 | 0.71 | 0.88*                        |
|       | Women | 8.89                 | 0.45 |                              | 7.28                                 | 0.43 |                              |
| 12    | Men   | 7.23                 | 0.70 | 0.72*                        | 7.31                                 | 0.71 | 0.88*                        |
|       | Women | 7.30                 | 0.45 |                              | 7.28                                 | 0.43 |                              |
| 13    | Men   | 7.67                 | 0.71 | 0.07*                        | 7.80                                 | 0.71 | 0.24*                        |
|       | Women | 8.14                 | 0.83 |                              | 8.09                                 | 0.80 |                              |
| 14    | Men   | 7.33                 | 0.58 | 0.74*                        | 7.45                                 | 0.68 | 0.54*                        |
|       | Women | 7.40                 | 0.62 |                              | 7.32                                 | 0.49 |                              |
| 15    | Men   | 6.76                 | 0.50 | 0.14*                        | 6.81                                 | 0.59 | 0.38*                        |
|       | Women | 6.08                 | 0.75 |                              | 7.00                                 | 0.67 |                              |

\*Student's t test; \*\*Mann Whitney U test; SD: standard deviation.

Table 2. (Continuation).

| Tooth | Sex   | Mesiodistal diameter |      |                              | Buccopalatal (buccolingual) diameter |      |                              |
|-------|-------|----------------------|------|------------------------------|--------------------------------------|------|------------------------------|
|       |       | Mean                 | SD   | Sexual dimorphism (p < 0.05) | Mean                                 | SD   | Sexual dimorphism (p < 0.05) |
| 16    | Men   | 10.20                | 0.14 | 0.41*                        | 10.15                                | 0.53 | 0.23*                        |
|       | Women | 10.37                | 0.16 |                              | 10.42                                | 0.77 |                              |
| 21    | Men   | 8.68                 | 0.59 | 0.35*                        | 8.72                                 | 0.60 | 0.90*                        |
|       | Women | 8.86                 | 0.43 |                              | 8.75                                 | 0.42 |                              |
| 22    | Men   | 7.18                 | 0.66 | 0.61*                        | 7.25                                 | 0.67 | 0.42*                        |
|       | Women | 7.30                 | 0.62 |                              | 7.08                                 | 0.53 |                              |
| 23    | Men   | 7.64                 | 0.71 | 0.18*                        | 7.77                                 | 0.67 | 0.40*                        |
|       | Women | 7.94                 | 0.55 |                              | 7.34                                 | 0.43 |                              |
| 24    | Men   | 7.46                 | 0.40 | 0.62*                        | 7.51                                 | 0.39 | 0.82*                        |
|       | Women | 7.53                 | 0.41 |                              | 7.54                                 | 0.43 |                              |
| 25    | Men   | 6.77                 | 0.61 | 0.18*                        | 6.71                                 | 0.52 | 0.12*                        |
|       | Women | 7.03                 | 0.47 |                              | 6.99                                 | 0.50 |                              |
| 26    | Men   | 10.19                | 0.14 | 0.41**                       | 10.00                                | 0.84 | 0.04*                        |
|       | Women | 10.38                | 0.16 |                              | 10.56                                | 0.70 |                              |
| 31    | Men   | 5.34                 | 0.51 | 0.88*                        | 5.42                                 | 0.53 | 0.76*                        |
|       | Women | 5.31                 | 0.34 |                              | 5.37                                 | 0.38 |                              |
| 32    | Men   | 5.92                 | 0.34 | 0.05*                        | 6.03                                 | 0.42 | 0.37*                        |
|       | Women | 6.18                 | 0.43 |                              | 6.17                                 | 0.55 |                              |
| 33    | Men   | 7.64                 | 0.70 | 0.18**                       | 6.95                                 | 0.46 | 0.24*                        |
|       | Women | 7.94                 | 0.55 |                              | 7.19                                 | 0.72 |                              |
| 34    | Men   | 7.56                 | 0.71 | 0.77*                        | 7.51                                 | 0.57 | 0.03*                        |
|       | Women | 7.63                 | 0.58 |                              | 7.69                                 | 0.48 |                              |
| 35    | Men   | 7.23                 | 0.84 | 0.10*                        | 7.37                                 | 0.76 | 0.21*                        |
|       | Women | 7.63                 | 0.47 |                              | 7.66                                 | 0.56 |                              |
| 36    | Men   | 11.02                | 0.84 | 0.14*                        | 10.90                                | 1.21 | 0.20**                       |
|       | Women | 11.41                | 0.63 |                              | 11.28                                | 0.60 |                              |
| 41    | Men   | 5.39                 | 0.45 | 0.87*                        | 5.42                                 | 0.53 | 0.77**                       |
|       | Women | 5.37                 | 0.39 |                              | 5.37                                 | 0.40 |                              |
| 42    | Men   | 6.06                 | 0.46 | 0.87*                        | 6.03                                 | 0.42 | 0.38**                       |
|       | Women | 6.09                 | 0.52 |                              | 6.18                                 | 0.56 |                              |
| 43    | Men   | 6.87                 | 0.43 | 0.05*                        | 6.91                                 | 0.56 | 0.04*                        |
|       | Women | 7.25                 | 0.67 |                              | 7.33                                 | 0.57 |                              |
| 44    | Men   | 7.42                 | 0.50 | 0.04*                        | 7.45                                 | 0.53 | 0.23*                        |
|       | Women | 7.77                 | 0.47 |                              | 7.67                                 | 0.57 |                              |
| 45    | Men   | 7.38                 | 0.85 | 0.34*                        | 7.13                                 | 0.73 | 0.05*                        |
|       | Women | 7.61                 | 0.53 |                              | 7.59                                 | 0.54 |                              |
| 46    | Men   | 11.02                | 0.84 | 0.14**                       | 10.89                                | 1.21 | 0.20*                        |
|       | Women | 11.41                | 0.63 |                              | 11.28                                | 0.60 |                              |

\*Student's t test; \*\*Mann Whitney U test; SD: standard deviation.

**Table 3.** Bilateral symmetry of the dental dimensions in the Afro-descendant group from the settlement of El Hormiguero (Cali, Colombia).

| Tooth | Mesiodistal diameter |                                   | Buccopalatal (buccolingual) diameter |                                   |
|-------|----------------------|-----------------------------------|--------------------------------------|-----------------------------------|
|       | Mean                 | Symmetry bilateral ( $p < 0.05$ ) | Mean                                 | Symmetry bilateral ( $p < 0.05$ ) |
| 11    | 8.78                 | 0.001**                           | 8.01                                 | 0.001**                           |
| 21    |                      |                                   |                                      |                                   |
| 12    |                      |                                   |                                      |                                   |
| 22    | 7.25                 | 0.001**                           | 7.23                                 | 0.001**                           |
| 13    |                      |                                   |                                      |                                   |
| 23    |                      |                                   |                                      |                                   |
| 14    | 7.84                 | 0.001**                           | 7.75                                 | 0.001**                           |
| 24    |                      |                                   |                                      |                                   |
| 15    |                      |                                   |                                      |                                   |
| 25    | 7.43                 | 0.001**                           | 7.46                                 | 0.001**                           |
| 16    |                      |                                   |                                      |                                   |
| 26    |                      |                                   |                                      |                                   |
| 31    | 6.66                 | 0.001**                           | 6.88                                 | 0.001**                           |
| 41    |                      |                                   |                                      |                                   |
| 32    |                      |                                   |                                      |                                   |
| 42    | 10.23                | 0.001*                            | 10.28                                | 0.001**                           |
| 33    |                      |                                   |                                      |                                   |
| 43    |                      |                                   |                                      |                                   |
| 34    | 5.35                 | 0.001**                           | 5.39                                 | 0.001*                            |
| 44    |                      |                                   |                                      |                                   |
| 35    |                      |                                   |                                      |                                   |
| 45    | 6.05                 | 0.001**                           | 6.10                                 | 0.001*                            |
| 36    |                      |                                   |                                      |                                   |
| 46    |                      |                                   |                                      |                                   |
| 37    | 7.03                 | 0.001*                            | 7.09                                 | 0.001**                           |
| 47    |                      |                                   |                                      |                                   |
| 38    |                      |                                   |                                      |                                   |
| 48    | 7.58                 | 0.001**                           | 7.58                                 | 0.001**                           |
| 39    |                      |                                   |                                      |                                   |
| 49    |                      |                                   |                                      |                                   |
| 40    | 7.44                 | 0.001**                           | 7.44                                 | 0.001**                           |
| 50    |                      |                                   |                                      |                                   |
| 51    |                      |                                   |                                      |                                   |
| 52    | 11.16                | 0.001*                            | 11.09                                | 0.001*                            |
| 53    |                      |                                   |                                      |                                   |
| 54    |                      |                                   |                                      |                                   |

\*Spearman correlation; \*\*Pearson correlation.

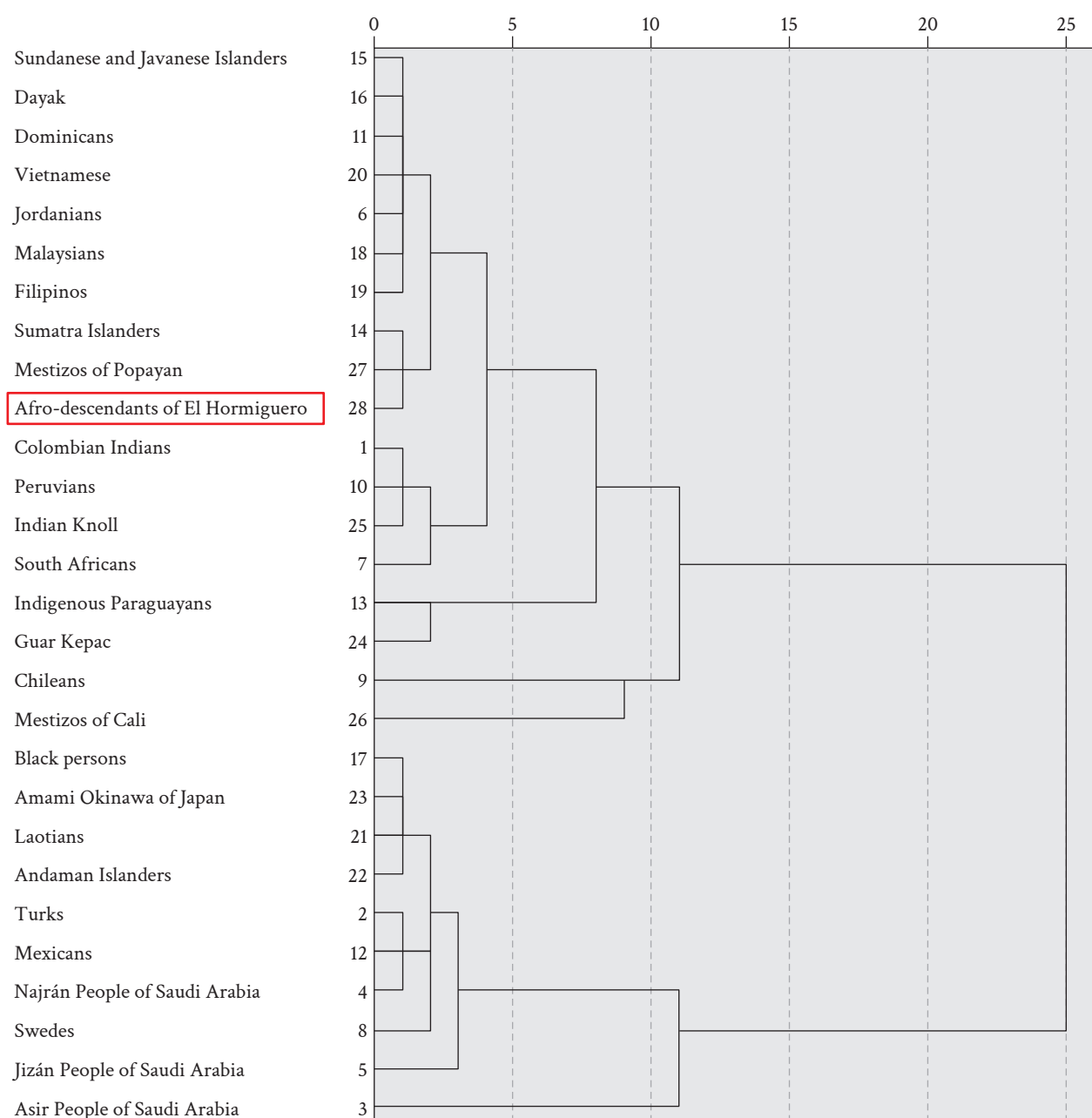
When comparing the Angle molar class between the right and left sides, statistically significant differences ( $p = 0.05$ ) were identified in bilateral symmetry (Table 4).

**Table 4.** Bilateral class symmetry in the dental dimensions of the Afro-descendant group from the settlement of El Hormiguero (Cali, Colombia).

| Right class | Left class |    |     | Total |
|-------------|------------|----|-----|-------|
|             | I          | II | III |       |
| I           | 7          | 3  | 5   | 15    |
| II          | 2          | 2  | 2   | 6     |
| III         | 3          | 0  | 12  | 15    |
| Total       | 12         | 5  | 19  | 36    |
| $p = 0.05$  |            |    |     |       |

In the dendrogram (Figure 1), regarding biological similarity, it was observed that the sample of Afro-descendants from the settlement of El Hormiguero shares the same conglomerate formed by Asian-descendant groups and a group of mestizos from Popayán, a geographically proximate population. Similarly, it is closely related to a conglomerate made up of human groups with strong Asian influence, such as Colombian Indigenous populations. A third similarity conglomerate links the sample to a group of mestizos from Cali, with whom they share virtually the same geographical territory. According to the coronal module of the first upper molar (10.2 mm), the sample of Afro-descendants in this study is classified as microdont, which may be associated with ethnohistorical processes of hybridization with European and Indigenous groups.





**Figure 1.** Dendrogram derived from the similarity matrix of Colombian and world human groups based on the mesiodistal diameter of incisors, canines, premolars and upper and lower first molars.

## DISCUSSION

Considering that bilateral symmetry was observed in the mesiodistal and buccopalatal (buccolingual) diameters of all teeth, similar to the evidence available in the specialized literature, the discussion will focus on sexual dimorphism, biological similarity and Angle's molar class behavior. However, it is pertinent to note that the absence of significant differences in the bilateral symmetry of the mesiodistal and buccopalatal (buccolingual) diameters shows the degree of preservation of this characteristic. This is of great

clinical importance for the diagnosis and prognosis of dental orthopedics and orthodontic treatments, considering that understanding the diversity of human groups allows us to approach the dental practice from more complex scenarios (15).

Human groups vary according to their phylogenetic origins (macro and microevolutionary), ethnic patterns, sexual characteristics and, ontogenetically, age. In addition to all this, individual variations of each human being as a member of a species are included. That is why, within the dental, anthropological and

forensic context, the analysis of human groups is conducted through levels or scales that range from the general to the particular and, in individuals, from the intragroup to the intergroup level. In this regard, sexual dimorphism corresponds to the intra-specific, phylogenetic and ethnic difference between women and men, in which the mesiodistal diameter varies to a lesser degree than the buccopalatal (buccolingual) diameter (16).

Rodríguez (2) proposed that dental reduction (size reduction) has been an evolutionary trend in human dentition; however, it should not be associated with the simplification of tooth morphological structures since paramolar formations (Carabelli's cusp, parastyle and protostylid, among others), which increase coronal volume, were developed during dental morphogenesis in the late stages of human evolution. This has been explained through the theoretical model of uncontrolled accumulation of mutations that disrupt correlated systems during ontogenesis. In the case of teeth, the reduction in the rate of individual body growth has been associated with a decrease in their size, leading to the disappearance of sexual dimorphism. Other factors described include genetic isolation, which may lead to an increase in tooth size, and hybridization or miscegenation, which, on the contrary, may have resulted in a decrease in the mesiodistal and buccopalatal (buccolingual) diameters.

Brook & Brook-O'Donnell (17) describe that the variability in dental diameters and sexual dimorphism has been attributed to genetic and environmental factors that affect the individual throughout their life, as well as the family and population across generations. However, miscegenation has impacted the formation of the dental crown, possibly contributing to the variation in tooth morphology and dimensions. Consequently, genetic expression and epigenetic influence have triggered a series of signaling factors that, during odontogenesis, have regulated and affected the morphological and metric configuration of the teeth, as seen in the positioning and spacing of the enamel knots that will give rise to the lobes of the anterior teeth and the cusps of the posterior teeth (18). In this regard, modern human beings have experienced the restriction of many factors that control dental morphogenesis, leading to a considerable reduction in sexual dimorphism. As a result, the dental sexual dimorphism index ranges between 8% and 9%, with canines being the most dimorphic teeth (16). Thus, the mesiodistal and buccopalatal (buccolingual) diameters of canines and first molars have become

reliable phenotypic biological markers for describing persistent sexual dimorphism (19).

It has also been demonstrated, based on the correspondence among teeth of the same class, that distal teeth—lateral incisor, second premolar, and second molar—are the most variable. This finding aligns with the results of this study regarding the upper right canine, the upper left first molar, the lower right canine, the lower left first premolar, and the lower right second premolar. These results are consistent with those reported in a study from the same geographical region, in which a sample of Euro-descendant mestizos from Cali and Popayan showed significant sexual dimorphism in the mesiodistal diameter of permanent mandibular canines and lower first molars, with larger dimensions in men (20, 21).

Harris (22) studied the mesiodistal and buccopalatal (buccolingual) diameters of teeth of Euro-descendant and Afro-descendant Americans, finding a 1.2% sexual dimorphism in all teeth and a 4.9 difference between both ethnic groups. This corresponds to the comparison between the Afro-descendant sample from El Hormiguero and the Euro-descendant mestizos from Cali, suggesting that contemporary samples from the Pacific region fit within the microdont complex. In addition, a meta-analysis concluded that all human teeth exhibit some degree of dimorphic expression in the mesiodistal diameter, which is more significant in permanent canines and molars (23).

This research study unusually observed sexual dimorphism in the buccopalatal (buccolingual) diameter of the left upper first molar, left lower first premolar, right lower canine and right lower second premolar, with higher dimensions in women. This finding has been associated with a reduction in the selective pressure on robustness as a dimorphic biological trait compared to men.

Regarding Angle's molar classification, few studies have compared the mesiodistal diameter of teeth within the same arch with the corresponding Angle's molar classification and its relationship with sexual dimorphism and bilateral symmetry. Thus, any differences that may arise have been associated with dental malposition (correlated with the mesiodistal diameter), tooth absence and discrepancies in bone growth and development (24).

In this study, a statistically significant difference was identified between the right and left Angle's molar classification, which was attributed to the arch shape asymmetry, as the sum of the mesiodistal diameters



showed no association with sex. However, the literature reports sexual dimorphism in Class II (with division 1 being more frequent in men and Division 2 in women) and Class III (more frequent in men). This phenomenon is explained by factors such as facial growth and maxillary development, genetic factors, hormonal expressions, and differences in the dental eruption pattern.

Contrary to the findings of this study, Malkoç et al. (25) identified a significant relationship between mesiodistal diameter, Angle's molar classification and sex, which was attributed to the strong sexual dimorphism of the teeth in this population group. Ünal & Dellaloğlu (26) found similar results. Finally, a literature review concluded that there is no consensus in the literature to determine that Angle's molar classification is influenced by the mesiodistal diameters of the teeth, sex and ethnic pattern. This is because the studies are primarily focused on groups from the Middle East and the wide variety of methodologies used (27).

In the case of biological similarity, the analysis of the mesiodistal diameter contributes to the explanation of the macro- and microevolutionary processes of hominid dentition. Similarly, it has been very useful when conglomerating human groups based on their geographical distribution in the continents of Africa, Europe, Asia, Oceania and America, facilitating the classification of dental population complexes from an anthropological perspective (9).

The groups included in the similarity matrix of this study, as shown in the dendrogram, form conglomerates based on the proximity of the mesiodistal diameter of permanent teeth. This finding aligns with dental size classifications that consider the crown module of the upper first molars. The sample of Afro-descendants from the district of El Hormiguero, classified as microdont, forms a conglomerate with mesodont Asian-descendant groups (Dayak, Malaysians, Filipinos, Andaman Islanders and Sundanese and Javanese Islanders) or groups influenced by them (Chileans, Dominicans and mestizos of Popayan) as a result of ethnohistorical processes. Regarding the sample of mestizos from Popayan, Pérez et al. (21) indicated that this population is characterized as mesodont and is constituted by the genetic influence of the three dental complexes resulting from historical miscegenation, evident in contemporary ethnic groups derived from European conquerors (Spaniards from Andalusia and Extremadura) and the pre-Hispanic indigenous peoples of the region (Paeces).

At the same time, the sample is significantly different from the conglomerate that includes the Euro-descendant mestizos of the city of Cali, with whom they share the same geographical territory but who have undergone greater European influence associated with colonial ethno-historical processes, despite the fact that in recent decades there has been a high urban concentration of the Afro-descendant population due to forced displacement resulting from the armed conflict in southwestern Colombia (20). In this regard, Europeans, Africans and human groups influenced by these two complexes cluster into microdont groups. This suggests that miscegenation has possibly been one of the factors with greatest influence on the tendency toward the reduction of dental diameters and, consequently, tooth size.

Scott et al. (3) pointed out that the constant interaction between different genotypes in human microevolution has generated variations in dental morphometry, related to differences in gene expression during odontogenesis. This is due to genetic regulation and molecular signaling mechanisms (including epithelium-mesenchymal interactions, morphogenetic field configuration, morphogenetic clones, homeobox gene expression and possible reductive mutational effects) that control the distinctive morphofunctional characteristics of human dentition, such as dental dimensions, with the mesiodistal diameter standing out in the dendrogram analyzed in this study.

Biological similarity enabled the grouping of this population sample with other microdont groups. These findings require validation through studies with diverse approaches and a larger number of samples encompassing groups distributed within the same geographical territory that share similar ethnohistorical processes.

## CONCLUSIONS

The mesiodistal and buccolingual diameters of a tooth compared to its contralateral of the same class exhibited bilateral symmetry. Minimal differences were observed between women and men, which allows us to conclude that there are genetic and environmental conditions that influence the reduction in tooth size regardless of sex. For Angle's molar classification, no significant differences were observed regarding sex, contrary to bilateral symmetry. When comparing the mesiodistal diameter with Angle's molar class by sex, no significant differences were observed.

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