Forensic Anthropology Population Data

Dental anthropology of a Brazilian sample: Frequency of nonmetric traits

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ABSTRACT

Dental elements are valuable tools in a study of ancient populations and species, and key-features for human identification; among the dental anthropology field, nonmetric traits, standardized by ASUDAS, are closely related to ancestry. This study aimed to analyze the frequency of six nonmetric traits in a sample from Southeast Brazil, composed by 130 dental casts from individuals aged between 18 and 30, without foreign parents or grandparents. A single examiner observed the presence or absence of shoveling, Carabelli's cusp, fifth cusp, 3-cusped UM2, sixth cusp, and 4-cusped LM2. The frequencies obtained were different from the ones shown by other researches to Amerindian and South American samples, and related to European and sub-Saharan frequencies, showing the influence of this groups in the current Brazilian population. Sexual dimorphism was found in the frequencies of Carabelli's cusp, 3-cusped UM2, and sixth cusp.

Human variation in different populations has been extensively explored by researchers from different branches of anthropology, showing that genotypic and phenotypic characteristics of population groups are related to the geographical distance between them, without clear and sharp division between two groups [1–5]. Instead of the classical division of humankind, as simplified by Curvier in 1817, in three ethnic groups – Caucasians, Negroids, and Mongoloids – the investigation of population patterns gives considerable importance to regionalized anthropological research for evolutionary, historical studies, and also for forensic purposes of human identification. [6–9] The analysis of skeletal remains for human identification involves metric and nonmetric methods of assessing biological profile, among which, age, sex, stature and ancestry are the principal focus, complemented by health state, pathologies and previous traumas, time since death, and any other information that may lead to identification. From the those, ancestry is a very important aspect, but also one of the most difficult to assess,

especially in mixed populations, and there is no single method to obtain this information, but a combination of metric and nonmetric techniques may provide more reliable results, to help design a biological profile that can lead to identification. [10]

Dental elements, for their resistance to decomposition, destructive agents and, mainly, through time, are valuable tools in a study of ancient populations and species. Besides being the only anthropological study object exposed during life, they also allow the investigation of modern populations, their origins, the migratory chain, and features such as habits and diet, with the same research techniques used in fossils [5,11]. In the field of dental anthropology, nonmetric traits are not affected by natural selection, since there is no evidence of environmental factors that may lead to the higher occurrence or inhibition of a trait [12–14], which gives them the evolutionary conservatism; and because of that, nonmetric traits can be considered a neutral variation, independently of each other, and valuable source of information regarding gene flow, coancestry and migration [1,4,15,16].

The study of nonmetric traits allows us observing the relationship with ancestry, justifying its importance in forensic human identification [17–20]. The ASU (Arizona State University) System standardizes the rating of each trait, so that studies around the world can be compared and groups of characteristic features of

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each population have been suggested, as the Asiatic complex [12,21], the European complex [22], the sub-Saharan complex [23,24] and the American complex [25], studied before [11,14,20,26–35], as well as Hanihara [36], who has compared twelve samples distributed worldwide, including South American countries. However, the author has analyzed recent specimens provided by collections, most of them from National Museum of Natural History (London, UK), National Museum of Natural History (Washington, USA), American Museum of Natural History (New York, USA).

Although many studies of metric and morphological dental traits have been developed in search of population patterns, Brazilian population post-colonization has not yet been analyzed, and data from the South American continent, fossils, and Indian tribes are considered to represent Brazilian population, seen by international researchers as Amerindians. However, the current Brazilian population descends from 500 years of hybridization between Amerindians, Europeans and sub-Saharan Africans, which makes it unique, and suggests specific regionalized studies.

This study aims to analyze the dental anthropology of a Brazilian sample from the southeast region, identify the frequency of non-metric traits and their relationship with international frequencies published in the literature, and to evaluate the possible use of these traits for forensic human identification.

1. Methods

The sample consisted of 130 native Brazilians, with two generation of Brazilian ascendants; therefore, one of the excluding criteria was participants who had any foreign parents or grandparents. The selected age group was between 18 and 30 years old, to ensure the presence of fully developed dental arches, and with no occlusal wear in a level that could interfere with the evaluation. All the participants were residents of the metropolitan area of Rio de Janeiro (southeastern Brazil), due to the high degree of phenotypic variation among Brazilian regions, as shown previously by genetic researches [37–39].

The dental arch of the sample was reproduced by dental plaster casts, for further analysis with magnifying glass. In each arc, a single observer examined six nonmetric traits, previously cataloged and researched by other authors internationally, described in Table 1. The traits were registered by a dichotomized protocol, identified as "present" or "absent", according to the ASUDAS parameters. Only the left hemiarch of each cast was examined, to avoid bias and distortions due to possible asymmetries. When the target tooth could not be examined due to carious lesion, restoration, anomaly or absence, the right target tooth was observed, assuming symmetry, though this side variation has been limited to the maximum of 20% of the sample; if neither the right element could be examined, the option "null" was registered, and the trait has not been examined on that participant.

The project of this study was analyzed by the Research Ethics Committee and approved by the Protocol 023/2009. All participants were asked to sign an Informed Consent Term, according to the ethical rules and legislation for scientific research. The data obtained were entered into an Excel®, and processed with SPSS®. The probability level of <0.05 was considered statistically significant.

2. Results

The sample was composed of 130 Brazilian subjects (59 male and 71 female), with profile and distribution by age and sex shown in Table 2.

The most common trait was the hypoconulid absence – or four cusped second lower molar – found in 83.0% of the sample, followed by the hypocone absence – or three cusped second upper molar, in 58.3% of the subjects. Three traits showed sexually dimorphic frequencies: Carabelli's cusp ($p = 0.0371$), hypocone absence ($p = 0.0354$), and sixth cusp ($p = 0.0011$), determined by statistical test of two proportions, with 5% significance level. Table 3 shows the frequency values and percentage of each morphological trait according to sex distribution, target tooth, and sexual dimorphism.

The data obtained from the Brazilian sample evaluated were compared to frequencies cited by Irish [35], and found by Hanihara [36]. In both comparisons, the frequencies of all traits differed from the data related to the Amerindians [35], and South Americans [36]. Fig. 1 shows the comparison between the frequency cited by Irish for Amerindian, European and sub-Saharan Africans, along with data from the Brazilian sample.

Fig. 2 shows the comparison between the frequency found in the Brazilian sample, and the frequencies found by Hanihara [36] to the South Americans, Europeans and sub-Saharan African samples. In this particular figure, there is no data related to the presence of the fifth cusp, because this trait has not been investigated by Hanihara.

3. Discussion

Among the interpopulational biological variations, nonmetric dental traits are key focus of observation for researchers who explore the link between biological history of populations and their phenotypic variation. The excellent preservation, the existence of numerous independent traits, the genetic determination, the evolutionary conservatism free of selective pressure, the interpopulational variation, and the easy observation in live individuals such as in fossils, are the main factors that give the dental anthropology great significance in the study of human variation [13,23,40,41].

Table 1
Definition, target tooth, and standard criteria for the each of the observed traits.

Trait (abreviation)	Target tooth	Definition and section point standardized by ASUDAS[**]
Shoveling (SH)	UI1	Mesial and distal ridges on the lingual surface of the upper incisor; grades 3–7 of ASU System, which equals semi-shovel and full-shovel, in Hrdlicka's classic paper[*]
Carabelli's cusp (CC)	UM1	Supranumerary cusp on the mesiolingual or lingual surface of the protocone; grades 5–7 of ASU System
Fifth cusp (C5)	UM1	Occlusal tubercle on the distal ridge of upper molars, between metacone and hypocone; grades 1–5 of ASU System
Hypocone absence (3-cusp UM2)	UM2	Absence of the distolingual cusp on the UM2; grades 0–1 of ASU System
Sixth cusp (C6)	LM1	Supranumerary cusp on the distal surface of the LM1, between the hypoconulid and entoconid; grades 1–5 of ASU System
Hypoconulid absence (4-cusp LM2)	LM2	Absence of the distobuccal cusp on the LM2; grade 0 of ASU System

[*] Ref. [17].
[**] Ref. [14].