Some remarks about the distribution of dental decorations in Latin America

Consideraciones sobre la distribución de la mutilación dental en Latinoamérica

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ABSTRACT

Introduction: *a descriptive analysis of the data obtained in the postdoctoral project "Construction of a Database on Dental Mutilations in Latin America: search, registration, feeding and reporting of new cases" is presented.* ***Methods:*** *information was searched on the Internet using a conventional Google Chrome browser, and a conventional statistical description was carried out using Jamovi 2.3 and R.* ***Results:*** *the variables of a set of 20 American countries are listed and described. Ambiguity is found in the information of some categories; a database is obtained that allows chronological and spatial comparisons.* ***Conclusions:*** *the comparative importance of the variables for archeology is discussed and some methodological and theoretical drawbacks encountered during the process are described. The practice of dental decoration originates in Mesoamerica and spreads to other places on the continent.*

Keywords: *dental anthropology, dental mutilation, dental decoration, Latin America.*

Resumen

Introducción: *se presenta un análisis descriptivo de los datos obtenidos en el proyecto posdoctoral "Construcción de una Base de Datos sobre Mutilaciones Dentales en América Latina: búsqueda, registro, alimentación y reporte de nuevos casos".* ***Métodos:*** *se buscó información en Internet utilizando un navegador Google Chrome convencional, y se realizó una descripción estadística convencional utilizando Jamovi 2.3 y R.* ***Resultados:*** *se enumeran y describen las variables de un conjunto de 20 países de América. Se encuentra ambigüedad en la información de algunas categorías, se obtienen una base de datos que permite comparaciones cronológicas y espaciales.* ***Conclusiones:*** *se discute la importancia comparativa de las variables para la arqueología y se describen algunos inconvenientes metodológicos y teóricos encontrados durante el proceso. La práctica de decoración dental se origina en Mesoamérica y se extiende a otros lugares del continente.*

Palabras clave: *antropología dental, mutilación dental, decoración dental, Latinoamérica.*

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INTRODUCTION

The practice of pre-Hispanic dental decoration has been widely referenced in studies of dentistry, archeology, and biological anthropology in America for more than 150 years. The practice of dental mutilation and adornment among humans has been a prevalent cultural phenomenon globally throughout history. These anthropological traditions, characterized by their varied motivations and methodologies, function to define ethnic, social, and at times, aesthetic identities within diverse cultural contexts. In specific societies, dental decoration functions as a ceremonial

ritual, symbolizing the passage into adulthood or alignment with a specific social group. Some indigenous societies, such as the Mursi people in Ethiopia, have incorporated dental decorations, particularly in conjunction with practices like lip plate usage, as integral components of their cultural traditions. Similarly, in Southeast Asia, communities like the Mentawai in Indonesia have a historical association with dental decoration within the context of their cultural heritage. Additionally, certain Native American tribes, including the Maya and Hopi, have documented instances of dental modification as part of their cultural and ritual practices. On the flip side, dental ornamentation, which includes practices such as embedding gemstones or tooth tattoos, is adopted for aesthetic reasons or as a symbol of social status in various communities. These traditions emphasize the richness of cultural diversity and highlight the influence of oral traditions in shaping identities within specific anthropological contexts. Anthropological investigations into these customs delve into their symbolic importance, evolutionary paths, and links to wider cultural and social dynamics.

The intentional modification of teeth is a widely reported research topic around the world in American archaeological literature[1]. Motivated by the quantity, context, time period, and ostentation of the findings, some researchers have proposed classifications[2,3,4] and typologies to identify stylistic patterns[5,6,7,8,9,10,11,12,13,14]. In some cases, the stylistic patterns of intentional dental modification have been successfully associated with periods, cultural development zones, and chronology[15,16,17,18, 28].

These efforts have been useful in solving some local problems related to contact between groups and the assignment of meanings of power, status, trophies, divinity, and sacrifices associated with this practice[1,2]. Other different evidence also allow us to see in some cases this practice in pottery[19], and ritual necklaces[20], but this field of research has been few explored.

Although there is a systematic observation and reports of the great work carried out by the Mexican anthropologist J. Romero[12,15,16,17,18,28] for the Mesoamerican region; in the neighboring countries and South America there was an undetermined number of case reports of dental decoration in different archaeological contexts. Many times, archaeological reports are invisible and isolated as valuable data for regional and continental comparative analysis. This causes that the spatiotemporal interpretations of this type of cultural practices are biased most of the time. The main objective of this research was to carry out a first descriptive approximation of all the data collected so far in the postdoctoral project "Construction of a Database on Dental Mutilations in Latin America: search, registration, feeding and reporting of new cases".

METHODS

For the gathering of information, an-Internet search was carried out using a conventional Google Chrome browser. The variables used to build the database in an Excel spreadsheet refer to the spatial (Country, Region, Site, Google Coordinates), temporal (Geologic Age, Period, Chronology) and cultural (Type of Burial, Status) description. of the findings, as well as identification of each case individually (Code, Individual, Sex, Age) and the location of the mutilation in each dental

piece by type of tooth and the typologies associated with it (Typology, Incrustation, Material, Other Details). The reference in APA 7 format from which each data was extracted was also included. It is understandable that there are cases not published up to now, or that we have neglected their inclusion because we do not know where they have been published. We must also stipulate that only cases of descriptions of living indigenous groups (by ethnographic founds) or skulls and teeth from indigenous archaeological contexts were taken considered. Other sources that describe cases of dental decoration among Spanish-Portuguese slaves and Afro-descendants were not developed here. Table 1 shows the variables considered in its construction. Therefore, it is considered a partial, substantive and complementary analysis to future findings on the subject. The data analysis was carried out with R21 and using the Jamovi 2.3 platform[22] from Excel Sheets (Table 1).

Table 1. Categories used in the construction of the database

Variable	Description
Country	Geographic
Region	Geographic
Site	Archaeological Name
Long, Lat, Google Maps	Approximate location
Geologic Age	Greenlandian, Northgrippian, Meghalayan
Period	Cultural or relative chronology
Chronology	C14 dates or dated periods
Code	Catalogue of previous reference
Type of burial	Primary, secondary, unknown, living
Status	High, Low, Sacrificial, Trophy, Unknown
Individuals	n
Sex	Male, Female, Both, Indeterminate
Age	Range 5 years, +40, +20
UM3	1-16
UM2	2-15
UM1	3-14
UP2	4-13
UP1	5-12
UC	6-11
UI2	7-10
UI1	8-9
LM3	17-32
LM2	18-31
LM1	19-30
LP2	20-29
LP1	21-28
LC	22-27
LI2	23-26
LI1	24-25
Typology	Van Rippen, Montadon, de la Borbolla, Delfino, Romero, Buikstra - Ubelaker, Serrano, Other
Incrustation	Positive, Negative
Material	Jade, Pyrite, Gold, Turquoise, Quarz, Lost, Other
Other details	Relative to archaeological context
Reference	Cite APA

Source: by the authors

Statistical approach

Descriptive variables such as central tendency, dispersion, shape, and distribution were calculated in the samples following the ways of classic statistic procedures[23]. For the median calculation the middle of a dataset when it is arranged in ascending or descending order was located. If the number of data points is even, the formula to find the median of x (Me) is:

$$M_e = \chi\left(\frac{n}{2}\right) + \chi\left(\frac{\chi}{2} + 1\right)$$

But if the number of data points is odd, the formula to find the median of x is:

$$M_o = \chi\left(\frac{n+1}{2}\right)$$

For the mode of ungrouped data, the calculation the following formulae was applied:

$$\text{Mod}_e = L + H\left(\frac{fm - f_1}{(fm - f_1) + (fm - f_2)}\right)$$

Where, L is the lower limit of the modal class, H is the size of the class interval, fm is the frequency of the modal class, f1 is the frequency of the class preceding the modal class, and f2 is the frequency of the class succeeding the modal class.

For the calculation of dispersion values the following procedure was used. For the Standard Deviation (σ) for a sample, the following formula was applied:

$$\sigma = \sqrt{\frac{(x - \bar{x})^2}{(n-1)}}$$

To calculate the variance, the following formula was applied:

$$\frac{\sum(x - m)^2}{(n-1)}$$

Where m is the sample mean and n is the sample size.

To calculate the range, the following formula was applied:

$$Range = \frac{max\, x - min\, x}{2}$$

To calculate the Skewness the following formula was applied:

$$Sk = \frac{u^3}{\sigma^3}$$

Where u^3 is the third moment of the mean and σ^3 is the standard deviation.

To calculate the Kurtosis the following formula was applied:

$$Ku = \frac{u^4}{\sigma^4}$$

Where u^4 is the fourth moment of the mean and σ^4 is the standard deviation.

To calculate the percentiles, this formula was applied to the accumulated frequencies:

$$Pk = Li + \left(\frac{\left(\frac{k \cdot N}{100}\right) - (fi - 1)}{f\text{i}}\right).ai$$

Where Li is the lower limit of the class where the percentile lies, N is the sum of the absolute frequencies, Fi-1 is the cumulative frequency before the percentile class, fi is the interval frequency, and ai is the amplitude of the class.

Finally, we calculated the Shapiro-Wilks test under the null hypothesis that both distributions (observed and theoretical) were equal, using the following formula:

$$SW = \left(\frac{(\sum_{i}^{n} = 1\ ai\ .\ x_{(i)})^{2}}{\sum_{i}^{n} = (xi - \ m)^{2}} \right)$$

Where $x_{(i)}$ is the number that occupies the i-th position in the sample (with the sample ordered from smallest to largest), m is the sample mean, and ai corresponds to the mean value of the covariance matrix calculated with the mean values of each variable in ascending order.

RESULTS

A general reading of the descriptive data from 20 countries shows that on average the presence of cases is more variable (30.4) than the number of samples (7.6) in the total set that show this cultural practice. Table 2 and Figures 1 and 2 shows the data by country.

Table 2. Data used in this research

Country	Samples	Cases	Possible more	Samples %	Cases %
Mexico	156	611		0.51	0.61
Belize	15	117		0.05	0.12
Guatemala	20	111		0.07	0.11
Honduras	8	10		0.03	0.01
Costa Rica	1	25		0.00	0.02
Cuba	1	7		0.00	0.01
Rep. Dominicana	1	1		0.00	0.00
El Salvador	2	4		0.01	0.00
Panama	2	2	x	0.01	0.00
Mesoamerica undefined	37	39		0.12	0.04
Argentina	7	9		0.02	0.01
Colombia	5	5	x	0.02	0.00
Brasil	7	22	x	0.02	0.02
Guayana Inglesa	7	8	x	0.02	0.01
Guayana Francesa	2	2	x	0.01	0.00
Venezuela	8	8	x	0.03	0.01
Ecuador	14	16	x	0.05	0.02
Peru	4	4	x	0.01	0.00
Paraguay	1	1		0.00	0.00
Bolivia	5	6	x	0.02	0.01
Total	303	1008			

Samples: count of referenced samples or collections. Cases: count of individuals with dental decoration
Source: by the authors

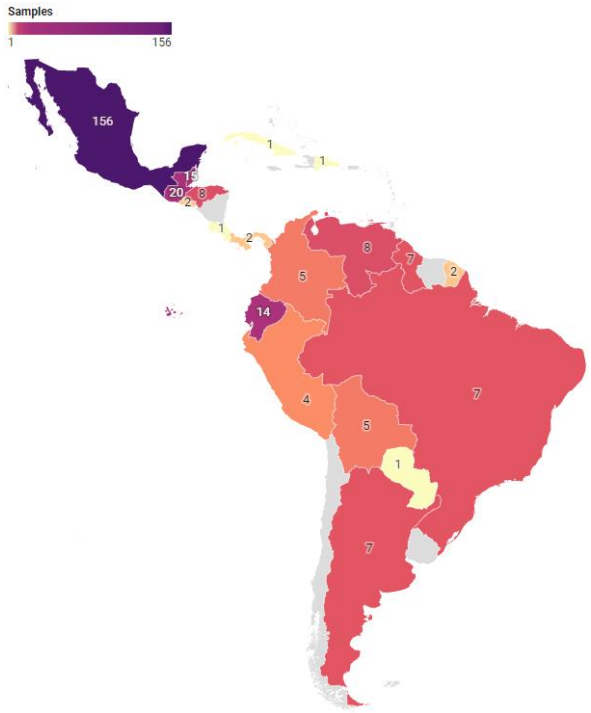

Figure 1. Distribution of Samples in Latin America with Dental Decoration reports

Source: by the authors

Figure 2. Distribution of Cases in Latin America with Dental Decoration

Source: by the authors

The descriptive values (Standard Deviation, Variance, Range) indicate that in this context, the cases are more variable (136, 18520, 610) than the samples (34.3, 1173, 155) in the set of countries. The CI values for both cases indicate that the distribution of cases and samples in the set of countries obeys an X2 distribution with very few degrees of freedom, very similar to a Rayleigh or Pareto distribution (Figures 3 and 4). This can be interpreted as a very wide variation of the data set, where there are atypical nodes that strongly attract the shape parameter, causing an extreme tail. The probability of the appearance of new samples or cases would be slightly affected. Most of the values are concentrated very close to their means and this causes excessive high-peak or extreme leptokurtic Kurtosis (cases: 14.3, samples: 14.1). In the same way, a positive asymmetry is presented in both cases (4.07, 4.05). This indicates that there is a concentration of numerous cases and samples with respect to the set of countries and that a small change in the means of the sets analyzed (for example, the inclusion of new findings in the future) can generate a significant change in the central tendency but not in the shape of the curve. Means and their descriptive derivatives look very weak in this schema and can vary considerably if the data set is updated. When we combine both sets of data, we see a similar distribution. Figures 3 and 4 shows this distribution.

Table 3. Descriptive analysis in this research

	Cases	Samples
N	20	20
Missing	0	0
Mean	50.4	15.2
Std. error mean	30.4	7.66
95% CI mean lower bound	-13.3	-0.881
95% CI mean upper bound	114	31.2
Median	8.00	6.00
Sum	1008	303
Standard deviation	136	34.3
Variance	18520	1173
Range	610	155
Minimum	1	1
Maximum	611	156
Skewness	4.07	4.05
Std. error skewness	0.512	0.512
Kurtosis	17.3	17.1
Std. error kurtosis	0.992	0.992
Shapiro-Wilk W	0.387	0.418
Shapiro-Wilk p	< .001	< .001
25th percentile	4.00	2.00
50th percentile	8.00	6.00
75th percentile	22.8	9.50

Samples: count of referenced samples or collections, Cases: count of individuals with dental decoration, N: number of countries considered in analysis. Note. The CI of the mean assumes sample means follow a t-distribution with N - 1 degrees of freedom
Source: by the authors

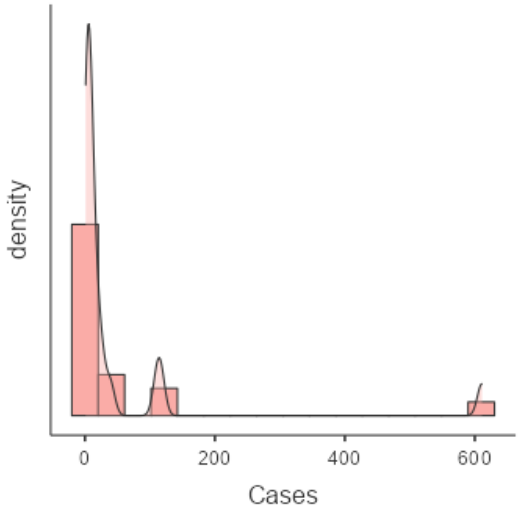

Figure 3. Histogram and density curve for 1008 cases with dental decoration in Latin America

Source: by the authors

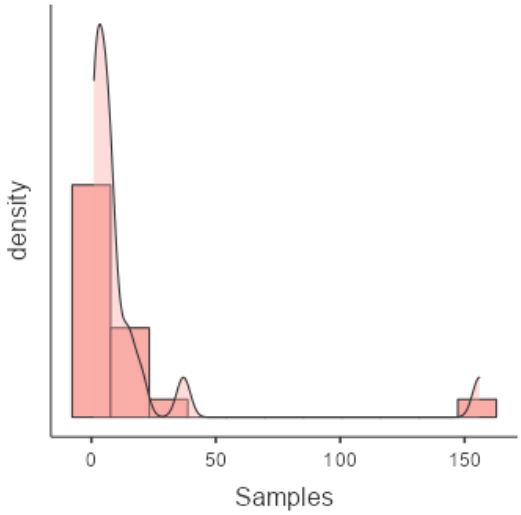

Figure 4. Histogram and density curve for 303 samples with dental decoration in Latin America

Source: by the authors

All of the above added to the high correlation (0.974) and the Shapiro-Wilks test (cases: 0.387, samples: 0.418) indicate that in both data sets, these are non-normalized data distributions. In this analysis, the samples with the highest proportion provided in the analysis (Mexico, Cases = 61%, Samples = 51%), are presented as atypical and at the far right of the tail. This makes it possible to predict that the appearance of new samples, new countries or already existing countries would affect the values of central tendency and its derivatives, but not this scheme since the general curve of the analysis would preserve the peak and asymmetry (Figure 5). The strength of Mexico, Guatemala and Belize in this analysis is translated into the importance of the findings at the level of continental archaeology. It can also be used as a comparative model with other countries, and it stores a sufficient data set to support non-parametric theoretical models. A surface graph built with a matrix of functions of values X^2 on the equation N/n, shows that the relationship between both types of distributions is still maintained when the z axis is exposed as a function of the samples and cases in each country (Figure 6).

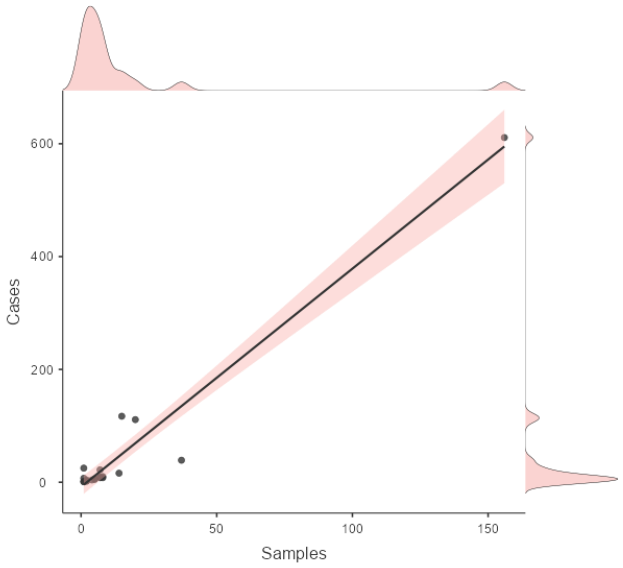

Figure 5. Scatterplot with standard errors, density curves and regression line between cases and samples with dental decoration in Latin America

Source: by the authors

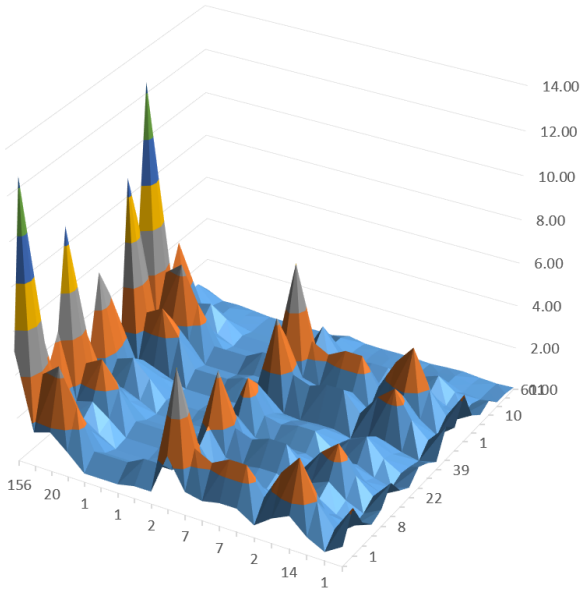

Figure 6. Surface graph of function X2 of distribution of countries with dental decoration in Latin America

Source: by the authors

DISCUSSION

In some cases, the variable "Site" includes the place of the find and its name also refers to the archaeological culture, especially in South America. In the same way it happens with the variable "Period" in some cases. This ambiguity was not possible to solve since some references combine the archaeological culture with the period, making it impossible to obtain a third defined category. This is a first impediment to compare cases between Mesoamerica and South America in a more detailed way.

There are some theoretical models that help us to classify the observations of this cultural practice in the different samples and understand their distributions in space and time. Alt and Pichler2 proposes a theoretical scheme that serves to differentiate this cultural practice from other normal functional and masticatory elements that can lead the researcher to make errors in the appreciation and registration of dental materials. Although we consider that it is the broadest and most detailed proposal of all, it is the least applied in our continent. Some difficulties in its application are the requirement of some laboratory equipment and the need for knowledge in dentistry. The category "Occupational / Traumatic" as part of the accidental modifications may also be the subject of debate. In numerous archaeological cases, evidence in this category can be interpreted as intentional. Directly in physical anthropology reports, or in subsequent publications, there are few cases where dental analyzes provide data on some of these categories associated with the precise identification of the practice of dental mutilation.

It is concluded that it is necessary to integrate and consolidation of the DB in this research will allow some ways of research to be carried out soon: 1. Discover and strengthen continental relationships between the practice of dental mutilation and spatial, chronologic, geographic, demographic, and cultural aspects; 2. Test theoretical assumptions previous studies on the importance and symbolic, social and archaeological representation of this practice; 3. Explore new types of association and distribution of relationships that allow the generation of theoretical models applicable to future findings; 4. Find indicators of regional and continental importance of materials, techniques and designs associated with this cultural practice, and 5. Relate distributions to processes of contact and diffusion of pre-Hispanic cultural practices in the Americas. At the moment, with the available material, it is possible to conclude two research hypothesis: 1) The cultural practice of dental decoration has a center or origin in Central America 28 that radiates gradually and slowly to other places, albeit to a lesser extent, and 2) The diversity and low proportion found in South America indicate that this practice is influenced by techniques and materials different from those in Central America, but still preserving a similar social and cultural value. We also believe that it is a compelling means of research to generate pedagogy in the application and advancement of non-parametric models in archeology and family sciences, especially in the Northern Region of South America[24,25,26,27].

The database used in this study is available by contacting the main author. The distribution maps presented here may vary with time and the inclusion of new finds. You can visit these maps at the following link: Samples (https://bit.ly/SamplesDentalMutilation), Cases (https://bit.ly/CasesDentalMutilation)

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CONFLICT OF INTEREST

The authors state that they have no conflict of interest.

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