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A New Method for Determining Age at Death in Human Skulls

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Abstract

A method is presented for estimating an individual's age at death based on the degree of cranial suture obliteration. It was developed based on an updated and representative sample of 36 human skulls from individuals of both sexes whose age at death was known, as they were extracted from public cemeteries for study purposes. The method is based on obtaining an X score, which is made up of the sum of the scores obtained from the analysis of the degree of obliteration for each of the cranial sutures in 6 phases, from 0 to 5. Through the statistical analysis of the relationships of the scores obtained for each skull and their respective ages, a linear regression formula was developed that allows certain values of the X score to predict the Y values, that is, certain X scores correspond to certain ages of Y, with confidence intervals of more than 80% for the purified data. In this way, the method allows the age at the time of death of individuals to be estimated quickly and easily, using algebraic operations, through the study of their skull using a linear regression formula. This is very useful for application in archaeological and forensic cases, either alone or in combination with other indicators of age at the time of death in human skeletal remains.

Keywords: Age at Death, Skulls, Forensic Anthropology, Montevideo, Uruguay

Introduction

The work presented here is a new method based on the study of the degree of obliteration of ectocranial sutures. The order of obliteration of the different cranial sutures, as well as the timing of their occurrence, has been the subject of numerous studies related to determining the age at death of an individual.

The first well-documented studies date back to the second half of the 19th century, by [1,2]. At the beginning of the 20th century, these studies were revived, with the excellent standing out [3]. In the 1950s, the order of cranial suture obliteration and the timing of its occurrence were widely discussed as valid criteria for estimating the age of human skeletal [4-6]. Recently, new work has rehabilitated the study of the degree of synostosis of the cranial sutures as a valid criterion for estimating an individual's age at death [7,8].

Materials and Methods

The available data come from a sample of 36 human skulls (25 male and 11 female) from individuals whose age at death was known, from the cemeteries of El Norte (20) and El Cerro (16).

The ectocranial sutures were studied for practical forensic reasons, as they are obviously the easiest to observe and are considered a better indicator of an individual's age than the endocranial sutures [8]. Racial and sexual differences among the individuals in the control sample were not taken into account, as these biological categories do not influence the obliteration process [9].

Observing the external surface of the cranial bones (ectocranial), the sutures were studied: sagittal, divided into four sectors; right coronal, divided into three sectors; left coronal, divided into three sectors; right lambdoid, divided into three sectors; and left lambdoid, divided into three sectors; right squamosal, divided into one sector; left squamosal, divided into one sector; and basal, divided into one sector, totaling 19 sectors. Each sector is analyzed on a numerical scale from 0 to 5 [10].

The values obtained for all sectors are added together, creating a score ranging from a minimum of 0 (19 x 0) to a maximum of 95 (19 x 5) (Table 2). Based on this score, which we will call X, the age of the individual, which we will call Y, is estimated, taking into account that:

• The method is of real interest when applied to the skulls of adult individuals, since other methods exist for estimating age at death in the remains of sub-adult individuals that provide a more satisfactory solution to the problem.

• Except in pathological cases, the greater age of the individual and a greater degree of suturing correspond; this is equivalent to saying that Y should correspond to an increasing function of X.

Statistical Model and Methodology

The model proposed was a linear regression, i.e.:

Yik = aXi + b + ei,k

The predicted ages were calculated for the scores within the studied range. Confidence intervals for these predictions were then established for different confidence levels (Arnold, 1981). This tells us that with a confidence level of p%, the edThe age at death of a skull with score X is greater than or equal to m(X) and less than M(X). Higher p values increase the range of M(X)-m(X).

Conclusions

This study allows us to conclude that there is a highly linear relationship between the score (X) and the individual's age at death (Y). Thus, the age at death of an individual with score X can be predicted according to the regression formula:

Y = 0.950468X – 2.63467

The predictions and confidence intervals corresponding to an 80% confidence level for scores X between 25 and 95 can be seen in Table 3.

Although the method itself is new, the study of the degree of synostosis of the ectocranial sutures to determine an individual's age at death is not. The biological categories of race and sex were not taken into account in this study, since they are considered not to influence the obliteration process. It is applied to adult individuals, since other methods exist for sub-adults that provide a more satisfactory solution to the problem. The main cranial sutures are divided into sections, facilitating the application of the method in forensic practice. This division is arbitrary and is justified only for pragmatic purposes. A broader grading scale is used than in other similar methods (0-5), with six phases. This allows the technician greater flexibility when faced with a specific case study, also making its application simpler. The degrees of synostosis and age are directly proportional. After obtaining the score, this method allows age to be estimated by simply applying a linear regression formula. In the final result, although the data are expressed in relation to a refined sample, the same statistical analysis was performed on the original sample for different confidence levels, with no substantial differences observed in the results obtained. In short, it is a more agile method, with an 80% confidence level, simple for forensic application, and with smaller age ranges than similar methods used to date to estimate age at death, based on the degree of cranial suture obliteration.

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