H76   Comparison of the Use of Lamendin Variables and Aspartic Acid Racemization to Estimate the Age-at-Death

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After attending this presentation, attendees will gain a better understanding of the potential application of aspartic acid racemization to the estimation of age-at-death from teeth in comparison to the use of Lamendin variables.

This presentation will impact the forensic science community by providing the first comparison between the two techniques and illustrating their accuracy of age-at-death estimates in two Spanish populations.

One of the challenges in forensic investigation is to estimate the age-at-death of an individual. This is a fundamental parameter in mass disasters where the skeletons are often incomplete, which makes the correct identification of the victims difficult. Teeth may be preserved long after all other tissues have disappeared and are often used to estimate characteristics like age-at-death.

There are several approaches to age estimation based on dental development. In forensic anthropology, the Lamendin technique and its variants are non-invasive methods for estimation of age-at-death. However, the method can only be used in single-rooted teeth. New methodologies for age estimation are based on the natural process of aging, which causes alterations of tissues and organs on different biochemical levels. The racemization of aspartic acid is one of these alterations. Although it is not exempt of disadvantages, such as the destruction of the sample teeth, its accuracy in the forensic age estimation has been demonstrated.

The aim of this research is to compare the use of Lamendin variables and aspartic acid racemization for the estimation of age-at-death and assess the reliability of these methodologies in two Spanish populations. Thirty-five healthy erupted third molars from Asturias, NW Spain, and thirty-five healthy erupted third molars from Cataluña, NE Spain, were collected from dental clinics. The Smithsonian Institution´s ethical committee approved all procedures related to experimentation with human subjects. Root height, periodontosis height, and root transparency were measured three times in each molar using a digital sliding caliper. The average of these three measurements was evaluated in relation to the age. In both populations, periodontosis height, and root transparency showed a positive and significant correlation with the age, stronger in the Cataluña population. Since there is not a formula to estimate the age-at-death in multiradicular teeth, multivariate regression equations were generated for both populations based on these three parameters. Although both regressions produced highly significant F values ($p<0.01$), the r value was higher in the Cataluña population (0.86) than the Asturias population (0.78).

After taking these measurements, the teeth were cleaned and enamel and cementum were removed. The dentin was isolated, mechanically ground, and divided in aliquots of 200mg each. The dentin from five Cataluña third molars and from ten Asturias third molars was subjected to chemical derivatization to analyze the aspartic acid racemization ratios in Gas Chromatography/Mass Spectrometry (GC/MS). Unexpectedly, the racemization ratios were highly different between the two populations; the Asturias population showed double the racemization ratio than the Cataluña population in each age range. Despite these differences, a linear regression formula was generated to compare with the Lamendin Spanish regressions. Both populations had highly significant F values ($p<0.01$); the r value was higher than observed with the Lamendin variables, 0.996 in the Cataluña population and 0.959 in the Asturias population. The aspartic acid racemization showed a better correlation with the age than the approach using the Lamendin variables.

The accuracy of the two techniques in age estimation was investigated using statistical analysis. For the Lamendin variable methodology, the Medium Error (ME) in the Asturias population was -2.30, Standard Deviation (SD) 7.37, and Error Standard (ES) 2.60. In contrast, using aspartic acid racemization the following values were determined: ME, 0.062; SD, 4.80; and ES, 1.70. Again, the results were better in the Cataluña population, using Lamendin variable methodology: ME, 1.41; SD, 3.49; and, ES, 1.56. However, the best accuracy was found with the aspartic acid: ME, 0.0014; SD, 0.94; and, ES, 0.42. These results are in agreement with previous studies in which the ES using aspartic acid racemization was also low.

These research results provide a comparison between anthropological and biochemical methodologies. Although the aspartic acid racemization seems to be the more accurate technique, it is not exempt of drawbacks, and thus the anthropological technique represents a viable option.

Age-at-Death, Lamendin Variables, Aspartic Acid Racemization