H20 Forensic Age-at-Death Estimation From the European American Male Sacrum: A New Component System

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The goal of this presentation is to demonstrate a new method for determining age-at-death from the human sacrum.

This presentation will impact the forensic community and/or humanity by introducing another researched skeletal region, increase the potential of age-at-death assessment, and demonstrate the utility of a new sequentially-coded component system, allowing for a greater understanding of the morphological gestalt than previous "summing" component systems.

The present contribution describes a newly developed sequentially coded component system for evaluating seven morphologies of the human sacrum in the production of statistically valid chronological age estimates.

Accurate age-at-death estimation from human skeletal attributes is critical for establishing a comprehensive and forensically significant biological profile of an unknown individual, which in turn facilitates the victim identification process. The introduction of novel techniques for reliable estimation of chronological age from previously unresearched skeletal areas represents a valuable contribution to the field for a number of important reasons: 1) it enhances the capability of assessing age in incomplete, fragmented, and/or commingled sets of human remains, especially in cases in which other diagnostic areas may be lost or taphonomically altered; and 2) by increasing the number of skeletal areas studied in the unknown individual, new age estimation techniques often serve to narrow the confidence intervals of the final age assessment. This is particularly valuable when new techniques provide accurate age estimates for later adult stages, as degenerative processes show a much higher population variability in comparison to the developmental processes, typically resulting in wider confidence intervals.

The primary aim of this study was to determine whether morphological changes observed in the auricular surface of the sacrum and associated structures (seemingly mirroring the degenerative aging processes observed in the conjoining structure of the ilium), could be statistically correlated with chronological age. The sacrum is particularly useful for age estimation in that a number of clearly defined developmental changes (such as fusion of the first sacral vertebral body epiphysis) continue well into adult life of the individual. Therefore, evaluations of morphological changes documenting both degenerative and developmental stages might be combined to produce a new, more precise analytical technique for estimating age at death from the sacrum.

The first phase of the present study consisted of the analysis of a sample of 109 sacra of European American males from the early 20th century Hamann-Todd Collection (Cleveland Museum of Natural History, Cleveland, Ohio), to assess age-trait correlations and develop the morphological stages and confidence intervals associated with the new method. Seven developmental and degenerative non-metric traits of the sacrum were studied including: fusion of sacral body elements 1 and 2, fusion of sacral body elements 2 and 3, degree of auricular apical lipping, state of auricular surface epiphyseal fusion, first sacral vertebral body epiphyseal union, auricular surface microporosity, and auricular surface macroporosity.

Originally, each morphological character was scored according to multiple trait variants (3-5 character states), similar to those employed in age determination from the ilium. However, the initial results demonstrated that in most cases the intermediate trait stages did not significantly contribute to the accuracy or precision of the age estimates, when compared to those obtained by coding most traits as binomial variables (i.e., on a presence-absence basis). This significantly simplifies the scoring system and serves to reduce inter-observer error.

The results of the initial phase of the study suggested that by including both developmental and degenerative features in the analysis, the seven traits could be sequentially arranged to reflect the differential timing of significant aging events (i.e., clearly defined age-correlated morphological changes). Consequently, a sequential coding component system was developed in which coding scores for each of seven traits were arranged to produce a seven-digit score. The order of appearance of each trait within the seven-digit score was calculated to maximize the Spearman's rank correlation coefficient of the code with age. Rank order statistics were selected to obtain a coding system in which a higher score in the seven-digit code corresponds more frequently to an older individual. Each unique seven-digit component score was then translated into a verbal and graphic description of the combination of morphological traits (morphological stage) and associated with an appropriate statistically validated chronological age interval

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(68 and 95% probabilities).

The new analytical method was tested on an independent sample of modern sacra from the William M. Bass Donated Collection (n=150), housed at the University of Tennessee, Knoxville. The method proved to be forensically accurate when tested on this independent sample.

This research indicates that the sacrum can be used to reliably estimate age-at-death in European American male individuals.

Age-at-Death Estimation, Sacrum, Forensic Anthropology

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