



A160 Age-At-Death Estimation Using Dental Cementum Increments: Validation and Limitations

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Learning Overview: After attending this presentation, attendees will understand the potential benefits, limitations, and possible pitfalls of dental cementum annulations when analyzed for age-at-death estimation.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by increasing knowledge of: (1) the potential applications of cementochronology to forensic investigations; (2) specific limitations of this method; and (3) recommendations for critically evaluating and implementing cementum analysis for forensic use.

Age-at-death estimation using dental cementum relies on the attractive principle of yearly deposits that would provide a direct access to chronological age. Dental cementum increments analysis has become a routine method for terrestrial mammalian species, but despite recurrent statements regarding its superior performance in humans, cementochronology remains an under-used method for assessing age-at-death. Demanding histological procedure is surely not the sole reason for disregarding this technique. Protocol discrepancies and inconsistent results lead forensic anthropologists to remain oriented toward classic techniques, more standardized and defined. Yet, frequently used procedures have long been known to yield inaccurate, imprecise, and biased (especially among the elderly) age estimates.¹ Cementochronology is being proposed to broaden the range of methods available; however, any method applied to forensic casework must be proven valid, reproducible, and limitations need to be acknowledged. This work aims to provide a standardized framework to define the method's performance and limits. Compounding the concerns over the precision and accuracy of estimation is the question of applicability of such a method to dental material with different preservation conditions. An additional objective is to evaluate the impact of taphonomical alterations.

The study sample consists of 200 canines from individuals of known age, sex, postmortem, and inhumation intervals from anatomical and anthropological collections, and of 200 canines from archaeological assemblages. Teeth were prepared and analyzed in a standardized procedure to prevent bias. All cross-sections have been assigned an index corresponding to microstructure readability, and the extent of cementum loss has been evaluated using two histological indexes: one exclusively considering microbial action and the other considering other types of physical and chemical alterations. Precision of age estimation was assessed by studying statistical dispersion of annuli counts and accuracy by examining the absolute and relative errors.

Results establish intra-observer consistency and demonstrate that dental cementum analysis achieves a reliable estimation of age at death. Results also demonstrate that cementochronology, like any other method, is characterized by significant limitations. While sex, postmortem, and inhumation intervals do not significantly influence effectiveness, a negative relationship between chronological age and annuli distinctness was observed, and multiple regression analyses demonstrate that these two parameters impact both precision and accuracy. The global accuracy is -4.5 years, but although accuracy for subjects under 60 years of age is excellent, absolute inaccuracy strongly increases for subjects over 60 years of age. This demonstrates that performance of cementochronology cannot be summarized into a single value and that this technique is a two-tier performance method. Furthermore, on subjects with a long Postmortem Interval (PMI), attention should be paid to taphonomy since it paradoxically either increases imprecision or artificially improves precision by limiting the number of usable cross-sections and reducing count dispersion.

To establish guidelines for forensic anthropologists to interpret estimates, threshold values were extracted from 95% confidence intervals. Values far above or below these ranges ought to trigger practitioner or reader doubt.

A user-friendly prediction table computed from regression models is proposed as a means of estimating age at death based on annuli count. This procedure, which represents a compromise between the strong accuracy among the young and the increasing inaccuracy among the elderly, broadens age ranges commonly published in cementochronology but maximizes the likelihood of making an accurate age-at-death estimation.

Reference(s):

- ¹ Cunha E., Baccino E., Martrille L., Ramsthaler F., Prieto J., Schuliar Y., et al. The problem of aging human remains and living individuals: A review. *Forensic Science International*. 2009;193(1-3):1-13.

Age-At-Death, Cementum, Taphonomy