F19 Cementochronology: Improvement of the "Tooth Cementum Annulations" Method for Age Estimation

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After attending this presentation, attendees will understand and appreciate how the Tooth Cementum Annulation (TCA) method can provide accurate results for individual age estimation, which is one of the most crucial biological variables obtained during an osteological examination of human remains.

This presentation will impact the forensic science community by demonstrating how the TCA method improves the field of age assessment through a distinct physiological phenomenon.

Growth markers can be found both in bones and teeth, the latter being the most reliable due to their hard and compact composition. Within tooth tissues, acellular cementum begins its regular growth with tooth eruption and then continues to be produced throughout as incremental layers of alternating dark and light bands of controversial origin. Cementochronology, or TCA, involves the counting of these incremental lines in tooth root acellular cementum using light and polarized microscopy.

Stott et al. (1982) were the first to precisely correlate the number of cementum annulations directly to calendar age in humans. Since then, many researchers published correlation rates above $r=0.9$ effectively making cementochronology the most precise technique for individual skeletal age estimation.

In this study, 250 recent teeth from known age individuals, collected at the Lille Dental Surgery Department, were used. Within this sample, 50 teeth were specially extracted because of periodontal disease and 50 were selected from individuals above 65 years of age. The study focused on two main issues in order to improve the TCA method:

1. Correlation between estimated age and calendar age, with a specific attention to the influence of periodontal health and advanced age.
2. Better understanding of the histologic structure of the observed light and dark layers, using Raman Spectrometry.

In the first part of the study, all teeth were embedded in a two-component epoxy resin and dried in a vacuum chamber. Six sequential 100mm – 130mm undecalcified cross sections were prepared for each tooth, from the middle third of the root, with a precision saw, in order to be properly observed under light and polarized microscopy. QSegments that showed readable lines were captured as JPEG images and read with appropriate software. Three observers were involved in each counting process.

In the second part of the study, five finely polished, thick cross sections (700mm), essential to optimal exploitation of Raman spectrometry, were prepared.

The results showed a statistically significant (Spearman Test) strong correlation ($r > 0.88$ for all observers) between estimated age and calendar age. Inter observer errors were minimal between the three observers (Pearson's $r > 0.9$) with the highest correlations obtained from the most experienced author. Also demonstrated was the influence of periodontal disease and old age, which both decrease the accuracy of the technique.

The Raman spectrometry observations yielded promising preliminary results that seem to indicate a difference of orientation of hydroxyapatite crystals and collagen fibers rather than a difference in organic or mineral composition between incremental layers.

Odontology, Age Estimation, Tooth Cementum Annulations

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