H65 Validation Dental Cementum Increment Analysis for Determining Season at Death

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After attending this presentation, attendees will understand the method of determining season at death using dental cementum increment analysis. Attendees will be able to explain how use of the method helped identify a cold case homicide victim.

This presentation will impact the forensic science community by providing criminalists, anthropologists, and odontologists with one more method to use in gathering evidence from unidentified human remains.

Dental cementum research was once exclusively the domain of zooarchaeologists who used the biology of cementum to determine the ages and seasons at death of mammals at archaeological sites.[1] Dental cementum forms the outermost layer of tooth roots and it binds to the periodontal ligament to hold teeth in their sockets. Cementum is not remodeled like bone, rather it is deposited and mineralized throughout adulthood. In humans, cementum is laid down in pairs of bands: one light or translucent band is laid down in the spring/summer and one dark band is laid down in the winter/fall. The layers of accumulated pairs of bands of cementum are used to determine age at death by adding the number of pairs of bands to the age at which the tooth erupts.

The applications and limitations for estimating age at death in humans using this method has been established previously; however, the use of dental cementum to estimate season of death was only recently evaluated.[2-6] Therefore, a pilot study was devised to test the applicability of using the color of the outermost band of cementum to determine season at death in humans by using 112 teeth donated by the patients of an oral surgeon.

Extracted teeth were embedded, sectioned, ground and polished, and examined under transmitted polarized light microscopy to great results: the color of the outermost cementum increment correlated with the season at death 99% of the time. Teeth extracted between October and April exhibited a dark outer band, thus, a fall/winter season. Teeth extracted between April and October exhibited a light outer band, therefore, a spring/summer season.

To confirm the results of the pilot study, 450 teeth were chosen at random from 1,300 teeth donated by patients of the Creighton University School of Dentistry. In addition to increasing the sample number, the geographic location from where the donated teeth originated differed, too. Creighton University is located in Nebraska, and Omaha has a very different climate than coastal Santa Cruz, California. Of particular curiosity was whether local weather differences would matter. Would the Nebraska teeth sort into the same broad seasons as had been identified in the Santa Cruz pilot study?

Analyses were performed in the blind, and it was not until the teeth had been embedded, sectioned, ground and polished, and data collection completed that the exact dates of extraction were made known to the investigators. Date of extraction was used as a proxy for date of death. Results of the study indicated that climate bore no effect on estimating season at death from dental cementum. The Nebraska sample sorted into the same two broad seasons as the Santa Cruz sample in 440 of the teeth, while 10 of the teeth yielded indeterminate results. Depicted in this paper are tables demonstrating the seasonal bands increasing in thickness from the beginning to the end of the season. Scatter plots form the basis of a discussion as to whether four seasons at death rather than just two are indicated.

Dental cementum increment analysis has now been used to determine season at death in a dozen forensic test cases in California. In one particular case, both age and season at death were determined for a 37-year-old cold case homicide. The remains of a young woman had been recovered in 1971 bearing evidence of sharp force trauma. Her remains went unidentified until 2008 when the remains were exhumed and reanalyzed for identification. Anthropological assessment indicated an age at death of 23 – 30 years based on medial clavicle and iliac crest epiphyseal fusion. Dental cementum increment analysis indicated an age at death of 23 – 25 years and a spring/summer season at death. The revised profile, along with a forensic facial reconstruction by Gloria Nusse, was posted to the Doe Network's web page, and a maternal relative came forward. The victim was 24 when she had gone missing in late August/early September.

References:

1. Lieberman DE. The biological basis for seasonal increments in dental cementum and their application to archaeological research. J Archaeol Sci 1994;21(4):525-39.
2. Wittwer-Backofen U, Gampe J, Vaupel JW. Tooth cementum annulation for age estimation: results from a large known age validation study. Am J Phys Anthropol 2004;123(2):119-29.
3. Grosskopf B, McGlynn G. Age diagnosis based on incremental lines in dental cementum: a critical reflection. Anthrop Anz 2011;68(3):2750-289.
4. Kagerer P, Grupe G. Age-at-death diagnosis and determination of the life history parameters by incremental lines in human dental cementum as an identiciation aid. Forensic Sci Int 2001;118:75-82.
5. Cipriano-Bechtle A, Grupe G, Schroter P. Ageing and life expectancy in the early Middle Ages. Homo 1986;46(3):267-79.

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6. Wedel VL. Determination of season at death using dental cementum increment analysis. *J Forensic Sci* 2007;52(6):1334-7.

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