H66 Does Cut Direction Affect Increment Viewing in Dental Cementum Increment Analysis for Age and Season at Death?

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The goal of this presentation is to compare two methodological preparations of dental cementum histological slides of the same specimen side by side to test whether cut direction affects cementum increment in determining season at death.

This presentation will impact the forensic science community by demonstrating how the validity of dental cementum incremental analysis on human teeth needs to be evaluated and expanded to answer which technique is most useful in determining season at death in humans. Of the same specimen, a transverse cut is found to yield readable seasonal information than its longitudinally cut counterpart.

Cementum is the tissue that binds the tooth to the periodontal ligament and is deposited throughout the course of life. Because cementum is variably mineralized, its fundamental structure of collagen fibrils yields a banded appearance to cross-sections of the outer edge of the tooth, analogous to tree rings. In mammals, one pair of cementum bands is laid down annually.[1-3] In the spring/summer, mammals lay down a translucent or clear band while in the fall/winter, they deposit an opaque or dark band. Counting the number of pairs of bands and adding that number to the age at which the tooth erupts yields an age at death estimate that is more accurate than age estimates achieved by most skeletal methods (e.g., epiphyseal union, sacroiliac joint surface appearance, rib end morphology, etc.).[4,5] Pilot work by Wedel demonstrated by observing the outermost increment, season at death could be determined with 99% accuracy.[6] She further demonstrated that the seasonal transition of the outermost cementum band in humans from translucent to opaque occurs in October and then transitions back to translucent in spring/summer, beginning in April.[6] All adult teeth that are erupted and in occlusion do exhibit increments.[6] Hsieh and colleagues demonstrated teeth of any type (cuspids, bicuspids, and molars) can be used in determining age or season at death without significant differences in the results.[7]

Hsieh et al.[7] focused on distinguishing the outermost increment in transverse thin sections of the middle third of the root by using transmitted polarized light microscopy; however, Stein reported a high accuracy (r=0.93) in age estimation using longitudinal cuts instead of transverse cuts.[7,8] Other recent researchers used longitudinal sections, while acknowledging a discrepancy in the sectioning method among cementum researchers.[5,9,10] Some authors prefer the section to be longitudinal, whereas a majority of authors prefer transverse cross sections. Unfortunately, no author explicitly explains his or her preference for transverse versus longitudinal sectioning. Further, none of the researchers compare these two techniques side by side, sectioning one tooth both transversely and longitudinally to see if the results differ.

Therefore, it becomes necessary to test the accuracy of determining season at death based on the color of the outermost cementum band using both transverse and longitudinal cuts from the same specimen in a fairly large sample of teeth of known season at death (or season at extraction, which is the proxy for season at death). It is hypothesized that transverse cuts yield more accurate and reliable results than longitudinal sections. This hypothesis will be rejected in either of two circumstances: (1) there is no statistical difference between the longitudinal versus transverse section results; or, (2) if either the season at death from each tooth does not match the season from when it was actually collected from the patient. In other words, the research will only be considered helpful if a fall/winter band is recorded from a tooth collected in the fall/winter.

Fifty-five transversely-sectioned single-rooted teeth were randomly selected and then sectioned longitudinally. Season at death was accurately determined in all of the transversely sectioned teeth, whereas season at death was only correctly determined in 56% of the longitudinally sectioned cases. Further, the sample of 55 longitudinal cuts contained six indeterminate samples (~10% of cases) in which the outermost increment could not be observed at all.

Of these 55 transversely and longitudinally cut teeth, the transverse cuts yielded a higher number of correctly classified samples and fewer indeterminate samples than the longitudinal sections. The longitudinal cuts yielded a significantly higher number of indeterminate samples and, thus, fewer samples were correctly identified as to season at death. Qualitatively, the transverse cuts were easier to read than the longitudinal cuts. In other words, a transverse cut is more likely to yield readable seasonal information than a longitudinal cut from the same specimen. Therefore, a transverse cut is preferred for its better preservation of information and a better chance to result in a valid sample for the use of anthropologists.

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