

G4 Cementum Annuli: Technique, Microscopy, and Age Estimation

Michael Clay, DMD, Foley, AL 36535; James M. Lewis, DMD, Madison, AL 35758; Paula Brumit, DDS, Nocona, TX 76255; Murray K. Marks, PhD, University of Tennessee, Knoxville, TN 37920*

Learning Overview: The goals of this presentation are: (1) to make attendees aware of the importance of tooth cementum annuli; (2) to increase knowledge of the procedure of analysis for Trichloroacetic Acid (TCA); and (3) to demonstrate the significant correlation between the annuli count, predicted age, and actual chronologic age.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by helping attendees understand the value of age estimation using histology of cementum annuli enumeration on select root regions.

Mineralized dental tissues possess superb postmortem longevity. While cementum annuli enumeration studies of modern and zooarchaeological wild deer, bear, and wolf are well documented as an accurate age indicator, application to human teeth has been histologically and methodologically far less successful. Recent research indicates that cementum annuli may be a more reliable age indicator than other parts of the skeleton.

This study describes the thin section procedure and enumeration of cementum on all tooth types and root locations using dissecting, light, and Scanning Electron Microscopy (SEM). Deciduous and permanent teeth ($n=108$) extracted from general dental and oral surgical practices because of periodontal disease and orthodontic and prosthetic reasons were used with known age, sex, and ancestry. Teeth were epoxy embedded, thin sectioned (whole tooth - labiolingual and root - transverse and mesio-distal), ground, polished, and etched or stained. Select intra- and inter-root locations (i.e., cervical, mid-root, apical and inter-radicular) were examined. The dissecting microscope at 5X–10X assessed cementum quality, thickness, and dentin coverage. At higher magnification (100X–200X), the SEM documented the structural reality of annuli and the Cementodentinal Junction (CDJ). The light microscope at 25X–50X allowed annuli counting for age estimation. A second sample was prepared using black bear, red fox, and macaque teeth, and a third sample was prepared using historic teeth. The second and third samples were exposed to “real” seasonal temperature fluctuations.

Light microscopy of the mid-root area, regardless of the molar’s mesial or distal root or tooth type, revealed the most easily visualized annuli for quantification. The cervical region is damaged or thinned many times from periodontal events and the thickened, cellular apical region reveals a more “confusing” and unassignable array of annuli. Countable annuli are present in human teeth. Images of the annuli in the form of dark and transparent bands were counted using image analysis software to arrive at an age estimation. The average number of years post-eruption for each tooth was added to the annuli count, found as a portion of the countable, measurable bands against the total measured cementum thickness. Results helped estimate the best methods to count the cementum annuli while also showing a significant correlation between the annuli count, predicted age, and actual chronologic age of each individual. Further studies are required to determine environmental effects such as temperature on cementum annuli formation.

Cementum Annuli, Dental Age Estimation, Mineralized Tissue Histology