F36 Age Dating Dental Enamel With Bomb-Pulse Radiocarbon

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After attending this presentation, attendees will understand how biological samples produced in the past 50 years can be dated using the radiocarbon bomb-pulse. Specifically, they will learn how the 14C content of dental enamel can be used to determine year of birth of persons born after 1950.

This presentation will demonstrating how the analysis of dental enamel for radiocarbon (14C) is a new tool for narrowing the identification skeletal remains. The 14C content of dental enamel is an excellent chronometer of date of birth for people born since 1950. Persons born prior to 1940 do not have any bomb-pulse carbon in their enamel.

Background: Determining the age of an individual is an important step in identification and a common challenge in forensic medicine. Age determination can be performed with high precision up to adolescence by analysis of dentition, but establishing the age of adults has remained difficult. The enamel of individual permanent teeth is formed at distinct, wellcharacterized time points during childhood. After being laid down, there is no turnover of enamel, and the ^{14}C concentration reflects the level in the carbon sources at the time of enamel formation. Atmospheric testing of nuclear weapons doubled the global $^{14}CO_2$ level between 1950 and 1963. After adoption of the Partial Test Ban Treaty in 1963, the level of atmospheric $^{14}CO_2$ started to decrease exponentially with a mean life of about 16 years due to transport into large carbon reservoirs such as the oceans. The enhanced level of ^{14}C worked its way up the food chain from CO_2 so that all living things are labeled with the pulse.

Material and methods: We measured the concentration of ^{14}C in tooth enamel from individual teeth and related it to the known concentration in the atmosphere over time (1950 – present) to establish the time of tooth formation. The dates were then used to estimate the year of birth of the person. To this end, the crown of the tooth was cut away from the root at the level of the cervical line. The crown was then immersed in 10N NaOH, before being placed in a water-bath sonicator. The enamel was then washed with DDH_2O and re-submersed in 10N NaOH every 24 hrs for several days until only enamel remains. Samples were rinsed with DDH_2O and shipped overnight for isotope analysis. Upon arrival, enamel samples were pretreated in 0.25N HCl for 10 minutes, rinsed 3 times with DDH_2O and placed on a heating block at 95°C to dry overnight. Enamel splits were hydrolyzed to CO_2 in individual reaction chambers, evacuated, heated and acidified with orthophosphoric acid at 90°C. The evolved CO_2 was purified, trapped, and reduced to graphite in the presence of iron catalyst in individual reactors. Graphite targets were measured for ^{14}C content by accelerator mass spectrometry (AMS).

Results: The technique matched ^{14}C content in enamel to known age to 1.6 ± 1.3 years in individual measurements. Much of the variability can be attributed to inter-individual differences in tooth formation and possible variations in carbon food sources at the time of enamel formation. Enamel formed prior to 1950 contains no ^{14}C elevation above atmosphere at the time. Analyzing multiple teeth with different formation ages (*e.g.*, incisor and molar) from a single individual can place date of birth on the ascending or descending side of the anthropogenic ^{14}C spike and improve the temporal precision.

Conclusion: AMS analysis of teeth offers a precise age determination that can be applied in forensic casework, particularly to assist in investigations of unidentified human cadavers.

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