A64 What Level of Biogeographical Information Is Available From ^{18}O and ^{13}C Signatures in Late-Erupting Molars of Modern Humans?

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After attending this presentation, attendees will better understand the forensic application of stable isotope analysis as it pertains to determinations of human provenance and the potential interpretive difficulties associated with analyses of enamel carbonate isotopic data.

This presentation will impact the forensic science community by illustrating the complexities associated with inferring geographic origins from isotopic data obtained from living individuals with self-reported dietary preference and residential history.

The goal of this presentation is to examine intra- and inter-tooth isotopic variability in the abundance of ^{18}O and ^{13}C in third molar enamel carbonate from individuals with self-reported dietary preferences and residential history and to explore this variability as an indicator of intra-individual variability.

Stable isotope analysis of biogenic tissues such as tooth enamel and bone mineral has become a well□recognized and increasingly important method for determining the provenance of human remains. Both ^{18}O and ^{2}H stable isotope signatures are well-established proxies as environmental indicators of climate (temperature) and source water and are therefore considered reliable indicators of geographic life trajectories of animals and humans.[1,2] Similarly, ^{13}C and ^{15}N abundance data have distinguished dietary preferences in ancient human populations, and have been used to qualify $_{2}H$ and ^{18}O geolocational data that may be consistent with more than one location.[3]

Third molar tooth enamel was sampled from ten living volunteers undergoing routine tooth extractions at Canadian dental clinics. Patients provided detailed residential history and answered questions pertaining to dietary preferences (e.g., vegetarian) prior to donating all four third molars. Enamel was drilled from the crown of two third molars from each subject, chemically cleaned, and subjected to an acid digest before being analyzed for their ^{18}O and ^{13}C composition using Isotope Ratio Mass Spectrometry (IRMS).

The pooled mean enamel carbonate $\delta^{13}C_{VPDB}$ value for all samples was suggestive of a persistent C_4 plant dietary influence at the time the sampled tooth enamel was forming. This is consistent with self-reported dietary intake information and residential history and with what is known about the typical North American diet.[4-6]

The pooled mean $\delta\,^{18}O_{VSMOW}$ value for enamel carbonate from all samples was 24.39 ‰. Although subject variation was significant, neither diet nor sex significantly influenced the oxygen isotope data. Following conversion of $\delta\,^{18}O_{Carbonate}$ values to $\delta\,^{18}O_{Phosphate}$ values, drinking water $\delta\,^{18}O$ values were calculated and compared to their corresponding regional estimated annual average $\delta\,^{18}O$ values in precipitation retrieved from the Online Isotopes in Precipitation Calculator (OIPC).[7-9] No statistically significant correlations were evident between drinking water $\delta\,^{18}O$ values and $\delta\,^{18}O_{OIPC}$ values.

The overall lack of strong linear relationships between calculated drinking water $\delta\,^{18}O$ values and precipitation $\delta\,^{18}O$ values in this particular dataset illustrates the importance of considering site-specific isotopic complexities and using multi-isotope data obtained from multiple tissues when investigating the geographic origins of humans in an archaeological or forensic context. It is not possible to quantify intra-individual isotopic variability without sampling from larger populations and controlling for as many variables as possible. The construction of a database containing isotopic data obtained from a variety of environmental, human, and faunal tissue samples, and the application of such data to individual cases in which geographic origins are desired, is recommended.

While standardization of analytical methodology is critical to appropriate interpretations of the data, stable isotope profiling is not a stand-alone method and should be used in conjunction with other lines of evidence in determinations of human provenance.

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