G17   Age and Sex Estimation of Ajnala Skeletal Remains From Trace Elemental and Radiographic Analysis of Molar Teeth: A Comparative Forensic Odontological Study

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Learning Overview: The goal of this presentation is to estimate sex and age of the unknown human skeletal remains excavated from an abandoned well by using the customized regression and discriminant function formulas developed from elemental composition of molars and radiographic Pulp-Tooth area Ratio (PTR) of canines of known teeth. A comparative significance of elemental and radiographic methods for sex and age estimation to add to the existing forensic anthropological literature will also be presented.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an alternate combined approach for objective and reliable age estimation from dental remains, in addition to existing dental, anthropological, and biochemical methods. Both the techniques are relatively cheaper and faster, delivering comparatively reliable results with higher accuracy rates.

Teeth generally serve as repository of valuable biological information about an individual, and they can reveal information about biological identity, residential mobility patterns, dietary habits, growth and development, exposure to disease and pollutants, social and geographical status of an individual or population groups, etc.[1,2] Trace elements usually get deposited in human hard tissues upon their prolonged consumption in dietary intakes, which, in turn, can decode lifetime events and activities of an individual to facilitate their identification. The elemental composition of human teeth has been widely studied from medical, public health, and dietetics perspectives, but has rarely been explored for forensic anthropological purposes. The requirements and preferences of food items vary with sex, age, disease, health, and geographical status of an individual. The amount of trace elements deposited in the human hard tissues can be used as a reliable indicator of their biological identity.[3,4]

The goal of the present investigation is to characterize the elemental profile of contemporary human teeth from some northwest Indian states and apply the discriminant functions and regression equations developed from known teeth samples to the elemental profile of unknown ancient teeth excavated from an abandoned well situated underneath a religious structure at Ajnala, Amritsar, India. Thousands of unknown human skeletal remains (along with some contextual items) were excavated non-scientifically by amateur archaeologists from the well in early 2014, after obtaining clues from some written records in the form of a book.[5,6] The identity of these remains posed a serious challenge for the investigators because of their badly damaged and seriously commingled nature. Hence, multitudes of anthropological, biochemical, radiological, and molecular techniques were used with the remains to arrive at their valid objective identifications. The main objective of the present study was to reconstruct the probable biological age of the remains from elemental and radiographic analysis of known molars collected from contemporary individuals and applying the developed customized logistic regression and discriminant formulas. Four hundred eighty human molar teeth (230 contemporary and 250 ancient teeth) were used for their elemental composition using a Wavelength Dispersive X-Ray Fluorescence (WD-XRF) analyzer and 703 canines were used for radiographic Pulp-Tooth area Ratio (PTR) estimation from their apical images using Gimp software. PTR was calculated by dividing the ratio of tooth pulp chamber by its outer surface area marked using apical radiographic images of the tooth. Sex prediction was performed using tooth measurements and customized logistic regression formulas for nearly every maxilla/mandible sample. Age estimates of the remains ranged between approximately 20–50 years using both the elemental and radiographical methods. These results corroborated other methods of age estimation, including skeletal anthropological techniques and biochemical analysis. Sex assessment from odontometrics and PTR showed that approximately 90% of the samples were categorized as males.[7] This potentially endorsed the written record theory that these remains do indeed belong to the 1857 conflict.[8]

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Forensic Anthropology, Age Estimation, WD-XRF and Pulp-Tooth Area Ratio