H71 Validation of X-Ray Fluorescence (XRF) to Determine Osseous or Dental Origin of Unknown Material

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After attending this presentation, attendees will understand the results of a study conducted to validate the use of x-ray fluorescence (XRF) in determining whether unknown material is osseous (bone) or dental (tooth) in origin or some other type of material (such as mineral, plastic, wood, etc.).

This presentation will impact the forensic science community by supplying an additional analytical tool for forensic anthropologists or other experts to quickly and effectively assess the potential skeletal origin of unknown material.

Forensic anthropological examinations typically involve the analysis of human skeletal remains, but it is sometimes necessary to first determine whether the material in question is even osseous or dental in origin (i.e., whether it is, in fact, part of a skeleton). This is especially relevant in cases where the material may be submitted for DNA analysis. Tissue identification can usually be achieved through visual macroscopic and/or microscopic (and in some cases radiographic) examination by a trained anthropologist when specimens are sufficiently large and in good condition. Occasionally, however, specimens are very small and/or taphonomically compromised, making this determination difficult. X-ray fluorescence spectrometry (XRF) is a technique that reveals the elemental composition of materials and is hypothesized to have utility in these analyses. Validation of the XRF technique for identifying osseous or dental tissue would impact the forensic community by supplying an additional analytical tool for forensic

anthropologists or other experts to quickly and effectively assess the potential skeletal origin of unknown material.

In this study, XRF analysis was conducted on a variety of tissues of known osseous and dental origin in good condition including human bones, human teeth, non-human bones, non-human teeth, and ivory. In addition, other biological hard tissues such were analyzed as horn, beak, coral, and shell, as well as other materials that may appear similar to osseous or dental tissue when in small fragments or altered states such as wood, minerals, plastic, metal, and glass. XRF was also conducted on these same tissues and materials in thermally, chemically, and taphonomically altered states. These states included various degrees of burning (e.g., charred, calcined), weathering (e.g., bleached, exfoliated), antiquity (up to 9,000 years old), and exposure to several destructive chemicals.

Analysis of the human and non-human osseous and dental tissues in good, burned and weathered conditions revealed characteristic levels of calcium and phosphorous. Osseous and dental tissue samples also commonly (though not always) contained trace levels of strontium. Significantly compromised osseous and dental tissue, such as ancient samples, showed very low or virtually absent phosphorous levels, as did the coral and shell samples. Horn, plastic, wood, metal, and other materials in either good or compromised conditions did not contain these characteristic levels of calcium, phosphorous or strontium. Because there was no sample preparation involved in the analysis, many specimens contained low levels of various other elements due to surface contamination. These levels did not substantially affect the results.

Materials were accurately identified as osseous or dental in origin based on the calcium and phosphorous levels identified by XRF using the analytical parameters of this study, with no other material showing profiles that might be mistaken for osseous or dental tissue. In other words, preliminary results suggest that osseous and dental tissue in altered states may be misclassified as some other material (due to its similarity to materials like shell and coral), but non-bone or non-tooth materials are unlikely to be misclassified as osseous or dental tissue. It is concluded that XRF analysis is a valid and effective means of determining osseous or dental origin of unknown material.

Forensic Anthropology, X-Ray Fluorescence, Elemental Composition

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