H82 Validity of Portable X-Ray Fluorescence in Assistance With Identification of Individuals in a Burial Setting by Comparison With mtDNA

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After attending this presentation, attendees will be able to discuss practical usage of portable X-Ray fluorescence in a burial setting with unknown individuals.

This presentation will impact the forensic science community by increasing knowledge of the application of new technologies to old questions to help thoroughly understand the limits of the technology itself, and what it can do in cases of unknown identity.

The Jackson Street Burials were excavated in 1997 after being discovered during work on a road construction site in Youngstown, NY. The eleven burials (five adults and six children) under investigation have no known history either from physical evidence or from past burial records. Based on the likely association of artifact assemblage and the history of Fort Niagara, the cemetery was used sometime between the late 1700s and 1840. The individuals were buried in an extended (supine) posture, in an east/west orientation with the head towards the west end of the grave. Based on the orientation of the burials, preliminary analysis suggested these individuals may be of European ancestry or buried by Christians. The purpose of this study was to gain insight into the identity and relatedness of these unknown individuals by DNA analysis, and to explore the possible application of portable X-ray Fluorescence (XRF) in a burial setting.

Certain trace elements in bone provide specific and pertinent information about the individual's environmental exposure, diet and geographical location of residence. XRF is a nondestructive method for analysis of trace elements and portable instruments are available which allow trace element analysis of samples in the field or in collections. The remains of the eleven individuals were analyzed by portable XRF. The results show individuals can be divided into groupings based on statistical analysis using Ward's agglomerative method, focusing on strontium readings from bones and teeth. Due to strontium's incorporation in bone and teeth from the local environment, it is theoretically possible to assess if an individual moved between areas of different strontium levels. Teeth incorporate strontium during fetal (deciduous) and childhood (permanent) development, and represent the intake at that specific point in time. Bone is constantly remodeling throughout one's life, and only represents the strontium intake for years before death. The hypothesis of this analysis was that the individuals may be related to one another due to dietary intake of strontium based on geographical location. Individuals 2, 10, and 13 had high bone strontium concentrations. Individual 2 had high teeth strontium concentrations. Individuals 7 and 13 had intermediate strontium concentrations in their teeth. Individual 7 had intermediate bone strontium concentrations. All others (1, 3-6, 8-10) had lower strontium in teeth, and intermediate in bones. This suggests groupings as follows for bone: Group 1 (Individual 13), Group 2 (Individuals 2 and 10), Group 3 (Individuals 3, 4, 7, and 8), and Group 4 (Individuals 1, 5, 6, and 9). For teeth, the groupings are as follows: Group 1 (Individual 7 and 13), Group 2 (Individual 2), and Group 3 (Individual 1, 3, 4, 5, 6, 8, 9, and 10).

Advancements in DNA extraction and amplification techniques have produced successful studies utilizing ancient DNA (aDNA) in various anthropological studies. Mitochondrial DNA (mtDNA) has been more successful in genetic analysis of skeletal remains, due to its high copy number than nuclear DNA. Many studies have utilized the mtDNA in understanding population history based on its unique characteristics including no recombination, maternal inheritance, and higher mutation rate particularly in the non-coding, control region. We extracted DNA from teeth specimens from each individual and sequenced the mtDNA control region following standard procedures. Results show that six individuals (burials 3-6, 8, and 9) have Native American ancestry. Two individuals (burial 8 & 9) have the exact same haplotype, suggesting shared maternal ancestry. Other individuals are not maternally related. Burial 2 seems to be of European origin and we were unable to resolve burial 7, while three samples (burials 1, 10, and 13) failed to produce successful DNA results.

Our study utilizing XRF and mtDNA analysis show conflicting results when compared with the osteological assessment with regards to geographical origins. The XRF groups formed based on strontium concentration compared to the related groups of mtDNA individuals presents some interesting scenarios. XRF may not be the best method to use for geographical region or relatedness within a group like this, but does offer insight into who these people may have been when used in combination with the mtDNA evidence. This study draws attention to problems that can arise from archaeological deductions and to the utilization of genetic analysis, which can validate or reject old conclusions to further our understanding.

Forensic Anthropology, Portable X-Ray Fluorescence, Mitochondrial DNA

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