A27 Multi-Method Resolution of Small-Scale Commingling

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The goal of this presentation is to highlight the use of a multi-method approach for resolving small-scale cases of commingled remains. After attending this presentation, attendees will understand the benefits of using portable X-ray fluorescence spectrometry in conjunction with traditional methods to resolve complex commingling cases.

This presentation will impact the forensic science community by highlighting the application of elemental analysis to resolve commingling in addition to the array of traditional methods in forensic anthropology.

Methods commonly used to sort commingled remains tend to rely on the presence of joint surface morphology, diagnostic anatomical features, osteometric sorting, or, more recently, the use of DNA analysis. Taphonomic conditions, such as carnivore scavenging, may inhibit the use of these techniques by fragmenting the remains, resulting in loss of diagnostic features and articular joint surfaces. In such instances, elemental analysis holds enormous potential. Previous research has established that portable X-Ray Fluorescence (pXRF) can be a useful tool for sorting small-scale commingling cases.[1-2] This presentation focuses on a case study involving the successful use of traditional osteological methods, DNA analysis, and pXRF for resolving a case of commingling.

In 2012, an informant told law enforcement that he and three other Mexican nationals were involved in an illegal marijuana growing operation in northern California. The informant further indicated that one individual shot and killed two of the others while they were in the marijuana field. The informant and suspect then buried both decedents in two shallow graves at the location before fleeing to southern California. Law enforcement located the gravesite and, although buried, both individuals were heavily scavenged by large carnivores, most likely black bears. This resulted in significant commingling of the remains. Each set of human remains was assigned a unique barcode and geographic location at the scene and was then submitted to the California State University, Chico Human Identification Laboratory for analysis.

Several traditional sorting methods were employed, including: (1) reconstruction of fragmented remains through physical matching; (2) visual pair-matching of bilateral elements; (3) articulation to evaluate joint congruence; (4) osteometric sorting; (5) evaluation of taphonomic patterns; and, (6) DNA analysis. After applying these methods, a left radius, ulna, scapula, clavicle, a left and right humerus, a mandible, and several right-hand elements still could not be assigned to an individual. In several instances, carnivore scavenging damage or lack of diagnostic joint morphology inhibited the use of these techniques and pXRF was used to segregate the remains.

Following methods recently outlined in Perrone et al., 95% confidence intervals were established for seven chemical elements detected (silicon (Si), phosphorus (P), potassium (K), calcium (Ca), manganese (Mn), iron (Fe), and cobalt (Co)) based on skeletal remains previously assigned to Individual I and Individual II.[2] Elemental concentration values were consistent with the informant's statement that the remains represented two individuals. Results of the pXRF analyses also indicated that nearly all unassigned skeletal elements belonged to Individual I, whereas Individual II was only represented by two mandibular fragments.

In this case study, the use of pXRF combined with several traditional sorting methods permitted the resolution of commingling. In addition, the correct assignment of skeletal elements to each individual facilitated the assessment of the biological profiles, trauma analysis, and evaluation of taphonomic patterns. This multi-method approach resulted in the accurate sorting of skeletal elements and the subsequent repatriation of the remains to their respective families.

References:

1. Gonzalez-Rodriguez J, Fowler G. A study on the discrimination of human skeletons using X-ray fluorescence and chemometric tools in chemical anthropology. *Forensic Sci Int* 2013; 231:407.e1-497.e6.
2. Perrone A, Finlayson JE, Bartelink EJ, Dalton K. Application of x-ray fluorescence (XRF) for sorting commingled human remains. In: Adams BJ, Byrd JE, editors. Commingled human remains: methods in recovery, analysis, and identification. Oxford: Elsevier Science, 2014; 145-164.

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