A42 Procedures for Sorting Small-Scale Cases of Commingled Remains: An Integrative Approach Using Morphological, Metric, and Chemical Methods

Colleen F. Milligan, PhD, California State University, Chico, Dept of Anthropology, 400 W First Street, Chico, CA 95929-0400; Eric J. Bartelink, PhD, California State University, Chico, Dept of Anthropology, Butte 311, 400 W First Street, Chico, CA 95929-0400; and Alexandra Perrone, MA, 2590 California Park Drive, Apt 13, Chico, CA 95928*

After attending this presentation, attendees will better understand the range and order of procedures for resolving commingled remains cases, including case studies that utilized morphological, osteometric, and non-destructive chemical methods.

This presentation will impact the forensic science community by demonstrating how using a range of methods for sorting commingled remains can produce optimal outcomes for medicolegal cases.

Methods for sorting commingled human remains have a long history in physical anthropology and include the determination of the minimum number of individuals and other quantitative measures for establishing how many individuals are represented within commingled and/or incomplete skeletal assemblages. Over the past decade, the Human Identification Laboratory at California State University, Chico (CSUC HIL) has developed a protocol for resolving small-scale commingling cases, including remains recovered from various scene contexts. This presentation discusses the CSUC HIL commingled remains protocol and presents four commingled case studies to highlight how the application of both low-tech and high-tech methods can successfully sort commingled remains prior to their return to next of kin for final disposition.

All methods for resolving commingled remains are based on the assumption that any two or more individuals vary on a number of different variables, including shape (morphology), size (osteometrics), taphonomic signatures, genetic markers, and chemical composition. Well-tested methods include physical matching and reconstruction of fragmented bones and teeth, visual pair matching of bilateral skeletal elements and tooth antimeres, physical matching of joint congruence of articulating skeletal elements and loose teeth with alveolar sockets, assessment of taphonomic patterns (e.g., staining, animal scavenging, and fragmentation patterns), and DNA profiles. More recently, the use of osteometric sorting and elemental analyses, such as X-ray fluorescence, has been introduced as a means for sorting commingled remains.

The CSUC HIL commingled protocol requires that analyses begin with a complete inventory of all remains and a sort by anatomical position. Where needed, analysis proceeds, beginning with skeletal reconstruction, followed by visual pair matching, osteometric sorting, and assessment of joint congruity. Assessment of taphonomic patterns can provide useful information to complement these methods; however, it can also be misleading if all remains were exposed to similar environments and, by extension, similar postmortem modifications. DNA results, if available, serve as a cross-check against the morphological and osteometric commingling assessment. For any remains that cannot be sorted through these methods, portable X-Ray Diffraction (pXRF) can be used to assign isolated skeletal elements to a particular individual. This application is most appropriate for two-person commingling scenarios. The most effective means for sorting commingled remains using pXRF is to scan a large sample of skeletal elements sorted to each individual through other means (e.g., reconstruction, visual pair matching, DNA), then to construct 95% confidence intervals for chemical concentration values. Concentration values for seven chemical elements (Silicon (Si), Phosphorus (P), Potassium (K), Calcium (Ca), Manganese (Mn), Iron (Fe), and Cobalt (Co)) provided the best discriminating power based on earlier research developed through the CSUC HIL. If the segregated bone groups from each individual do not overlap in their confidence intervals for at least one chemical element, unsorted skeletal elements can be assigned to the individual whose confidence interval includes the chemical concentration values. Thus, pXRF is a valuable tool for sorting commingled remains, but may not discriminate between individuals in all cases.

The use of multiple methods in the identification sequence helps to maximize the correct identifications of individual skeletal elements, especially in instances where a cross-check with DNA analysis is limited. Four recent case studies are used to highlight the utility of the CSUC HIL commingled remains protocol, including an outdoor surface context, a buried context, a fire scene, and a cold case representing several commingled individuals. Each of the case studies represents a different scene context, different length of time between recovery and identification, and different relationships between the individuals. They address issues associated with taphonomic damage, familial relationships, and detection of the number of individuals in group sizes larger than two. The goal of this presentation is to show how flexibility and diversity in the identification methods can aid in reducing the limitations often associated with commingled cases.

Forensic Anthropology, Commingled Remains, Portable X-Ray Fluorescence

*Presenting Author