BS5 Dining With DNA: Extracting Usable Profiles From Burned Bone

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Learning Overview: The major goal of this presentation is to offer best-practice procedures for the recovery of samples from burned skeletal remains for the purpose of recovering DNA for identification purposes.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a predictive model for determining which samples from incinerated skeletal remains are likely to produce the best results for Short Tandem Repeat (STR) testing (expanded Combined DNA Index System (CODIS) loci with miniSTRs), for mitochondrial Genome (mtGenome) sequencing, and for genome-wide Single Nucleotide Polymorphism (SNP) analysis given the extent of charring and other visible signs reflecting the level of burning.

Individuals who die before or during a fire often are quite difficult to identify due to the obliteration of typical characteristics useful for scientific identification. While DNA analyses have become central to forensic science, with applications ranging from unidentified decedents to trace evidence, burned bone analysis remains elusive. Extracting DNA from these samples presents a special challenge to medicolegal investigations. Fire and heat cause major alterations in soft tissue and bone, with cremation or near cremation producing unusable samples for DNA profiling. Or so it was previously thought! New methods for ancient DNA extraction, DNA library construction, and targeted enrichment developed during the last two to five years have great promise for such forensic applications. In ancient contexts, these methods have been applied to: (1) conserve (and effectively immortalize) DNA from small and/or degraded samples, enabling multiple analyses without exhausting the sample and allowing additional analyses to be performed in the future; and (2) target a large genome region or number of SNPs (such as the complete mtGenome or genome-wide SNPs) for subsequent Next Generation Sequencing (NGS). This seminar will highlight the utility of applying this methodology to modern forensic samples with the express intent of increasing scientific identifications.

Over a period of two years, this study obtained and documented 80 samples from 27 fire death and cremation cases. Samples were chosen with the goal of obtaining statistically significant results from different skeletal tissues showing different levels of burning. From these, DNA was successfully extracted from 68 samples (including blanks) using two different DNA extraction protocols: one currently used to obtain DNA from ancient remains and another used in forensic DNA analysis. This presentation will report the success of this sampling strategy, noting the degree to which visible markers upon thermally or otherwise altered human remains (here, bones and teeth) can be used to predict DNA preservation, and thus inform project design for sample selection. This presentation will discuss this process, offering the first evidence for optimal extraction practices for burned skeletal remains recovered from fire-related forensic contexts.

Using modern forensic cases to illustrate, this seminar will offer evidence-based best practice procedures for the analysis of human remains with burned DNA, answering the call of the National Research Council of the National Academies 2009 Report, *Strengthening Forensic Science in the United States: A Path Forward*, to develop reliable and accurate scientific methods. Further, this presentation will encourage collaborations between academic institutions and medical examiner/coroner offices nationally and internationally.

Degraded DNA, Burned/Cremated Bone, DNA Profiling