



A54 Portable Laser-Induced Breakdown Spectroscopy (LIBS) for the Categorization of Human Skeletal Remains

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Learning Overview: After attending this presentation, attendees will understand how LIBS can be utilized as a non-destructive technique to categorize human skeletal remains in bioarchaeological and forensic anthropological contexts.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating that forensic anthropologists and bioarchaeologists may be able to utilize LIBS to categorize human skeletal remains through rapid elemental analysis in the field using portable instrumentation.

Bioarchaeology and forensic anthropology require the classification of unidentified fragmentary materials. In cases of mass disasters and commingling, it is important to determine whether fragments are osseous or not to aid in the process of identifying individuals. Currently, most elemental analyses of bones are conducted using portable X-Ray Fluorescence (pXRF). However, there are limitations to the elements pXRF can detect without the need for additional equipment or analysis time, specifically elements with lower atomic mass. Portable Laser-Induced Breakdown Spectroscopy (pLIBS) offers a sophisticated alternative to pXRF by using rapid laser ablation to analyze elements. With this analysis occurring at the micro-scale, the technique is non-destructive to the sample as it typically cannot be seen by the naked eye. Considering this, pLIBS could offer a superior approach for materials discrimination and human identification. This study addressed the following questions: Can individuals be distinguished from one another using pLIBS to obtain elemental signatures from bones? If so, can pLIBS be considered an improvement over current methods for skeletal analysis in bioarchaeology and forensic anthropology?

Human skeletal materials were utilized from the donated collection at the Institute of Forensic And Applied Science (IFAAS) at the University of South Florida. The sample consists of seven donors, including one set of cremains, made up of four females and three males ranging from 28 to 79 years of age. Two archaeological samples from a medieval Transylvanian skeletal collection were analyzed for comparison between modern and historical remains. Data were collected at 206 locations on 29 bones across the skeleton in order to capture the best representation of the overall elemental composition of an individual and to test for intra-individual variation. Elemental analysis was performed using a SciAps Z-300 LIBS analyzer connected to the proprietary SciAps ProfileBuilder spectral analysis software. IBM® SPSS Statistics 25 was used to perform Multivariate Analysis Of Variance (MANOVA), post hoc analyses, and Discriminant Function Analysis (DFA) on the data set. Through a combination of LIBS and multivariate data analyses, it was determined that elemental data taken from human skeletal remains could be used to differentiate each individual from another. Beyond this, donors were successfully categorized by disposition (i.e., caged, tarped, surface) based on their placement at the IFAAS facility, indicating the influence of the burial environment on sorting skeletal remains. This research provides new insights into the use of LIBS for human skeletal analysis and its ability to rapidly and non-destructively differentiate between individuals using elemental variation within bones.

LIBS, Commingling, Forensic Anthropology