B147 DNA Extraction and Profiling From Human Bone and Tooth Samples Exposed to High Temperatures: A Comparison of Current Techniques

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Learning Overview: The goal of this presentation is to offer best-practice procedures for the isolation of DNA from burned human remains and to recover DNA useful for identification.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a predictive model to determine which incinerated human remains are likely to produce the best results for Short Tandem Repeat (STR) analysis.

In the identification of forensic cases, it is critical to obtain information on the victim's identity from burnt bone and tooth remains. When bone and teeth are burned, both their physical and chemical properties change significantly, which prevents anthropological evaluations and successful DNA profiling. Heat causes difficulties in the identification techniques in which bones and teeth are used, depending on the degree of temperature exposure.[1] Therefore, it is necessary to evaluate the results of observation and analysis, and the information obtained in a certain order, with the changes occurring in bone and teeth during the burning period. The identification of burnt or buried bones and teeth has always been a difficult process due to the diminished quality and quantity of DNA, and it is still a challenge.[2] Due to heterogeneity in DNA due to the heterogeneity within the bone, unfortunately, the only reliable method for obtaining DNA from highly degraded specimens, such as burnt bones and teeth, in the literature is still not available.

Because teeth and bones are the hardest tissues in the human body and known as the most abundant types of biological remains that are available in forensic cases, this study focused on the evaluation of the DNA extraction efficiency of burned bone and tooth samples and obtaining a DNA profile under different environmental conditions of exposure to temperature and time. In this study, 50 samples consisting of 25 bones and 25 teeth obtained from 22 females and 28 males aged between 18 and 71 years were used, and 50 samples of oral swabs belonging to the same persons were also used to compare current extraction methods, and the maximum temperatures at which DNA from bone and teeth can be obtained were determined. The collected tooth samples were healthy erupted third molars. All bone and tooth samples were divided into eight groups and exposed to certain temperatures, which were 100°C, 200°C, 300°C, 400°C, 500°C, 600°C, 700°C, and 800°C. Each group was treated at the determined temperature for 1, 5, 10, and 15 minutes. The control and burned samples were mechanically ground and subjected to DNA extraction and amplification. Based on the amplification data, it was not possible to obtain DNA from the teeth subjected to 400°C for 10 and 15 minutes, 500°C for 15 minutes, 600°C, 700°C, and 800°C for 5, 10, and 15 minutes. In the first temperatures and times, which were 100°C and 200°C, and one and five minutes, it was possible to obtain an amplification similar to that of the control samples; however, in most Short Tandem Repeats (STRs), the amplification was very low from 300°C for one or five minutes onward. These observations support earlier findings and indicate that even in teeth subjected to high temperatures and that were burned, it is possible to amplify the DNA; however, the data also show that it would be difficult to obtain an STR profile, which is probably due to the size of these regions that makes them more prone to degradation.[3,4] In this study, DNA extractions could be carried out in bone samples exposed to a maximum temperature of 190°C and tooth samples exposed to a maximum temperature of 400°C and a new modified extraction method was also proposed for increasing the effectiveness and efficiency in routine forensic genetic identification processes.

The results of this research provide a quantitative study in order to obtain a DNA profile from highly degraded bone and tooth samples and may increase the ability of forensic scientists to target the burned human bone and tooth remains to produce high yields of DNA, thereby increasing the probability of positive identification. Under the same or similar conditions, future research could extend these results by analyzing other potential regions of DNA for forensic identification.

Reference(s):

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Burned Bone, Burned Teeth, Identification

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