A73 Forensic Examination of Burned Human Skeletal Remains: Shifting the Paradigm

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After attending this presentation, attendees will better understand Heat-Induced Changes (HIC). Additionally, current methods for assessing the biological profile, when applied to burned skeletal remains, will be improved.

This presentation will impact the forensic science community by proposing new approaches to the analysis of burned skeletal remains and by providing knowledge obtained from the research carried out in the framework of the ResearcH PrOject of the 21st-Century Skeletal Collection (CEI/XXI) Burned SkeleTons (HOT).

The forensic analysis of burned skeletal remains is often complicated by HIC because they interfere with the application of standard methods. Probably the most obvious difficulties are related to fragmentation and to the inability in assessing the extent of HIC — namely concerning dimensions and warping — affecting a particular bone or tooth. Despite the increase in the amount of research, a reliable method to estimate this extent is still escaping us. At the University of Coimbra in Portugal, skeletons from the CEI/XXI are being experimentally burned under controlled conditions.[1] The main objectives of this project are: (1) to achieve a better understanding of HIC; (2) to test the reliability of current methods for assessing the biological profile, when applied to burned skeletal remains; and, (3) to develop new analytical methods more specific to burned skeletal remains according to the extent of burning.

Unclaimed skeletons from a public cemetery donated to the University of Coimbra are being compiled, allowing for invasive procedures such as burning. Only the right antimeres of each skeleton are subject to controlled burning (up to 1,050°C) while unpaired bones such as the cranium are not being burned. The unburned bones serve as a basis for comparison. Analyses of the skeletons are performed before and after burning to document color, weight, and morphological and dimensional changes. Comprehensive research on burned skeletal remains is already underway, although the current sample size is still small (n=20).

The potential of cementochronology for age estimation on calcined teeth has been investigated. Although the estimated age through Tooth Cementum Annulations (TCA) presented poor agreement with chronological age (mean error=24.2 years), partly due to the poor visibility of the lines, a new cementochronological approach based on the estimation of the amount of TCAs present in each tooth provided better results (mean error=11.4 years). In addition, an attempt to determine the effect of bone collagen on the occurrence of heat-induced warping was conducted. Although a slight significant effect (p=.040) was indeed found, multivariate statistics identified other more significant factors in the model: maximum temperature (p<.001); duration of combustion (p<.001); sex (p<.001); and age at death (p=.010). The results demonstrated that warping can occur on bones with both low and highly preserved collagen contents, suggesting that the role of the burning dynamics is particularly important. As a result, warping appears to be an unreliable indicator of the pre-burning condition of skeletal remains (fleshed vs dry). In another research project, the focus is on the potential of geometrics morphometrics to assess the pre-burning shape and size of burned bones. A multivariate approach is being adopted to determine if these parameters — usually impossible to assess during the examination of burned remains — can be reliably obtained through virtual retro-deformation. Initial results show some promise, although additional research is needed.

Several incidents involving fire (e.g., airplane crashes, terrorist attacks, bush fires) can result in victims whose remains are skeletonized and burned. Experimentation with human remains is critical since other species may not serve as reliable proxies. A good documentation of HIC and the validation of analytical methods are also fundamental. Controlled laboratory burnings do not always replicate the usual on-and-off burning exposure occurring in some forensic scenes; also, dry bones may react differently than fleshed or green bones.[2] These are some of the shortcomings of this new collection, but it still allows important insights about HIC, and its contribution for the improvement of more adequate bioanthropological methods for the analysis of burned bones and teeth is undisputable.

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Reference(s):

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2. Gonçalves D., Cunha E., Thompson T.J.U. Estimation of the pre-burning condition of human remains in forensic contexts. *Int J Legal Med* 2014; DOI 10.1007/s00414-014-1027-8.

Burned, Skeleton, Forensic