Identifying Pre-Incineration State from Heat-Induced Fracture and Warping Patterns Found on Human Remains in a Hungarian Bronze Age Cemetery

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Introduction

The purpose of this research is to examine the possible internal skeletal structures of a Bronze Age population in the Körös region of Eastern Hungary by testing whether or not burial in the distribution of macroscopic heat-induced fractures varied across the cemetery site of Békes 103. Fragments from nine cremation urns were assessed for the presence of diagnostic fractures and warping patterns according to their anatomical region. Their relative frequencies were then compared among human burials and among urn layers.

Sample: The Bronze Age Körös Off Tell Archaeology (BAKOTA) team has excavated 64 cremation burials and fire inhumations from the cemetery since 2011. This research will focus on 14 cremated human burials of varying ages and sexes from different areas of Békes 103 to facilitate an analysis fully spanning the cemetery. Remains from each human burial (HB) are divided by the urn from which they were extracted, and a random twenty percent sample was taken from each layer for evaluation.

Heat-induced features: The withdrawal of muscle fibers and tissues from the distal ends of long bones and towards the axial bodies of fleshed individuals results in the formation of curved transverse fractures (Symes et al. 2015). Prominent longitudinal fractures running along osseous canals in addition to superficial patina cracks found around alizarin red ends and on the flat planes of postcranial bones also frequently appear on cremains (Bukkstra & Swegle 1989). The similar corruption of cranial flesh due to burning produces delamination or surface ashen posterior skin in addition to curved fractures on meatier portions of the anterior face (Poppe A, Smith 2004). Warping, referring to another consequence of heat exposure, the combustion temperature, degree of collagen preservation, and the amount of bone matrix alteration are suggested causes. (Cunna, Goncalves, & Thompson, 2011).

Materials and Methods

The frequency of fractures and warping patterns was quantified for fourteen human burials: 10, 11, 12, 13, 21, 26, 46, 47, 48, 50, 51, 53, and 54. A random twenty percent sample was taken from each layer per human burial by evenly scattering fragments across a 20 x 25cm grid and subsequently selecting a sample. The localized detection of cranial and postcranial fracture and postcranial heat-induced fracture patterns are generally distinct from one another. Therefore, samples from each burial were organized according to their two anatomical elements. Within this broader cranial and postcranial categories, only diagnostic fractures (those occurring primarily in the cranial or postcranial elements were considered). Macroscopic fractures were assessed for a particular type's presence or absence based on the fragmentation using a hand lens. Longitudinal, straight transverse, curved transverse, and patina were considered for postcranial elements (Symes et al. 2015). Non-diagnostic fractures were evaluated for postcranial elements that could not be conclusively attributed by the author to a bone possess by walking/standing. In the absence of sufficient cranial hemispheres (space for marrow in long bone shafts). Delamination, linear, and curved transverse fractures were considered for both elements (Symes et al. 2015). Warping was evaluated for both postcranial and cranial. Every fragment was assigned to one indicating the human burial to which it belonged and its order within the burial according to an arbitrary numbering system. These data were examined from an analysis of information detailing the remains' sex and HB17 number.

Results

Of the fourteen original human burials, nine human burials were compared, and the urn layers from ten human burials were compared. Given the small sample size available for cranial elements, statistical analysis utilizing chi square for fixed number of categories and the χ2 test for trend was used to assess the significance of observed differences. Additionally, straight fractures (longitudinal, non-directional, and straight transverse) were considered to be unique fractures because they are similar to one another and because individually they yield too small a sample. Thus, human burials of sufficient sample size can use the chi-square statistic. Because individuals indicated that significant differences exist among burials in regards to the distribution of straight fractures (P<0.05) and curved transverse fractures (P<0.005) only. As indicated by the corresponding graph, a relatively low percentage of both straight fractures and curved transverse fractures in the burial were observed. The following burials were selected: from human burials 29 were included, and a relatively low percentage of curved transverse fractures are found in human burial 54.

Discussion and Conclusion

This study questions the interpretation of cranial and postcranial human remains from Békes 103, the possibility of delamination on human remains in Hungary, and the significance of heat-induced fractures. The BAKOTA team excavated 64 cremation burials and fire inhumations from the cemetery. The remains were selected to this research due to the consistent distribution of fractures. The study revealed that the fractures found in human burials 55 and 54 were attributed to the burning of flesh (Gonzales and Thompson, 2011). Another potential explanation involves the environment of the cremation fire. A cooler overall temperature or less exposure to intense heat may result in fractures (Chaplin, 2015). The low percentage of delaminated bone or bone that was subjected to intense heat, among the postcranial fragments in human burials 21 and 54 and 55, are not consistent with the high temperatures that are common to cremation. The individuals in the other burials; the manifestation of macroscopic heat-induced fractures is often attributed to the burning of flesh (Gonzales and Thompson, 2011). This results in the destruction of bone, and the likely the bone that was subjected to intense heat, among the postcranial fragments in human burials 21 and 54 and 55, are not consistent with the high temperatures that are common to cremation. The individuals in the other burials; the manifestation of macroscopic heat-induced fractures is often attributed to the burning of flesh (Gonzales and Thompson, 2011).

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Figure 1: Comparison bar graph of postcranial fracture type frequencies across qualifying human burials.

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