Fragments of the Past: An Analysis of Cremated Remains

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Abstract:

This study sought to estimate the cremation temperature for a single burial from the Bronze Age (1600-1200 BC) site Békés 103 Jégvermi-Kert as part of the BAKOTA project. The primary focus of our research was the estimation of cremation temperatures and the conditions of the body prior to cremation. Using a *Munsell Soil Color Book* we were able to qualitatively measure the color of cremains in order to estimate burning temperature. Determining whether or not the body was burned with flesh relied on two methodologies: the analysis of color patterns across the body and the identification of specific heat related bone fractures. With the majority of bones being a shade of white, it was estimated that the crematory fires likely exceeded 800˚C. Thumbnail fractures along long bones and the prevalence of nonwhite bones on specific areas of the body, such as where two bones articulate, both suggest that the body was cremated while flesh was on the body. Together, these two conclusions indicate that the people of this region during the Middle Bronze Age took care to cremate the dead soon after death and then carefully tended to the pyres, allowing them to reach such high temperatures.

Background:

Since excavation began at Békés 103 Jégvermi-kert in southern Hungary in 2011, 61 burials dating to Bronze Age (1600 – 1200 BC) have been discovered (Duffy et al. 2014). The vast majority of these burials consist of fragmented, cremated remains entombed within decorative urns (Duffy et al. 2014). Little information is currently known regarding the nature of the cremation .

Two types of skeletal data are frequently collected in order to learn more about the cremation process: fracture patterns and bone color. The heat of fires used in cremation alters the physical structure the inorganic material in bones, creating recognizable and patterned changes (Symes et al. 2015).

Figure 1 - A Map of Hungary within Europe with the proximate location of Bekes County circled(Photo: commons.wikimedia.org).

Figure 2 - The location of Human Burial 54 at Békés 103 Jégvermi-kert (Photo: Paul Duffy; Justine Tynan).

Heat stress on the bones can cause any combination of five distinct fracture patterns: longitudinal, curved transverse, straight transverse, delamination, and patina (Herrmann and Bennett 1999). Curved transverse fractures are of particular note to cremation studies because they are only seen when flesh is present at the time of incineration (Herrmann and Bennett 1999).

Bone color can also contribute evidence as to whether or not a body was cremated with flesh still attached. During the process of cremation, bones that are covered by flesh are shielded from the effects of flame (Symes et al. 2015). Colors associated with lower exposure temperatures can frequently be found in areas with more tissue as a result of this shielding principle (Walker et al. 2008).

Bone color is also useful in determining the temperature a bone has been exposed to. As bone is heated, a gradual color change occurs. Bone color stems from a number of different variables including, but not limited to temperature of the heat source, length of exposure, and anatomical position of the bone (Symes et al. 2015). Starting with a light tan color, bone develops a black appearance as temperature increases and organic material is burned away, ultimately developing a white, ashy appearance as the organic makeup of the bone is incinerated (Walker et al. 2008). Therefore, color is related to fire temperature. For example, an intense white color typically indicates that a bone was exposed to temperatures exceeding 800˚C (Absolonova et al. 2012). By combining the inferences made through each technique available, it is possible to approximate the conditions that a body was exposed to during cremation.

Materials and Methods:

Urns uncovered at the Hungarian site Békés 103 Jégvermi-kert were microexcavated off-site, each producing fragmented human bones. The specific urn examined in this analysis, designated HB 54, contained thousands of fragments ranging in size from less than a millimeter to over 100 mm.

Remains were separated on gridded paper into categories based on size and location in the body (cranial, postcranial, or indeterminate). Sizes included hypermicro (0-5mm), meso (6-10mm), macro (11- 50mm), and hypermacro (>50 mm) (Nemeskéri and Harsányi 1968) (see Accuff et al. 2016). Bone color was identified specifically using a Munsell Soil Color Chart (Shipman et al. 1984). On bones exhibiting multiple shades, the color indicative of highest temperature was recorded (Walker et al. 2008; Shipman et al. 1984).

Figure 3 - Organization of cremated remains by body location and size on gridded paper.

Figure 4 - longitudinal fractures on the shaft of a long bone (Photo: László Paja).

Figure 5 - Transverse fractures on the shaft of a long bone (Photo: László Paja).

Figure 6 - Curved transverse fractures on the shaft of a long bone (Photo: László Paja).

Figure 7 - Patina on the surface of bone (Photo: László Paja).

Bone was also identified as originating from heavily fleshed regions based on the type of bone (trabecular versus compact) and the region the fragment likely originated from. Trabecular bone originating from joints and fragments of the os coxae were types of bone indicated as being from heavily fleshed regions of the body. These locations were chosen due to their nature of deep tissue cover age. This assessment was used to help determine whether the remains were originally cremated with flesh present.

To further confirm whether the bones had flesh on them when they were burned, each bone was then examined for the presence of fractures that resulted from the cremation process. Bones were assessed for fractures (longitudinal, straight transverse, and curved transverse), delamination, patina, and deformation/ warping by presence or absence of the condition (Symes et al. 2015).

Results:

Of 1,473 observable fragments, 83(5.6%) had curved transverse fractures. When only taking into account tubular bones, 61 of 790 fragments (7.72%) had curved transverse fractures. Warping occurred on over 10% of bones for both tubular bones only and for all examined bones.

Analysis of color revealed that 80.0% (n=1325) of all bones were white, an indication that these remains had become calcined. Only 7.5% of calcined bone (n-418) was from heavily fleshed regions, which was significantly less than non-calcined bone (c^2= 68.8, df=2, p<0.001), indicating that calcination is not independent from the anatomical location in the body.

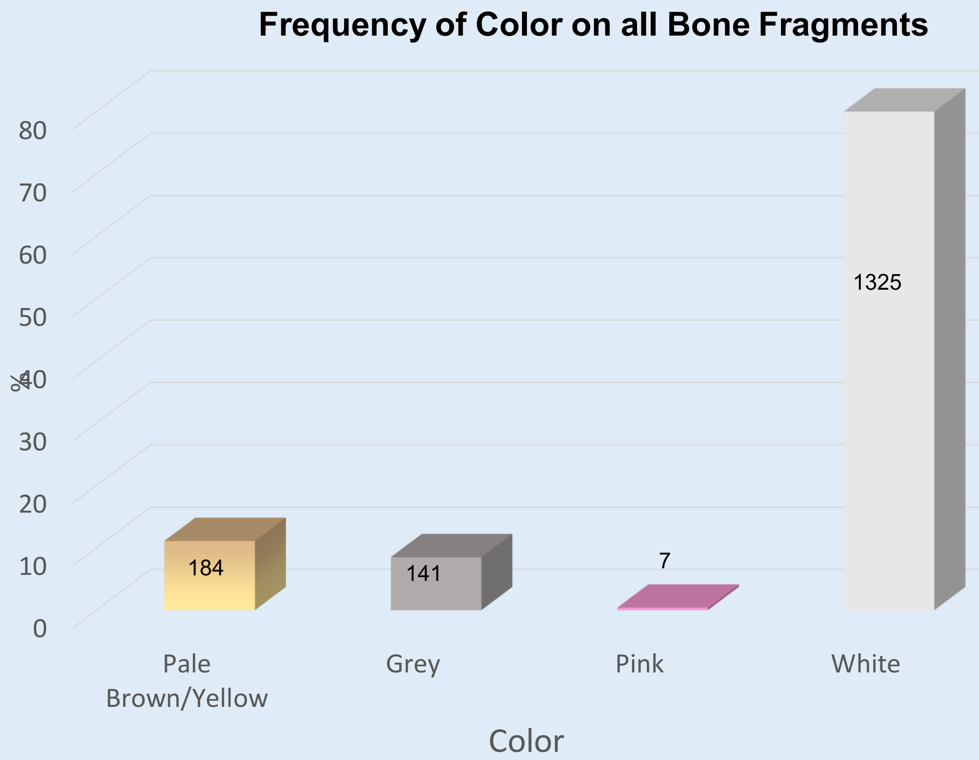

Figure 8 - Frequency of identified color on all examined bone fragments.

Calcination by Anatomical Region			
Bone Type	**n**	**n from Heavily Fleshed Regions**	**Totals**
Calcined	389	29	418
Not Calcined	101	54	155
Totals	490	83	573

Table 1 - A chart detailing the number of calcined and non-calcined bones from heavily fleshed regions of the body.

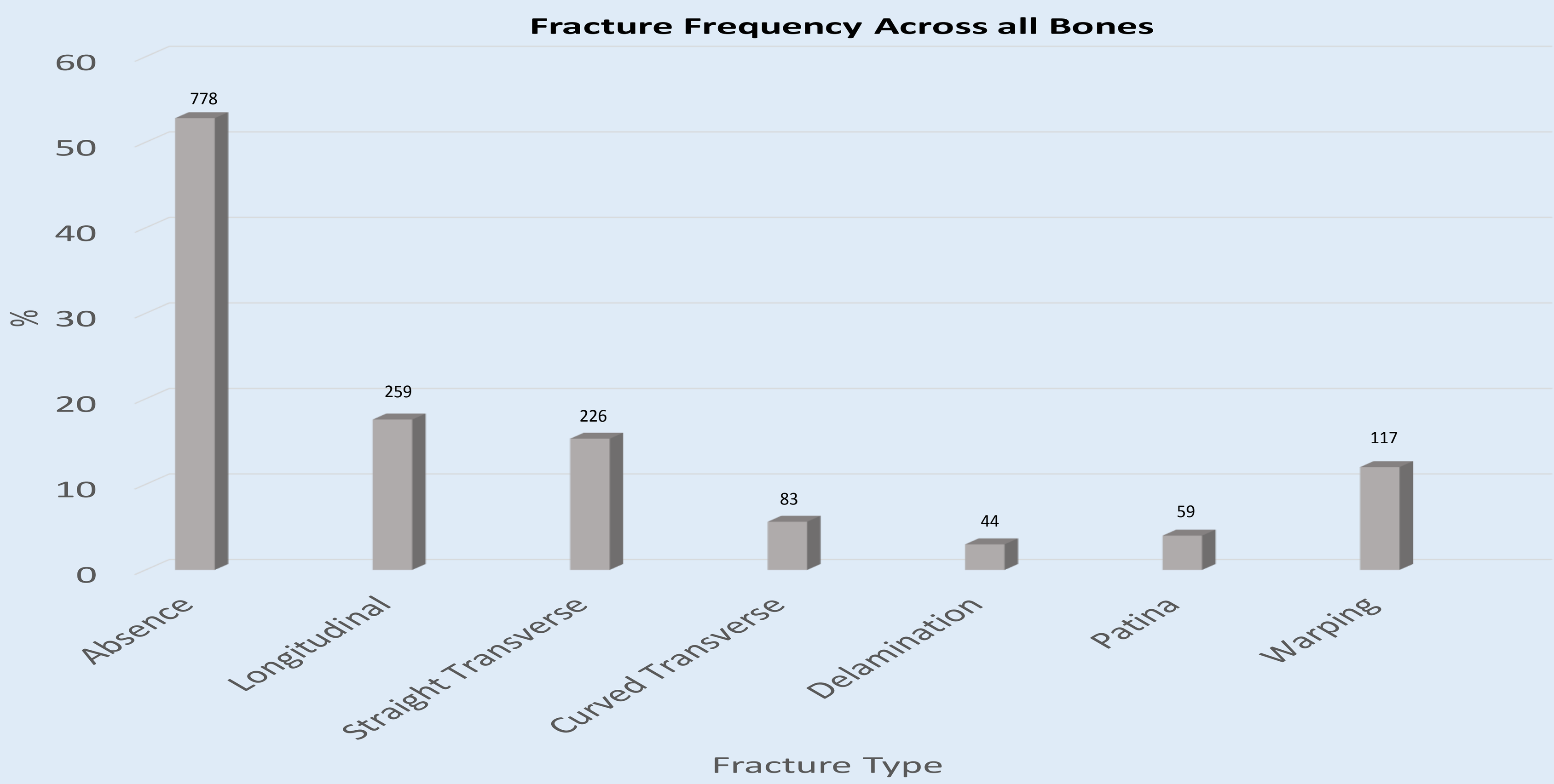

Figure 9 - Frequency of fracture types on all bone examined.

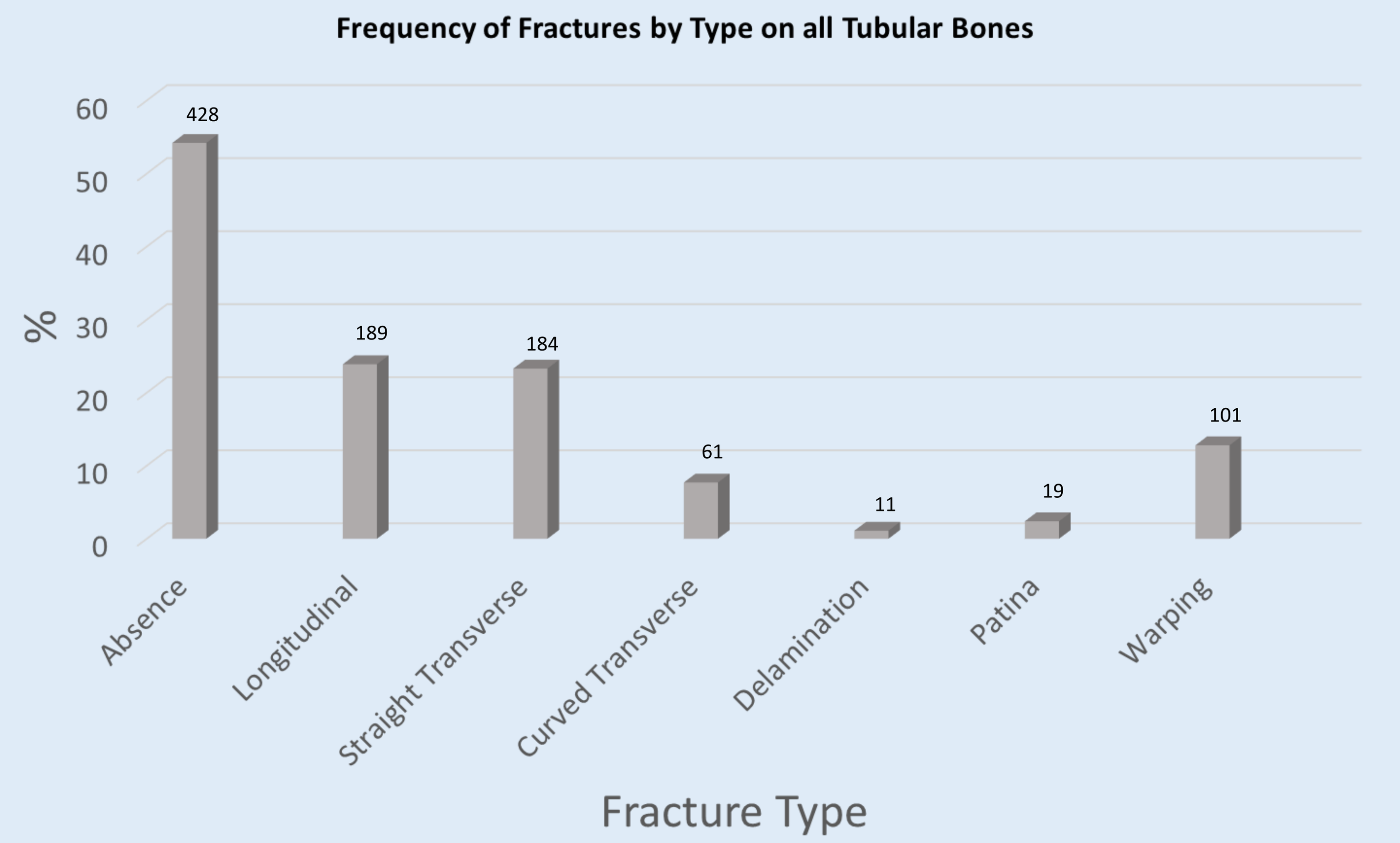

Figure 10 - Frequency of fractures by type on all scorable tubular bones examined.

Discussion:

The presence of curved transverse fractures in numerous bones indicates that the body being examined for this study was cremated while flesh was still attached (Herrmann and Bennett 1999).

Areas with greater tissue depth are usually subject to burning after areas of lesser tissue depth, meaning that exposure time to heat is reduced for heavily fleshed areas of the body (Symes et al. 2015). This was demonstrated in this sample through analysis which suggests that bone calcination is related to anatomical location.

The majority of bones (79.4%) displayed signs of calcination. Therefore, it is probable that the heat source used during cremation exceeded 800˚C (Walker et al. 2008). The notion that the body was fleshed at the time of cremation helps explain the lack of uniform coloration, while also providing support that the body was not exposed to its heat source long enough for all bones to become white.

To produce the level of calcination that is seen in this individual, the heat source would likely have to have been tended to maintain high heat (McKinley 1989). During this time, a wood fire would require constant refueling in order to keep the temperature above the 800˚C needed to instigate the chemical changes that cause calcined bone to form (McKinley 1989).

The differential color pattern of the cremated remains in concert with the fracture patterns detected helped to surmise that the body being examined was cremated while flesh was still present. From this, it was concluded that the body was likely exposed to the cremation fires of approximately 800˚C . These results suggest that the mourners of the dead carefully tended to wood fires in order to complete the cremation process for the deceased.

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