A49 Dehydration-Induced Quantitative Morphometric Alterations to Sharp Force Trauma on Bones

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Learning Overview: After attending this presentation, attendees will understand how the taphonomic changes caused by dehydration alter the dimensions of bones as well as the v-shaped cross sections, commonly known as kerf marks, left on bone by sharp-edged objects.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating alterations resulting from a taphonomic agent that is often overlooked in the forensic literature. This presentation will also provide an increased understanding of the reliability of kerf mark data collected from skeletal remains that have been subjected to dehydration.

When human remains are recovered in a forensic context, there is a general understanding that taphonomic processes have affected the presentation of evidence on the body. As human bone is composed of 15%–25% water, dehydration is a taphonomic agent that may cause morphological alterations, including dimensional and volumetric shrinkage and fracture characteristics.[1-3] It has also been suggested that dehydration affects the presentation of striations in sharp force trauma wounds.[4] Despite these findings, dehydration as a taphonomic agent is often overlooked in forensic taphonomy research and forensic analysis.

To quantify the effects of the dehydration process, this study created a controlled experiment that subjected bone samples to lab-induced dehydration. It was hypothesized that the loss of water would affect the morphology of the bones and associated kerf marks, though it was unknown whether these changes would be significant. Domestic pig radii (n=9) were macerated and sectioned into samples no wider than 1.5cm (n=43). Sharp force trauma was then inflicted on each sample using a household steak knife with a serrated blade. One kerf mark was created on the medial aspect of each section, then immediately photographed to record the pre-dehydration measurements. Bone sections were then subjected to five 24-hour heating and cooling cycles using an Andrew James Food Dehydrator. Samples were weighed using a digital scale after each 24-hour cycle was finished to determine the percentage of water loss. Upon completion of the five heating and cooling cycles, each sample was photographed again to record the post-dehydration measurements. Using ImageJ, six measurements were taken from each sample's before and after photograph: (1) bone section length from the anterior and posterior midpoints; (2) bone section width from the superior and inferior midpoints; (3) bone section medial surface area; (4) kerf mark maximum length; (5) kerf mark maximum width; and (6) kerf mark area. Inter- and intra-observer error tests were completed to ensure consistency in landmark identification and measurements.

Results indicated that both bone sections and kerf marks were altered by the dehydration process. Following the completion of the five 24-hour cycles, the bone samples experienced an average of 22.8% reduction in weight (p=<.001) and an average of 8.8% reduction in size (p=<.001). Kerf marks experienced an average size reduction of 28.5% (p=<.001). This illustrates that kerf mark data obtained from dehydrated skeletal remains may not accurately represent the dimensions of the original wound, thus impacting conclusions regarding type of weapon and trauma infliction in forensic cases. Further, these results demonstrate the demand for future taphonomic research to consider the effects of dehydration on the morphology of bones and bone trauma.

Reference(s):

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2. Lewis, Mary E., and Ambika Flavel. Age assessment of child skeletal remains in forensic contexts. In *Forensic Anthropology and Medicine*, Humana Press (2006): 243-257.
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4. Stanley, Sophie A., Sarah V. Hainsworth, and Guy N. Rutty. How taphonomic alteration affects the detection and imaging of striations in stab wounds. *International Journal of Legal Medicine* 132, no. 2 (2018): 463-475.

Forensic Anthropology, Taphonomy, Sharp Force Trauma

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