H2 A Preliminary Study of the Timing of Specific Characteristics of Copper and Iron Discoloration on Bone

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After attending this presentation, attendees will understand the early stages of copper and iron alloy corrosion and their transfer to bone.

This pilot study will impact the forensic science community by contributing to the understanding of the postmortem interval in forensic cases in which skeletal remains are recovered with associated metal objects.

Metal objects are often found in association with human skeletal remains in forensic contexts. Due to the presence of these objects, evaluation of the processes of metal discoloration on bone should be further explored. This preliminary qualitative analysis evaluates the timing and extent of stains on bone over a one year period from two general metal classes: copper and iron alloy. Specifically, this research evaluates the timing of discoloration, the reflection of the object form, the depth of cortical penetration, and the persistence of the stain through cleaning.

Five common metal object types, with different chemical compositions and forms, were affixed with non-metallic mesh on a sample of defleshed non-human (*Bos taurus*) bones. These objects included steel shot, steel utility knives, copper zippers, copper-plated shot, and copper-jacketed bullets. Bone samples were placed on the ground surface in secure enclosures that allowed for exposure to year- round environmental conditions in mid-Michigan. One bone sample from each metal category was then collected monthly and evaluated in a laboratory setting. Monthly climatic data were documented at each collection episode through the use of an on-site weather station.

Macroscopic changes related to metal staining on the bone surfaces were photographed and recorded by two observers. Microscopic changes related to the penetration of the metal discoloration into the cortical surface of the bone were documented using histological analysis. Samples exhibiting extensive staining were thin sectioned and observed microscopically to determine the diffusion of the stain into the cortical bone.

Discolorations were consistent with the corrosion of the specific metal type. Both metal classes exhibited evidence of corrosion within the first month of exposure, but only the corrosive product of the iron alloy objects stained the cortical surface of the bone. The iron alloy objects consistently produced deep-penetrating red-brown stains: the steel shot closely mirrored the shape of the corresponding metal object, while the utility knife did not. All of the iron stains persisted through the subsequent cleaning process. Conversely, the rate of stain for copper objects was inconsistent. Although the teal-green corrosive product was visible superficially on both the metal object and the adhering soft tissue within the first few months of exposure, the copper stains rarely persisted through the subsequent cleaning process. When visible, the copper stains vaguely reflected the form of the corresponding object.

Metal staining on bone may provide forensic investigators with vital clues concerning secondary burials or primary burials where metal artifacts associated with human remains are transported away from the crime scene. Although this pilot study does not reflect the total breadth of crime scene recoveries, it does contribute to understanding the phenomenon of metal corrosion and its effect on bone in a controlled environment. With further studies, this research may help investigators interpret the postmortem interval when known metals are discovered in close proximity to skeletal remains.

Metal Corrosion, Human Osteology, Taphonomy

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