H37 Diagnosing Peri-Mortem Blunt Force Trauma in Burnt Remains

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The goal of this presentation is to utilize photographic and radiographic overlays enabling the participants to form their own opinion(s) regarding the etiology of observed fracture patterns (i.e., blunt force trauma vs. heat and fire-induced fractures).

This presentation will impact the forensic community by focusing on the combined effects of blunt force trauma plastic deformation and subsequent heat exposure on bone. Attendees will be provided with a basic model for reconstructing and differentiating fracture patterns.

Intentional clandestine burning is a relatively common manner of inhibiting discovery and identification of a murder victim. Forensic anthropologists may be called upon to distinguish between perimortem injuries and taphonomic modification (burning) of bone that confounds trauma interpretation. Controlled experiments are an ideal way to understand the fracture pattern of blunt trauma and burning. Previous themed experiments have focused on questions regarding bone shrinkage, alteration of bone histology, the relationship of discoloration to intensity of fire, and heat-induced fracture patterns. This experiment specifically explores gross radiographic and microscopic differences in peri-mortem blunt force trauma fractures as compared to those fractures that are the product of intense heat and fire.

This study focuses on the combined effects of plastic deformation of blunt force trauma and subsequent heat exposure on bone. Identification of plastic deformation in burned bone can be vital to understanding peri-mortem trauma, as the morphology of fractures indicates the forces involved and the direction of the mechanical loading. Damage to bone from fire has been described, but the conditions and causes that produce cracking, checking, transverse splitting, warping, longitudinal fractures, curved transverse fractures, straight transverse fractures, patina fractures, and delamination fractures of burnt bones are not completely understood. Many characteristics, including the freshness of the bone, the amount of soft tissue, temperature of the fire, and duration of exposure cause variation in the expression of the diagnostic characteristics of fire damage.

Twenty deer humeri were used in the experiment: 16 experimental and 4 controls (Control A: burned but no blunt force trauma; Control B: blunt force trauma but no burning). Defleshed deer humeri were chosen as a model given their local availability and similarity in cortical thickness to human humeri (white-tailed deer proximal/distal mean: 3.1 mm, 3.5 mm, human proximal/distal: 3.6 mm, 3.9 mm). Radiographs and photographs were taken before and after trauma infliction, at 10 minute intervals during the burning process, immediately after burning, and following reconstruction. The experimental humeri were suspended at both ends, fractured with a lead pipe, and burned in a fire pit for a minimum of 120 minutes at a temperature of at least 200°C. To create a more realistic scenario, common fuels and accelerants were used including hickory wood chips, newspaper, and an ethanol-based lighter fluid. Temperature recordings were taken every 10 minutes with an EDL® E-Z Probe pyrometer with an air cage probe to ensure the fire was above 200°C. The temperature of the fire fluctuated throughout the burning period. The observed temperature fluctuations were reflected in the variation in discoloration on the bones. All ash was screened after burning for maximum recovery. Each humeri was independently described by the second and third author and compared. The temperature and duration of the fires were modeled against the final morphological state of the humeri using ordinal and logistic regression.

Comparison of both the radiographs and descriptions of the five major heat-induced fracture patterns (longitudinal, patina, delamination, curved transverse, and straight transverse) to the traumatic fracture patterns observed in the experimental humeri illustrates the fundamental morphological differences between traumatic and heat-induced fractures that are distinguishable in a forensic context. When a blunt impact causes a butterfly fracture, the sharp and symmetrical fractures remain distinguishable following burning. In contrast, heat-induced fractures rarely traverse the bone and instead create short segments that flake off during the burning process. Recovery yield after burning affected the number of features available to describe; moreover, humeri with lower recovery yields had much more ambiguous descriptions and diagnoses.

Blunt Force Trauma, Burned Bone, Radiograph

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