H25 Differentiating Peri- and Postmortem Fractures in Burned Postcranial Remains

Elayne J. Pope, PhD, Heidi S. Davis, BA, BS, and Ashley E. Shidner, BA, University of West Florida, Anthropology Department,11000 University Parkway, Building 13, Pensacola, FL 32514*

The goal of this presentation is to examine how preexisting skeletal trauma alters the normal heat-related changes of the soft and skeletal tissues, causes limb deformation, and produces characteristic burn patterns in the bone that are discernable from normal heat-related fractures.

This presentation will impact the forensic science community by demonstrating how there are identifiable characteristics of peri-mortem trauma in poscranial remains that alter the normal burn patterns for each limb and leave permanent evidence of injury after the fire.

The classic characteristics of peri-mortem and postmortem fractures are relatively easy to determine in skeletonized long bones, however this distinction becomes more difficult to assess in burned human remains. When bone is exposed to heat, it undergoes systematic biochemical and structural changes from pyrolysis that can result in charring, calcination, heat-related fractures, and fragmentation, all of which makes it very brittle during and after the fire. This presentation examines how preexisting skeletal trauma alters the normal heat-related changes of the soft and skeletal tissues, causes limb deformation, and produces characteristic burn patterns in the bone.

Blunt force trauma was intentionally produced in long bones of 10 limbs prior to burning and documented for their post-fire condition as they would appear at an actual scene, followed by laboratory analysis. The characteristics of preexisting trauma was evaluated for the type of wound (closed or open), contextual soft and skeletal anatomy for the upper and lower limbs, degree of limb deformation (*in situ* and after recovery), heat-related color changes, and morphology of the fracture margins. These were then compared to characteristics of normal postmortem heat-related and post-fire handling fractures that are commonly produced during and after the fire.

Peri-mortem Skeletal Trauma Characteristics: It takes a considerable amount of external force to produce fractures in living and green bone, especially while being protected within soft tissues. Long bones of the appendicular skeleton have been shown to fracture

predictably based on variable of area and amount of force, cortical and trabecular thicknesses, injury types, and other biomechanical factors (Galloway 1999). This study found that additional factors contribute to the heat-related changes of peri-mortem trauma in burned postcranial remains. One of the biggest influences was the anatomical arrangement of muscle and soft tissues around the bone itself.

Muscle Protection: Muscle is dense and fibrous, and heat exposure causes it to gradually shrink and retract, regardless if the bone is intact or not. It was observed that in thicker musculature of the thigh that the broken margins pulled over one another in the charred muscle. In contrast, limbs that had differential amounts of soft tissue, such as the lower leg, the fractured ends of the anterior tibia protruded into the fire environment as the thicker musculature of the calf continued to shrink and opened the broken areas open like a hinge. Both conditions caused marked limb deformation that is observable after the fire.

Open or Closed Wounds: The soft tissue wound around the fractured bone also influences the heat-related changes of limb deformation and condition of the fractured margins. Open wounds (compromised layers of soft tissue) exposed the fractured margins the earliest and longest to the fire, thus producing abnormal burn patterns and heat-related changes to the bone. Closed wounds did not always expose the fractured ends to the fire, since they remained protected and overlapped within charred muscle, but still shows marked limb deformation.

Limb Anatomy: The upper arm and leg both have a singular bone, which are more uniformly protected by musculature. In contrast, the lower arm and legs have two bones with irregular distributions of musculature around each bone, particularly the lower leg. One of the variables tested was to examine the differences of breaking one or both bones within the same distal limb. Fractures to both bones resulted in marked limb distortion, while fractures to a single bone resulted in partial limb deformation. Neither condition affected the pugilistic position of distal joints below the traumatized sites.

Fracture Morphology: Fractured margins from peri-mortem trauma exhibited one or several identifiable characteristics of (1) fractures in or extending into unburned bone; (2) stark color differences divided by a fracture; (3) pieces of fractured bone present in charred musculature; and/or, (4) deformation/erosion of the fracture margin and sometimes color differences (in charred and calcined bone).

Postmortem Heat-related Characteristics: Heat-related fractures in bone result from direct exposure and the depletion of organic components during the process of pyrolysis, thus causing the external surfaces of cortical bone to shrink and split. At this point, minimal force applied to burned bone can result in fracturing and fragmentation during and after the fire. These and other postmortem fracture characteristics of burned human remains will be presented.**Peri-mortem Skeletal Trauma, Fractured Long Bones, Burned Bone**

 ** Presenting Author*