B81 Burning Observations of the Body: Sequencing Soft and Hard Tissue Destruction

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The goals of this presentation are to identify effects of heat to the human body; to recognize progressive stages of thermal breakdown in skin, muscle, fat, and bone; to understand the dynamics of pugilistic posture; to be familiar with anthropological analysis of burned human remains; and to appreciate the reconstruction of the body in the context of a fire scene.

Discovery of burned human remains creates a challenging dimension to fire investigation involving houses, vehicles, or large structures. In addition to evaluating structural and physical properties of fire scenes, the human component requires similar standards of analysis. Specialists trained in forensic pathology, anthropology, and odontology serve as excellent resources for recovery and interpretation of human remains. Collaborative works by arson and forensic investigators approach problems of the scene and circumstances similarly by understanding the dynamic process of how the human body reacts to heat during a fire. Unless extinguished during early phases, burning obliterates identifiable personal soft tissue features. Cessation halts the destructive process but leaves nothing short of speculation, even in advanced forensic texts, about how and why bodies actually burn. While there are many assumptions based on subsequent charred remains, none stem from actual observation.

In an effort to better understand this process, burning simulations were conducted using three unembalmed human bodies from anatomical gift donations. Although crematorium resources are available, it is important to utilize open-air fires mimicking forensic casework in order to accurately observe and record subtle changes as they occur, rather than intermittently collect information via the door of a kiln. Subsequently, a range of materials were selected to contain and maintain heat with combinations of wood, metal, charcoal, and accelerants, while allowing free movement of soft tissue structures and thermal shielding for the observer. Documentation of time, duration, delicate reactions of skin, sequences of pugilistic posture, anatomical degradation, and origins of anatomical burn patterns, became crucial to understanding the processes responsible by which the human body is consumed by fire, particularly bone. This snapshot approach provides invaluable information when trying to reconstruct a fire event based on the pattern and sequence of burning to soft and hard tissues.

Destruction of organic material from combustion is fundamental to the entire burning process for soft tissues and bone. Once placed in the context of heat, the skin becomes waxy, glossy, tightens, blisters, blackens from charring, and begins to split into transverse, longitudinal, and stellate patterns to expose underlying layers of fat, muscle, tendon, and finally bone. Dehydration of muscles from heat causes shortening and produces the predictable "pugilistic posture" by contracting the robust flexors. Gradually arms become flexed, rotated, and drawn away from the body, while fingers tuck into the palm of the flexed wrist. Legs bend at the hip and knee under the influence of massive muscles of the leg while the calves induce plantar flexion at the ankle. Patterns of the skull and face advance from superior to inferior due to thicker muscle layers lower toward the cranial base. Skeletal degradation follows as muscle burns away, leaving bone exposed to dehydration, charring, calcification, and fragmentation. Concurrently, predictable anatomic sites will to undergo varying rates of thermal destruction determined by soft tissue thickness, body mass, orientation to the heat source, and relative body position.

In extreme cases where partial to complete incineration occurs, intense reduction of soft tissue leaves skeletal remains as the primary material for analysis. In addition to recording soft tissue changes to experimentally burned bodies, it became equally important to examine and reconstruct fragments of the remaining burned bones. Color changes and in some cases, heat-induced fracture patterns, are indicators that record progression and extent of burning to the body. Continuous documentation during each experimental burn episode captured details of body position, combustion rates of anatomical regions, and periods of localized heat fluctuations. By incorporating these rich layers of data along with physical evidence of solitary burned bone, a foundational understanding of each stage of burning can begin. Translation of this information for use by forensic investigators aids in reconstructing the burning event and incorporates the contextual relationship of the victim to the scene. A photographic essay illustrating progressive stages of burning and subsequent methods for body reconstruction will be presented along with examples of preexisting trauma and cautionary exemplars.

Fire Investigation, Burned Bodies, Burned Bone

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