

REVIEW ARTICLE

DIFFERENTIATING PERIMORTEM AND POSTMORTEM BURNING

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INTRODUCTION: One of the most challenging cases in forensic medicine is ascertaining the cause of death of burnt bodies under suspicious circumstances. The key questions that arise at the time of investigation include:¹

- Was the person alive or dead prior to fire accident?
- Did the victim die because of burn?
- If death was not related to burns, could burns play a role in causing death?
- Were the burns sustained accidentally, did the person commit suicide or was the person murdered?
- Are the circumstances suggesting an attempt to conceal crime?
- How was the fire started?
- How was the victim identified?
- In case of mass fatalities, who died first?

Postmortem burning of corpses is supposed to be one of the ways to hide a crime. Differentiating the actual cause of death in burn patients is therefore important. Medical examiners usually focus on the defining the changes that occur in tissues while forensic anthropologists deal with the changes related to the bone with or without any the influence of other tissues. Under the circumstances of fire, differentiating the perimortem trauma from that of postmortem cause of bone fractures is vital in determining the cause and motive of death.²

TYPES OF BURN INJURIES: For the purpose of cremation, the body is incinerated at 1000°C for nearly 1 ½ h.¹ Burns are produced when the body is exposed at 44°C for 4–5 h or at 65°C for 2 sec. Hence, the degree of heat required to completely burn a body might not prevail in a home accidental fire. The nature of burn injury depends on the source of fire. Burns can occur upon exposure to heated solid body or molten metal, flame, fire induced by using kerosene, oil and petrol as source, explosions (in coal mines), x-ray and radium, ultraviolet rays, corrosive substances and electrical burns.¹

PATTERNS OF SKELETAL TRAUMA: Relative to the timing of death, two time phases of trauma are defined as antemortem and perimortem. Postmortem alterations to bone are considered taphonomic events and not as trauma.³ Injury to wet or fresh bone (retaining moisture and organic contents) is referred to as perimortem trauma. Injury to dry bone (lacking organic content, collagen and degrading) is referred to as postmortem taphonomy.⁴ The bone fracture in antemortem and perimortem differs from that of post-mortem taphonomic events. Color, fracture outline, angle surface and termination of radiating fracture help in differentiating wet bone from that of dry bone. In living people, bone healing after trauma can be seen as early

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as in 1 week. The biomechanics of antemortem and perimortem 'green' bone is the same except for the 'healing' or 'evidence of osteogenic reaction'. The bones in the postmortem stage have a different biomechanical profile. Postmortem bone will be dry and brittle; when broken it will shatter and the fracture will be regular with sharp edges and will not have any sign of bending. Perimortem fractures will splinter and shares the characteristics of fresh bone fractures.^{2,3}

PATTERNS IN BURN INJURY: Burn trauma adds more complexity in differentiating perimortem from postmortem because thermal conditions accelerate the process of degradation.⁴ Unlike normal decomposition, soft tissues prolong the modification of bone during the process of burning.⁴ What is important is differentiating perimortem thermal trauma from that of postmortem thermal taphonomy to unearth homicide cases. When a person dies of fire accident, certain aspects such as presence of soot in the airways, oesophagus, and stomach confirms that the person was alive at the time of fire accident.⁵ In addition, a positive level of carbon monoxide or cyanide correlates to place of exposure, the nature of the fire and the fuel used. However, when the victim is reduced to ashes, it is difficult to differentiate perimortem trauma from that postmortem taphonomy. The circumstances of death in burn victims can be evaluated based on position and orientation of the dead body, burn patterns on the victim and patterns of skeletal trauma.⁶

Pugilistic position is the characteristic position that a body assumes when burnt. The pugilistic position of the body protects some parts of the tissue from total burns. In the absence of a pugilistic position, a homicide can be suspected. Color gradation in the same bone might provide insights into the degree of exposure to fire.⁶

Physical changes that are seen with burns include dehydration, fracture, patina, splintering, and delamination might not be very different with perimortem trauma and postmortem taphonomy. However, in the process of bone decay, the biomechanical properties of bone undergo transition from wet to dry. In other words, the bone loses its organic components and viscoelasticity properties and becomes brittle or dry. Accelerated loss of bone viscosity following thermal accident provides unique features that differentiate perimortem trauma and postmortem taphonomy. Under intense heat, fracture due to drying of bones is generally postmortem because the fracture occurs in a dry bone and the structure fracturing is not viscoelastic bone. In addition, certain features on the fresh body, curved transverse fractures, heat lines, bordered and calcined bones provide vital clues. A confirmed finding of dry bone is indicative of postmortem report because the dry bone condition remains the same irrespective of the prior burn condition. In case of fresh body, perimortem destruction characteristics (tissue destruction, shrinkage and organic tissue removed from the bone) encompass the fresh body stage as well as calcined bone in some places.⁴

CONCLUSION: Observation of burned body necessarily raises the question as to whether the victim was exposed to fire before or after death. Burning of dead bodies is one of the attempts to conceal the crime. Forensic anthropologists look for signs that differentiate perimortem trauma and postmortem taphonomy. Pugilistic postural changes, biomechanics of burnt bone and fracture morphology provide the vital clues in ascertaining perimortem or postmortem

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burning. Thermal destruction to soft tissue and bone provides vital insights to perimortem burning. With time, the biomechanical properties of the bone changes following the interaction with the environment. Accelerated loss of bone viscosity following thermal accident provides unique features that differentiate perimortem trauma and postmortem taphonomy. State of bones (wet or dry) and its characteristic fracture patterns help in differentiating perimortem and postmortem burns. Despite the difference in biomechanics, in practice, differentiating taphonomic events from trauma as the cause of death is challenging.

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