H68 Using Spatial Analysis to Recognize Normal and Abnormal Patterns in Burned Bodies

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After attending this presentation, attendees will be introduced to the utility of spatial data in recognizing normal and abnormal patterns in burned bodies.

This presentation will impact the forensic science community by quantifying the progression of heat alteration in burned bodies, independent of the circumstances of death or area of heat exposure, thus suggesting criteria for identifying normal and abnormal burn patterns. A mapping approach will demonstrate the utility of geographic information system (GIS) technology for the analysis and quantification of heat alteration to human remains.

Recognizing the typical pattern of heat alteration in burned bodies under normal circumstances is important in a forensic context. Deviations from this pattern may imply special burning conditions such as protective shielding, the presence of accelerants or pre-existing trauma. Symes and colleagues (2008) provided a preliminary model for the normal sequence of bone exposure and heat alteration resulting from tissue thickness and limb position (i.e., body posture). While an invaluable resource, that model is merely derived from observation (based on extensive case experience) and has not been empirically quantified or tested. This study employs GIS to achieve these goals.

The sample data were collected at the Office of Chief Medical Examiner (OCME) in New York City. Burned body information with detailed documentation and known circumstances of death were compiled from cases spanning from January 2005 to July 2009. After excluding superficially burned victims and deaths due to smoke inhalation with little or no heat alteration to the body, the final sample included 74 forensic cases. Cases consisted of accidents (including vehicular accidents), homicides, suicides, and undetermined manners of death at both indoor and outdoor crime scenes. The burn patterns were charted in homunculi diagrams, with an anterior and posterior chart for each body. The degree of heat alteration was coded into five categories: 1 = no burning/minimal burning; 2 = charred tissue; 3 = charred tissue with burned bone visible; 4 = charred tissue with calcined bone visible; and, 5 = missing or fragmentary bone. Polygon shapefiles of the body outlines and burn patterns were created in a GIS application for each case. The vector data were converted to raster data and added together, and the surface areas for each heat alteration category for each case were calculated.

A composite image of the 74 cases illustrates the areas of the body that are more severely altered by heat, as well as the extent of this modification. As predicted by Symes and colleagues (2008), the degree and anatomical pattern of heat alteration can be most accurately predicted from tissue thickness, principally in relation to the sequence in which the areas exposed to heat will attain a particular degree of alteration. In this way, deviations from this sequence can be marked as suspicious, regardless of the overall degree of heat exposure. In order to test this, individuals were ranked based on degree of burning and that rank was compared with the total area burned. Results indicate a strong correlation (R^2 = 0.98, *p-value* < 0.001) between the degree and extension (area) of heat alteration, in such cases where the whole body was exposed to fire, but not at a temperature or period long enough to result in the alteration of the entire body surface. These bodies, therefore, provide a baseline for the normal sequence and intensity of heat alteration. After approximately 80% of the body shows heat alteration, any degree of burning to the body is not uncommon. Abnormal burn patterns are recognized when less than 80% of the body is burned yet a category of 3 or higher of heat alteration is observed. The examination of cases meeting this proposed criteria for the detection of abnormal patterns revealed that they include a homicide with the victim's legs bound by a ligature, a vehicular accident in which the victim sustained extensive blunt force injuries, and accidents with evidence of substantial clothing on the body.

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Burned Body, Pattern Recognition, Spatial Analysis

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