H22 Effects of Heat-Modification on Sharp Force Trauma in Charred Remains

Daisy D.M. Vincent, MA, 29 rue des Poudrieres, Neuchatel, 2000, SWITZERLAND*

The goal of this presentation is to evaluate the significance of heat- modification on sharp force trauma found in charred remains.

This presentation will impact the forensic community by demonstrating that the influence of heat on sharp force trauma found in charred remains is minimal and that the forensic analysis may be carried out with accuracy.

Postmortem criminal burning holds a prominent place in attempts to delay the identification of the victim and the cause of death. Previous experiments have focused on the microstructure of the bone, qualitative changes such as color, shrinkage and warping, and to a lesser extent, trauma in relation to fire modification. Due to the reaction of bone microstructure to fire, it is expected that trauma would be affected as well, which may have an effect on the accuracy of its analysis.

This experiment explores qualitative and quantitative differences between sharp force trauma found on heated bone and on normal bone. The first part of this project focuses on the qualitative effects of heat and fire modification on sharp force trauma. Variability of color shades, as well as the shape of the edges and extremities were documented. The quantitative analysis includes measurements of the defects and of their related morphological features. Depth at each extremity, width of the internal extremity, width at the border of the rib and size of the bone raising at border were recorded. A count of associated fractures and a measurement of the angle of penetration were also included in the quantitative analysis.

Forty-eight fresh domestic pig carcasses were stabbed four times in the left ribs with a utility kitchen knife mounted on a guillotine to obtain stabs of similar orientation and force. The carcasses were stabbed perpendicularly to the ribs. Half the sample (24) was subsequently charred using Propane UN1978 blowtorches. They were superficially charred on their entire side and exposed to flames directed into the trauma sites for 10 to 20 minutes. The process was stopped when the epidermis flaked off and the trauma sites had opened into oval-shaped, gaping wounds with deeper charring on the neighboring soft tissues. The interface temperature of the blowtorches varied between 985 and 1070 degrees Celsius. The carcasses were monitored during decomposition at the TRACES facility in northwest England, and the ribs were collected at various stages of decomposition. After maceration, the trauma sites were analyzed both macroscopically and microscopically. Microscopic analysis included light microscopy qualitative observations and scanning electron microscope measurements. The final sample contained 50 control cut marks and 92 experimental cut marks.

A detrended correspondence analysis and an analysis of similarity (ANOSIM) were used to interpret the qualitative data. The ANOSIM, using the Bray-Curtis dissimilarity coefficient, showed that there is no significant difference between the groups based upon location, morphology and color ($R=0.01372$, $p=0.28394$).

A multivariate analysis of variance (MANOVA) and a principle components analysis were used to analyze the quantitative data and identify the significant variables. The multivariate analysis of variance showed that there is no significant difference between the groups. (Pillai=0.27526, $F_{8,57}=1.16417$, $p=0.33656$). A principle components analysis identified two variables explaining 99% of the variance between the cuts marks: width of the defect at the border of the rib and size of the raising at border.

The results of this experiment show that in charred remains, heat does not seem to affect the shape, size and characteristics of the trauma defects. This discovery is significant as it indicates that tool mark analysis and sharp force trauma analysis can be carried out with the same level of accuracy than on normal bone. It is however expected that a modification of the trauma features may be observed at higher degrees of temperature and longer exposure to heat and fire. More data needs to be collected to evaluate at which stage heat modification may start to significantly affect sharp force trauma features and the accuracy of forensic analyses.

Sharp Force Trauma, Charred Remains, Scanning Electron Microscope

 ** Presenting Author*