



Physical Anthropology Section – 2008

H104 Detection of Gunshot Residue (GSR) on Bone: Potential for Bullet Direction and Range Estimation

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After attending this presentation, attendees will appreciate the potential of using Scanning Electron Microscopy (SEM) with Energy Dispersive X-Ray Analysis (EDXA) to confirm both visually and by elemental composition, the presence of gunshot residue (GSR) on bone with the additional prospect of direction and range estimation.

This presentation will impact the forensic community by presenting findings that may potentially lead to the development of techniques to estimate the distance of shooter to victim by the presence of GSR on bone.

The purpose of this study was to determine if gunshot residue could be detected on bone at varying distances by visual means using Scanning Electron Microscopy as well as by elemental composition using Energy Dispersive X-Ray Analysis. Six pork ribs were shot at distances of one through six feet at one foot increments using American Eagle .45 caliber, 230 grain, full metal jacket bullets. Each rib, with the meat intact, was placed inside a plastic Ziploc® bag and shot with the bullet penetrating the plastic, approximately one inch of muscle tissue, and the bone from external to internal surface. After each rib was shot the meat was removed using scissors and the periosteum was forcibly stripped from the bone. The ribs were placed in paper bags and put into an incubator to dry at 40 degrees Celsius (approx. 104 degrees Fahrenheit) for five days. The ribs needed to be completely dry so that vacuum could be achieved in the SEM without contaminating the instrument. After the ribs were dried they were removed and allowed to cool. The ribs were not coated with conducting material, such as gold or carbon as is common practice, in an attempt to be as non-destructive as possible.

The fracture pattern associated with each rib was examined in order to verify the entrance side of the bone. For ease of placement of the rib into the specimen holder, the exit side of the rib was defined as the side of the bone directly opposite to the determined entrance side. The ribs were then positioned in the specimen holder so that the analysis could be performed on either the entrance or exit side of the bone and then placed in the specimen chamber of the Hitachi VP-SEM S-3400N for analysis.

Visual analysis was performed as close to the fracture site as possible at 20kV and a working distance of 10mm. An area of high concentration of gunshot residue was identified and micrographs were taken of the site. The initial micrograph taken at 130X magnification was used to count the number of GSR particles present in a 400µm diameter circle. This initial micrograph was chosen due to the nature of the GSR particles as they tend to melt after a prolonged period under the electron beam. Elemental analysis was performed using the Oxford INCA Energy 200 Dispersive X-Ray Analyzer over the area of high concentration of GSR particles at 270X magnification, which was chosen due to the GSR particles melting part of the way through the analysis if performed at a higher magnification. Elements of interest that were identified were Lead, Antimony, Barium and Molybdenum which are known components of GSR.

Results indicate that this is a feasible means to identify the presence of gunshot residue on bone both visually and elementally using SEM/EDXA from distances ranging from one to six feet. There is potential for visually differentiating between the entrance and exit sides of the bone as the gunshot residue appears to distribute differently on each side. Additionally, this technique may hold potential for the development of an objective method for estimating firearm to target distance as the number and diameter of GSR particles counted in this study tended to decrease with distance. Since the forceful removal of the periosteum did not seem to interfere with the adherence of these particles to the bone, further testing is planned to determine the affects of decomposition on GSR on bone.

Gunshot Residue, Terminal Ballistics, Gunshot Trauma