## H53 Strontium Particles: Confirmation of Primer Derived Gunshot Residue on Bone in an Experimental Setting

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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 primer derived gunshot residue (GSR) on bone.

This presentation will impact the forensic science community by discussing how the use of an SEM and EDXA on bone fractures has the potential of providing a means of determining whether a bullet was involved and a mechanism of trauma.

Motivation for this project was derived from recent research that resulted in two papers presented at the 60th annual meeting of the American Academy of Forensic Sciences held in Washington, DC. This research was first undertaken to demonstrate the presence of primer derived GSR deep within the wound tract (Berryman *et al*., 2010); a finding that is counter to the generally-held belief that it is found only on clothing, skin, or at the subcutaneous level. The GSR examined in this study is solely primer-derived and not other general soot-related particles that can arise from multiple sources including propellant, lubricants, and metals found in the bullet, bullet jacket, cartridge casing, and gun barrel. It is vital to differentiate the sources of GSR, as it is only primer derived GSR that are considered unique to the shooting environment. It is these unique particles measuring 0.1 µm to 55 µm in diameter that are examined in this study.

The current research was directed at confirming the original findings of primer derived GSR (Berryman *et al*., 2010). The experimental design is essentially the same as the original one. Pork ribs with intact muscle tissue were used in an experimental attempt to identify bullet wipe on bone at distances from one to six feet. Instead of the barium/antimony/lead-based primers used in the initial study, bullets with strontium-based primers were used since this element is not readily present in the shooting environment. In addition, the authors devised a rigorous protocol both in the shooting and processing environments to eliminate the potential risk of contamination. The presence of strontium therefore, would confirm that the GSR particles observed on bone are derived solely from primer components, and not from elements present in the bullet, bullet casing, or gun barrel.

After processing, which involved the forceful removal of periosteum and drying of the ribs, each fragment was placed in the Hitachi S-3400 SEM for visual analysis. With backscattered electrons, the intensity of the signal is directly related to the atomic number of the material being illuminated by the electron beam. By adjusting the contrast, brightness, gain, and scan rate, particles containing heavy elements, having a higher atomic number, in this case Strontium, will glow brightly as compared to the rest of the field, specifically the bone. Particles that glowed brightly using this process were then examined for their elemental composition using the Oxford INCA Energy 200 Dispersive X-Ray Analyzer.

Strontium particles were found on ribs shot at gun-to-target distances of one to six feet confirming the original findings of Berryman *et al*. (2010), that *primer derived* GSR occurs well below the level of subcutaneous tissue and is present on bone, even after the forceful removal of the periosteum in gun-to-target distances of up to 6 feet. This research is ongoing with expanded sample size and an increase in gun- to-target distances to determine the maximum range primer-derived GSR can be detected on bone. Further research could provide a method for determining gun to victim distance although this could be extremely complicated due to the wide variety of ammunition available, including variations in primer composition, caliber and bullet type; however, this technique could prove useful in situations where ammunition type is known permitting test firings to establish case-specific distances. Additionally, if GSR particles are present after decomposition then these observations can be used to verify a gunshot wound to bone in the absence of a typical gunshot wound fracture pattern.

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**Gunshot Residue, Terminal Ballistics, Gunshot Trauma**

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