G96 Gunshot Wounds Covered by Different Textiles: Determination of GSR Through Micro-CT Analysis

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After attending this presentation, attendees will have novel information on the role of Micro-CT analysis of gunshot wounds for estimating the firing range.

This presentation will impact the forensic science community by adding new data on the estimation of the firing distance of intermediate- range gunshot wounds in clothed victims, through a micro-CT analysis of the gunshot residue.

Estimation of the firing range is often critical for reconstructing gunshot fatalities, where the main measurable evidence consists of the gunshot residue (GSR). Several techniques and methods have already been used for characterizing GSR, such as Atomic Absorption Spectroscopy, Neutron Activation Analysis, Autoradiography, Routine- CT, Scanning Electron Microscopy, and Histochemistry. Recently, a novel approach, based on the use of Micro-CT, proved to be an objective, reliable, rapid, and inexpensive tool for estimating the firing range in intermediate-range shots.

Aim of the Study: It is well known that the presence of clothes covering the body heavily affects the distribution of GSR on the entrance wound, hindering the estimation of the firing range on the basis of the sole macroscopic inspection.

The goal of the present study was to evaluate the differential distribution of GSR, with regard to the different kinds of textiles covering the skin, by means of micro-CT analysis, with the final purpose of reconstructing the firing distance.

Materials and methods: Human legs, surgically amputated, were cleaned of dried blood and any other contaminants, and cut into sections of approximately 6 cm in length.

A total of 60 sections were selected; each section was covered with a single type of textile, chosen among cotton fabric (n = 15), jeans (n = 15), leather (n = 15), and waterproof synthetic fabric (n = 15). Bare skin sections were used as controls (n = 15).

Firing was carried out perpendicularly at distances of 5, 15, and 30 cm, using a .32 pistol loaded with full-jacketed bullets. A total of 75 shots were performed (five replicates for each distance). After each firing test, the gunshot wounds were photographed and formalin fixed.

The skin specimens, comprising the epidermis, dermis, and subcutaneous fat, were cut into parallelepipeds (height 1 cm, side 1 cm) with a lancet. Samples were scanned following standard processing procedures, using a high resolution scanner.

The acquired raw data were reconstructed with reconcilliation software, which uses the back-projection algorithm to reconstruct axial subsequent images saved as bitmap format. The bitmap images were analyzed by a CT analysis software: the selected volume of interest (VOI side of 1 cm and height of 3.8 mm) was focused in the centre of the specimen in order to have the entire entry wound positioned in the middle. All the samples were binarized using the same parameters.

The percentage of GSR deposit was calculated analyzing all particles with a density higher than 1000 Hu (particles with a density lower than 1000 Hu were excluded to reduce iron artefacts). The 3D images were reconstructed through a Ct-Vox Software.

Results: The visual inspection of the skin did not allow the estimation of the firing distance for the covered gunshot-wounds; the morphological features of the entrance wounds (blackening and tattooing) were, indeed, not discernible.

The micro-CT analysis revealed that:

- GSR particles were less represented in cases compared to controls;
- In cases GSR particles were distributed inside the cavity and the fatty tissue of the entrance wound, while in controls they were present mainly on the skin around the hole; and,

  Increasing the firing range, the radiological detection of GSR progressively decreased in both cases and controls, allowing a good discrimination of the firing distances tested in the present stud

  Conclusions: Micro-CT analysis might be useful for the forensic

assessment of the firing range, particularly when the morphological features of intermediate-range wounds are not visually discernible (i.e., black people or clothed victims).

Forensic Pathology, Gunshot Wounds, Firing Range

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