H78 Staining in Firearm Barrels: A Fundamental Study

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The goal of this presentation is to encourage medical examiners and police investigators to use firearms as a valuable source of victims' DNA.

This presentation will impact the forensic science community by revealing how staining in gun barrels develops and its importance for shot range estimation.

Background: In firearm suicides, backspatter is found on the hands of the deceased, which can be valuable evidence of a self-inflicted injury. Biological staining inside the barrel is increasingly revealed by endoscopy of firearms involved in contact gunshots to the head.[1] The Swiss National Foundation funded a three-year research project to investigate the conditions determining these traces inside barrels. The systematic experimental approach to the phenomenon is introduced.

Material and Methods: According to the "triple contrast method," 2ml acrylic paint, 1ml barium sulphate and 2ml human blood were mixed and sealed in thin, flat foil bags measuring 5cm x 5cm.[2] These bags were glued on a synthetic absorbent kitchen wipe on which 10% gelatin solution was molded to create cubes of 12cm in length. The kitchen wipe covering the paint pad on the inside formed the front of the cube. Following Fackler's recommendations, gelatin was stored at 4°C for at least 60h. Close contact shots were performed on the target models and recorded by high-speed videography (SA-X2, Photron). Common firearms covering the forensically relevant calibers 0.22, 0.32, 0.38 special, 9mm Luger® and 0.45 Automatic Colt® Pistol (ACP) were fired using non-deforming bullets. Immediately after each shot the barrel was examined using a rigid borescope and staining was documented by video. Samples were taken from the anterior and the posterior part of the barrel using the double-swab technique. The DNA yield was determined by quantitative Polymerase Chain Reaction (PCR).

Results: Endoscopy revealed a great variability of pattern and amount of colored material inside the barrels. In many shots, visible traces could be observed up to the chamber. For those without visible staining in the posterior part of the barrel, DNA analysis was positive. The comparison of the results demonstrated that the intensity of staining did not depend on the caliber, but on the system of the weapon. The greatest yield of traces was obtained with self-loading pure blowback pistols, followed by bolt-action rifles and high-power semi-automatic pistols. Revolvers yielded much less staining.

Close contact shots by the same firearms using blank cartridges caused analogous staining. Admittedly, the amount of staining was not comparable, because blank cartridges did not reach the same muzzle gas pressure as live ammunition.

The gelatin block was shortened up to an ultra-slim target containing only the kitchen wipe and the paint pad embedded in a small layer of gelatin. Close contact shots continued to demonstrate the typical pattern of staining in the barrel. As a consequence, the temporary cavity cannot be the principal force causing the staining inside barrels; however, the influence of the temporary cavity on the amount of traces has to be investigated.

Conclusion: The experimental study of close contact shots provided a reliable staining, in part along the entire barrel length. Different factors influencing the staining, such as the weapons' system, muzzle gas pressure, and the temporary cavity, have been investigated. In real cases, other factors, such as the positioning of the firearm or a temporary gap between muzzle and skin, have to be taken into account.

Reference(s):

1. Schyma C., Madea B., Courts C. (2013) Persistence of biological traces in gun barrels after fatal contact shots. *Forensic Sci Int Genet.* 7(1): 22–27
2. Schyma C., Lux C., Madea B., Courts C. (2015) The 'triple contrast' method in experimental wound ballistics and backspatter analysis. *Int J Legal Med*. 129(5): 1027-1033

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