



E105 Validation of New Test Media for Gunshot Residue Visualization in Distance Determination Methods

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Learning Overview: After attending this presentation, attendees will better understand the advancements in, as well as limitations of, contemporary substrates used to perform chemical analyses in gunshot distance determinations.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by validating the capabilities of modern test media to replace the dwindling supply of conventional resources, as well as demonstrating the efficacy, or lack thereof, of the new materials when integrated into proven laboratory methodology.

Considering the staggering number of violent crimes committed using firearms in the United States, it is crucial for analysts to have a reliable means of evaluating and reconstructing a gunshot incident.¹ The estimation of muzzle-to-target distances is commonly inferred by measuring the diameter of the nitrite residue pattern transferred from the victim's clothing onto desensitized photographic paper via the Modified Griess Test (MGT), then comparing that measurement to a range of laboratory-generated standards. However, with the proliferation of digital photography, inkjet photo papers have been examined as a replacement to their increasingly costly and scarce predecessor with remarkable success.^{2,3}

The goal of this study was twofold: (1) validate an inkjet photo paper to be incorporated into the Standard Operating Procedure (SOP) for the North Carolina State Crime Laboratory, and (2) evaluate the potential of the paper to retain adequate lead residues following Modified Griess processing to be revealed using an application of Sodium Rhodizonate.⁴ The goal of the latter parameter was to identify a means of reinforcing the results obtained through the traditionally accepted methodology.

During the MGT, a hot clothing iron is pressed onto an assembly comprised of a piece of gauze saturated with a 15% acetic acid solution and the sample material placed face down on the emulsion side of photo paper. The paper was previously treated with a sulfanilic acid and alpha-naphthol solution. The acetic acid is vaporized and penetrates the sample material, inducing a chromophoric reaction on the photo paper indicating the presence of nitrite residues. It was the secondary intention of this study to confirm the incidental transfer of lead residues to the photo paper during MGT processing. The Sodium Rhodizonate test could then be performed on the photo paper to reveal the presence of lead residues that may have been displaced by the MGT. The fundamental mechanism driving the movement of lead residues is similar to that of the Bashinski Transfer method, a previously verified procedure among firearms examiners.⁴ Filter paper saturated with acetic acid is placed over a bullet hole on the victim's clothing, ironed until dry to attract the lead, and subsequently treated with Sodium Rhodizonate. If lead residues adhered to the photo paper in a similar manner during the MGT, the paper could be treated with Sodium Rhodizonate alongside the other materials, and the results used to supplement any findings using the Bashinski method.

The inkjet paper performed comparably to the desensitized paper without any alterations to the established Modified Griess procedure, noting that the papers with a glossy or semi-gloss finish were substantially better suited for this analysis. It was not possible, though, to observe lead residues on the photo paper to a degree that would satisfy evidentiary standards or outperform the recognized methodology.

Reference(s):

- ¹ *Crime in the United States: 2016*. Uniform Crime Reporting, Federal Bureau of Investigation, last modified April 12, 2018, <https://ucr.fbi.gov/crime-in-the-u.s/2016/crime-in-the-u.s.-2016>.
- ² Kathleen A. Hafeli. *Investigating a Substitution for Photographic Paper When Performing the Modified Griess Test for Gunshot Residue Analysis*. MS thesis, California State University, Los Angeles, 2012, 23-40.
- ³ Philip A. Hess, BS, MS, and Leslie L. Poole, BS, D-ABC. The Validation of Inkjet Photographic Paper for Use with the Modified Griess Test. *AFTE Journal* 37, no. 3 (Summer 2005): 213-223.
- ⁴ Firearms Technical Leader. Technical Procedure for Distance Determination. *North Carolina State Crime Laboratory—Firearms Unit*, version 7 (September 2017): 3-9.

Firearms Examination, Gunshot Residue, Distance Determination