TECHNICAL NOTE

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Modified Sheet Printing Method (MSPM) for the Detection of Lead in Determination of Shooting Distance

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ABSTRACT: In this study the sheet printing method (SPM) for determination of shooting distance has been modified. Instead of cellulose hydrate foil, a plastic-based photographic paper was used as a substrate for transfer of metallic gunshot elements from cloth. The modified sheet printing method (MSPM) has been successfully tested in more than 100 shooting experiments. This technique saves time and has several additional advantages in comparison with the SPM method.

KEYWORDS: forensic science, shooting distance, desensitized photopaper, lead detection, sheet printing method

The sheet printing method (SPM) developed by Leszczynski (1) is a well-known and commonly used method for the determination of shooting distance. It is an impression method where a sheet of cellulose-hydrate, treated with acetic acid, is pressed against the clothing being investigated. The disadvantages of this thin sheet is that it is difficult to handle, is fragile and easily torn. Rinsing of the sheet, drying and mounting (for putting into records) is a time-consuming process.

In our laboratory, three different chemographical processes (wet chemistry methods) are routinely used for the determination of shooting distance. In addition to the SPM method, also the Modified Griess Test (MGT) (JH Dillon, FBI Laboratory, unpublished results) and the copper/nickel test method (KTM) are carried out. All these methods can be combined and thus used on the same examined material, provided that the SPM method is the last test performed.

The MGT and KTM methods both employ desensitized photographic paper instead of cellulose-hydrate sheet. The emulsion layer of the photopaper is the place where the reaction for the detection of lead and copper/nickel, respectively, occurs.

In this study, an effort was made to modify the SPM method by replacing the cellulose-hydrate sheet with photopaper. Various manufacturers and grades of photopaper, as well as materials of shot objects, were tested with good results.

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Material and Methods

All the reagents used were the same as in the original SPM procedure (1). The photographic paper (plastic-based) was purchased from ordinary photoshops. Prior to use, the photopaper was desensitized using a photographic fixer and dried.

Procedure

The photopaper is treated with a 15% acetic acid solution for 30 min, then placed with the emulsion side towards the target object. The backsides of the target material and photopaper are covered by plastic-coated cellulose and finally placed between two massive metallic plates for equalization of pressure applied in the pressing. The whole package is compressed in a hydraulic press for 30 min, the pressure applied is 7 tons (7000 kg). Afterwards, the photopaper is removed and treated with a saturated solution of sodium sulfide. Brown patterns of lead are developed by this treatment. The photopaper is rinsed with tap water for 2 min and dried (about 10 min hanging in a drying cabinet or 15 min in a fume-cupboard). The dried paper can easily be marked with information, such as the case number or the name of the investigator, using a felt-tip pen.

Results

Figure 1 shows an example of the results obtained by the proposed modification of the SPM method. This figure depicts the distribution pattern of lead particles developed by the presented technique on Kodak multigrade photopaper. The shooting distance was 10 cm, 30 cm and 50 cm, respectively. The weapon was a Taurus revolver with a 6 in. (15.24 cm) barrel and the ammunition was .38 caliber Federal with round-nose lead bullet. The colored spots appear very clearly on the white paper background.

A series of test shootings was carried out using a Smith & Wesson revolver (Model 17, 6-in. barrel) at a shooting distance of 0.5 m. The ammunition used was .22 Norma with lead bullet. Pieces of cotton cloth were employed as shooting objects. In 30 shootings, cellulose hydrate sheet and the SPM method was used for transfer of lead particles from the cloth to the sheet for detection by the color reaction. In another 30 shootings, desensitized photopaper and the modified SPM method was employed. A number of photopapers from various manufacturers and of different gradations were tested to investigate suitability of these materials as substrate for the determination of shooting distance. The differences in the

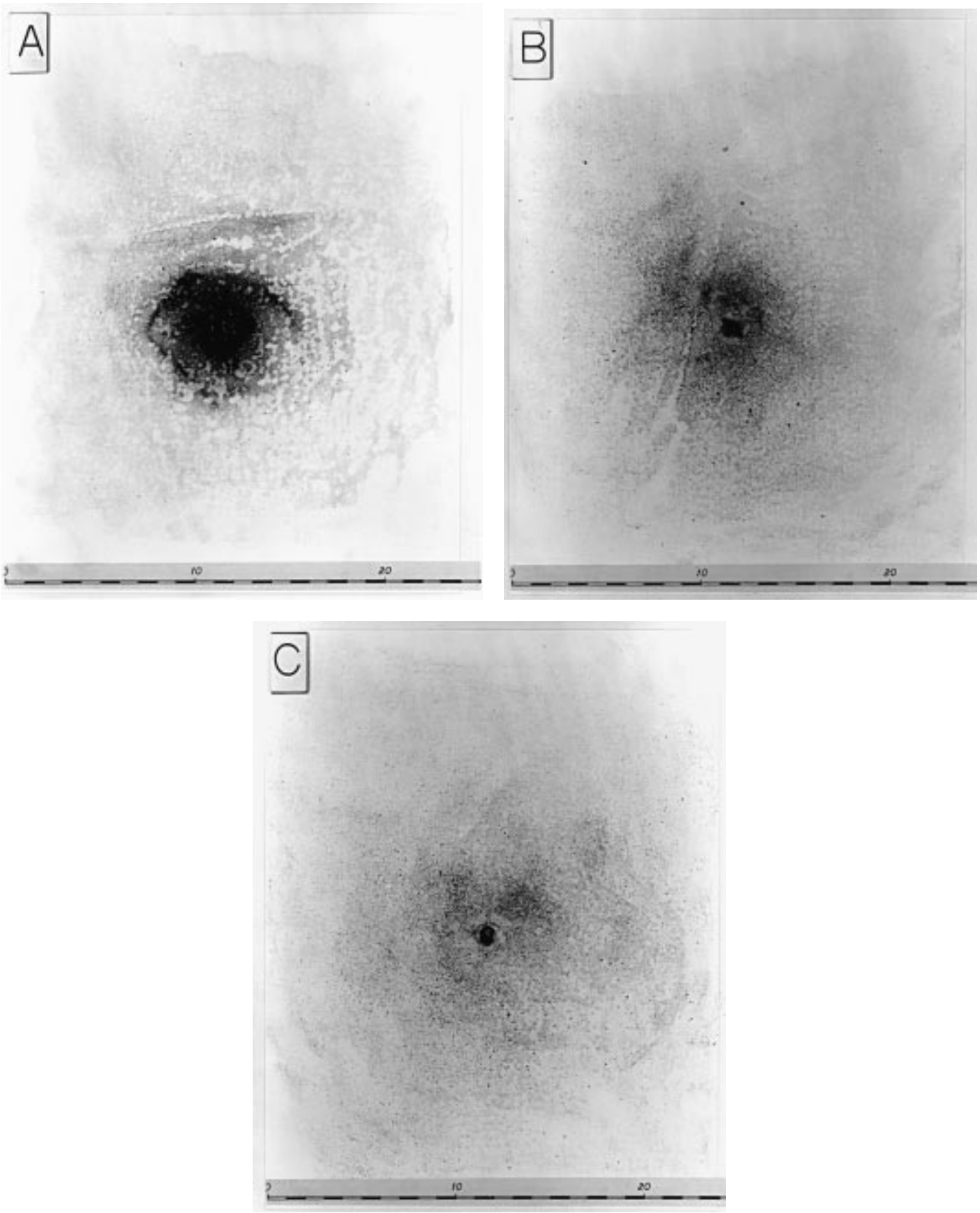

FIG. 1—*Distribution pattern of lead particles developed by color reaction on desensitized photopaper using the modified SPM method. Shooting distance—10 cm (A), 30 cm (B) and 50 cm (C). A Taurus revolver firing .38 caliber Federal ammunition with round-nose lead bullet was used.*

TABLE 1—*Results obtained using various types of photopapers. All the papers had a glossy surface and were 24.0 × 30.5 cm.**

Manufacturer and Type of Photopaper	Quality of Results
Kodabrome II RC, F2	very good
Kodabrome II RC F3	very good
Kodabrome II RC F4	good
Agfa Brovira Speed 310 RC, 1	good
Agfa Brovira Speed 310 RC, 2	very good
Agfa Brovira Speed 310 RC, 3	good
Agfa Brovira Speed 310 RC, 5	good
Ilfospeed RC de Luxe 1 M, 2	good
Ilfospeed RC de Luxe 1 M, 3	very good
Ilfospeed Multigrade IV de Luxe	very good

* The price of 50 sheets of the various photopapers is about $25. This is somewhat more than the price of the cellulose-hydrate sheet—$38 for 100 sheets.

character of the emulsion layer might produce different results. Altogether, ten different photopapers from three different manufacturers (Kodak, Agfa, Ilford) were tested, both multigrade and normal gradation papers (Table 1). A comparison of the results achieved by the SPM and the modified SPM methods, respectively, revealed that the photopaper is a very suitable substitute for the cellulose hydrate sheet. Results comparable or even better than using the conventional method were obtained for all the photopapers tested.

Another series of shootings was performed using various materials as shooting objects including leather, wool, acrylic clothing and several kinds of clothing made from mixed fibers (rayon/cotton, acrylic/nylon, etc.). The shooting distance was 0.5 m with two Smith & Wesson revolvers (6-in. barrel for both weapons) and the ammunition was .22 and .357 magnum. Also in this experiment, 30 shootings were carried out and the results of the SPM and modified SPM methods, respectively, were compared. The photopaper used was Kodak multigrade. All the results with photopaper were clearly positive and good distribution patterns for the lead particles were obtained. No significant difference in the results achieved by the two methods was noted.

Some experiments were performed to investigate the possibility of repeated pressing of photopaper on the same shooting object (a new desensitized paper and the same procedure for each pressing). As with the conventional SPM method, also photopaper gave positive results when pressed for a second and third time into the same object.

Conclusion

The modification of the SPM method (MSPM) by replacing the cellulose-hydrate sheet by photographic paper has several advantages. Colored spots, indicating a positive reaction for lead, appear clearly on the white paper background; even weak spots are visible. The time needed to perform the test is much lower compared with the original method. This is due mostly to a shorter drying process needed for photopaper, unless the laboratory possesses quite expensive equipment for drying cellulose-hydrate sheets. Also, the whole procedure for the determination of shooting distance is simplified, since the same material (desensitized photopaper) is used in all three test methods (SPM, MGT and KTM). In our laboratory the process of desensitization of photopaper is automatic with the capacity of about 50 papers in 5 min (inclusive drying).

Reference

1. Leszcynski C. Bestimmung der Schussentfernung, Kriminalistik 1959;9:377.

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