TECHNICAL NOTE

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Laser Detection of Latent Fingerprints on Skin

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ABSTRACT: Latent fingerprints on skin can be developed by dusting them with fluorescent powders or evaporative staining with fluorescent dyes, followed by laser examination. On dead skin, latent fingerprints could be developed by evaporative staining over time spans up to two days after deposition.

KEYWORDS: criminalistics, fingerprints, lasers, skin, Rhodamine 6G

The first publication on the use of lasers for latent fingerprint development appeared in this journal in 1977 [*1*]. While that paper emphasized the laser detection of latent prints by their inherent luminescence, a number of alternative procedures, including staining or vapor deposition of fluorescent substances and treatments with chemicals reacting with fingerprint components to form luminescent products, were also suggested. These and other approaches were subsequently explored [*2-9*]. Most surfaces are now amenable to laser detection, particularly in view of the recently reported method involving ninhydrin and zinc chloride [*9*]. It has been pointed out [*6*] that nonfluorescent ridge detail on fluorescent surfaces can occasionally be enhanced by laser examination. This approach can be effective on ninhydrin-treated surfaces such as brown paper or cardboard [*10,11*]. Cloth, however, is still only rarely amenable to laser procedures, and skin remains difficult to deal with. Successful case examinations with several laser procedures have been reported [*6,10-12*]. Because of the importance of development of latent prints on skin in murder cases, for instance, a number of procedures, including dusting with magnetic powders [*13*], Kromekote card lifting [*13*], electronography [*14*], and laser detection by inherent luminescence [*1,6,12*], have been investigated. These methods, however, are only occasionally successful. The iodine-silver plate method is presently perhaps the most widely tried approach. It, too, fails all too frequently. The current methods of fingerprint development on skin have recently been reviewed [*15*]. In this paper, the potential of dusting with fluorescent powder or vapor deposition of fluorescent dye, followed by laser examination, is considered.

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Experimental Procedure

Three kinds of skin samples were investigated. Very thin skin samples of the type used in skin transplants, which had been removed from a back (white) with an air dermatome, placed in a saline solution with 10% glycerine, and refrigerated, were obtained from E. Harold Hoffmeister of the Texas Department of Public Safety. These samples were first warmed to room temperature, blotted, and then left to dry further in a fume hood for several hours. Once the samples had dried to the point of only very slight dampness, fingerprints were deposited by the investigator by touching the samples for about 1 s with moderate pressure. The samples were then immediately inspected under argon-laser illumination. No fingerprints could be detected by inherent fluorescence. The samples were then stored in a fume hood with the blower off, that is, under essentially normal ambient indoor conditions. One day later, some of the samples were dusted with Mars Red (Criminal Research Products, Inc.), and Rhodamine 6G was vapor deposited on the remaining samples. The vapor deposition consisted simply of holding the samples over a heated, 10-cm-tall beaker containing the dye. Some of the dusted samples showed fingerprint development on argon-laser examination, even though no development was discernible in room light. Figure 1 shows a fingerprint in this category. The vapor-stained samples showed substantially superior development under the laser. Fingerprints with good ridge detail and luminescence contrast were found on every sample. The dye-developed prints were reinspected under the laser (3 W, all lines) one day after the dye deposition. Partly because of dye migration and partly because of fingerprint residue migration, some smudging of developed prints was found. Figure 2 shows one of these prints, photographed under laser illumination one day after vapor staining. While only some ridge detail ramains visible, the fluorescence contrast between the print and the surrounding skin remains high.

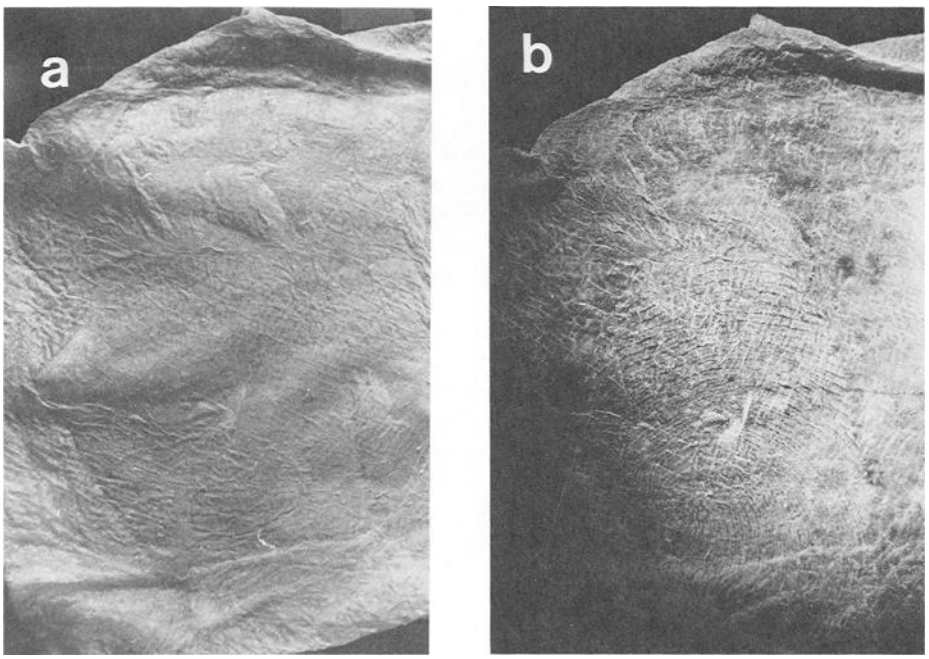

FIG. 1—*Skin sample dusted with Mars Red in room light* (a) *and under argon-laser illumination* (b). *The print in* b *was photographed through an argon-laser safety filter (Fisher, 11-409-50A) with Tri-X Pan film.*

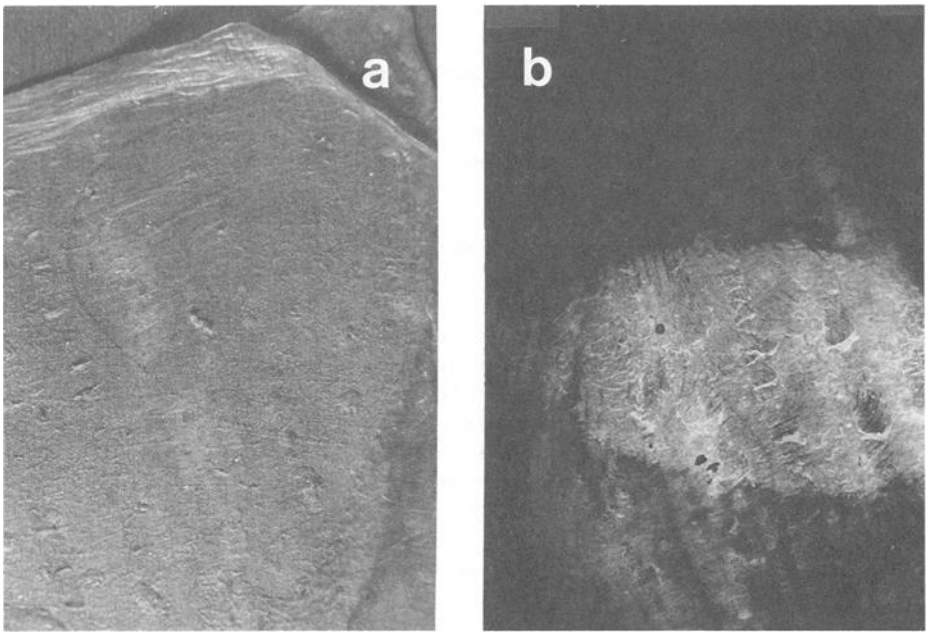

FIG. 2—*Skin sample treated by Rhodamine 6G evaporation in room light* (a) *and under argon-laser illumination* (b).

Because of the encouraging results obtained with these samples, a second set of samples was studied. These samples, female (white) breast skin with underlying fatty tissue, were furnished by Dr. Milton M. Rowley of Lubbock, TX, immediately following two breast reduction surgeries, and were preserved by freezing. Some weeks later they were thawed, blotted to remove excess moisture, and left in a fume hood for several hours to achieve a dryness similar to that of live skin under conditions of low perspiration. Fingerprints were then deposited by the investigator by touching for about 1 s with light to moderate pressure. Laser examination immediately following revealed no latent prints by inherent fluorescence. About 15 min later some of the samples were dusted with Mars Red and others were subjected to Rhodamine 6G evaporation. No ridge detail was found in room light on any sample and only few prints emerged under the laser on dusted samples. However, fingerprints were developed by laser on most of the dye-treated samples.

Dye evaporation was successful for both freshly deposited prints and prints one day old, with storage as described above. However, for the one-day-old samples, the development intensity and success rate had decreased considerably in comparison with the fresh samples. Figure 3 shows a one-day-old developed print. Reinspection of samples one day after dye deposition showed very pronounced smudging caused by dye migration. An effort was made to compare the iodine-silver plate method to the dye evaporation approach. Prints were deposited under equal conditions on two samples obtained from breast reduction surgery. One of the samples was subjected about 15 min later to the iodine-silver plate procedure and the other sample was simultaneously treated by Rhodamine 6G evaporation. No prints were developed by the iodine-silver plate method. Prints were developed on laser examination of the dye-treated sample. Though it may be that the investigator's lack of experience with the iodine-silver plate method contributed to the negative result with it, the dye evaporation procedure clearly emerges as a promising one. Several samples were treated with Rhodamine 6G two days after fingerprint deposition. While some prints could be detected, the success rate was low and the ridge detail was faint. Because of the presence of fatty tissue, this second set

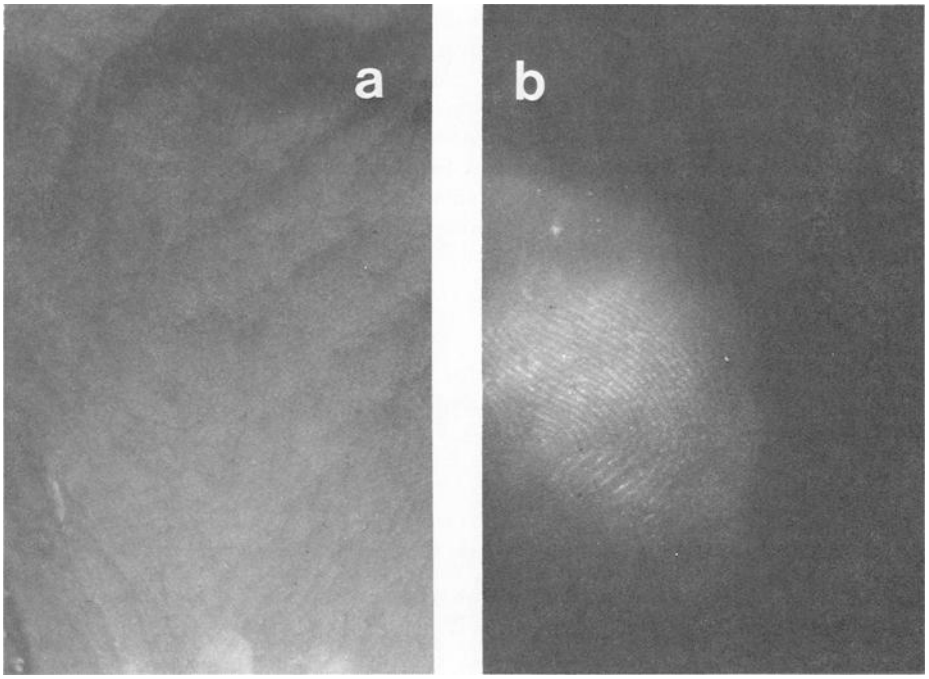

FIG. 3—*One-day-old latent print on skin sample treated with Rhodamine 6G in room light* (a) *and under laser* (b).

of samples had a softness very similar to that of live skin, that is, these samples approached the actual case situation more closely than the first set of back skin samples.

A third set of experiments was performed on live skin (the investigator's forearms). Skin treatment was kept to a practical minimum because extensive experimentation on live skin is not advisable in the absence of health hazard evaluation of chemicals. Prints deposited by the investigator by touching with slight pressure for about 1 s were dusted a few minutes later with Mars Red and a fluorescent magnetic powder (FMP-01, Sirchie Laboratories) that responds to near-ultraviolet light (obtainable with the argon-laser). Although the fluorescence contrast between the dusted prints and the surrounding areas was good under laser examination, ridge detail was generally not as good as on the earlier two sets of samples. Evaporative Rhodamine 6G deposition produced good luminescence contrast but poor or no ridge detail, presumably because the heating associated with the dye deposition step caused skin perspiration. Skin inspection under laser is often aided by a magnifying glass, and photography with print enlargement often reveals detail not seen on inspection.

Discussion

Because of the restricted availability of skin samples to the investigator, the experimental scope was necessarily limited. Nonetheless, the present study indicates a potential use of laser examination together with dusting or evaporative dye staining. A combination of this approach with current procedures, such as Kromekote lifting, may be useful on live skin [*16*]. The results obtained suggest that evaporative dye staining may be well suited to the examination of cadavers. Construction of a dye evaporation apparatus akin to the iodine fuming pipe should not be difficult. The potential value of evaporative dye staining becomes apparent when one compares it to the iodine-silver plate method. The latter is in essence a two-step procedure. First, the iodine vapor has to preferentially adhere to the latent print. Sec-

ond, iodine has to be transferred to the silver plate. Evaporative dye staining is analogous in principle, but the second or transfer step is absent and the corresponding loss factor is eliminated.

Quite clearly, extensive comparison between the approach described here and current procedures is called for. Various fluorescent dyes should be investigated, including dyes that respond to the near-ultraviolet. In the present work, Rhodamine 6G was chosen because it is superbly suited to blue-green argon-laser illumination and because earlier studies by the investigator have yielded good results on a variety of surfaces, including paper, Styrofoam®, anodized aluminum, plastic, and glass.

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