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TR-07-95
A Comparison of Techniques for the Visualisation of Fingerprints on Human Skin Including the Application of Iodine and α-Naphthoflavone

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TECHNICAL REPORT

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Submitted by
RCMP Forensic Identification
Research and Review Section

NOTE: Further information about this report can be obtained by calling the CPRC information number (613) 998-6343

Figure 1a Latents visualised with cyanoacrylate ester and TEC dye deposited at skin temperature of 30 degrees C

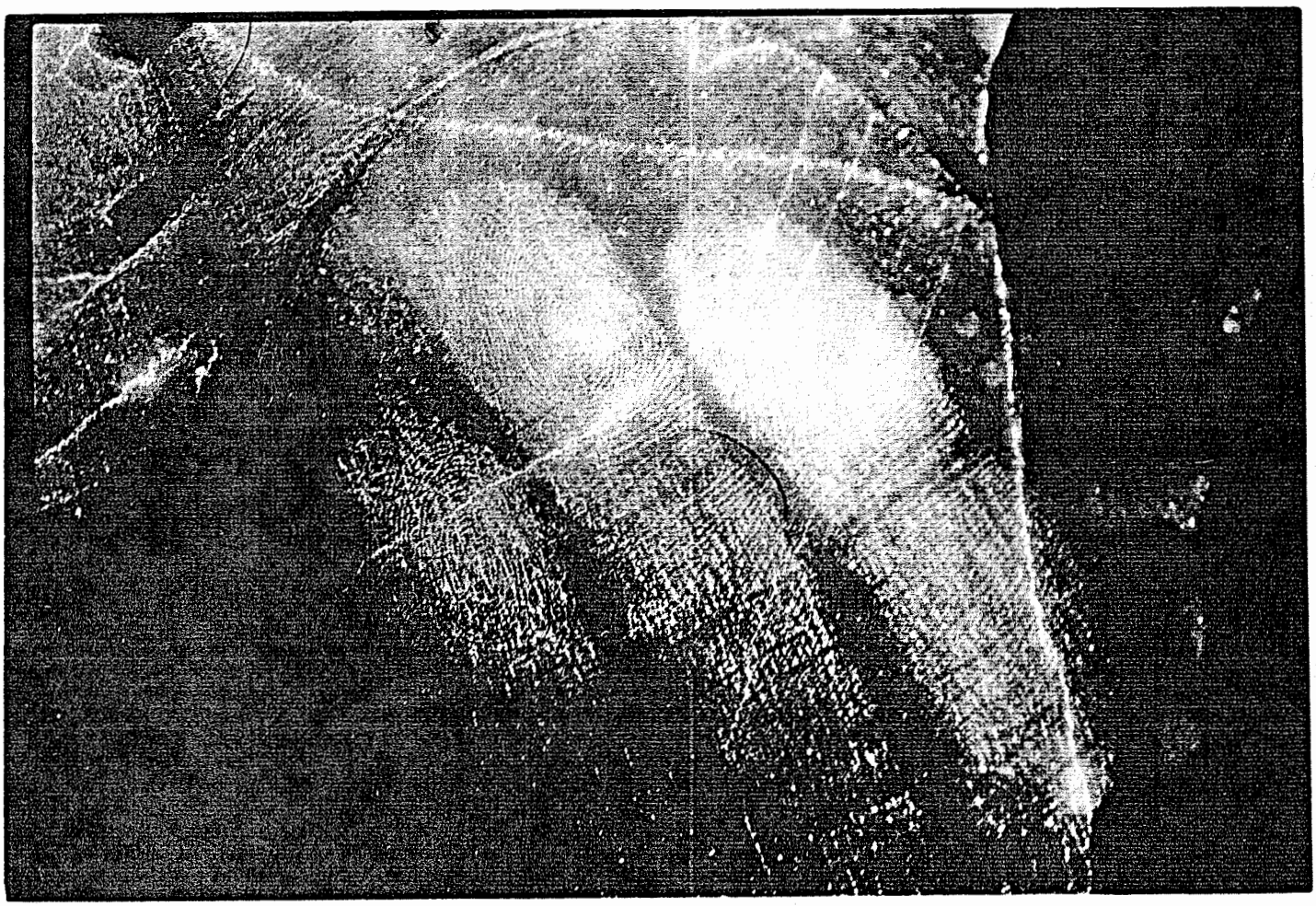

Figure 1b Latents visualised with cyanoacrylate ester and TEC dye deposited at skin temperature of 28 degrees C

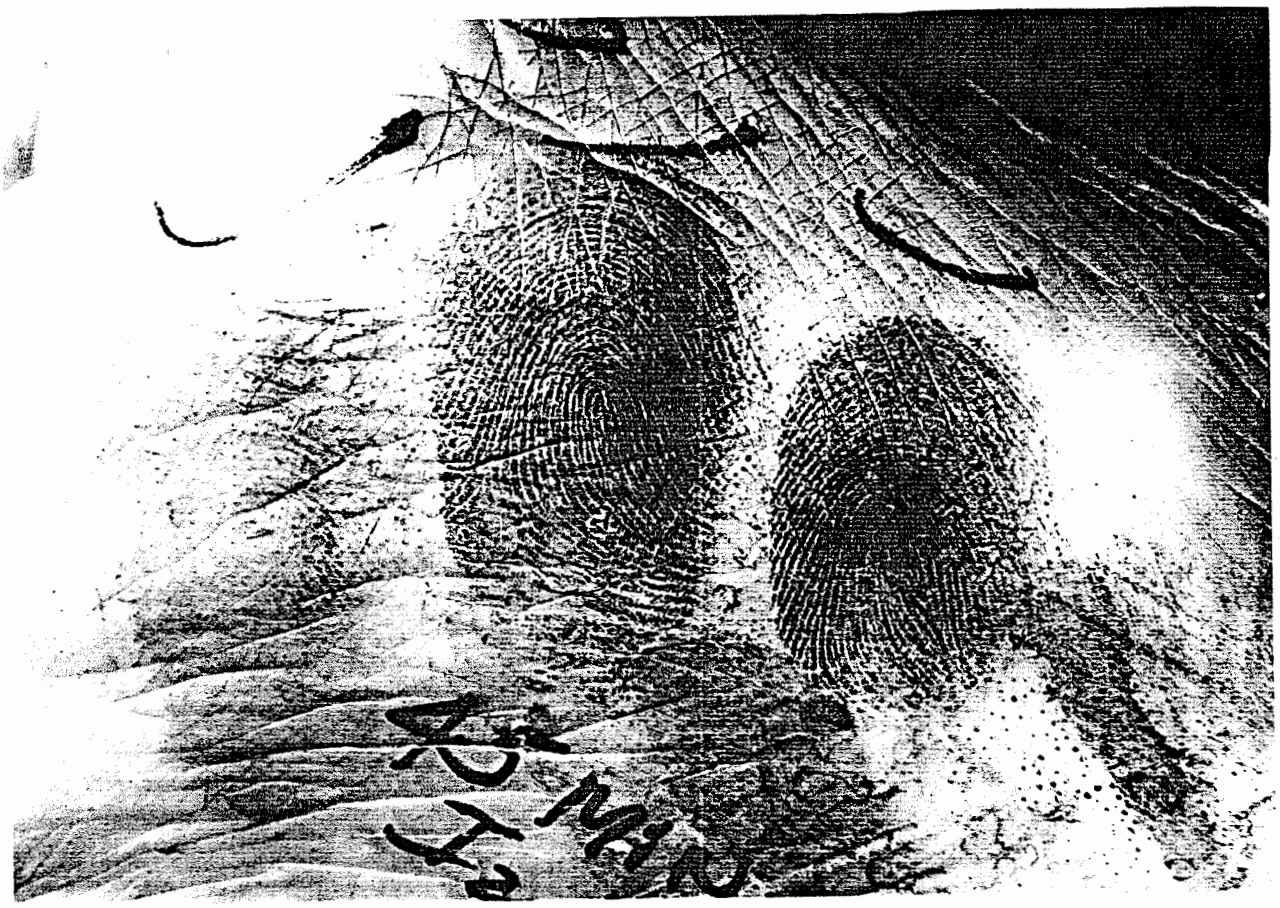

Figure 2 Latents on skin visualised with Iodine and α-naphthoflavone

Figure 3a Latents on skin visualised with magna powder after being aged for five minutes

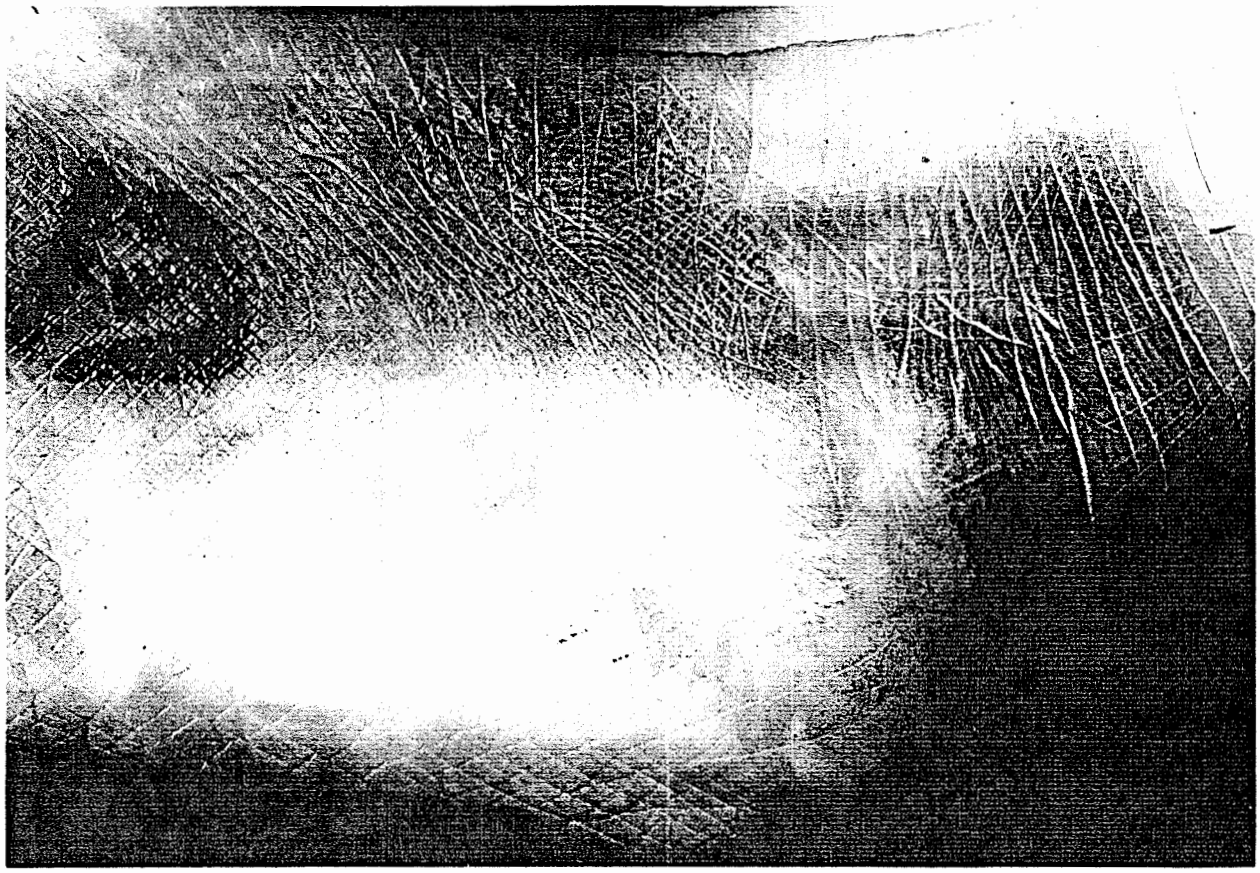

Figure 3b Latents on skin visualised with magna powder after being aged for ten minutes

Figure 3c Latents on skin visualised with magna powder after being aged for twenty minutes

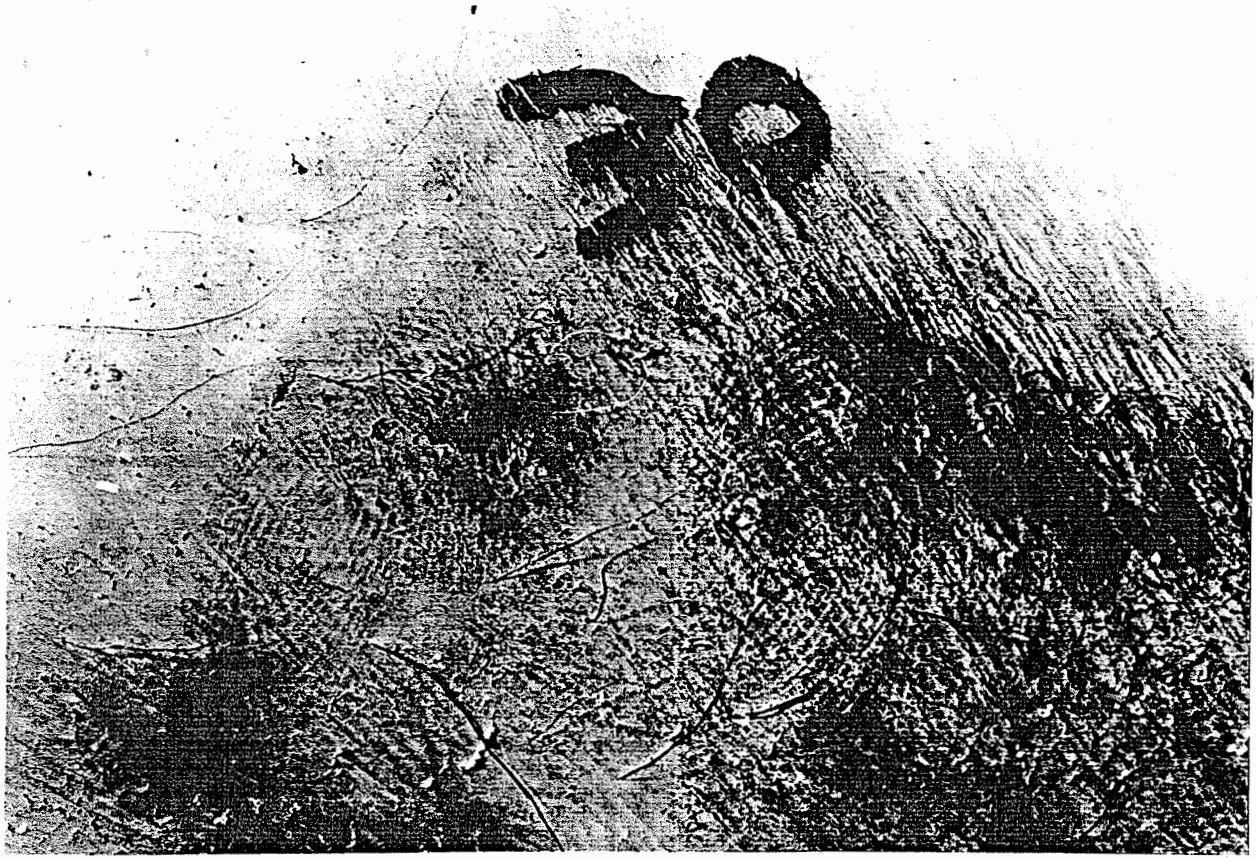

Figure 3d Latents on skin visualised with magna powder after being aged for thirty minutes

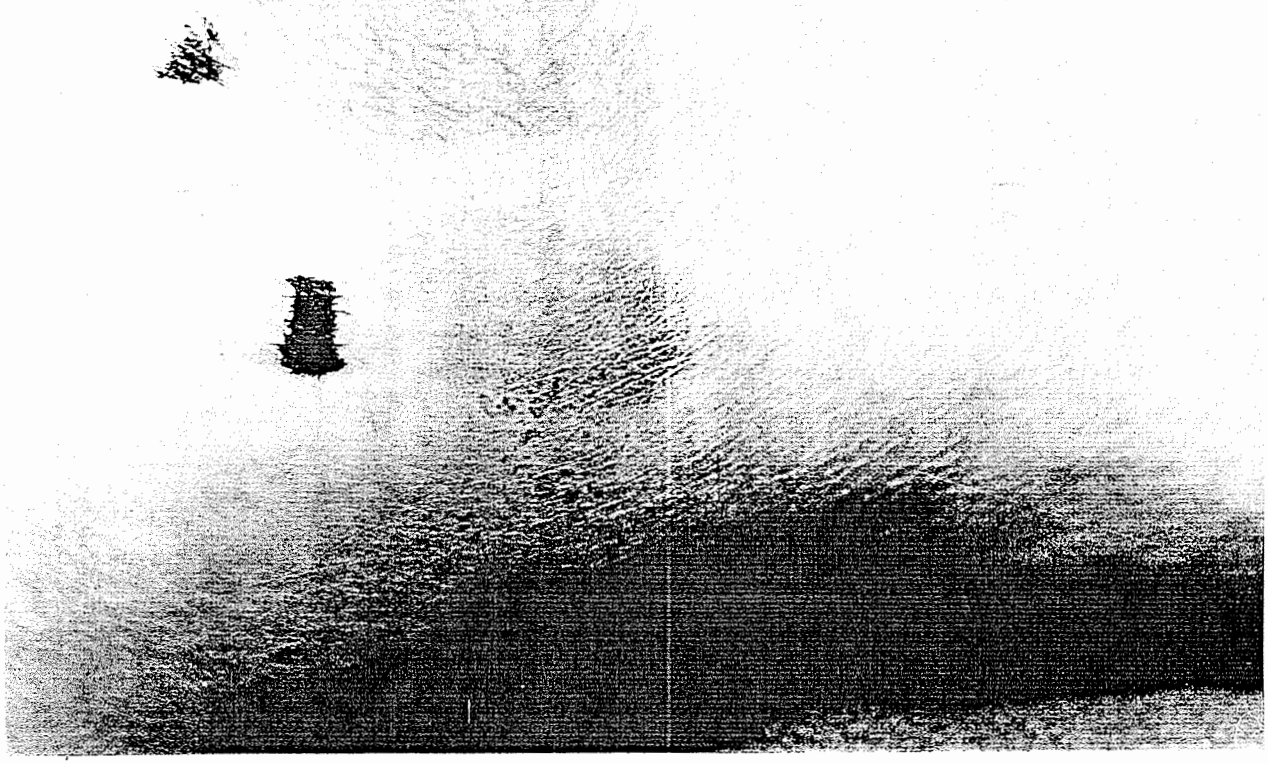

Figure 4 Latents on skin visualised with ruthenium tetroxide

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Executive Summary

Research addressed a comparison study conducted on human cadavers where latents were deposited on warm, unwashed skin close to the time of death. A variety of techniques were used for the visualisation of those fingerprints.

Human skin is covered with a thin emulsion of sweat and sebum secreted from the eccrine and sebaceous glands respectively. Experienced investigators estimate the chances of visualizing an identifiable fingerprint on a murder victim at about 1% based on hundreds of attempts using light examination followed by iodine silver plate lifts.

The visualization of fingerprints varied according to the method used. Consequently, this affected the conclusion with each method. The primary draw back at this time is the irregularity of the supply cadavers for testing purposes.

Résumé

On a mené une étude comparative dans laquelle on a déposé des empreintes latentes sur une partie de peau non lavée et encore chaude de cadavres, peu après le décès. Plusieurs techniques ont été utilisées afin de visualiser ces empreintes.

La peau humaine est recouverte d'une fine émulsion de sueur et de sébum sécrétés respectivement par les glandes eccrines et les glandes sébacées. Selon des spécialistes, les chances de visualiser une empreinte digitale discernable sur une victime de meurtre sont d'environ 1 %. Cette estimation repose sur des centaines de tentatives par examen à la lumière, suivi de la méthode iode-plaque d'argent.

Le niveau de visualisation des empreintes digitales variait en fonction de la méthode utilisée, de même que les résultats obtenus. Actuellement, le principal inconvénient est l'irrégularité de la disponibilité des cadavres aux fins des essais.

A Comparison of Techniques for the Visualisation of Fingerprints on Human Skin including the Application of Iodine and α-Naphthoflavone

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Abstract

We report a comparison study conducted on human cadavers where latents have been deposited on warm, unwashed skin close to the time of death. The techniques that we have compared include magna powdering [1], ruthenium tetroxide fuming [2], cyanoacrylate fuming followed by TEC dye staining [3], cyanoacrylate fuming using the 3M UV cartridge [4], iodine fuming followed by silver plate lifting [5] and the novel use of iodine fuming followed by application of α-naphthoflavone.

Introduction

Numerous techniques have been described in the literature for the visualisation of fingerprints on human skin. These include methods that have been successfully applied in casework, such as, magna powdering [1,6,7], iodine fuming followed by silver plate transfer [5,8], cyanoacrylate fuming followed by magna powdering [9], and the use of chemicals or a laser to enhance latents formed in blood [10-12]. Other papers describe the use of X-rays [13], ruthenium tetroxide [2], kromekote lift [14], polyethylene terephthalate (PET) [15], cyanoacrylate fuming followed by dye staining [3, 16], and several variations of iodine fuming [17-22]. In addition studies have been published comparing some of these methods on human cadaver skin [23-27]. The most recent paper compared several techniques that ranged from simple powdering to iodine fuming followed by transfer onto a nylon membrane treated with leuco crystal violet [27].

Experienced investigators estimate the chances of visualising an identifiable fingerprint on a murder victim at about 1%, based on hundreds of attempts using light examination followed by iodine silver plate lifts [28, 29]. The combined factors that influence this figure are (a) whether the cadaver was touched; (b) whether a print with identifiable detail was transferred; (c) whether the transferred print persisted; (d) and whether the detection method is sensitive enough to detect the print. The relative effect of these factors is unknown.

The detection of prints deposited on cadavers should help to determine the conditions under which (b), (c) and (d) occur. Our previous paper showed the reliable detection of prints on cold post-autopsy cadavers [3]. We were encouraged by these results to extend the study to conditions that more nearly approximate that of a murder.

Human skin is covered with a thin emulsion of sweat (amino acids) and sebum (lipids), secreted from the eccrine and sebaceous glands respectively [30]. Eccrine glands are located all over the body except for the soles of the feet whereas the sebaceous glands are found primarily on the face, neck, upper chest and upper back. Although only secreted over a relatively small area of the skin the lipids, which are viscous liquids at the skin surface temperature of 32°C, will diffuse over the entire area. Latent fingerprints are also comprised of sweat and sebum. Although sebum is not directly secreted onto the fingers it is easily transferred in significant amounts by frequent contact of the hands and fingers with the face and neck. The detection of fingerprints on human skin would seem an impossible task from this description since both the latent and the surface on which it is located are of the same chemical composition. In addition it has been noted by Pounds *et al*. that during the commission of a crime distortion and blurring are likely which will further decrease the chances of visualising an identifiable print [23]. That several murder cases have been solved by the recovery of a suspect's fingerprint from the murder victim shows that the situation is not as hopeless as it first may

appear [1, 5-9]. Since the components of fingerprints and skin are practically identical these successes may be attributed to the fact that there were more lipids in the fingerprint than on the background skin. In at least one of the cases the fingerprint was possibly contaminated with fats from fried chicken [7].

Before any experimentation could begin, it was necessary to gain permission from the various hospital committees for the study to proceed. We were very fortunate to have the assistance of a coroner at the Riverside Hospital in Ottawa who was responsible for gaining consent from relatives of terminally ill patients to participate in the study. At the time of death the nursing staff would contact the one member of our research team who was wearing our pager. In order to maximize our accessibility to cadavers we were willing to go to the hospital at any time of day or night. The experiments described in this paper were conducted over a time period of two years. The results are being reported at this time because the research has temporarily been put on hold as a result of insufficient cadavers for experimentation.

Experimental

Condition of human cadaver skin

Fingerprints were deposited on warm, unwashed cadaver skin as close to the time of death as possible by nurses participating in the study. The cadaver was then transferred to the morgue but not placed in the morgue cooler. The relative humidity and room

temperature were recorded. The cadavers were wrapped in light blankets which maintained the surface temperature of the skin close to normal. During the course of the experiments the surface temperature dropped until it eventually reached room temperature. The skin of the cadaver was unwashed. In this current study a total of fifteen cadavers were treated which is in addition to the nine post-autopsy cadavers that were part of an earlier paper [3].

Conditions of print deposition

Nurses participating in the study had been instructed to wipe their fingers across their foreheads before print deposition and to apply medium to light pressure when touching the skin. It is impossible to know if this procedure was always followed. Most of the nurses placed their prints on the thigh of the cadaver where blurring of the ridge detail is likely to occur under too heavy a pressure. In order for us to assess the quality of these prints the nurses also deposited prints onto a sheet of aluminum foil immediately after touching the cadaver skin. These prints were then usually treated with the same technique as those on the cadaver skin.

Our experiments began within an hour of death. In addition to the nurses' prints (which were placed on the skin within a few minutes of death) fingerprints were deposited by a variety of donors onto the legs of the cadavers. These areas were labelled using a waterproof marker. The surface temperature of the skin was measured during print deposition and ranged from 32°C to 14.5°C.

Donors' fingers were wiped across their foreheads prior to deposition since it is the authors' belief that "sweat-only" latents are nearly impossible to recover from human skin. Generally each donor deposited a cluster of prints to enable sequential recovery of individual prints over set time and temperature intervals. The clusters were deposited under medium to light pressure depending on the location of deposition i.e. on the inner thigh light pressure was used whilst on the shin and ankle regions medium pressure was applied.

Materials

All chemicals required for iodine fuming/α-naphthoflavone and TEC dye treatments were purchased from Aldrich. The magna powder and magnetic applicator were purchased from Forensi-Tech. The ruthenium tetroxide solution was provided by Chris Tiller and Associates. Locktite 495 Superbonder was used to generate cyanoacrylate fumes except for one experiment when the 3M Fuming wand and UV glue cartridge, on loan from Forensi-Tech, was tested.

Visualisation of latents

Cyanoacrylate Fuming This was carried out as described previously [3]. In addition cyanoacrylate fuming with the 3M wand was attempted. A small polyethylene tent was constructed around the area being treated and the 3M fuming wand loaded with a UV cyanoacrylate cartridge was ignited then positioned inside the bag. After a minute the wand was switched off. The skin was exposed to

the dense cyanoacrylate fumes for five minutes before the tent was removed.

TEC Dye Staining after Cyanoacrylate Fuming After close scrutiny of the skin surface with reflected light the marked areas were treated with TEC dye (0.1 gram per litre of 20% methyl ethyl ketone in water) from a squeeze bottle. If transfer of the dye was judged to be insufficient then a concentrated solution of TEC was used (1 gram per litre of 20% methyl ethyl ketone). After application of TEC the solution was allowed to evaporate for several seconds and then the area was washed with 80% methanol in water. On occasions where the TEC could not be removed from the background skin the area was washed with pure methanol.

Iodine/Silver Plate Transfer Iodine fuming followed by silver plate transfer was performed simply for comparison with the quality of the iodine/α-naphthoflavone prints. Iodine fumes were generated in the standard manner by gently passing air through a hand-warmed glass pipe containing iodine crystals. The fumes were directed onto the skin through a flexible hose ending with a large plastic funnel positioned on the skin. The skin was exposed to the iodine fumes for approximately thirty seconds. The exposed area appeared slightly orange due to iodine absorbing into the background skin. A freshly cleaned silver plate was then pressed onto the surface and the image developed by exposing the plate to light.

Iodine/α-Naphthoflavone To the best of our knowledge this is the first documentation of the use of iodine and α-naphthoflavone for the recovery of fingerprints on human skin. The previous

application of iodine and α-naphthoflavone (also known as 7,8-benzoflavone) has been reported for the visualisation of fingerprints on paper [31-32].

Iodine fumes were generated as described above. The iodine was allowed to evaporate from the background skin for several seconds before application of the α-naphthoflavone. The solution was prepared by dissolving 0.3 grams of α-naphthoflavone in 10 ml of chloroform which was further diluted with 90 ml of cyclohexane. The α-naphthoflavone solution can either be applied to the skin as a gentle stream through a squeeze bottle, or as a mist spray using an aerosol sprayer. Both methods were studied. The application of α-naphthoflavone to the latent allows for a chemical reaction to occur, (similar to the iodine/starch reaction), which produces a dark blue reaction product that can be clearly seen against the skin.

Magna powder Magna powder was applied using a magnetic wand that was loaded with powder and then lightly brushed over the surface. Any excess powder was removed using the wand.

Ruthenium Tetroxide The solution of ruthenium tetroxide (RTX) was used as supplied and sprayed directly onto the skin where latents had been placed. Attempts at lifting any visualised prints using a white plastic tape also provided with the solution were made by placing the tape over the print and applying pressure.

Recording of images

Photographs were recorded using Kodak Technical Pan 2415 film

and Kodak Ektachrome Colour film. The fluorescent prints were viewed using a 150-Watt UV lamp (Built-in Ballast, Spectronics Corporation) and a Schott KV550 filter. For non-fluorescent images the use of a ring light significantly enhanced contrast.

Health and Safety

Identification specialists should always protect themselves from the powders, chemical vapours and cyanoacrylate fumes associated with their everyday work. The application of these materials to human skin is no different. When using powders, dust masks should be worn to avoid inhalation of dust particles. When fuming with cyanoacrylate and applying chemicals, a face mask with the correct organic vapour cartridge must be worn. Eyes and hands should be protected by wearing laboratory glasses and latex gloves, respectively. It should be noted that chloroform is a suspected carcinogen and further experiments are under way to find a suitable replacement. In the meantime following the safety procedures described above will provide suitable protection. The ventilation system in most morgues is capable of removing all residual vapours but masks must still be worn by all persons present.

Results

Cyanoacrylate Fuming and TEC Staining

Cyanoacrylate fuming and TEC dye staining was attempted on twelve out of the fifteen cadavers. Table 1 summaries the results.

In several experiments ridge detail was observed but the contrast was poor due to dye adhering to the background. Since the dye could be removed from areas of the skin not exposed to cyanoacrylate it was concluded that cyanoacrylate was developing on the background skin.

In only two experiments did the quality of the visualised latents approach that observed when this process was tested on post-autopsy cadaver skin [3]. In one experiment (number 13) the print was deposited when the skin temperature measured 30°C and was detected when the temperature had dropped to room temperature (16°C), see Figure 1a. In the other experiment (number 11) the skin temperature was 28°C and the print was recovered after a time interval of two hours and forty minutes, see Figure 1b. The "hazy" appearance of the background in both figures is believed to be due to a film of cyanoacrylate developing on the skin's surface. The bright spots are thought to be concentrated areas of cyanoacrylate that have formed on the sweat pores covering the skin. Neither type of background cyanoacrylate was observed when this technique was used on washed cadaver skin as described in our previous paper [3].

To reduce the background cyanoacrylate an attempt was made at rinsing the skin surface to remove water-soluble chemicals such as sweat that initiate formation of cyanoacrylate. After print deposition two cadavers (experiments 12 and 14) were cooled in the morgue cooler to help preserve the water-insoluble components of the print during the rinse. The skin was hosed down with cold

water and the residual water evaporated with the aid of an electric fan. Cyanoacrylate fuming and TEC dye staining failed to visualize any prints on cadavers that had been treated in this manner since background cyanoacrylate still persisted.

In general the results for cyanoacrylate fuming followed by TEC dye staining were inconsistent. Prints deposited on one cadaver (experiment 13) whose skin surface temperature measured 30°C showed excellent ridge detail but the next experiment on a cadaver (experiment 14) whose surface temperature ranged between 30°C to 16°C yielded no prints. Other methods for vaporising cyanoacrylate produced similar inconsistent results.

UV Cyanoacrylate Cartridge

No print detail was observed on skin treated with the 3M fuming wand and UV glue cartridge. On viewing under UV light the background skin had developed excessive cyanoacrylate and appeared bright yellow as a result of the dye contained within the glue.

Iodine Silver-Plate

In experiment 22 (see Table 2) iodine was directed onto the skin as described. The image developed on the silver plate showed partial ridge detail. Further application of clean silver plates failed to visualise any other ridge detail.

Iodine/α-naphthoflavone

The use of iodine followed by α-naphthoflavone was performed

in three experiments (see Table 2) and was the most consistent technique that we studied. Prints were deposited on skin over a temperature range of 32.2°C to 23.4°C. The visualized ridge detail was excellent and in one example every latent deposited was recovered as an identifiable print, see Figure 2. The most difficult step when using this procedure is the recording of the image by the camera. The photographic skill of the Identification Specialist is required to successfully maximize the information contained within the print.

Magna powder

In three cases (see Table 2, experiments 16, 18 and 21) magna powder was applied without much success to areas of the skin after the cadaver had been fumed with cyanoacrylate. However, magna powder was more commonly applied immediately to fresh latents to ensure that the ridge detail of the print was transferred from the fingers onto the skin surface. In one experiment (experiment 19) we followed the lifetime of the latent with magna powder. A cluster of prints was deposited when the surface temperature measured 29.5°C and the first print was visualised immediately with magna powder. The second print was visualised after five minutes and the third after ten minutes until thirty minutes had passed, see figure 3a-d. It is apparent from Figure 3 that magna powder also visualises the background skin pattern.

Ruthenium Tetroxide

Ruthenium tetroxide was used in only one experiment (see Table 2). Immediate visualisation of a freshly deposited latent developed ridge detail (see Figure 4) but the resultant print lacked sufficient contrast compared to similar prints visualised with iodine and α-naphthoflavone. Lifting of the ruthenium tetroxide print with white plastic tape failed to transfer any ridge detail.

Persistence of Fingerprints on skin

The results contained in Tables 1 and 2 show that fingerprints on warm cadaver skin persist at least for several hours in an identifiable form. Experiment 11, 13, 19 and 23 all resulted in identifiable prints being visualised after being left on the skin for periods of one hour to over two and a half hours. These prints were deposited when the skin surface temperature was close to that of a living victim. We felt that the skin surface temperature played a significant role in the prints survival and care was taken to measure the temperature during print deposition. That prints survive for a few hours at temperatures of 32 to 30°C is very encouraging. If the prints can survive this initial cooling period then the chances of detecting them will be quite high, unless there is another factor that contributes to print deterioration, such as the absorption of lipids into the epidermal layer of the skin.

Discussion

We believe the visualisation of fingerprints *in situ* will enhance the ridge detail when compared to lifted prints. The quality with which prints can be recovered by lifting depends on the pressure applied to the print during the lift. If the pressure is too great the ridge detail of the fingerprint will be obliterated and if the pressure is too weak then not all the detail will be transferred.

In addition, any technique that is to be successful on skin must exhibit good sensitivity by reacting with the more abundant lipids from the ridges of the fingerprint rather than reacting with the lipids that exist on the background skin. We have seen by our attempts to lift latents from skin using a clean, glass plate and then developing the transferred print with cyanoacrylate that there appears to be more lipid material in a fingerprint than exists on certain areas of the skin surface *i.e.* limbs and lower torso [34].

At the onset of this study we felt that cyanoacrylate fuming followed by TEC dye staining was close to being the ideal method since it is a fluorescent technique, applied *in situ*, and had shown good sensitivity in our previous experiments. However, in this recent study the majority of fingerprints observed by this technique were non-identifiable except in a few instances where the ridge detail was excellent.

Many of the techniques that we tried in order to improve print quality worked well in one experiment only to fail in the next with no apparent explanation as to why. For example in experiment 21 we "super-heated" the glue to generate cyanoacrylate fumes which

resulted in good ridge detail. However, in the next experiment the lack of print detail was a direct result of excessive cyanoacrylate developing on the background. In experiment number 19 we washed the cadaver prior to print deposition to test the hypothesis that our previous success was a consequence of the skin being washed after autopsy. Excellent ridge detail was observed in only some of the many prints that we deposited. This lack of consistency on the same skin surface is not a consequence of temperature and is difficult for us to explain.

In general the results have indicated that on warm, unwashed skin the cyanoacrylate method exhibits poor sensitivity by developing cyanoacrylate on the background skin. This formation of background cyanoacrylate has led to a significant reduction in contrast. As a consequence we have not been able to consistently detect latents by this method even when development occurred immediately after print deposition. At first we attributed this lack of success to insufficient transfer of ridge detail to the skin. However, other techniques have consistently developed freshly deposited fingerprints which indicates a problem with the cyanoacrylate technique.

In our previous study we learnt that humidity must be carefully controlled to avoid excessive amounts of cyanoacrylate forming on the skin surface. From this current study it is believed that the moisture being expelled by the skin, up until the time of death and possibly for hours after death, will also result in background cyanoacrylate.

The use of the 3M wand and UV glue cartridge also supports this theory since it demonstrated a total lack of sensitivity and developed excessive cyanoacrylate over the exposed area. Since the cyanoacrylate was doped with a UV dye the background skin appeared fluorescent yellow when viewed under UV light. It was also difficult to control the amount of cyanoacrylate the surface was exposed to, when using the fuming wand. Without the confines of the tent it was difficult to direct the cyanoacrylate fumes over the skin and with the tent the application was too heavy.

The application of a silver plate to the iodine fumed print only developed partial ridges and proved very awkward on bony regions of the cadaver. A further difficulty with this method is the time delay between visualising the print and observing the final image.

Iodine fuming followed by spray application of α-naphthoflavone showed great promise. Unfortunately, we were unable to really test the ability of the method for recovering prints that had been left on the surface for several hours due to the limited availability of cadavers. However the technique demonstrated excellent selectivity, providing care was taken to ensure that excessive iodine was allowed to evaporate from the background skin. Although only tested on three cadavers it appeared to be the most consistent technique tested and we were able to visualize almost every print that we deposited on the skin surface. Based on this ability to consistently visualize fresh prints we feel that it would be worth trying.

The iodine fuming should not interfere with the collection of other evidence but spraying the body with the α-naphthoflavone solution will wash away bodily fluids, hair and fibres. Ideally, the iodine fuming and application of α-naphthoflavone will be attempted at the crime scene, after removal of biological evidence, to ensure the greatest chance of latent recovery. Some coroners and pathologists will not allow for the use of iodine fuming within the morgue since it is extremely corrosive to metal surfaces. If the procedure can not be carried out at the scene then it will depend on the goodwill of the particular coroner as to whether you can perform the fuming in the morgue. The amount of iodine used for each body is extremely small and should not pose any significant corrosion risk to the morgue ventilation system.

The other non-fluorescent methods studied were magna powder and ruthenium tetroxide solution. Both methods visualised freshly deposited prints. Magna powder exhibited poor sensitivity since the background skin pattern almost always caused interference with the ridge pattern of the latent (see Figure 4). Although easy to use, ruthenium tetroxide solution developed prints which lacked contrast against the skin and proved impossible to lift.

We believe that the probability of finding fingerprints on a murder victim will improve if the skin is young, hairless and clean. Other factors which are likely to increase the chance of recovering prints are finding the body in a location that allowed for rapid cooling of the skin and in conditions of low humidity. Obviously the Identification specialist must decide if the evidence

at the scene suggests that the body has been handled by the aggressor and thus if an attempt should be made to visualize latents from the skin surface.

Conclusion

Unlike most experimental methods we were unable to control all the factors that go into visualising a print. Therefore conclusions derived from one cadaver need not necessarily apply to the next. In addition we required permission to access each cadaver and the unfortunate irregularity of the supply has limited our experiments. We had hoped to be in a position to recommend thoroughly tried and tested procedures for Identification specialists to apply in the field. However, after several years we have had to accept that availability of cadavers for experimentation has become a major problem. Future research projects must be conducted in an environment that allows for frequent access to cadavers.

In contrast to our previous study on clean, cooled cadaver skin we must report that cyanoacrylate followed by TEC staining proved inconsistent on warm, unwashed skin. However, of all the methods tested, when prints were visualized by this method, they were of exceptional quality in terms of ridge detail. The contrast, however, was not as good as previously observed. I n addition the process can take several hours and can interfere with the collection of other evidence.

Of the non-fluorescent techniques tested we believe that iodine fuming followed by spray application of α-naphthoflavone offered the most consistent and convenient method for visualising good contrasting latents on human skin. The technique has the advantage of being extremely quick and easy to attempt as well as providing quite satisfactory results. We feel that ease of use is important since it will promote the number of attempts made at visualising latents on murder victims which in turn will increase the probability that prints will be found.

In spite of recommending the iodine α-naphthoflavone method for field testing, at present, it is our opinion that a fluorescent method of lipid detection, if it could be developed, would be superior. For instance if europium chelates could be used, natural background fluorescence of the skin would be eliminated as seen in our previous study [3]. Of course the method would still be limited to detecting prints on body areas with low lipid concentration compared with fingerprint ridges. We are now trying to find conditions under which TEC will transfer into lipids.

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Figure 1 Latents visualised with cyanoacrylate ester and TEC dye
(a) deposited at skin temperature of 30°C
(b) deposited at skin temperature of 28°C

Figure 2 Latents on skin visualised with Iodine and α-naphthoflavone

Figure 3 Latents on skin visualised with magna powder after being aged for (a) five minutes, (b) ten minutes, (c) twenty minutes, and, (d) thirty minutes

Figure 4 Latents on skin visualised with ruthenium tetroxide

Table 1: Summary of Cyanoacrylate Results

Detection Method	Expt No.[1]	Skin Temp/ °C	Time[2] /min	Observation of Prints
CA/ TEC	10	29.6 - 25.3	165	None
	11	28.5 - 23.1	160	Excellent ridges
	12	30.1 - 25.7	70 1	None[3] Smudged nurses prints
	13	31.3 - 14.5	160	Excellent
	14	30.0 - 16.0	163	None[3]
	15[4]			None
	16	31.5 - 28.5	15	Partial ridges
	17	32.0 - 24.6	30	None
	18	29.2 - 22.2	40	Partial ridges
	19	29.5 - 22.7	100	Excellent ridges on washed skin[5]
	20	32.0 - 20.0	20	None
	21	30.2 - 24.4		Good ridges[6,7]
	22	31.0 - 25.8	5	Partial ridges
CA/ Magna Powder	16	31.5 - 28.5	15	Good ridges
	18	29.2 - 22.2		None
	21	30.2 - 24.2		Partial ridges
3M Wand/ UV glue	23	32.2 - 25.7	5	None Heavy background CA

KEY:
1 For experiments 1-9 see reference 3
2 Time interval prints remain on skin before treatment
3 Skin washed after print deposition
4 Murder victim therefore temperature and time are unknown
5 Skin washed before print deposition
6 Superheated cyanoacrylate
7 Sodium hydroxide generated cyanoacrylate

Table 2: Summary of Non-Cyanoacrylate Results

Detection Method	Expt No.	Skin Temp/ °C	Time[1] /mins	Observation of Prints
Magna Powder	18	29.2 - 22.2	1	Good ridges
	19	29.5 - 22.7	100 1	Good ridges Smudged outline of nurses print
	20	32.0 - 20.0		Good ridges
	22	31.0 - 25.8	1	None
Iodine/ Silver Plate	22	31.0 - 25.8	1	Partial ridges
Iodine/ α-Naphthoflavone	22	31.0 - 25.8	45 1	Excellent ridges Good pore detail Reasonable contrast Smudged outline of nurses print
	23	32.2 - 25.7	90	Excellent ridges Good pore detail Reasonable contrast
	24	26.3 - 23.4	40	Excellent ridges Good pore detail Reasonable contrast
Ruthenium Tetroxide	24	26.3 - 23.4	1	Good ridges Poor contrast

KEY:
1 As for Table 1