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Lifting techniques for finger marks on human skin previous enhancement by Swedish Black powder — A preliminary study

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ABSTRACT

An examination was done to investigate whether certain lifting techniques can lift recovered latent fingerprints on human skin surfaces of living subjects. For recovery Swedish Soot powder mixture (Swedish Black) was used.

Donors intentionally placed fingerprints on the skin surface of living subjects. Finger marks were then in all cases recovered with Swedish Black powder. The procedure was repeated after 1 h and 4 h. Treated finger marks were secured and preserved as latent fingerprint evidence by different lifting processes. Having examined skin surfaces and finger marks we observed that the lifters such as white instant lifter, white fingerprint gelatin, black fingerprint gelatin, silicone, transparent adhesive tape, are suitable. Moreover, white fingerprint gelatin and white instant lifter proved to be very good at lifting treated finger marks. Black fingerprint gelatin was very good also, but finger marks were examined by slant light.

1. Introduction

At the crime scene the finger marks are one of the most common forms of evidence. They may be found on many surfaces, including glasses, woods, papers, metals, fruits, vegetables and human skin. According to forensic literature human skin is one of the least convenient surfaces for recovering bridge skin impressions [1]. Some eliminating components are present in both friction ridge prints and on the skin surface of a body. Forensic literature reports many detection procedures for detecting recovery of fingerprints from human skin. Sampson et al. [2] successfully carried out processing techniques for recovery of latent fingerprint evidence from human skin, whereas Delmas [3] presented the use of luminous magnetic powder. He examined intentionally deposited fingerprints on the skin of five victims. The time interval between death and deposition of prints ranged from 35 min to 36 h, while the time interval between placing the latent prints and examination ranged from 1 to 5 h. There were positive results in four cases. Mashiko and Miyamoto [4] achieved positive results of finger mark recovery from human skin by means of the RTX method. This was the method Hebrard and Donche [5] used in their study of detection methods on 16 living persons and 23 dead bodies in addition to powdering [6–8], iodine fumes [7,8] and CA fuming [2].

Treated finger marks lifted from human skin of living subjects should be secured and preserved for further forensic examinations. This means that the finger marks from human skin are separated by different lifting processes. For lifting powdered finger marks adhesive tape, instant lifter, fingerprint gelatin and silicone are used.

This paper is part of a study on fingerprints deposited onto human skin of living subjects. It contains findings and results of lifting techniques for finger marks on these surfaces. Published research into fingerprint recovery techniques has dealt with the detection and recovery of friction ridges on human skin surfaces [2,3,5]. On the other hand, published research has not dealt extensively with lifting techniques for fingerprint recovery on human skin treated by powders, in our case by Swedish Black powder. The purpose of this short preliminary study is to determine the best lifting processes for treated finger marks by Swedish Black, to be used at crime scenes when it is thought that the perpetrator may have handled or touched the victim's skin surface. The purpose of our study was to determine a suitable lifter in finger mark detection procedure for such exhibits.

2. Materials and methods

Fingerprints of four donors were intentionally deposited on skin surface of four living persons separately.

First, a forensic light source, i.e. side white light, was used to visually scan for latent fingerprints on the surface of live epidermis prior to fingerprint deposition. No traces were detected on the

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Table 1
The quality of recovered finger marks on the human skin secured with different lifting techniques.

Lifting technique	Time	Sample (number)	Finger mark graded: ++ %	Finger mark graded: + %	Finger mark graded: − %
Whiteinstant lifter	Atonce	18	11	39	50
White instant lifter	1 h	15	7	20	73
White instant lifter	4 h	15	13	27	60
White fingerprint gelatin	At once	20	35	40	25
White fingerprint gelatin	1 h	12	17	42	41
White fingerprint gelatin	4 h	12	8	34	58
Black fingerprint gelatin	At once	12	40	43	17
Black fingerprint gelatin	1 h	–	–	–	–
Black fingerprint gelatin	4 h	–	–	–	–
Silicone	At once	18	54	40	6
Silicone	1 h	16	31	44	25
Silicone	4 h	14	35	43	22
Transparent adhesive tape	At once	11	18	37	45
Transparent adhesive tape	1 h	10	10	30	60
Transparent adhesive tape	4 h	10	20	20	60

examination site. Second, the site was labelled with a number. Then four participants (donors) two male, two female (all 35–40) deposited their fingerprints on the wrist area of the living subjects, i.e. areas most likely to exhibit perpetrator-victim fingerprint contact during the commission of a crime (for instance, wrists are exposed when the victim is dragged). Hands of participants were washed prior to finger mark deposition. Finger mark depositions were carried out in a forensic laboratory where the conditions were under control, with room temperature ranging between 22 °C and 26 °C and relative humidity at roughly 60%. During the deposition of finger marks contact time was between 3 s and 5 s. Finger marks were recovered immediately after the impression had been deposited and then 1 and 4 h post deposition. Each set of conditions was repeated in duplicate and examined with enhancement technique Swedish Black. All lifting techniques used were stored in the laboratory and they are described below.

In the majority of cases the four individuals deposited between three and five sample finger marks on human skin surfaces. There were about 79 samples available for Swedish Black. The total number of all samples for all procedures carried out at different times was 183. Results were recorded by a Canon EOS 5D camera, with resolution 4368x2912.

3. Enhancement methods

3.1. Visual examination

Visual examination was used prior to other methods. The latent prints were examined using white light.

3.2. Powder/brush

Swedish Black powder (100/250 ml) was used for detection as a physical method. Powder was applied to the examined area with a round fingerprint brush.

3.3. Lifting method

Five different lifting techniques were used to lift secured and preserved treated finger marks from skin surfaces as latent fingerprint evidence — white instant lifter, white fingerprint gelatin, black fingerprint gelatin, silicone, and transparent adhesive tape.

White instant lifter consists of a transparent adhesive film with a protective cover adhered to a white backing. The protective cover is die-cut and it is easy to remove. A white backing sheet is attached to the adhesive film. On the front of the lifter the text “viewing side” is visible. At the bottom of the backing sheet there is a paper strip on which notes like date and case number can be written.

The *white or black fingerprint gelatin* is composed of a thick, non-aggressive and low-adhesive gelatin layer which makes it possible to lift finger marks, a carrier of linen rubber and a transparent polyester film used for protection. The white linen rubber backing is suitable for writing notes like date, case number, place of crime, etc.

The *silicone* rubber casting material called Silmark was used. For the curing of the silicone rubber a paste hardener was added. The paste hardener was conveniently measured and mixed with silicone.

In this study the *transparent adhesive tape* was also used. The width of the tape was 4 cm.

All solvents, chemicals and lifters were purchased from the BVDA company (Bureau voor Dactyloscopische Artikelen) [9].

4. Results and discussion

Best results as regards the enhancement of the treated finger marks on human skin were achieved using silicone and white fingerprint gelatin. In both cases friction ridges were almost invariably easily identified and characterised regardless of the surface. Less convincing results were obtained using transparent adhesive tape and white instant lifter on these surfaces. These results are illustrated in Tables 1 and 2.

Each recovered and secured (lifted) finger mark was graded as follows:

- recovered finger marks where the entire profile of the friction ridge can be observed on transfer (++)
- recovered finger marks where a partial profile of the friction ridge can be observed on transfer (+)
- no observed marks on transfer (−).

4.1. Results of the experiment by shares of usable finger marks with regard to lifting techniques

4.1.1. Immediate lifting and transfer of finger marks

By means of Swedish Black, donors lifted 79 samples of finger marks usable for further examination (++ or +). Of these 18 were

Table 2
Overall average value performance rating for different lifting technique.

Lifting technique	Overall average value performance rating
White instant lifter	1.49
White fingerprint gelatin	1.78
Silicone	2.23
Transparent adhesive tape	1.60

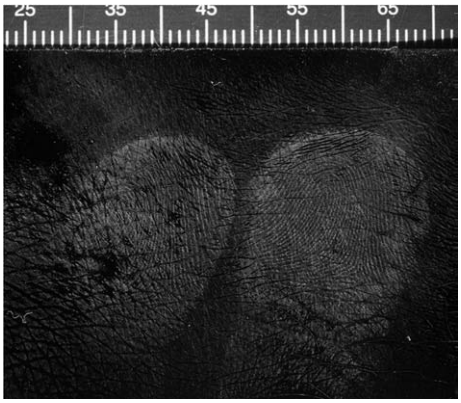

Fig. 1. Finger mark lifted by black fingerprint gelatin.

secured with white instant lifter and 50% were usable for further examination. With the white fingerprint gelatin techniques 20 marks were secured, and 75% were usable for further examination. Only 17% of marks were not usable for further examination with black fingerprint gelatin, but 83% of marks were examined by means of slanted light. Due to a need for additional optical method, we stopped using this securing technique in further examinations. By using Silicone 18 marks were transferred and only 6 were unfit for further use. As the last transfer transparent adhesive tape was used for 11 lifted prints. The results show that 55% were usable. The most suitable transfers were proved to be silicone, white fingerprint gelatin and black fingerprint gelatin, the latter assisted by light.

4.1.2. Lifting and transfer of finger marks after 1 h

Donors secured 53 samples of usable finger marks for further examination (++ or +). Of these 15 were secured with white instant lifter and 50% were unfit to be used for further examination. With the white fingerprint gelatin techniques 12 marks were secured, and 59% were usable for further examination. By using Silicone 16 marks were transferred and 75% were usable. Transparent adhesive tape was used for 10 lifted prints. The results show that 40% were usable. The most suitable transfers were proved to be Silicone with only 25% marks unfit for further use, and white fingerprint gelatin with 7 usable marks.

4.1.3. Lifting and transfer of finger marks after 4 h

Donors secured 51 samples of usable finger marks for further examination (++ or +). Of these 15 were secured with white instant lifter and 60% were unfit to be used for further examination. With the white fingerprint gelatin techniques 12 marks were secured, and 42% were usable for further examination. By using Silicone 14 marks were transferred and 22% were unfit to be used for further examination. Transparent adhesive tape was used for 10 lifted prints. The results show that 40% were usable. The most suitable transfers were again proved to be Silicone with only 22% marks unfit for further use, and white fingerprint gelatin with 57% results unfit for further examination.

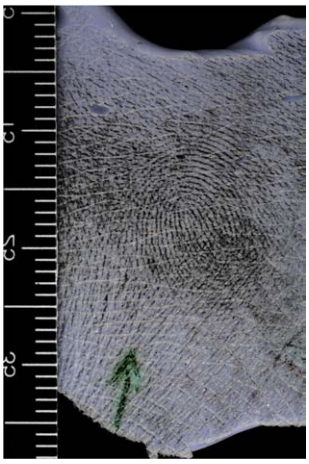

Fig. 3. Finger mark lifted by silicone.

4.2. Results of the experiment by using the method of average value

A comparison of lifter types used to transfer lifted finger marks was made. The method of average value [10] was used in processing data.

The finger marks was multiplied by an adequate factor (frequency). Each lifted finger mark was graded as follows: recovered finger marks where the entire profile of the friction ridge can be observed on transfer (++) with number 3, recovered finger marks where a partial profile of the friction ridge can be observed on transfer (+) with number 2 and no observed marks on transfer (−) with number 1. The result thus obtained was added and divided by the sum of lifted marks per person in each method. Results are described in Table 2.

Average value (mean) is the most important statistic parameter. Different values of the statistical symbol are marked as $x_1, x_2, x_3, \ldots, x_n$, their frequencies as $f_1, f_2, f_3, \ldots, f_n$ and number of samples N.

Fig. 2. Finger mark lifted by white instant lifter.

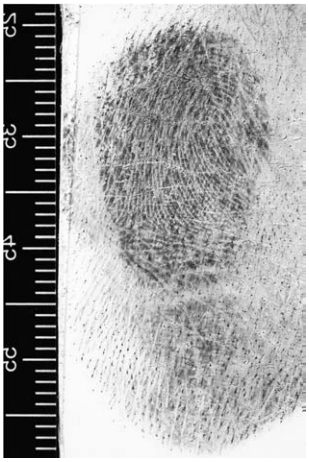

Fig. 4. Finger mark lifted by white fingerprint gelatin after 1 h.

Mean ($\overline{X}$) was calculated by using the formula:

$$\overline{x} = \frac{x_1 f_1 + x_2 f_2 + x_3 f_3 + \ldots x_n f_n}{N}$$

By this calculation the value of transfer was defined with reference to the rating of samples under the rule described above. A survey of average values of samples of finger marks lifted with Swedish Black and transferred shows that on average silicone achieved the rating of 2.23. This is an excellent result as in the majority of all recovered finger marks the entire profile of the friction ridge can be observed on transfer. White fingerprint gelatin also gave a very good result, the average rating is 1.78. The remaining two, transparent adhesive tape and white instant lifter, have poorer ratings, i.e. 1.60 and 1.49 respectively. The data presented in Table 2 indicates that the silicone and white fingerprint gelatin were most suitable for recovered finger mark transfer in our work. The poorest results were obtained from the white instant lifter. Figs. 1–4 show the results of the finger mark enhancement with the Swedish Black with different lifting techniques.

5. Conclusions

Powder dusting remains the basic and least complicated method for the recovery of fingerprints from the skin. Of course there are some differences depending on the type of powders. In this study Swedish Black was used for the recovery of finger marks. This short study has shown that the best transferring results were obtained with silicone and white fingerprint gelatin. Poor results were obtained using white instant lifter and transparent adhesive tape.

Future work will investigate these lifting techniques on skin surface of dead bodies.

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References

[1] C. Champod, C. Lennard, P. Margot, M. Stoilovic, Fingerprints and Other Ridge Skin Impressions, Crc Press, London, 2004.
[2] W.C. Sampson, K.L. Sampson, M.F. Shonberger, Recovery of latent fingerprint evidence from human skin: causation, isolation and processing techniques, KLS Forensics, 1997.
[3] B.J. Delmas, Latent print recovery from skin surfaces, Fingerprint World, 1987, pp. 35–37.
[4] K. Mashiko, T. Miyamoto, Latent fingerprint processing by the ruthenium tetroxide method, Journal of Forensic Identification 48 (3) (1998) 279–290.
[5] J. Hebrard, A. Donche, Fingerprint detection methods on skin: experimental study on 16 live subjects and 23 cadavers, Journal of Forensic Identification 44 (6) (1994) 623–631.
[6] G.J. Reichardt, J.C. Carr, E.G. Stone, A conventional method for lifting latent fingerprints from human skin surfaces, Journal of Forensic Science 23 (1) (1978) 135–141.
[7] G.S. Sodhi, J. Kaur, Powder method for detecting latent fingerprints: a review, Forensic Science International 120 (2001) 172–176.
[8] D.S. Bettencourt, A compilation of techniques for processing deceased human skin for latent prints, Journal of Forensic Identification 41 (2) (1991) 111–120.
[9] BVDA (Bureau Voor Dactyloscopische Artikelen International), Postbus 2323, 2002 CH HAARLEM — www.bvda.com.
[10] L. Pfajfar, F. Arh, Statistika 1, Ekonomska fakulteta, Ljubljana, 2004.