Recovery of latent fingerprints after lifting with water soluble tape

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Abstract

At the crime scene, latent fingerprints are the main piece of evidence to investigate due to the unique and unchanged nature of the ridge patterns of each individual. They can be used for the personal identification of both an offender and a victim in criminal cases. The limitations of latent fingerprints are clarity and the possible lack of ridge characteristics for identification. DNA analysis is one of the techniques used to identify latent fingerprints. The same fingerprints can not be used for both DNA analysis and latent print detection.

The aims of this study were to determine the appropriate technique for recovering latent fingerprints after lifting them with water soluble tape and to compare the quality of recovered latent fingerprint before and after lifting. This type of research could help increase the efficiency of investigations. Latent fingerprints were prepared on glass slides, aluminum sheets and on transparent plastic sheets. The three techniques for developing latent fingerprint were - Black powder dusting, Superglue fuming prior to Black powder dusting and Superglue fuming prior to Rhodamine 6G.

After being lifted with water soluble tape, latent fingerprints were recoverable by all three techniques, on all 3 surfaces. The quality of the latent fingerprints after lifting showed a decreased clarity when compared to those before lifting. The ridge characteristics of different aged latent fingerprints could be identified. The techniques used in this study could be applied to recover latent fingerprint and extract DNA profiles from the same pieces of evidence collected at the crime scene.

Key words : *Latent fingerprint / Ridge characteristics / Water soluble tape/ Superglue / Rhodamine 6G / Black powder*

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Introduction

Fingerprint in forensic science is used to identify suspects, victims and persons who touched a surface at the crime scene. The science of fingerprint identification is still in high ranking in forensic science base on the fact that: fingerprints are unique, an individual's prints remained unchanged throughout lives; and no two individuals could have exactly the same patterns. Fingerprint impression originated from the friction ridge, i.e. arches, loops and whorls, which covers the surface of the finger and the sweat.

The investigation of fingerprint has pointed to the individual ridge characteristic which has a clear detail enough to make a comparison with known prints possible. The ridge characteristics (minutiae) in fingerprints are used in the identification process such as bifurcations and ridge endings. Automated Fingerprint Identification System (AFIS) is the instrument for encoding, storing, searching, identifying latent fingerprint and matching fingerprint images.

The fingerprints left on surfaces are: visible and latent fingerprints. The latent fingerprint was made visible by physical or chemical techniques to develop the print contrast with the surface on which the print was left. The important of fingerprint is not only used the individual ridge characteristic comparison; DNA from fingerprint is also considered. Many studies have been accepted the profiling of DNA from fingerprint examinations. Van Oorshot and Jones (1997) reported that swabbing a single skin contact from latent fingerprint on document surfaces was enough for DNA analysis. Zamir *et al.*, (2000) could extract DNA from adhesive tape after fingerprint development. Schulz and Reichert (2002) could directly swab latent fingerprint for completed STR typing. Balogh *et al.*, (2003) achieved DNA from fingerprint on objects handled and specific areas of hands by cotton swab. Li and Harris (2003) used Scotch® tape 3M No. 5414 for DNA collection from relatively hairless areas on the body. Lempan, (2007) successfully recovered DNA using the Scotch® tape 3M No.5414 to collect cells from clothing.

The aims of the present study were: 1) to determine the appropriate technique for recovering latent fingerprint on various surfaces after tape lifting with hydrophilic adhesive Scotch® tape 3M No. 5414. 2) to compare the quality of latent fingerprints before and after lifting.

The experiment defined many techniques with possibly for recovering latent fingerprint on non-porous surfaces (e.g. plastic, glass, metal) at various time. The application techniques were black powder dusting, black powder dusting after superglue fuming, and Rhodamine 6G treatment after superglue fuming.

Materials and Methods

Reagent preparation

Stock solution of Rhodamine 6G (Champod *et al.*, 2004) was prepared by dissolving Rhodamine 6G 0.4 g in isopropanol 400 ml and methyl ethyl ketone 600 ml and mixed until dissolved. The stock solution was stored in a dark bottle. The working solution was prepared by mixing 25 ml stock solution in 75 ml. distilled water.

Latent fingerprint preparation

Latent fingerprints were prepared on each nonporous surface (glass slides, aluminum sheets and transparent plastic sheets). The quality of the complete latent prints was checked by using an oblique light. The latent prints on all surfaces were left at room temperature (25^{O}C) for 1, 3, 5 and 7 days. Fresh print was examined right away within 1 to 2 hours. Each surface sample with latent print was lifted with water soluble Wave Solder Tape Mark Plus II Scotch® 3M No. 5414. In the lifting process, the index finger must be pressed onto the tape for 20 times before pulling up to make sure there were enough cells for DNA analysis. Control samples were also prepared by fingerprint impression on each surface sample. Latent fingerprint detection was performed without lifting with Scotch® tape 3M No. 5414.

Latent fingerprint development

After lifting, the latent print on each surface sample was recovered by each technique include: Black powder dusting, Superglue fuming prior to Black powder dusting and Superglue fuming prior to Rhodamine 6G. Any visible latent print on each surface was photographed, then lifted with transparent tape and stuck on a piece of white A4 paper, except the visible latent prints from Rhodamine 6G had to photograph in the dark room under a Forensic Light Source at 515 nm using orange filter, and a piece of black paper was put under the tested sample to increase contrast between the print and the background.

Fingerprint examination

Photographs of the developed prints were examined by Automated Fingerprint Identification System (AFIS). The ridge characteristics in fingerprint were identified.

Results

The quality of latent fingerprints obtained before and after lifting with Scotch® tape 3M No. 5414 showed satisfactory results of ridge details recovered by Black powder dusting, Cyanoacrylate (Superglue) fuming and Black powder dusting, or Cyanoacrylate fuming and Rhodamine 6G on glass slides, aluminum sheets, and transparent plastic sheets. The numbers of ridge characteristics of recovered latent fingerprints were shown in Table 1. The ridge characteristics more than 12 points could be identified from fingerprint samples of all surfaces using AFIS. Some of the results of developed latent fingerprints samples were shown in Figs1-3.

Discussion

All latent fingerprints recovered by three developing techniques in the present study showed complete images. When compared with controls (without lifting), the contrast between the fingerprint image and the background was decreased; the clarity of ridge details were destroyed from lifting with adhesive tape and from the age of latent print on different surfaces. The best image was obtained from the fresh fingerprint. This was due to the components in the sweat left on the surface. The aged-fingerprint showed less contrast might due to the components in the sweat were destroyed by natural temperature, humidity, and dust in the environment, after it had been left. It is the fact that if the fingerprints were left outside and uncover in the natural atmosphere i.e. sun light, humidity and dust, the fingerprint residues would be damaged.

The advantages of the hydrophilic adhesive Scotch® tape 3M No. 5414 are: a water soluble adhesive tape, polyvinyl alcohol backing, biodegradable and pH neutral, no adhesive residue after removal, and low static upon liner release and when taping board.

Care must be taken when lifting technique was used to recover latent fingerprint with adhesive tape. The tape must be carefully and gently pulled continuously in the lifting process. The adhesive tape could absorb the atmospheric moisture rendered the tape dissolved at the edge of the fingerprint image. Therefore, after lifting, the edge of latent fingerprint should be wiped with clean, wet and soft paper before the developing process.

In the present study, it was shown that fingerprint development was performed after adhesive tape lifting (for DNA analysis). The advantage of this method is to avoid the risk of DNA destroyed by physical (soot, magnetic powder) or chemical agents during latent fingerprint process (Li and Harris ,2003; Zamir, Springer, and Glattstein, 2000). Moreover, the remaining fingerprint could still be recovered and identified which had never been demonstrated before.

Table 1. *The numbers of ridge characteristic (minutiae) of recovered latent fingerprints*

Non porous surfaces	Techniques	Number of Minutiae									
		Controls					Samples after tape lifted with Scotch® 3M No. 5414				
		Days									
		0	1	3	5	7	0	1	3	5	7
Glass slide	BPD	44	42	41	40	40	39	39	38	36	35
	SPG + BPD	43	42	42	42	39	43	42	40	40	38
	SPG + R6G	47	44	43	39	38	45	42	41	38	30
Aluminum sheet	BPD	45	43	39	39	39	43	41	39	38	35
	SPG + BPD	45	43	43	41	37	42	41	39	36	32
	SPG + R6G	45	45	44	40	35	45	42	26	23	20
Transparent plastic sheet	BPD	42	42	42	41	41	39	40	39	39	35
	SPG + BPD	45	43	42	42	41	43	41	41	41	36
	SPG + R6G	44	44	44	42	35	44	42	41	38	23

The criteria used for latent fingerprint ridge characteristic on each surface sample
The ridge characteristics: could not be identified = 0
1-5 points = 1
6-9 points = 2
10-12 points = 3
>12 points = 4

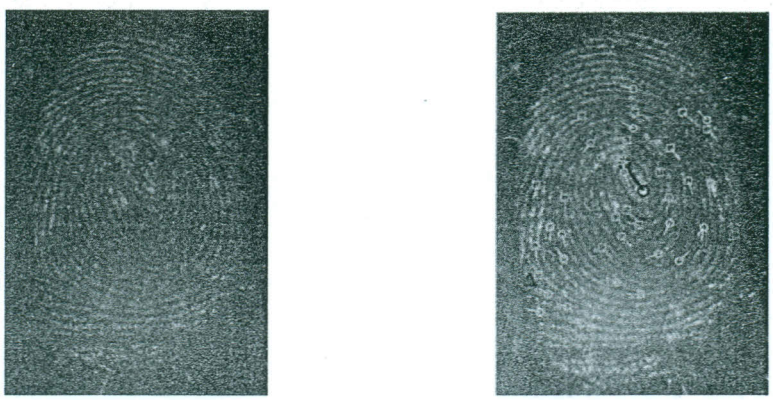

Fig 1. *Latent fingerprints on transparent plastic sheet, 3 days after lifting, developed by Superglue fuming and Rhodamine 6G (number of minutiae = 43)*

Fig 2. Latent fingerprint on glass slide, 5 days after lifting, developed by Superglue fuming and Black powder dusting (number of minutiae = 41)

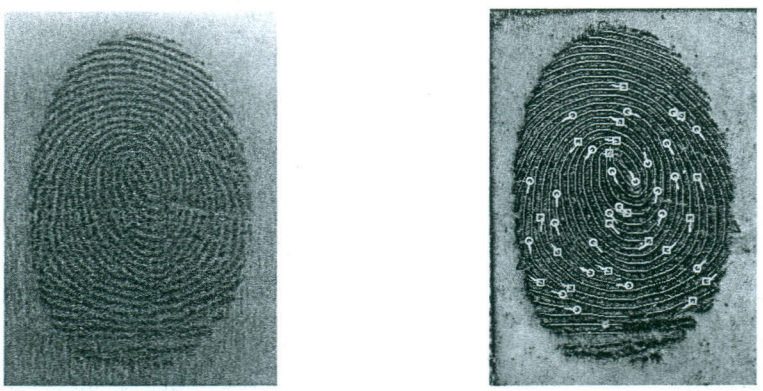

Fig 3. Latent fingerprints on aluminum sheet, 7 days after lifting, developed by Black powder dusting (number of minutiae = 43)

Conclusion

The latent fingerprint after lifting with Scotch® tape 3M No. 5414 could be developed by BPD, SPG+BPD, and SPG+R6G. The quality of ridge characteristics (minutiae) in the samples before and after tape lifting was comparable, before lifting samples showed better results. Most of the latent fingerprints showed complete fingerprint images, good contrast and clarity of the ridge detail. The techniques used in this study could be applied to recover latent fingerprint and to extract DNA profile from the same piece of fingerprint evidence collected in the crime scene.

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