Fingerprint ridge drift: an undescribed phenomenon


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INTRODUCTION

Alterations of the fingerprint topography and of the respective acquired images are usually considered during a comparison process between a latent and an exemplar fingerprint (inked or scanned).

Latent fingerprint (fingerprintmark) distortions have been described in the literature as the result of applying a non-uniform pressure during deposition, combined with the inherent elasticity of friction ridge skin and the curved anatomy of the finger. In addition, fingerprint image deformations can also occur as consequence of camera lens defects or caused by the print visualization/development process.

In addition to these well identified and described types of deformations, a new visual phenomenon that modifies latent fingerprint ridge patterns is described herein; and is named fingerprint ridge drift. The documentation of this phenomenon will have implications in future fingerprint identifications.

OBJECTIVES

a) Determine the prevalence of the drift phenomenon in aged latent fingerprints beyond accidental occurrence and its correlation with environmental conditions analyzed.

b) Estimate the frequency of the drift in the sample population of aged impressions.

c) Identify possible causes of the phenomenon.

d) Ultimately, increase the probative value of criminal evidence to minimize potential misattributions caused by these “naturally” occurring dissimilarities.

METHODS AND TECHNIQUES

- Monitored environment: Temperature, Relative Humidity, air currents, time exposure to sunlight and intensity of light indoors (i.e. direct light, shade and darkness).
- Surface of deposition (non-porous): Plastic (polyurethane) and glass.
- Type of finger secretions: Sweaty (eccrine-rich) and greasy (sebaceous-rich).
- Fingerprinters’ donor: One for all samples.
- Fingerprinters’ developer: Titanium dioxide (white powder).

Total number of experimental samples: 310 (index, middle and ring fingers of the left hand).
- Of these, 90 samples were chosen for observation of drift. These presented the best ridge quality (level 3 ridges). The remaining samples were discarded as being too degraded or obliterated by the natural aging process.
- Aging period: 7 days to 6 months, 11 collection periods.
- Sample selection was at random from the pool of prints.

An area of 1x1 cm was selected in the center of each fingerprintmark for the study.

- Quantitative analyses: occurrence of drift was recorded by 3 independent experts by comparing FRESH and AGED prints.
- Presence of drift was documented categorically (+, -).

- Statistical tests were performed to detect frequency differences between environmental conditions.

RESULTS

<table>
<thead>
<tr>
<th>Number of samples per case and statistical significance (Pearson’s Chi-squared test)</th>
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<tr>
<td>Environmental Factor</td>
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<tr>
<td>Sweat Type</td>
</tr>
<tr>
<td>Eccrine-rich</td>
</tr>
<tr>
<td>Sebaceous-rich</td>
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<tr>
<td>Total</td>
</tr>
<tr>
<td>Glass</td>
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<tr>
<td>Plastic</td>
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<td>Total</td>
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RIDGE DRIFT STATISTICS (categorial analysis)

- Visual comparisons of latent fingerprints (FRESH vs AGED) revealed that random changes in the original position of a single ridge occurred, whereas adjacent ridges remained unaltered.
- This modification produced a change in the distribution of minutiae at that specific location.
- The single ridge modification was observed regardless of the sweat type, the substrate, the light condition used and the extent of the aging period (seven days to six months).
- The underlying causes of ridge drift are currently not clear. It is hypothesized that it could be the result of either:
  1. a microscopic movement of the ridge over the non-porous surface by a diffusion (sliding) effect, as in Fig A;
  2. a process of degradation that effects only specific locations along the same ridge (selective degradation), as in Fig B;
  3. the specific sensitivity of the powder (TiO2) to the components of the sweat.

- The results shown are preliminary, and in future work data may be slightly modified or completely revised.
- The use of TiO2 as developer was arbitrarily chosen based on a real crime case where this reagent was used.

DISCUSSION

- Latent fingerprint ridge drift needs not to be confused with the typical degradation process of the ridges, known as interruptions (discontinuities) or with image distortions.
- An examiner who compares aged latent prints to a fresh (inked) exemplar without considering ridge drift may erroneously report an inconclusive result where a positive identification may be justified.
- Latent fingerprints from the same person can exhibit slight dissimilarities if the factor “time” is included. Ridge drift occurs at random areas within the print and has a very localized effect.
- Ridge drift is an intrinsic phenomenon related to the natural aging process not caused by external actions.
- Exposure to natural light has no apparent effect on the occurrence of ridge drift.
- The occurrence of ridge drift seems to be more common on plastic than glass substrates.
- Further studies with the inclusion of more donors and number of samples are necessary to confirm the frequency of drifting.
- These also include other substrates and developers.
- This new phenomenon can help explain the detection of certain dissimilarities at the minutia level between an aged latent and its inked counterpart during an identification.

CONCLUSIONS

- Latent fingerprint ridge drift is more common when comparing latent fingerprints on glass and plastic substrates.

REFERENCES


