

B54 The Sensitivity of Fingermark Color Contrast Between Sexes

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Learning Overview: After attending this presentation, attendees will be familiar with the use of image color contrast as a tool to distinguish latent fingermark aging patterns of males and females in a monitored, indoor environment.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the robustness and sensitivity of using color contrast as a potential age estimation model for latent fingermarks.

For decades, latent fingermark identifications have been routinely performed to link perpetrators and victims to crime scenes and pieces of evidence. However, a reliable and validated method for determining the time of deposition of a latent fingermark has yet to be standardized. This valuable piece of information could help corroborate witness statements and possibly exclude individuals from being present during the occurrence of a crime. Researchers have started to address this matter by investigating the degradation patterns of latent fingermarks in various environments.

Prior research has identified four morphometric parameters that could be used to quantify visual changes that occur during the aging process of latent fingermarks, one of which is the color contrast between the ridges and furrows after enhancement with a powder.¹⁻⁶ The methods used to analyze the morphometric parameters were inexpensive, readily available, and easy to perform, which is crucial for implementation into routine forensic casework. Previous results showed that the environmental factors of substrate type (glass vs. plastic), secretion type (eccrine-rich vs. sebaceous-rich), and natural lighting condition (light, penumbra, vs. dark) influenced latent fingermark degradation differently.¹⁻⁶ To better understand the observed trends, additional factors must be examined in combination with the aforementioned environmental conditions, including human factors such as biological sex. The purpose of the present study was to determine whether latent fingermarks from males and females have distinct aging processes that lead to significant differences in changes to the color contrast parameter over time.

The current experiment involved aging a total of 756 sebaceous-rich latent fingermarks from seven males and seven females over a period of three months. Inclusion and exclusion criteria were used to minimize exogenous factors and other sources of human variation. The impressions were deposited in triplicate on glass and plastic substrates using a controlled amount of pressure and contact time. These were stored in complete darkness in an environment in which the temperature and humidity were continuously monitored. At nine discrete times, random impressions on glass and plastic for each individual were enhanced with titanium-dioxide powder, photographed, edited, and analyzed using digital imaging software. The image color contrast data in grayscale was collected from histograms that display the distribution of every pixel color making up a photograph. Darker pixels were represented by low color values (with zero being pure black), while lighter pixels were represented by high color values (with 255 being pure white).

Preliminary data revealed an increasing trend in the mean pixel color value of the images over the nine aging periods and a decreasing trend in the amplitude pixel color value. The mean is the average of all pixel colors contributing to the color in the image while the amplitude is a measure of how many different colors are making up the image. The trends in these values were observed in the impressions on both the glass and plastic substrates with no observable differences between the males and females. As the latent fingermarks aged, the powder appeared to be more dispersed throughout the impressions. This shifted the histograms toward the lighter pixel colors causing a higher mean value, a lower amplitude value, and a more concentrated distribution in the histogram (Figure 1).

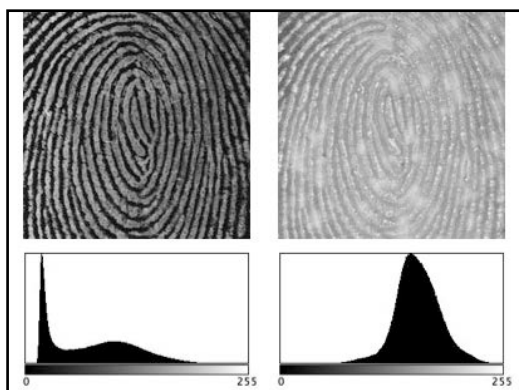


Figure 1. Examples of a fresh (left) and a three-month-old (right) enhanced latent fingermark on glass from a single male and their representative histograms. The ridges are shown in white.



The results of this study suggest that male and female latent fingerprints have similar aging patterns and comparable trends in changes to the image color contrast over time. From a practical perspective, an age estimation model based on color contrast could therefore be robust enough to include impressions from both biological sexes but sensitive enough to detect degradation over time. This study contributes to the current knowledge base regarding visual aging parameters of latent fingerprints and provides a foundation for future research on the influence of other human factors.

Reference(s):

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Biological Sex, Aging, Color Contrast