Case Report

Detection and Identification of a Latent Palmprint on a Cartridge

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Abstract: In crime scene work, fragments of latent prints are occasionally detected on cartridges. The development or observance of identifiable latent prints on cartridges is a less frequent occurrence. Furthermore, the authors are unaware of an instance to date when an identifiable palmprint has been developed on a cartridge. This case involved the development of friction ridge detail on a cartridge that was removed from a weapon near a suspect. The person who developed the print and the examiner initially believed the latent print to be from a finger. This case will explore how the examiner was ultimately able to identify the latent print to the palm of the suspect.

Introduction

Friction ridge detail that is suitable for comparison is difficult to develop on cartridges. In a study done by the Minneapolis Police Department between 2006 and 2007, of 2,727 cartridges that were processed, no latent prints that were suitable for comparison purposes were developed [1]. In a study by the Denver Police Department, conducted between 2008 and 2010, latent prints that were suitable for comparison purposes were developed on 0.25% of 817 cartridges that were processed [2].

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It makes sense that it would be difficult to develop latent fingerprints on cartridges because of the size and curvature of cartridges and how they are typically handled when loading a weapon. It is also not surprising that the chances of developing an identifiable latent fingerprint are increased when the caliber of the round or surface area is increased [3]. Cartridges are typically loaded by grasping them with the fingers, rather than with the palms, and inserting them into a revolver or magazine, thus making it less likely to obtain a palmprint from a cartridge. Other reasons for the lack of success in developing usable latent prints on cartridges might stem from how the cartridges are unloaded or packaged for submission to the laboratory. This case report explores a rare example of the successful development and identification of a latent palmprint on a cartridge.

**Case Background**

Upon responding to a potential overdose call, a Sarasota County Sheriff’s Office Deputy encountered a man (Subject 1) in a bathroom with a revolver that was wrapped in a towel. Subject 1 was attempting to kick the towel away when he was encountered by the deputy. It was later discovered that Subject 1 had a prior felony conviction and should not have been in possession of a firearm or ammunition.

Six .38 Special cartridges were removed from the cylinder chambers of the revolver and were sent to the laboratory. The items were then processed for latent prints with cyanoacrylate, Ardrox dye stain, and then black powder. The items were observed with light at 365 nm, 450 nm, and 532 nm wavelengths in-between processing steps. No latent prints of value were developed or observed on either the firearm or five of the six cartridges. One latent print of value was developed on the remaining cartridge (Figure 1), but only after dye staining and observation under light at 365 nm and 450 nm wavelengths.

The detective working the case requested that the latent print of value be compared with five subjects: Subject 1 and four other subjects who were either residents or people who had been present in the house when the deputy arrived.

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1 Under Florida law, it is unlawful for any person to own or have in his or her care, custody, possession, or control any firearm, ammunition, or electric weapon or device, or to carry a concealed weapon, including a tear gas gun or chemical weapon or device, if that person has been convicted of a felony in the courts of the state of Florida [4].
The latent print on the cartridge was initially believed to be a fingerprint. Comparisons of the latent print with fingerprint exemplars for the five subjects excluded the latent print as having come from the fingers of any of those subjects.

The latent print was searched through the local, state, and federal automated fingerprint identification system (AFIS) databases with negative results. After further examination and analysis, the print was searched through the AFIS databases as a palmprint. Manual comparisons were also conducted with palmprint exemplars for the five subjects. The AFIS results came back negative, but the latent print was manually identified to the left palm of Subject 1.

![Image of a latent print developed with cyanoacrylate on a .38 Special cartridge](image.jpg)

*Figure 1*

*Photograph of a latent print developed with cyanoacrylate on a .38 Special cartridge (enhanced with Ardrox dye stain and viewed at 365 nm with a deep yellow 15 filter).*
Discussion

The scientific method used in fingerprint examinations is known as ACE-V (analysis, comparison, evaluation, and verification). The analysis phase of ACE-V involves examining the characteristics of a latent print impression and its relationship to the substrate. Comparison is a side-by-side examination of the similarities and differences between a latent print and a known impression. During the evaluation phase, a determination is made as to whether the impression originated from the same source, did not originate from the same source, or the comparison is inconclusive because of insufficient data. The ACE-V method is not a linear process, however, and involves revisiting the various stages throughout the entire examination until a verifiable conclusion is reached [5].

Upon initial examination of the latent impression, it was thought to be a fingerprint impression. The manner in which cartridges are handled and the existence of what appeared to be recurving ridges led to this initial belief. The impression was enhanced using the channel, invert, and apply image features of Adobe Photoshop for further analysis (Figure 2).

During analysis, what appeared to be a scar was observed above the core area with possible puckering of the ridge structure on either side. There were other linear breaks in the pattern area, but because of the relatively undisturbed ridges surrounding them, it was unknown whether they were scars, creases, or disturbances in the matrix of the impression. The core and “scar” were then used as anchor points for the comparison phase. Because all known exemplars were taken after the alleged crime, the scar would be expected in the known impressions of the source. Determining orientation proved to be a difficult task. Ridges radiating outward from the left of the scar did not suggest the presence of a delta within an expected ridge count. No indicators of a delta were observed in the impression overall, and the pattern type could not be determined.

When the tenprint cards for comparison were analyzed, it was noted that the right thumb impression on Subject 1’s card had a scar similar in structure to the scar in the unknown impression (Figure 3). This was the only known impression that was compared against the latent impression for any significant length of time because of some observed similarities. At this point, the fingers of all five subjects were excluded as being the source of the latent print on the cartridge.
Figure 2
Enhanced photograph of a latent print developed on a .38 Special cartridge.

Figure 3
Known right thumb impression of Subject 1.
If the case had been written up at this point, the wording in the report would have made it clear that only fingerprints had been compared and excluded as the source of the latent print. Holder et al. state that sufficiently complete and clear recordings of detail from the volar surfaces are needed to exclude a subject [5]. This is true despite how unlikely it would be to have footprints on various items. Often examiners do not know all the details of a case, and sometimes unknown or unusual circumstances may make it more or less likely that a particular source of friction ridge skin had contact with evidence. For example, in this case, Subject 1 could have been barefoot in the bathroom and perhaps some of the rounds could have been on the floor.

After excluding the fingerprints of the five subjects as the source of the latent print, the examiner re-analyzed the print, paying special attention to areas that were puzzling during previous analyses. The large radiating ridge count to the upper left of the recurve, the “scar”, and the unknown linear voids were re-examined. It was then considered that the source of the impression may be the interdigital region of a palm, and the linear disturbances might actually be creases. The latent impression was then searched through the AFIS databases as a palmprint, with negative results. In the meantime, manual comparisons were conducted between the latent impression and known palmprint exemplars for the five subjects. The latent print examiner observed consistent ridge flow and creasing in the interdigital area of one left palmprint exemplar (Figure 4) and, through comparison, was able to identify Subject 1 as being the source of the latent palmprint (Figure 5). Two qualified latent print examiners independently verified the results of the examination.

When searching a latent print through AFIS, the chance of missing an identification, even when the source is in the database, is 25% [6]. Success in searching latent prints depends on a number of factors including database print quality, latent print quality, operator skills, and AFIS factors (e.g., the search algorithms being employed).

For all searches performed on the latent impression in this case, autocoding was employed and manual coding was used to clean up any potentially false minutiae, as well as to add clear minutiae missed by the autocoding. In this case, the latent impression was first incorrectly searched as a finger, resulting in a nonidentification. The impression was then oriented with the recurve down, searched as the interdigital area of either a right
Figure 4
Known left palmprint impression of Subject 1.

Figure 5
Comparison between latent impression and known left palmprint.
or left hand, and resulted in a nonidentification with the top 30 candidates. After the manual identification was made, the coded latent impression and the coded source palmprint were examined in AFIS to determine whether any false or misplaced minutiae were present. Differences in how the computer autocoded the known palm and how the examiner autocoded and manually coded the latent impression were observed. These differences appeared mainly in minutiae placement along ridge endings that terminated on or near creases. Further examination of the charted identification showed smaller furrows, and thus, a shorter distance between the lowest marked minutiae and the highest marked minutia in the latent impression (Figure 5). This difference in distance could be the result of the cylindrical shape of the cartridge or the manner in which it was held. If the suspect’s hand had been holding the cartridge in a fist, for example, that might account for the distance differences between minutiae. The shifts in minutiae placement near creases and the distance across ridges are just two possible explanations for why the impression did not result in an identification in AFIS.

This case is a good example of how guidelines for exclusion could prevent an examiner from making an erroneous exclusion. Some factors to consider when determining whether the print could be from a finger, palm, or foot might include:

- anchor points (e.g., delta or core or clues such as cross-hatching creases or funneling ridges) indicating location or orientation
- specific location of print (e.g., whether the impression is inside the narrow mouth of a bottle, under the lever of a car door handle, or in another location where a palm or foot would not physically fit)
- size of the latent impression (e.g., whether the impression is too large to be a finger)

Absent specific factors to consider, such policies could require a complete search as a finger, palm, and foot to exclude a subject, thus reducing the chances of an erroneous exclusion.

Conclusion

This case was unique in many ways. The authors had never seen a case where an identifiable palmprint had been developed on a cartridge. The palmprint was visible only after cyanoacrylate treatment, Ardrox dye staining, and observation under light with 365 nm and 450 nm wavelengths and a deep yellow filter. The appearance of the latent print was much like that of a latent fingerprint, which resulted in a complex examina-
tion. Often fresh eyes can reveal details not initially observed, making it important to take breaks, examine complex prints over time, and not perform rushed examinations. This case also brought to the forefront the importance of clear and accurate report writing, as well as the limitations of AFIS. Furthermore, this scenario illustrates the need for explicit guidelines on when to exclude comparison subjects.

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