Crime Scene Analysis Through DNA Testing of Canine Feces—A Case Report

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ABSTRACT

Forensic DNA testing can play a critical role in homicide investigations. Selecting the appropriate evidence on which to perform DNA testing requires foresight and reasoning based on experience and science. Although successful DNA testing can occur using many substrates, including blood, hair, and sweat/epithelial cells, positive results can also result from testing various unorthodox samples. The authors report on a triple-murder investigation where DNA testing of dog feces at the crime scene matched DNA testing of feces found on the shoe of a suspect resulting in successful prosecution of the case.

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STATEMENT OF HUMAN AND ANIMAL RIGHTS

Other than DNA testing performed on animal (canine) feces, this article does not contain studies conducted with animals or on living human subjects.

STATEMENT OF INFORMED CONSENT

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Image 1: Aerial view of property with pole barn, within which the 3 victims' bodies were discovered.

INTRODUCTION

DNA testing offers great value to a range of scientific and medical disciplines. Studies have shown the efficacy of DNA testing using bodily fluids, including sweat, semen, and saliva, toward crime scene investigation. Protocols for DNA isolation and amplification from feces have been particularly successful when used for the diagnosis of illnesses such as gastrointestinal cancer and, in children, infections caused by *Helicobacter pylori* (1-5). In this case, we present a triple homicide in which a suspect was successfully connected to a crime through matching of DNA isolated from dog feces at the crime scene to feces taken from the suspect's shoe. With this, we show that stool sample DNA testing may help to elucidate critical evidence in homicide investigations.

CASE PRESENTATION

A construction worker arrived to join his 3 coworkers at a pole barn at an upscale property (Image 1). The homeowners were away on vacation at the time, and the house was secured while the workers were in a barn adjacent to the house. The three men were found dead, each on the floor of the pole barn, face-down, with their wrists duct-taped together behind their backs, appearing to have been shot in the head "execution-style" (Image 2). Two of the victims died of single gunshot wounds of their heads, while the third died of multiple gunshot wounds. Toxicology tests were negative for all victims. In addition to the homicides, investigation of the household indicated that the perpetrators had entered the house via an upper-level window using a ladder and stole numerous belongings (Image 3). During the scene investigation, detectives recovered a fresh pile of dog feces from a sidewalk leading from the driveway into the house (Image 4). The feces appeared to have a shoe imprint embedded into it (Image 5).

While the investigation was taking place, police received a call from the coworker of a young woman who had heard about the triple homicide on a special television alert while she was on break at her place of employment. She reportedly became very upset and frantically confided in her coworker that she might be an accomplice. Her coworker

Image 2: Interior of pole barn, with the 3 victims' bodies in the prone position, with their wrists duct-taped behind their backs.

Image 3: The house was accessed by the suspects through the second floor window via a ladder.

notified the police. Subsequent interviews of the woman by police revealed that she had been in a relationship with the adult son of the owners of the home where the homicides occurred. She had informed some "friends" about the possibility of robbing the home, providing information that the family was out of town, of the days that the maid would not be present, and of a way to bypass the security system through accessing the upper-level window. She subsequently provided the police with the names of her "friends" and the location of their "hangout." Four subsequent arrests were made within hours, and roughly 20 pairs of shoes were collected from the suspects' location.

Image 4: Location of dog feces on sidewalk leading from the driveway to the back door.

Image 5: Dog feces with shoe impression.

Evidence from the crime scene included ballistics, fingerprints, trace evidence, and footwear impressions, along with the dog feces. Four 9-mm casings and bullet fragments from the scene were recovered, with firearms examination suggesting that the murder weapon was an Intratec Tec-9. However, no weapon was recovered from the suspects. Multiple latent fingerprints were identified at the crime scene, but none matched the suspects. Infrared spectroscopy and refractive indices of carpet fibers found embedded in the bottom of the suspect's shoe matched class characteristics from carpet fibers of the home, but no match could be made between the suspects' shoes and footwear impressions from the scene due to insufficient detail.

Image 6: Suspect's shoes.

One suspect's shoe contained apparent feces embedded within its sole (Image 6). This, along with the presumed dog feces recovered from the walkway of the home, were sent to the Veterinary Genetics Laboratory at the University of California-Davis for genetic testing. DNA from both samples were identical for 11 canine-specific microsatellite DNA markers; allelic frequencies indicated that 1 in 1.16 billion dogs would have this same genotype (Figure 1). Subsequent trials resulted in the conviction of all 4 suspects. The 4 males directly involved in the homicide are currently serving sentences ranging from 45 years to life in prison. The young woman was also found guilty but served only 5 years in prison following an appeal.

DISCUSSION

Literature has shown that DNA from feces can be reliably recovered from both humans and animals and can also be used to identify the source of feces (1-3). Standardized protocols for fecal DNA isolation show a 93% success rate in correctly typing fecal sample to source material with preservation techniques allowing for testing to be performed after several years (1,2). These techniques have been applied to various disciplines. Notably, within medicine, fecal DNA analysis utilizing genetic material taken from intestinal epithelial cells shows a correlation between methylation at certain promoters and the presence gastrointestinal tumors, providing a valuable screening tool for colorectal cancers (4). Similar approaches have aided in the identification of *H pylori* infections in children (5). Furthermore, fecal DNA testing has also been used to examine the diets of animals in ecological research as well as to track individuals who fail to clean up after their dogs while on walks (3).

A

DNA Results

FH2137:	174/190
FH2054:	159/171
AHT121:	104/110
AHT137:	134
FH2001:	130
PEZ08:	231/239
FH2159:	188/204
RVC1:	154/162
PEZ18:	223
PEZ03:	131/134
PEZ10:	281
FH2159:	188/204

B

DNA Results

FH2137:	174/190
FH2054:	159/171
C08.618:	/
PEZ12:	272/300
AHT121:	104/110
AHT137:	134
FH2001:	130
PEZ08:	231/239
FH2159:	188/204
PEZ22:	/
RVC1:	154/162
PEZ18:	223
PEZ03:	131/134
PEZ10:	281
FH2159:	188/204

C

Locus	Allele 1	Allele 2	Frequency Allele 1	Frequency Allele 2
FH2137	174	190	0.112	0.021
FH2054	159	171	0.064	0.077
AHT121	104	110	0.278	0.041
AHT137	134	134	0.062	0.062
FH2001	130	130	0.225	0.225
PEZ08	231	239	0.209	0.111
FH2159	188	204	0.216	0.027
RVC1	154	162	0.169	0.207
PEZ18	223	223	0.196	0.196
PEZ03	131	134	0.050	0.082
PEZ10	281	281	0.093	0.093

Figure 1: Genetic marker reports for scene sample (A) and shoe sample (B). Probability calculations based on average allele frequency data across 30 dog breeds for each of the 11 markers tested on the 2 samples (C).

In conjunction with literature supporting the ease and accuracy of fecal DNA testing, we show in this case that these techniques may provide valuable information in homicide investigations toward linking a suspect to a crime. This case illustrates this notion of the current utility of fecal samples toward DNA analyses in forensic investigations. We wish to shed light on the utility for law enforcement officials as well as forensic pathologists to adopt forward-thinking strategies as it pertains to evidence. This type of thinking was famously illustrated in the 1993 Brown Chicken massacre, where an investigator saved a partially eaten chicken wing from the crime scene, cryopreserved it, and was later able to link it to a suspect via DNA testing once technology had advanced far enough (6). Like the Brown Chicken massacre, the case presented shows the implementation of DNA testing that is individualized to a situation, yet able to yield very conclusive data. This forward-thinking approach is founded on the notion of examining all details of the crime scene, even those whose value are not immediately apparent, and promptly conducting necessary tests (or, in the case of Brown's chicken, preserving the evidence for later use or evaluation) (7). In the present case, had police investigators not thought to collect the dog feces, the important link between the crime scene and a suspect would not have been possible.

A recent review concerning DNA testing in homicide investigations reported on various situations with a series of example cases in which such testing provided useful information (7). The case presently showcased in this article was included in the review, in abbreviated form (7). Of note regarding this case, consideration should be placed on testing nontraditional, nonhuman sources of DNA if the source is deemed relevant to the investigation. Several other important points were emphasized in this review. For example, emphasis should be placed on investigation of scene entry/exit points ("flight paths") used by perpetrators, as DNA transfers are more likely in these locations (7). An additional point of importance involves the potential transfer of contaminating DNA, which may occur during the collection and DNA extraction process. It is imperative for all those involved in the investigation (police, investigators, laboratory personnel) to minimize this risk through implementing stringent work protocols (7). In the field, trace evidence and DNA samples should be collected first, and investigators must restrict access to the area (8). The DNA lab must have an isolated sample collection area equipped with near-neutral airflow, and full protective equipment must be worn (8). Additionally, laboratories should document DNA profiles of personnel who routinely come into contact with the lab and may potentially contaminate samples (8,9).

CONCLUSION

We present a triple homicide in which a suspect was linked to the crime scene using DNA recovered from canine feces found at the crime scene and on the sole of a suspect's shoe. This case emphasizes the need for crime scene investigators to adopt forward-thinking strategies. These include thorough examination of all details of a crime scene, even those for which the value is not immediately apparent, and promptly conducting necessary tests or retaining evidence for future testing. Positive results obtained from DNA testing can be very valuable in providing adjunct evidence or, as indicated in the presented case, providing evidence that is critical toward the outcome of the case.

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