

CASE REPORT

Elayne A. Schwartz,¹ M.S.; Karen E. Vallaro,¹ M.S.; Ted M. Pool,¹ B.S., MT(ASCP); Robert A. Adamo,² M.S.; Mark L. Taff,³ M.D.; and Lauren R. Boglioli,³ M.D.

Optical Analyses of Eyeglass Lens Fragments and the Unexpected Detection of Oral Sperm in a Homicide Case

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ABSTRACT: A homicide case in which intact spermatozoa were found in the oral cavity of the deceased forty days after his disappearance is reported. The victim's partially frozen body was found outdoors in a wooded area of upstate New York during the month of January. During a subsequent investigation, pieces of eyeglass lens fragments and bloodstains were found in the suspect's house and vehicle. Chemical and optical analyses of the lens fragments are presented as well as results of the serological tests.

KEYWORDS: pathology and biology, homicide, death investigation, sperm survival, eyeglass frames, eyeglass lenses, lens prescription, vertometer, optometry

Case History

In December 1991, a 38-year-old man was reported missing by his wife. Forty days after his disappearance, the victim's body was found 200 feet from the nearest road in a heavily wooded area in Putnam County, New York. A subsequent police investigation found that a baseball card dealer had an appointment with the decedent shortly before his disappearance. The victim had invested approximately \$70,000 for the purchase of baseball cards, which he never received.

Autopsy and Investigation Findings

The victim's body, which was partially frozen at the time of autopsy, exhibited early stages of decomposition. The cause of death was determined to be a single gunshot wound to the back of the head resulting in multiple brain lacerations, skull fractures and extensive hemorrhage.

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^{1,2}Forensic Scientists, and Senior Forensic Scientist, respectively, Westchester County, New York, Department of Laboratories and Research, Valhalla, NY.

³Forensic Pathology Office, West Hempstead, NY.

Examination of the victim's fully clothed body revealed an unbuckled belt that was removed from two belt loops. As a matter of routine in questionable death cases, the medical examiner collected the standard specimens for a Sexual Assault Evidence Collection Kit. In addition to the kit, the victim's clothing, eyeglasses, and two glasslike fragments were submitted to the laboratory for analysis.

Examination of the suspect's basement revealed a blood spatter pattern on the leg of a workbench (Fig. 1). The contents of a shop vacuum found in the basement were removed for further examination. Twenty glasslike fragments and several reddish-brown stains were collected from the suspect's vehicle for trace evidence and serological analyses.

Laboratory Findings

Serology/DNA

The blood spatter pattern on the leg of the workbench was found to be of human origin. Attempts at ABO grouping, enzyme and



FIG. 1—Suspected site of the homicide, showing a freshly painted floor and workbench in the defendant's basement. The right leg of the workbench exhibited a blood spatter pattern.

DNA analysis (both RFLP and PCR) were unsuccessful. This may be due to an insufficient quantity of blood and/or interferences from the wood. Three areas of the suspect's vehicle demonstrated the presence of human blood and blood group B antigens. These results were consistent with the victim's blood type. In one area (the rubber seal around the rear cargo door), RFLP analysis using the FBI Hae III protocol yielded a three probe match (D1S7, D17S79, D2S44) with the victim's blood. The probability of selecting an unrelated individual at random from the population having a DNA profile matching the victim's blood sample for these loci is approximately 1 in 230,000 in caucasians [1].

Ten intact spermatozoa were observed on the oral slide present in the Sexual Assault Evidence Collection Kit. A p30 analysis conducted on the oral swab yielded negative results. Subsequent examination for the HLA DQ α locus using polymerase chain reaction (PCR) analysis proved inconclusive. No spermatozoa were observed on the rectal slides.

Trace Evidence

The victim's eyeglasses consisted of a right lens composed of a polymer and a missing left lens with no fragments affixed to the frames. Microscopical examination of all the trace evidence revealed eight glasslike fragments to be organic polymers that appeared to be eyeglass lens material. These eight specimens consisted of four found on the victim's body, one recovered from the suspect's vehicle, and three recovered from the shop vacuum in the suspect's basement. Physical matches were attempted between these eight fragments, however none were achieved.

Five commonly used lens materials were obtained for comparison purposes courtesy of a local optician. These exemplars included three polymers, Tintable Polycarbonate, Columbia Resin 39, and Hyperindex 160. The evidentiary specimens and polymeric exemplars were analyzed using an Analect Instruments MICRO-20U fourier transform infrared microspectrophotometer and a Perkin-Elmer 8500 gas chromatograph with a Chemical Data Systems, Inc. 190 pyroprobe. The results revealed all the evidentiary specimens were consistent with Columbia Resin 39.

The seven largest fragments were then analyzed for optical refraction status by a local optician using a model 101 Marco vertometer. The right lens was also submitted for analysis to act as a proficiency specimen. The results of the examinations (Table 1) were consistent with the victim's most recent lens prescription obtained in June of 1986. The first and second values represent spherical and cylindrical readings, respectively. The third value

represents an axis of the cylindrical correction and is dependant on the orientation of the lens within frames. No readings could be obtained for three of the samples due to their small size.

Discussion

Serology/DNA

One unusual finding in this case was the occurrence of intact spermatozoa on the oral slide. There are two possible explanations for this finding. Either semen was deposited in the mouth a few hours before death, or it was deposited sometime after death.

There are varying opinions on the survival time of spermatozoa in the oral cavity of live individuals. It has been reported that spermatozoa can be found on oral smears up to six hours after deposition, despite the use of mouthwash, the brushing of teeth, and drinking various fluids [2]. Another study suggests that spermatozoa may be observed up to thirteen hours in saliva samples and up to eight hours on oral swabs [3].

Little data is available on the persistence of spermatozoa in the oral cavities of deceased individuals. There are however a few reported cases describing the survival of spermatozoa in the vaginal cavity. In one case, where a body was found in a mountainous area, spermatozoa were found in the vagina sixteen days after death [4]. In a second case, spermatozoa were found in the cervical canal of a partially frozen victim who had been dead for one and one-half months [5]. A common factor in both cases was the preservative effect the cold weather had on the bodies. As Wilson concluded, "the cold temperatures to which the body was exposed probably slowed the destructive influences of proteolytic enzymes, bacterial multiplication and phagocytosis" [4].

The outdoor temperatures for the forty day time period, in three towns surrounding the site where the body was found, are presented in Table 2. These data were obtained from the U.S. Department of Commerce National Oceanic and Atmospheric Administration. The average temperatures were below or close to freezing for the forty day period. The medical examiner also reported that the body was partially frozen at the time of autopsy. It is known that spermatozoa can be preserved through such methods as cryopreservation [6]. These freezing methods are advantageous to preserving spermatozoa for the purpose of artificial insemination. While this case does not incorporate the extreme low temperatures and care that are used in cryopreservation, one could deduce the below-freezing temperatures present were beneficial for preserving intact spermatozoa.

If, however, the semen deposition was postmortem, several possible explanations exist. It could represent a case of necrophilia. This type of activity has been documented in the literature [7,8]. A less likely possibility would be semen deposition by an animal.

TABLE 1—Comparison of victim's most recent lens prescription with the lens fragments from the crime scenes.

	Diopter Spherical	Diopter Cylindrical	Diopter Degrees
Right Eye Prescription	-0.75	-0.75	85
Left Eye Prescription	-1.25	-0.75	85
Right Lens in Frames	-0.75	-0.75	85
Fragment #1 from Victim	-1.25	-0.75	175
Fragment #2 from Victim	-1.25	-0.75	175
Fragment from Victim's Shirt	ND	ND	ND
Fragment from Suspect's Vehicle	-1.25	-0.75	ND
Large Fragment from Suspect's House	-1.25	-0.75	ND
Med. Fragment from Suspect's House	ND	ND	ND
Small Fragment from Suspect's House	ND	ND	ND

ND - Not Determined

TABLE 2—Meterological data for period from December 20, 1991-January 29, 1992.

Weather Station	Temperature (F)		
	Mean of Maximum Temperature	Mean of Minimum Temperature	Average Temperature
Yorktown Heights, NY	37.2	22.2	29.7
Glenham, NY	40.2	19.8	30.0
U.S.M.A., West Point, NY	38.4	27.2	32.8

In order to eliminate this scenario, sperm cells from twenty different animal species were examined microscopically. The morphology of the spermatozoa on the oral slides did not resemble any of the known animal exemplars and clearly was typical of human sperm cells. The authors could not reference any cases regarding postmortem deposition of sperm by an animal.

The defendant never admitted to having had sexual relations with the decedent prior to or after death. As a result, it is unlikely that a determination will be made as to who deposited the semen in the victim's mouth. Regardless of the mechanism of the semen deposition, the cold weather conditions clearly contributed to the preservation of the sperm cells.

This case also illustrates the importance of collecting specimens associated with a sexual assault even when there is no reason to believe that one has occurred. There may be many cases where specimens are not collected and seminal fluid evidence goes undetected.

Trace Evidence

The use of eyeglass frames and lenses as physical evidence has been previously reported in the literature. In 1924, a pair of eyeglasses provided an important lead in the infamous Leopold and Loeb homicide case. Two graduate students from the University of Chicago, Nathan Leopold Jr. and Richard Loeb, were charged and later convicted of the kidnapping and murder of a 14-year-old boy. A pair of shattered eyeglasses was found near the victim's body. Officials using information obtained from the eyeglass frames and lens construction were able to trace the eyeglasses back to Leopold [9]. In another case that involved the rape and homicide of a young housewife, a pair of intact eyeglasses was also found near the victim's body. During trial, two optometrists gave testimony on the comparison of the eyeglasses found at the scene and a pair that was taken from the defendant. An opinion was rendered that "these two pairs of glasses were made for, and worn by, the same individual" [10]. Hinojosa reports two cases where eyewear provided crucial evidence for the personal identification of a victim and suspect, respectively [11]. In the latter case, broken lens fragments found at the scene of a homicide were reconstructed into an entire lens. Through the use of a vertometer an optician was able to obtain the prescription of the lens which subsequently aided in the apprehension of a suspect.

In this case, a somewhat different approach was taken with respect to the lens prescription analysis. Due to an insufficient number of evidentiary fragments available to reconstruct the left lens, the unassembled individual fragments were measured for refraction status using a vertometer. Vertometers are used routinely by opticians to determine the correct orientation of an eyeglass lens with respect to a patient's eye. In a typical analysis, an entire lens is placed on the vertometer stage and several measurements are taken. These include spherical, cylindrical, and cylindrical axis readings. A review of this technique is reported by Woods [12]. Discrepancies in the diopter degree values as represented in Table 1, could result from the fact that this value is a measurement of the lens as positioned in a pair of eyeglass frames. Since it was not possible to determine the correct orientation of the fragments within a pair of eyeglass frames, a match to the victim's known axis value was not expected. Four of the seven evidentiary fragments were large enough to be analyzed on the vertometer. These four fragments were hand-held by the optician performing the examination because they were too small to be mounted on the

vertometer stage. The smallest fragment that yielded prescription values was approximately 6×5 mm long.

Data compiled from a national survey of eyeglass wearers with respect to their refraction potential has been conducted by the National Center for Health Statistics. The frequency of occurrence of prescription values was examined over a broad group of individuals distinguished by such demographic factors as age, sex, race, and ancestry [13]. According to this survey, the spherical and cylindrical powers that were observed in the victim's left eye prescription, occur with a frequency of approximately 0.3% in the general population. Caution should be exercised however, when referencing statistics that are representative of only a single study.

Conclusion

This case points out two important aspects in the recognition and collection of physical evidence. In death investigations, the use of a Sexual Assault Evidence Collection Kit should be considered even though the outward appearance of the deceased might not suggest that any consensual or aggravated sexual activity occurred. Secondly, the numerous styles of eyeglass frames and lenses available today, combined with the countless possibilities of prescription values of lenses, makes eyeglasses and/or their fragments ideal specimens for trace evidence analysis with a potential towards personal identification.

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References

- [1] Budowle, B. et al., "A Preliminary Report on Binned General Population Data on Six VNTR Loci in Caucasians, Blacks and Hispanics from the United States," *Crime Laboratory Digest*, Vol. 18, No. 1, Jan. 1991.
- [2] Enos, W. F. and Beyer, J. C., "Spermatozoa in the Anal Canal and in the Oral Cavity of Female Rape Victims," *Journal of Forensic Sciences*, Vol. 23, No. 1, 1978, pp. 231-233.
- [3] Willot, G. M. and Crosse, M. A., "The Detection of Spermatozoa in the Mouth," *Metropolitan Police Forensic Laboratory, Report No. 51*, Dec. 1984.
- [4] Wilson, E. F., "Sperms' Morphologic Survival After 16 Days in the Vagina of a Dead Body," *Journal of Forensic Sciences*, Vol. 19, No. 3, 1974, pp. 561-564.
- [5] Spitz, W. and Fisher, R., *Medicolegal Investigation of Death*, Charles C Thomas, Springfield, IL., 1973, p. 518.
- [6] Jeyendran, R. S. and Perez-Pelaez, M., "Cryopreservation of Human Spermatozoa," *Illinois Medical Journal*, Vol. 170, No. 2, 1986, pp. 81-83.
- [7] Torre, C. and Varetto, L., "An Exceptional Case of Necrophilia," *The American Journal of Forensic Medicine and Pathology*, Vol. 8, No. 2, 1987, pp. 169-171.
- [8] Smith, S. M. and Braun, C., "Necrophilia and Lust Murder: Report of a Rare Occurrence," *American Academy of Psychiatry and the Law*, Vol. 6, No. 3, 1978, pp. 259-268.
- [9] "Chicago Murder Mystery Solved Through Pair of Glasses," *The Optical Journal and Review*, Vol. 50, No. 23, June 5, 1924, p. 25.
- [10] "Optometrist's Testimony Key to Murder Conviction," *Journal of Illinois Optometric Association*, Vol. 30, No. 5, Sept./Oct. 1972, p. 12.
- [11] Hinojosa, A. V., "Optics and Crime Investigation," *International Criminal Police Review*, Vol. 347, Apr. 1981, pp. 102-109.

- [12] Woods, T. A., "Basics of the Lensmeter—Verifying, Measuring and Locating Optical Properties of Ophthalmic Lenses," *Eye Quest Magazine*, Vol. 3, No. 1, 1993, pp. 44–53.
- [13] National Center for Health Statistics, J. Roberts and M. Rowland, "Refraction Status and Motility Defects of Persons 4–74 Years," United States, 1971–72. Vital and Health Statistics. Series 11-No. 206. DHEW Pub. No. (PHS) 78-1654. Public Health Service. Washington. U.S. Government Printing Office, Aug. 1978.

Address requests for reprints or additional information to
Karen E. Vallaro
Westchester County Dept. of Laboratories and Research
2 Dana Road
Valhalla, NY 10595