

## CASE REPORT

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# The Use of Microscopic Postmortem Changes in Anagen Hair Roots to Associate Questioned Hairs with Known Hairs and Reconstruct Events in Two Murder Cases

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**ABSTRACT:** In two cases investigated by the New Orleans Police Department Crime Lab, hairs recovered from crime scenes were found to exhibit microscopic postmortem changes in anagen hair roots. These microscopic characteristics were used to associate these hairs with various victims in the cases. In addition to associating questioned hairs with known hairs, the fact that the victims were dead when the hairs were pulled helped investigators reconstruct events in both crimes and corroborate statements made by the arrested subjects in each case.

**KEYWORDS:** forensic science, forensic hair comparison, postmortem changes

Forensic hair comparisons have been used for many years to show associations between questioned hairs, usually from crime scenes, with known hairs from victims, suspects, or witnesses to a crime. The method of comparison is a microscopic examination of the hairs in question in which various morphological features commonly used in forensic hair comparisons (1) are compared. The questioned hairs may be associated with, or excluded from, the known hairs based on the similarity or significant dissimilarity of these features (2).

In addition to the association of questioned hairs with known hairs, other information may be discovered relative to the events that occurred during the course of the crime. This paper will show how this occurred in two cases investigated by the New Orleans Police Department Crime Laboratory in 1997 and 1998. The morphological characteristic that was used to determine the sequence of events in these two crimes was postmortem changes in the roots of the hairs recovered during the investigations.

It has been determined that roots of anagen hairs still embedded in a person's skin will undergo postmortem changes in the hours and days after a person's death. These changes first are seen as a

black band (postmortem banding) about .5 mm above the tip of the hair's root. This is actually a number of longitudinal spaces filled with air that appears black when viewed under transmitted light. The next change that occurs and is seen usually after the hair has been pulled from the hair follicle is a fracture of the hair through the root (brushy root) which gives the proximal end of the hair a brush like appearance. While a postmortem interval cannot be determined from these changes, it can be determined that a victim was dead or alive when the hair was pulled from the victim's skin. The elapsed time for these changes to occur depends on the ambient temperature of the body but has been seen as early as ten hours after death (3). Other circumstances of the crime, scene, or victim will determine the conclusions that may be drawn by the forensic scientist investigating the crime.

### Case 1

In January 1997, an elderly female was kidnapped by her tenant who then forged checks on her bank account while she had the victim in her custody. She was tied up and held in the tenant's residence and in the trunk of a car for about two weeks. During that time she died. The body was kept for another two weeks and then was soaked with gasoline and burned. When the police investigated the incident, a piece of duct tape was found at one of the scenes where her body was hidden before it was burned. This duct tape was found to have five human hairs stuck to its surface. The author collected the hairs and compared them with known hairs taken from the victim at autopsy. The hairs were similar in microscopic characteristics which suggested a possible association between the questioned hairs and the known hairs from the victim. These hairs were gray but some of them had been dyed red. The anagen hairs from both the questioned hairs and the known hairs exhibited post mortem banding (Fig. 1). On one of the questioned hairs a blue synthetic fiber was found that was similar in microscopic characteristics to known fibers collected from the victim's upper body garment. This further associated the hair on the duct tape with the victim.

When the victim's tenant was questioned, she confessed to the crime and stated the victim's face was wrapped with duct tape. This statement was corroborated by the hairs and the fiber on the duct tape. The Orleans Parish Coroner's Office reported the prob-

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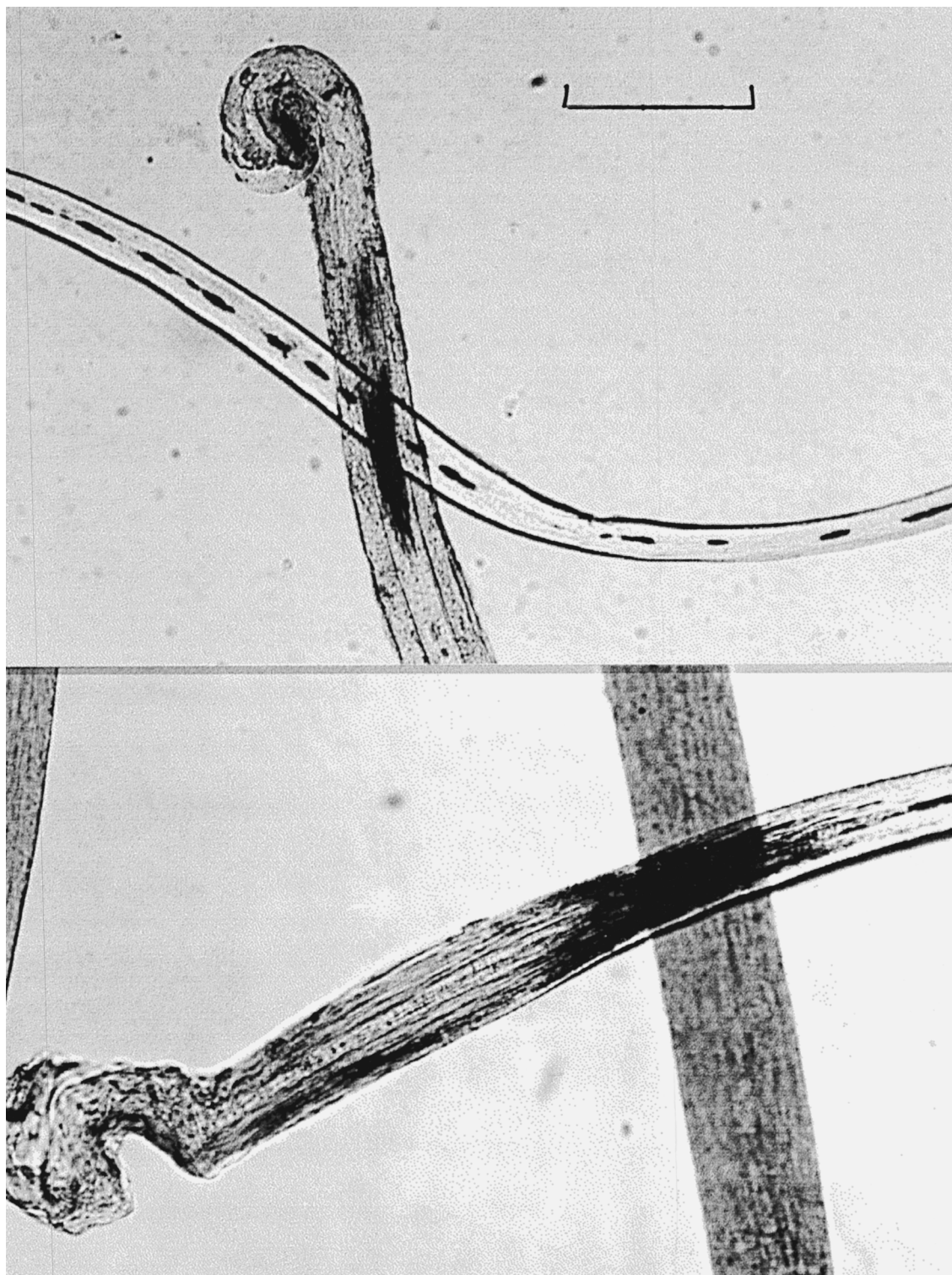


FIG. 1—Root of a questioned hair recovered from duct tape (below), root of a known hair from the victim (above). Both hairs exhibit postmortem banding. Scale equals 100 micrometers.

able cause of death to be suffocation. This was also corroborated by the tenant's statement and the duct tape itself which contained hairs and a fiber associated with the victim. The victim was elderly and could very well have suffocated while being held in the trunk of a car as the tenant reported, if her mouth was covered with duct tape.

While hair and fibers cannot be individualized to the exclusion of all others using microscopic comparisons, the similarity in microscopic characteristics between the questioned hair and fiber and known hairs and fibers strongly associated the questioned hairs and the fiber on the duct tape with the victim and corroborated the tenant's statement and the coroner's cause of death.

*Case 2*

In March of 1998, four victims were found dead in a residence in New Orleans, Louisiana. There were two adult males, one adult female, and one nine-year-old male child. They had been dead about a week. Known hairs were collected from the victims by the

Orleans Parish Coroner's Office. The author examined each sample and observed that the two male victims had hair that could readily be distinguished by general microscopic characteristics. Known hair from the female and the juvenile victims, who were mother and son could not be separated because they both had the same general microscopic characteristics. But when postmortem changes were

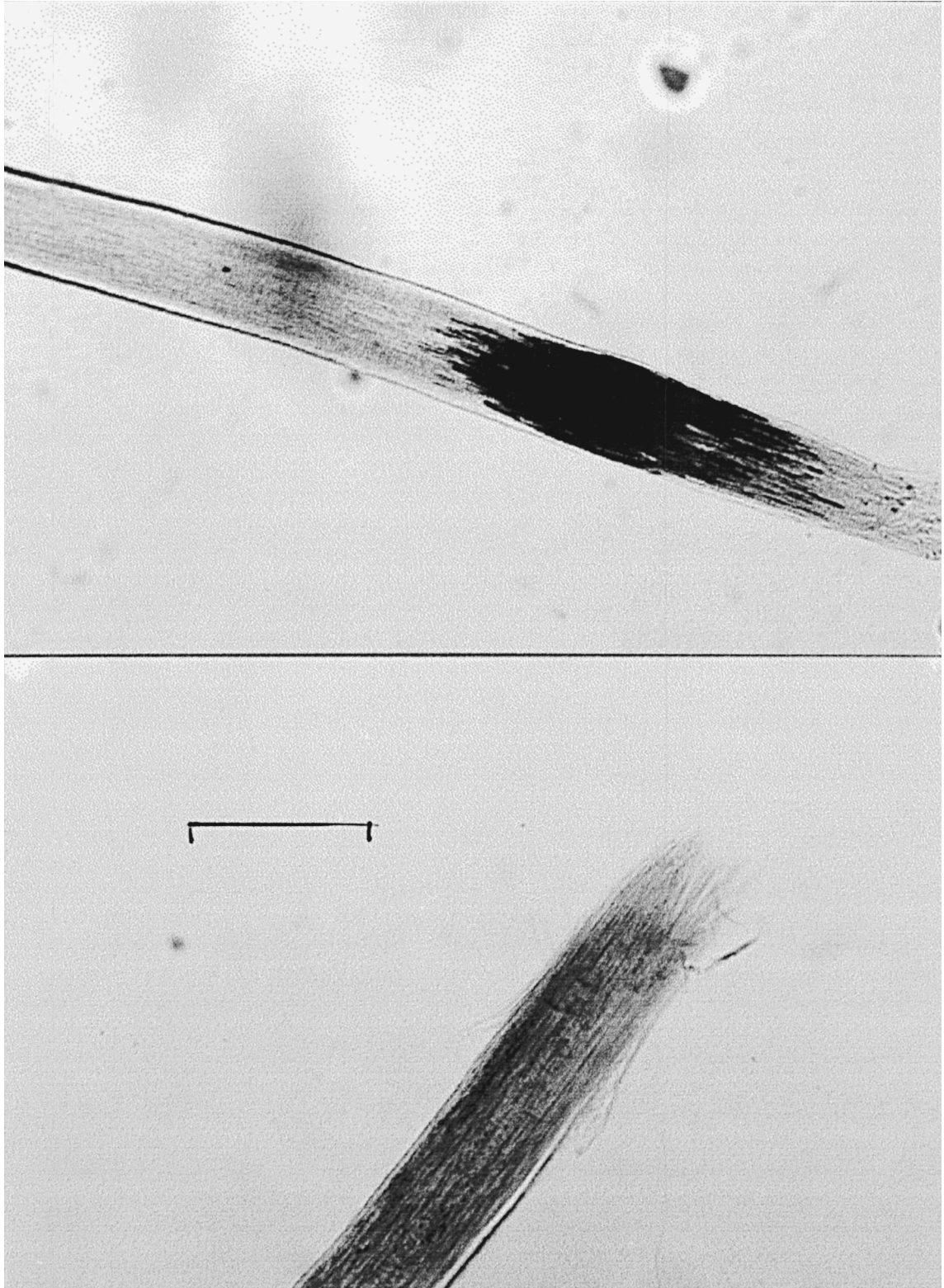


FIG. 2—Known anagen hair roots from the female (below) and juvenile victim (above). Scale equals 100 micrometers.



observed it could be seen that the juvenile's hair exhibited post-mortem banding while his mother's hair exhibited a brushy root which is a more advanced postmortem change (Fig. 2). The two adult male victims showed no post mortem changes in their known hair.

Questioned hair samples were collected from two knives and a large rock from the scene, and from the female victim's shirt. When these questioned hairs were compared to known hairs from all four

victims it could be readily seen that the hairs from the rock could be associated with one of the male victims indicating the rock may have been used as a weapon. The other three samples were similar to hair from either the female victim or the juvenile. One of the samples from one of the knives had no roots on any of its hairs and could not be differentiated from the female or the juvenile. But the other knife and the hair from the T-shirt contained brushy roots that could be associated with the female victim (Fig. 3). The fact that

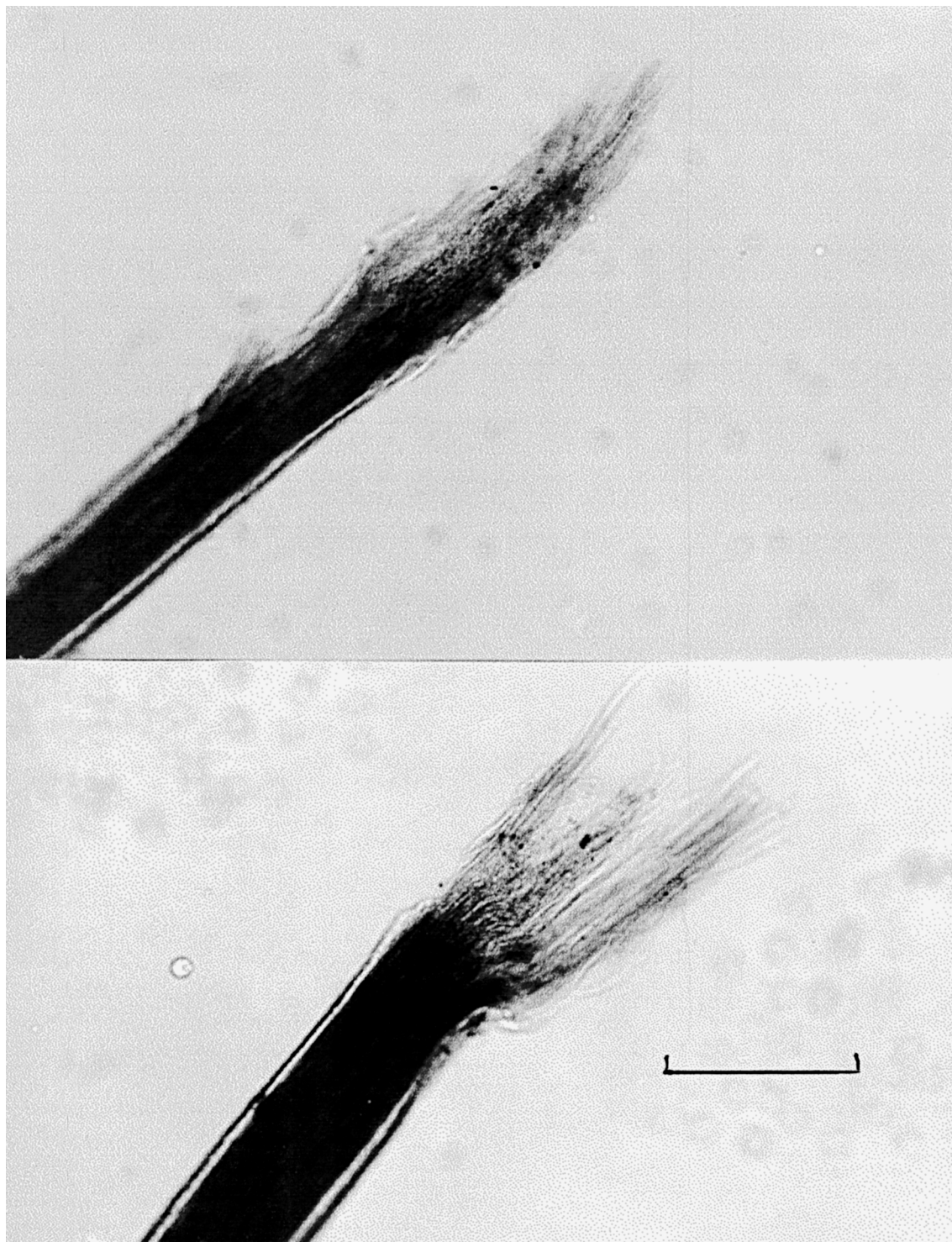


FIG. 3—Questioned hairs from the crime scene: root from a hair recovered from a knife (above) and a root from a hair recovered from the female victim's shirt (below). Scale equals 100 micrometers.



these hairs had brushy roots indicated they were pulled from the victim's head some time after she died.

The fact that the hairs were pulled after the victim's death corroborated the statement of a person subsequently arrested for the murders of all four victims. He said he went back several days after the crime and cut all the victim's throats with the two knives recovered with hairs stuck to them. The hair found on the victim's shirt could have come out in the accused's hand when he cut her throat and then could have been dropped on to her T-shirt where it was found.

## Materials and Methods

Hairs and fibers were recovered by the use of fine forceps and a stereoscopic microscope (using magnifications of 10 to 30 $\times$ ). They were mounted on microscope slides using Permount which has a refractive index of 1.525. This is close enough to the refractive indices of the hairs and fibers in question to allow the optimum amount of contrast between the specimen's microscopic characteristics when viewed with a compound microscope using transmitted light (4). Magnifications of 40, 100, 200, and 400 $\times$  were used to view the specimens. The microscopic characteristics for known and questioned hairs and fibers were recorded and the slides were compared side by side using a Leitz comparison microscope.

## Discussion

Because it is known that postmortem changes occur in anagen hairs after the death of the hair donor, it can be said a hair exhibiting postmortem banding or a brushy root was pulled from the skin of the donor after he or she died. In Case 1, the fact that the head hairs (which have been associated with the victim) were found on the duct tape indicates the duct tape could have been wrapped around the victim's head. The sweater fiber (which also has been associated with the victim) found on one of these hairs gives more weight to this argument. This argument is corroborated by the accused's statement that duct tape was wrapped around the victim's head.

In Case 2, the significance of the presence of brushy roots and the absence of roots exhibiting postmortem banding on questioned hairs found on the murder scene supports a strong association of the questioned hairs with the female victim and the exclusion of them from the juvenile victim. It also suggests that the victim was dead when the hair was removed from her head and this fact was impor-

tant in reconstructing the crime. In both cases inculpatory statements were made by the accused. Defense attorneys often argue these statements have been coerced or are inaccurate. Physical evidence, which corroborates them, is very valuable to the prosecution both in refuting these arguments and in lending credibility to the statements themselves.

## Summary

The two cases described above show how postmortem changes in the roots of anagen hairs can be used to associate questioned hairs with known hairs, corroborate statements of witnesses and suspects, or assist the investigator in reconstruction of a crime. In the above cases, information as to whether a victim was alive or dead when questioned hairs were pulled from his or her skin was very important in reconstruction of the crimes. In these two cases, the postmortem changes observed helped the author associate the questioned hairs with known hairs from specific victims. It is possible that in some cases postmortem changes could be used to exclude questioned hairs from known hairs.

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