CASE REPORT

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Tool Mark Determination in Cartilage of Stabbing Victim

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ABSTRACT: Striations produced on rib cartilages by a knife were conclusively matched with the individual characteristics of the cutting edge of the knife. This was accomplished using Dip-Pak® (cellulose acetate butyrate), Coe-Flex® (polysulfide dental impression), and comparison microscopy. An absolute identification was made in which all significant striae matched the individual characteristics of the blade's cutting edge.

KEYWORDS: criminalistics, striations, musculoskeletal system, pathology

Instruments used to inflict lethal and nonlethal wounds often leave patterned lesions on the skin and at times on the subjacent soft tissue. Homicidal blunt force trauma caused by an instrument can produce a similar pattern [*1*] on bone. In this case report, sharp force trauma produced a pattern on the skin of the victim's chest and subjacent thoracic cartilages sufficient to identify positively the weapon used to inflict the injury (Fig. 1).

Case History

A 21-year-old male victim was involved in an argument about drug money. The assailant stabbed the victim numerous times in the chest, abdomen, and back. The victim also sustained several defense-type cutting wounds on his upper extremities. Most of the stab wounds had one sharp and one blunt corner and sharp margins. The depths of the wounds ranged from 0.5 to 10.0 cm.

Five of the chest wounds penetrated the heart and several entered both pleural cavities. Many of the costal cartilages were severed. The cut surfaces of the cartilages had grossly visible striae (Fig. 2) suggestive of irregularities of the cutting edge. The deepest stab wounds, 2 of 31, were associated with a curved abrasion (Fig. 3) on the skin continuous with the blunt corner of each of these two stab wounds. This pattern suggested the presence of a quillon (cross guard) between the blade and hilt. One of the wounds (Fig. 4) had a 0.7-cm serrated portion of one wound margin suggestive of a serrated blade. These observations, as investigative leads, were furnished to the police.

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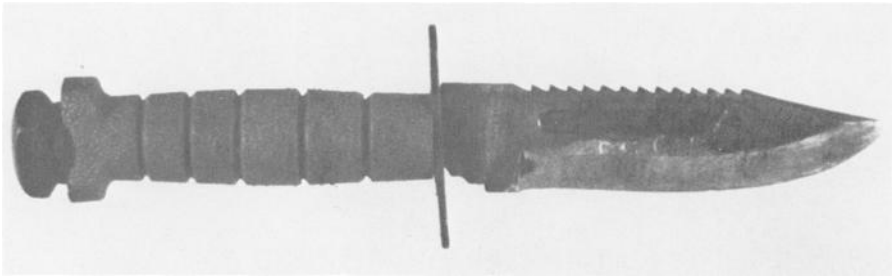

FIG. 1—*The suspect weapon, a marine survival knife.*

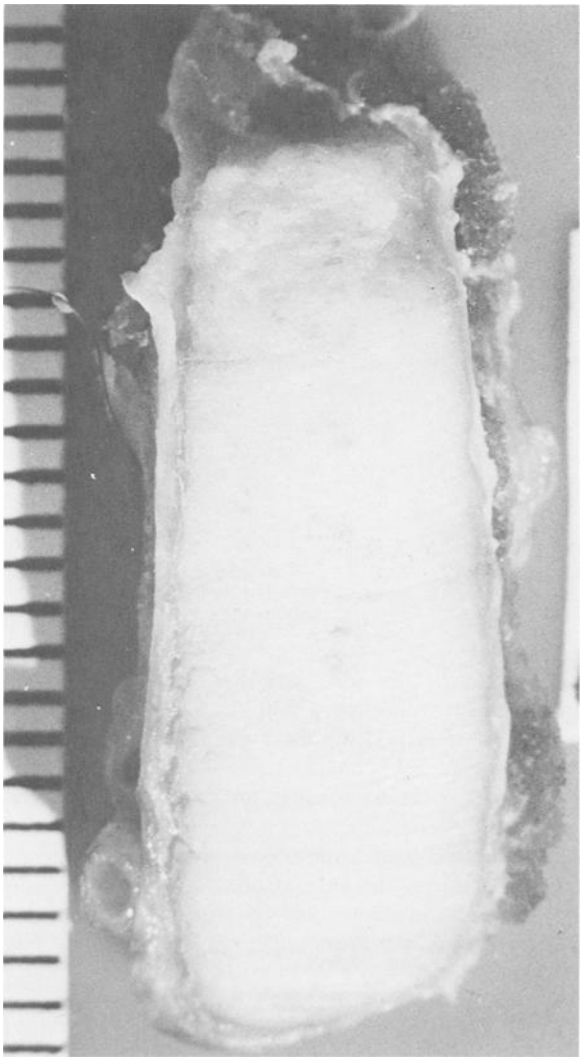

FIG. 2—*The "striae," fine and coarse on cut faces of pierced cartilage.*

FIG. 3—*Quillon abrasion.*

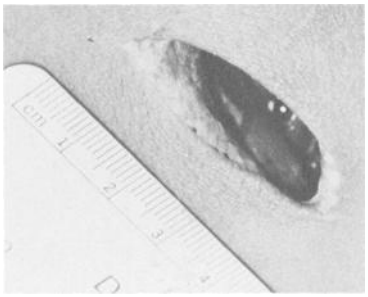

FIG. 4—*Focally serrated wound margin.*

Material and Methods

The striated cartilage segments preserved in buffered 10% formalin were submitted to the Metropolitan Dade County Police Department Crime Laboratory for comparison with a suspect knife found in the suspect's home. An unaided visual evaluation of the cartilage segments was done, followed by examination under oblique light, and low (×12) magnification.

Seven of the cartilage pieces had sufficient macroscopic detail to warrant comparison microscopy. Direct comparison to the knife standards was unsuitable because of cartilage translucency. Cast impressions of the cut ends were made which avoided the translucency problem and distortion from dehydration, which would still occur if one used the method described by Burd and Greene [2].

The casting medium was Coe-Flex® (regular), a polysulfide dental impression medium manufactured by Coe Labs of Chicago, IL. This material meets the needed criteria of faithful reproduction and little adhesion to most surfaces. The opaque, light-brown color and low surface reflectance are ideal for comparison microscopy.

The next step was to produce standard knife cut impressions from the suspect weapon to duplicate marks similar to those on the cut faces of the cartilage. The best results were obtained by stabbing the knife into Dip-Pak®, (Fidelity Chemical Products, Newark, NJ), a brand of cellulose acetate butyrate (Figs. 5 and 6). This material has a translucent yellow appearance and a rubbery texture. The medium was 12.7 mm (½ in.) in thickness and backed by corrugated board. It was "stabbed" at varying depths and angles. The resulting cut faces were spread apart and cast with Coe-Flex for comparison with the cartilage casts.

A fireams comparison microscope was used to compare casts from the cut faces of cartilage and the suspect's knife. A conclusive and positive identification of the suspect's weapon was made based on the fine and coarse striae present on both sets of casts (Fig. 7).

Prior studies [2] have suggested that, in order to make a positive identification, at least 60% of the striae on the weapon and injured tissue must match. One-hundred percent of the major striae on the cut faces of four cartilages matched the parallel recurring surface irregularities produced by the blade of the suspect's knife.

Discussion

The comparison identification of a cut mark with a blade is based upon two factors. First is the ability of the target substrate to receive and record characteristics of the blade. Second is the quantity and magnitude of individual characteristics of the knife blade.

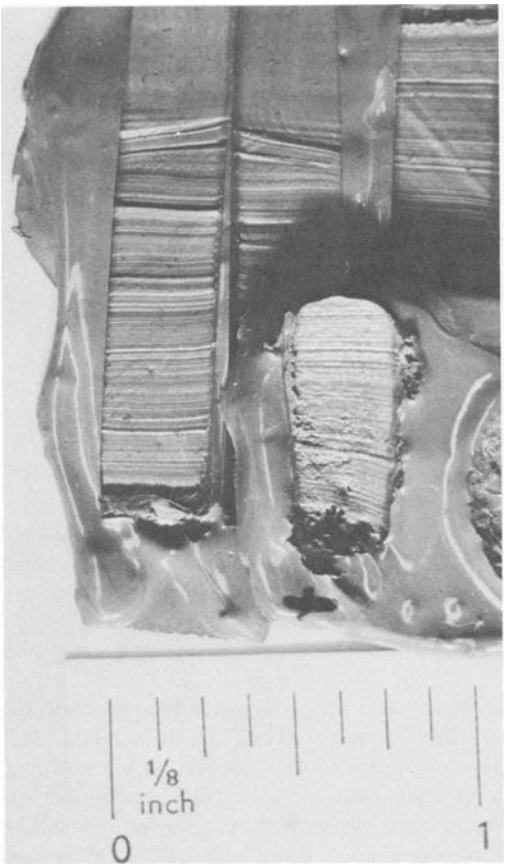

FIG. 5—*Coe-Flex "casts" of the suspect knife and cartilage faces. 1 in. = 25.4 mm.*

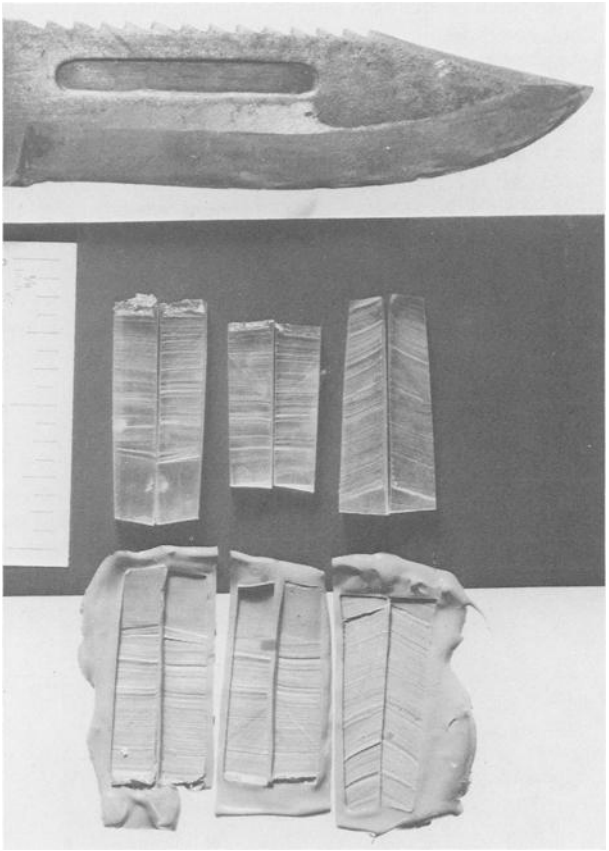

FIG. 6—*The knife showing the defects on the blade with the Dip-Pak and Coe-Flex "casts." 1 in. = 25.4 mm.*

Every tool has two sets of peculiarities referred to as class and individual characteristics. Class characteristics result from modern mass production [*3*] with repetitive structural detail being left on tool surfaces, especially when the tool is produced by molding, die stamping, or die forging. Individual characteristics result largely from wear and tear of the individual tool.

As the magnitude of the defects increase, the ability of the target to retain fine detail can decrease while retaining enough characteristics to permit positive identification. Reported identifications of cut bone generally involve tools with exceptionally gross defects of the cutting edge. Cartilage, on the other hand, may record much finer detail than bone because of its firm and softer texture. It facilitates identification comparison of tools with less prominent individualities.

Bonte [*4*] states that "saw marks and knife wounds in rib cartilage have yet to be mentioned in the Anglo-American literature." The German literature [*5–7*] is replete with work of this nature. This case study provided us with excellent material to support the science of tool mark identification on body tissue in the United States. In this case class characteristics and individual characteristics of the suspect weapon were established within reasonable scientific certainty. Supporting evidence came from the two quillon abrasions in the skin and the focally serrated skin margin of one wound. The suspect weapon was a marine survival knife with a quillon, a serrated blunt edge, a sharp edge, and visible defects on the blade.

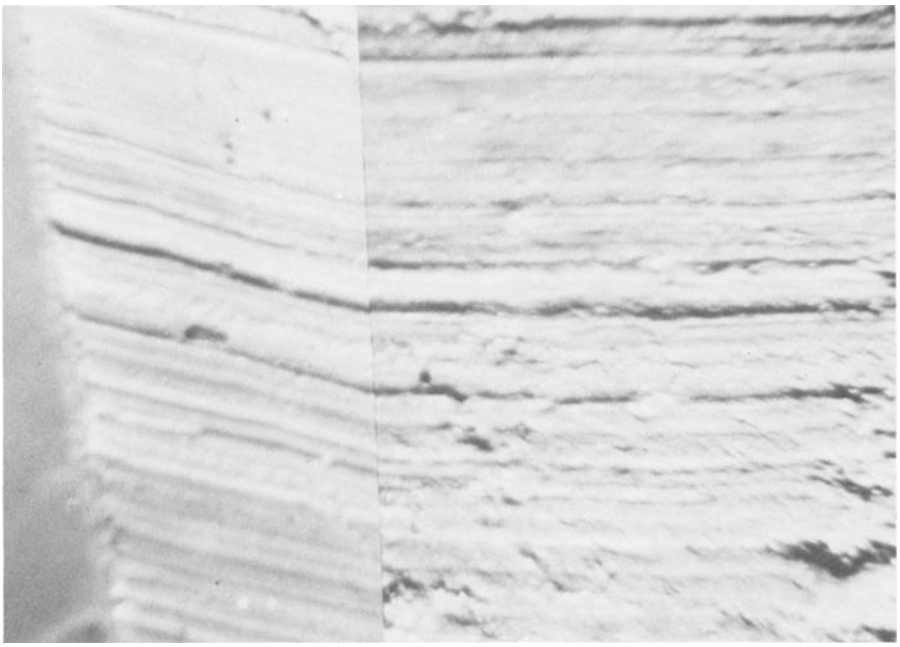

FIG. 7—*Comparison microscopy showing the "mirrored images" of the casts obtained from the knife blade and the pierced cartilage faces.*

This case study demonstrates the necessity to look for and preserve patterned imprints produced by objects used to inflict sharp force injury on the body.

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