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Crossbow Injuries

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ABSTRACT: The crossbow is an uncommon source of fatal injury. In Los Angeles County, two crossbow homicides have occurred in the past 20 years. Following the second case, a crossbow was test-fired into a fresh pork thigh, resulting in distinctive wounds. Experimental studies also showed that the vanes of the bolt (arrow) may be a source of trace material found in the wound.

KEYWORDS: forensic science, ballistics, wound ballistics, criminology, crossbow, wounds, injuries

Since the invention of efficient firearms, the crossbow has become an unusual weapon. Crossbows are mechanically simple, relatively quiet, and potentially lethal. Their major disadvantage, however, is a slow rate of refire.

The bow, which usually requires a mechanical aid to be drawn, is mounted at the end of a wood or metal stock called the tiller. A trigger device holds the string until release. A device for drawing the bow is either built into the tiller or carried separately. The bolt (arrow) is inserted into a trough cut into the upper surface of the tiller [*1*]. Three kinds of tips are commonly used on the bolt—a short conical tip, a two-bladed tip, and a four-bladed tip.

Crossbow injuries are most often suicidal [*2–4*] or accidental [*5*]; few crossbow homicides have been reported [*4*]. We report two cases of crossbow homicide which occurred in Los Angeles County in the past 20 years, one using a two-bladed bolt and one using a four-bladed bolt. Following the second case, we test-fired a crossbow using a conical tipped bolt and a four-bladed bolt to determine the characteristics of the wounds produced.

Case Reports

Case 1

A 30-year-old man, a member of a burglary ring, was found wrapped in a blanket inside an automobile trunk. He had several scalp lacerations, with underlying skull fractures and brain injury. Taser darts, used by the assailant to incapacitate the victim, were

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present in the chest and abdomen. A 24.8-cm (9¾-in.) crossbow bolt was embedded in the right chest. The two-bladed tip was 7.0 cm long and 2.6 cm wide (Fig. 1). The weapon, entering at an angle, produced a 3.2-cm-long linear skin wound, with sharp corners. There was no abrasion or discoloration of the wound edges. The wound penetrated an intercostal space, the right atrium, and the right lung, and the tip lodged in a posterior rib. The crossbow was not recovered.

Case 2

A 79-year-old man with violent behavior and delusions that someone was going to kill him was admitted to a convalescent hospital five weeks before death. A nurse found him in his bed with a 43.2-cm (17 in.) crossbow bolt embedded in his chest. The crossbow was in a duffel bag under the bed. The four-bladed tip produced a cross-shaped skin wound with sharp corners measuring 2.5 by 2.5 cm (Fig. 2*a*). The vanes were touching the entry wound, and the tip of the bolt had exited the body and gone partly through the mattress. A small amount of black discoloration was present at the lower margin of

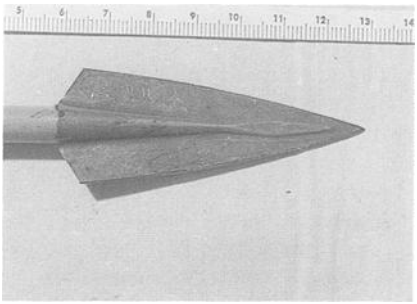

FIG. 1—*Case 1: two-bladed tip.*

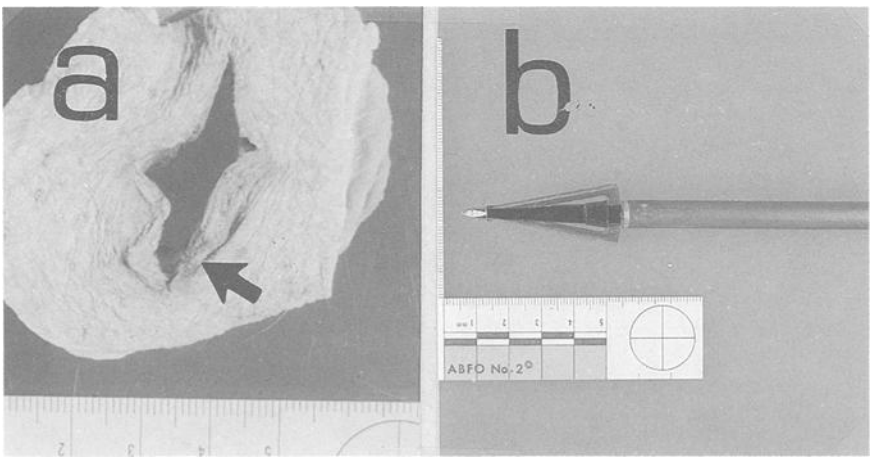

FIG. 2—*Case 2:* (a) *entry wound showing dark discoloration of lower margin* (arrow); (b) *four-bladed tip.*

the wound (Fig. 2*b*). The wound penetrated the costal cartilage, heart, hilum of the left lung, and aorta. It then exited the posterior body wall, cleanly incising the ribs. The decedent's son, who shot his father for euthanasia, committed suicide with a handgun the next day.

Materials and Methods

The crossbow used in Case 2 was a Barnett Wildcat model requiring a draw of 68.1 kg (150 lb). This was fired into a fresh pork thigh 6 ft (1.8 m) away, using a 43.2-cm bolt.

The conical tip measured 0.7 cm in diameter and 1.8 cm long. It was not sharpened. This was fired perpendicular to the skin, creating wounds of the skin and the underlying femur. The four-bladed tip was 4.8 cm long and 2.5 cm wide. Each blade was sharpened. It was fired perpendicularly into the skin and also roughly parallel to the skin to create a graze wound.

Impressions from the four-bladed tip were made in dental wax, inserting the tip at different angles. In addition, carbon particles were applied to the vanes, and the bolt was then passed completely through the wax, creating impressions from the vanes.

Results and Discussion

The conical tip (Fig. 3*a*) created a roughly round skin wound 0.9 cm in diameter, with a symmetrical rim of heaped-up tissue 0.3 cm wide (Fig. 3*b*). No abrasion or discoloration of the rim was present. The underlying femur showed a clean circular wound 0.9 cm in diameter, without any secondary fractures. The wound penetrated almost the entire thickness of the femur (3.2 cm).

The four-bladed tip produced a cross-shaped entry wound similar to those in Case 2. There was slight irregularity of one limb near the center of the wound (Fig. 4). The exit wound was similar to the entry wound, but did not show any irregularity, and had outward displacement of the skin flaps. None of the wounds showed discoloration or abrasion of the edges, and there was no marking attributable to the vanes.

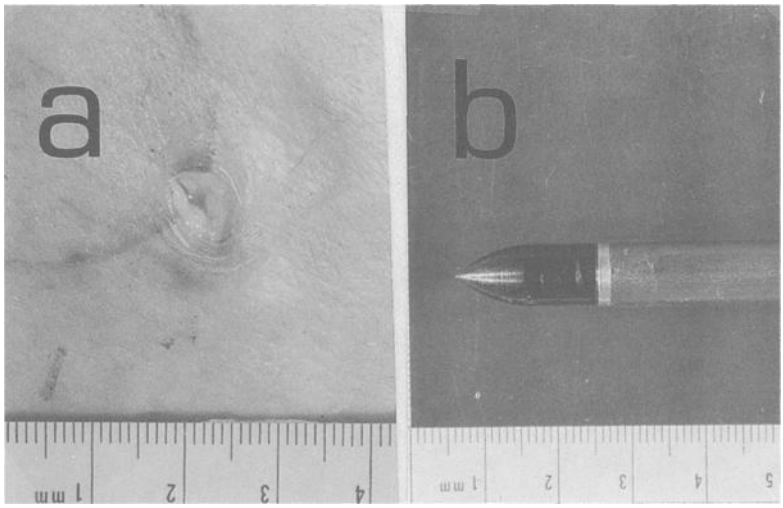

FIG. 3—*Test firing into pork thigh:* (a) *entry wound of skin from conical tip,* (b) *conical tip.*

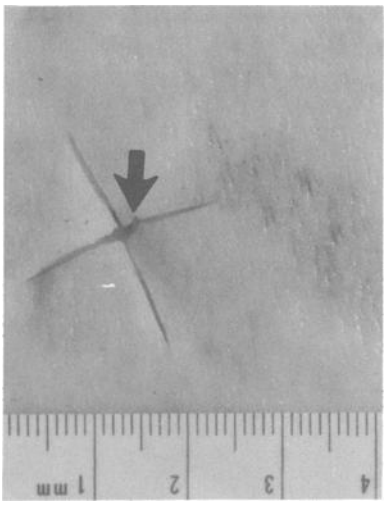

FIG. 4—*Entry wound on pork thigh, using four-bladed tip. One limb shows irregularity* (arrow).

Figure 5 shows the sequence of events when the four-bladed tip grazes the skin.

The wax impressions of the four-bladed tip demonstrated that the center of the tip penetrated the surface before the blades did, creating an initial polygonal wound. The cross-shaped wound made by the blades varied with the angle of entry (Fig. 6). The vanes produced a brush-like impression in the wax, and trace material from the vanes could be deposited at the edge of the wound.

Previous experimental studies of the crossbow have shown that the bolt reaches a velocity of approximately 58 m/s, and that the maximum range of fire is approximately 270 m [6]. It may thus easily produce fatal injuries, especially at close range.

In our cases, it was fortunate that the bolts remained in place, making the mechanism of injury obvious. However, even if the bolt exits and is lost, the distinctive wound

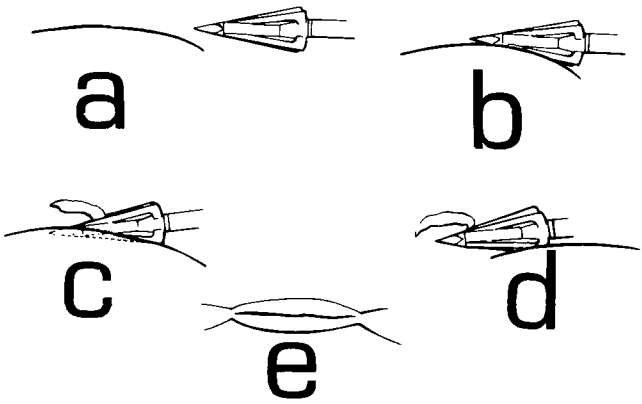

FIG. 5—*Graze wound:* (a) *tip approaches curved surface;* (b) *lower blades incise skin;* (c) *tip goes beneath skin and upper blades cut out a segment of skin;* (d) *lower blades incise skin;* (e) *final appearance of wound.*

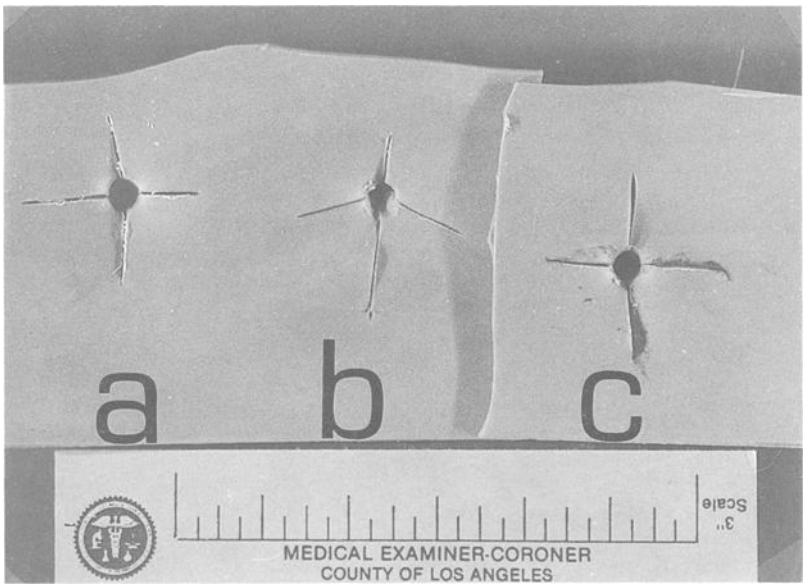

FIG. 6—*Wax impressions of four-bladed tip:* (a) *perpendicular insertion;* (b) *insertion at 45 deg;* (c) *discoloration of wound margin caused by vanes.*

patterns allow one to establish the mechanism of injury. Arrow wounds and gunshot wounds may be differentiated chemically [7]. In addition, if the vanes pass through the wound, they may deposit trace material which can be linked with the weapon.

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