

CASE REPORT

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Bullet or Bite—A Contribution to the Morphogenesis of Gunshot Dermal Injury

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ABSTRACT: Histopathologic studies of dermal dog bites revealed changes identical with those observed in distant gunshot skin entrance wounds and in a presternal skin stab wound made by a screwdriver. The similarity of the epithelial and collagen changes produced by these three totally different traumatizing, perforating agencies indicate that it is the bullet's penetrating and crushing power, and *not* its caloric content, that is responsible for the characteristic dermal collagen changes noted in these common injuries.

KEYWORDS: pathology and biology, bite marks, wound ballistics, skin, dog bite, bullet entrance wounds, thermal dermal damage

Although many aspects of "dog bites man" are discussed in current medical writing, for example, epidemiologic considerations [1,2], etiology including canine "psychology" [3,4], septic sequelae [5-7], prophylaxis [3,8,9], therapy [10,11], and fatal consequences [4,12-14], relatively little attention has been devoted to the gross morphologic features [14,15] of this not uncommon variety of trauma and less to its histopathologic characteristics [12].

A recently investigated case of this infrequently encountered modality of *lethal* violence provided an unusual opportunity to study the histologic features of the dermal epithelial and collagen alterations created by the dog bites in an infant killed by a family pet pit bull. Because the microscopic details of the canine-created injuries cast unanticipated, welcome light on the morphogenesis of cutaneous entrance gunshot wounds, the observations are deemed worthy of report.

Case Report

An eight-week-old infant was heard crying by its grandmother in whose living room the child had been put to sleep in a bassinet resting on a coffee table. When the grandmother

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entered the living room, she observed the infant tightly grasped in the family pet pit bull-dog's mouth. Horrified, she attempted to free the infant from the canine's grasp. The beast dropped the child and bit the would-be rescuer severely about the hands. A second adult family member arrived on the scene and managed to drag the animal to the basement.

The child was rushed by police to a nearby hospital where it was pronounced dead on arrival.

In the interim, the local animal warden, who had been called to the scene, failed in several attempts to snare the beast as it repeatedly lunged at him and attempted to bite him. It was then shot to death by a police officer. Necropsy of the dog revealed no fabric or flesh in its stomach, and its brain showed no evidence of rabies.

Subsequent investigation of the dog's past history elucidated contradictory stories. Some observers, including the victim's grandmother, said that the animal had never previously displayed any indications of violence. A veterinary physician said that it *had* been vicious, and that he had treated it for bites sustained in dog fights. Another observer revealed that the dog had killed a cat by repeatedly biting the feline's stomach.

Anatomic Examination

The child was a well-developed and well-nourished white female infant weighing 12 lbs (5.4 kg) and measuring 20 in. (51 cm) from crown to heel. There were no external indications of remote trauma or pre-existing natural disease.

The anterior and posterior trunk, from clavicles to groin, was the seat of innumerable focal and confluent abrasions, lacerations, and sharply marginated wounds of "stab" and "slash" varieties, the latter measuring from $\frac{3}{8}$ to more than 1 in. (1 to 2.5 cm) in length. Some of the wounds were sufficiently deep to expose lacerated muscle. Where the skin surface was intact, there were zones of prominent ecchymotic discoloration.

The child's head and neck were completely spared, and her extremities revealed only a few superficial injuries in the upper arms and proximal thighs. Similar slight injuries were present in the supraclavicular regions. In no site was there tissue damage indicative of the dog's having eaten the child (Figs. 1*a* and *b* and 2*a*, *b*, and *c*).

Internal examination revealed small quantities of free blood in all body cavities. The second through twelfth ribs bilaterally were comminuted, and fragments of ribs were present in both pleural cavities. The pericardial sac, heart, lungs, liver, spleen, kidneys, and adrenals were all extensively lacerated and perforated. The lungs and liver were subtotally transected, and the kidneys were completely transected. Hemorrhagic infiltration was present in the anterior and posterior mediastinal regions, the mesentery, and the sites of visceral injury.

Microscopic study disclosed early granulocytic infiltration in several traumatized viscera. The skin injuries were characterized by epithelial damage and absence, "streaming" of the epithelial nuclei, and dense condensation of the dermal collagen which stained intensely eosinophilic, a constellation of alterations strikingly similar to that observed in distant, dermal entrance gunshot wounds (Fig. 3*a* and *b*).

Discussion

The histologic appearance of the epithelium and corium in the child's dog bite injuries is sufficiently similar to that observed in distant dermal entrance gunshot wounds to provide an enlightening explanation for the factor(s) responsible for the cellular and collagenous alterations produced by these latter, all-too-common, traumatizing instrumentalities.

Microscopic examination of distant dermal entrance gunshot wounds reveals an orderly series of epithelial changes ranging from little or no alteration at the periphery through vary-

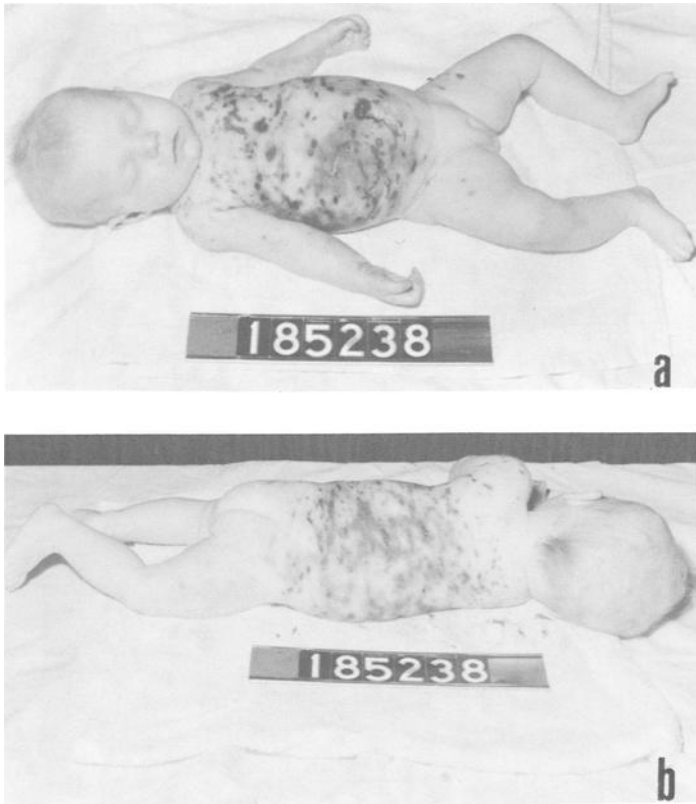


FIG. 1a and b—Overall photographs depicting location and distribution of dog bite injuries.

ing degrees of cellular distortion and disruption to total epithelial destruction (absence). Nuclear “streaming” is prominent in damaged epithelial cells [16].

Bullet-damaged dermal collagen presents tinctorial variations along with fusion and homogenization (coagulation?) to the extent that the traumatized site frequently presents itself as an almost solid sheet of densely packed, eosinophilic, hyaline material. Occasionally, the collagen may swell to the extent that it protrudes through the skin defect above the level of the adjacent epithelium (Fig. 4a and b). Similar collagenous condensation and fusion is frequently observed in dermal *exit* gunshot wounds.

Because the foregoing collagen changes in dermal gunshot injuries closely resemble what is observed in third-degree thermal burns [17], they have in the past been attributed to heat contained in the speeding bullet supposedly derived from two sources: (a) friction resulting from the bullet's passage through the tightly fitting lands in the barrel and (b) the explosion in the chamber which dispatches the missile in its flight. (To be noted at this point is that we are here not concerned with thermal injury to the skin from muzzle flame which can create dermal damage in *contact* or *near* entrance wounds. The changes observed in the wounds depicted and described herein are all from “distant” gunshot wounds where the sole traumatizing agency is the missile in flight.)

The appearance of the dermal collagen in the dog bites (Fig. 3a and b), which so strikingly resembles that observed in bullet wounds, cannot be attributed (at least solely or

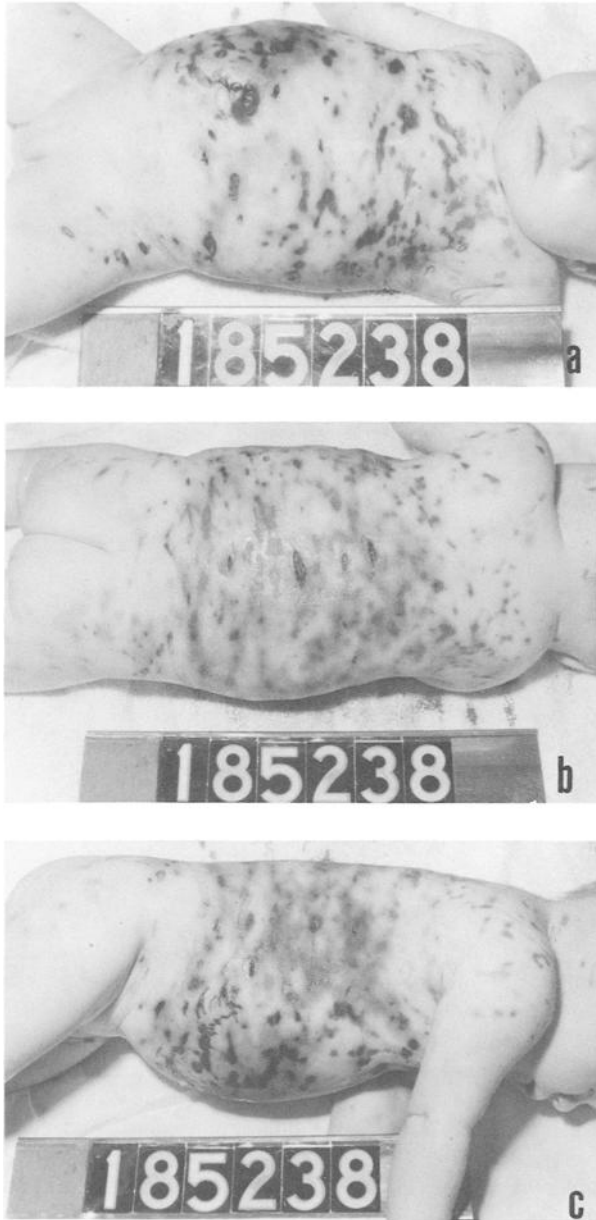


FIG. 2a, b, and c—Closer views of child's trunk to demonstrate the heterogeneity of the canine-created traumata.

mainly) to heat. A dog's mouth temperature ranges between 101 and 102°F (38.3 and 38.8°C),² a temperature entirely insufficient in and of itself to produce the changes observed in deep (third-degree) thermal injuries. And it does not appear reasonable to ascribe the

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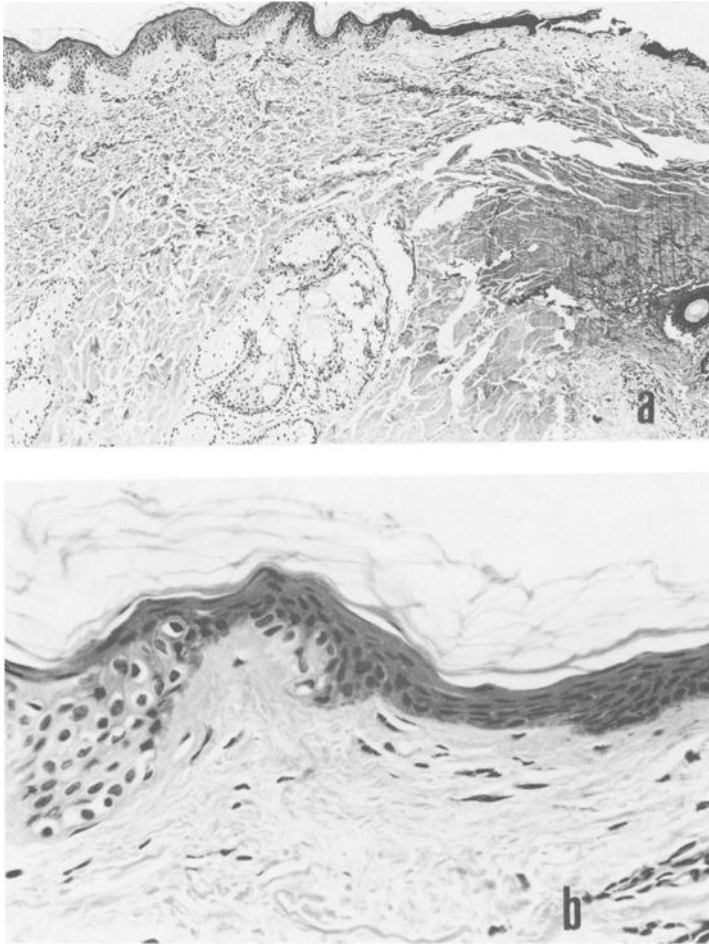


FIG. 3a and b—Low ($\times 70$) and high ($\times 450$) views of dog bite depicting dermal collagen condensation and “streaming” of epidermal nuclei. (Compare with Figs. 4a and b and 5a and b).

collagen damage to heat created by *friction* as the dog’s smooth tooth surface penetrates the entire thickness of the corium.

A more logical, and I believe correct, explanation for the collagen metamorphosis in bullet wounds *and* bite wounds is severe mechanical compression by the speeding pellet in the former instance and by the pressure executed by the dog’s jaws in the latter situation. The vise-like action of a dog’s jaws is said to be able to generate pressures in excess of 200 to 400 psi (1380 to 2760 kPa), sufficient to perforate sheet metal [5]. Such pressure applied to the skin creates a *crushing* type of injury with consequent collagen homogenization so vividly depicted in this case.

The foregoing thesis is solidly buttressed and supported by the additional objective fact that identical epithelial nuclear changes and dermal collagen alterations are present in the skin entrance wound of the victim of a fatal screw driver assault (Fig. 5a and b), again attesting convincingly to the fact that it is the crushing power of the bullet, *not* its “retained” heat, which is responsible for the dermal collagen changes invariably observed in these traumata.

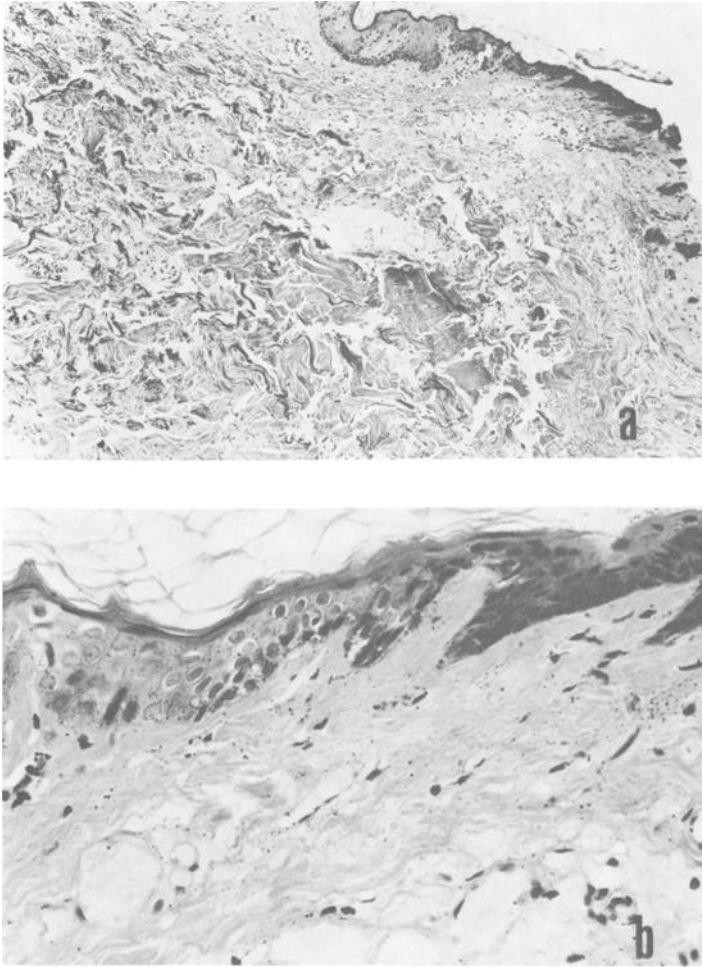


FIG. 4a and b—Low ($\times 70$) and high ($\times 450$) power views of entrance gunshot wound produced by a .22 caliber handgun bullet. Note similarity of epithelial and collagen appearances to those observed in dog bite (3a and b) and screw driver stab wound (5a and b).

Conclusion

In summary, the foregoing observations and discussion indicate convincingly that the dermal epithelial and collagen alterations observed in distant gunshot wounds are produced mainly if not solely and exclusively by the crushing force created by the kinetic energy of the missile in flight and *not* by the thermal energy residing in or imparted to the speeding bullet.

Acknowledgment

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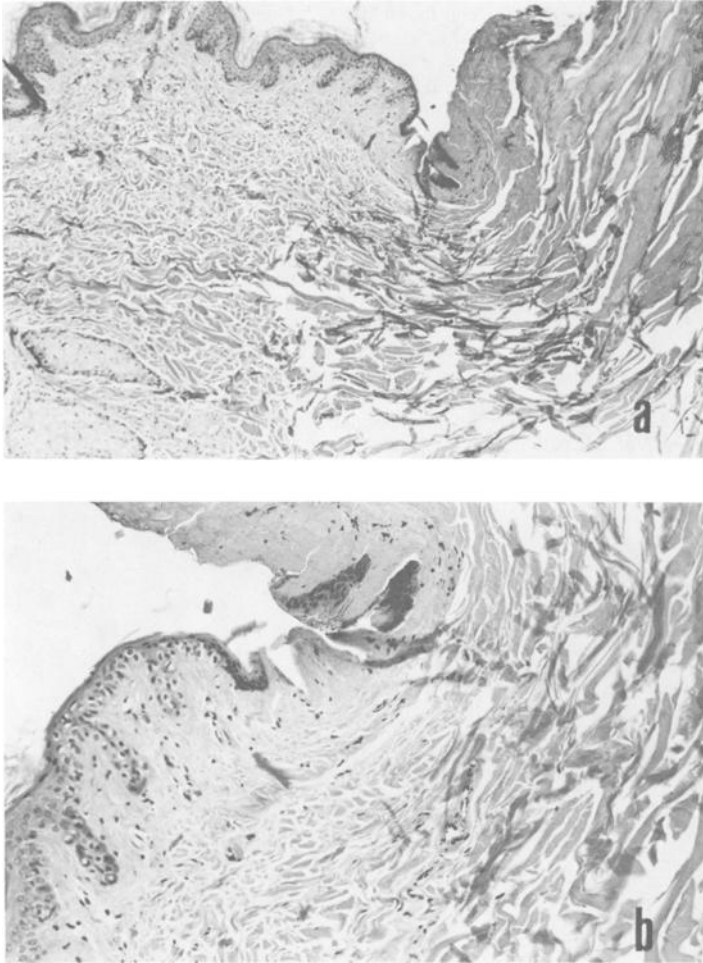


FIG. 5a and b—Low ($\times 70$) and medium ($\times 180$) power views of screw driver dermal entrance stab wound.

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