Journal of Criminal Law and Criminology

Volume 39 | Issue 4 Article 14

1949

Progress in Medico-Legal Investigation of Gunshot Injuries

Frank R. Dutra

PROGRESS IN MEDICO-LEGAL INVESTIGATION OF GUNSHOT INJURIES*

Frank R. Dutra

Frank R. Dutra has specialized in Pathology since he graduated from Northwestern University Medical School (M.S. and M.D.). He received his training in this field at Western Reserve University Medical School. During the war he saw duty as a pathologist and medico-legal pathologist in various military hospitals. While a Fellow in Legal Medicine at Harvard Medical School Dr. Dutra became interested in gunshot injuries. He now serves as Pathologist to the Coroner of Hamilton County, Ohio, and is Assistant Professor of Industrial and Forensic Pathology, College of Medicine, University of Cincinnati.—EDITOR.

The last few years have brought increased knowledge and skill in the investigation of fatal gunshot wounds. New technics and scientific instruments have been applied to the problems related thereto, and a large mass of facts and information has been forthcoming.

There has also been a significant increase in the number of civilian deaths from gunshot wounds. This has been an unfortunate by-product of the fact that the recent war taught many young men, who might otherwise never have held a loaded gun in their hands, to kill other men with firearms. It has also been contributed to by a short-sighted government policy of allowing repatriated soldiers to retain as "trophies" any kind of foreign small arms they might have, prohibiting only those with machine-gun mechanisms.

One of the most important facts of wound ballistics that became apparent early in the war was that projectiles of high velocity could produce extensive tissue damage, even some distance from the actual tract of the bullet. This fact was elucidated by three investigators[1] using firm gelatin blocks and a stroboscopic camera. They showed that an experimental round pellet striking the block at approximately the muzzle velocity of a bullet from a military rifle would markedly deform the whole gelatin block. Later, in experiments with animals, they were able to produce fractures or injuries of the soft tissue as far as several centimeters from the tract of the bullet. The energy of motion transmitted by the bullet to the tissues spreads in a radial direction from the pathway of the bullet, and the tissues act like a liquid medium in transmitting this lacerating energy.

* This paper was presented at the Convention of Ohio State Coroners' Association. Columbus, Ohio, Dec. 10, 1947.

1 Black, A. N., Burns, B. D., and Zuckerman, S.: An experimental study of the wounding mechanism of high velocity missiles, British Medical Journal, *2*:872, 1941.

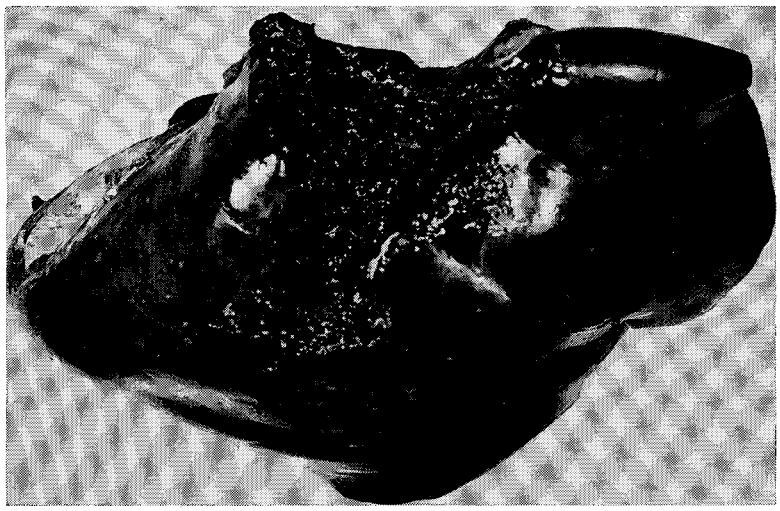

Figure 1.

A high velocity bullet from a German P-38 pistol passed through the upper part of this liver from right to left. Note the marked laceration of tissues even several inches from the actual tract of the bullet.

The British Army had become interested in the problem because there were reports from the battlefields that the Germans were using explosive or dum-dum bullets. The report of these investigations served as a warning that wounds which resembled those produced by projectiles of types prohibited by the Geneva Convention could in fact be caused by high-speed bomb fragments or rifle bullets.

The medico-legal significance of this observation is that some wounds which superficially appear to have been produced by the explosive effects of muzzle gases at point-blank ranges, or by tumbling, ricocheting, soft-nosed, or dum-dum bullets, must also be considered as possible high-velocity bullet wounds (Figs. 1 and 2).

The value of differentiating entrance wounds from exit wounds of projectiles, as a part of gathering objective evidence with which to reconstruct the circumstances of a shooting, is too obvious to require enlargement. While it is true that entrance wounds are usually readily distinguished from exit wounds, either or both may be so atypical that investigators should avoid unconsidered judgments made prior to complete examination of the wounds. In a recent case, the expanding gases from the muzzle of a pistol in contact with the right temple had produced a large lacerated bloody entrance wound,

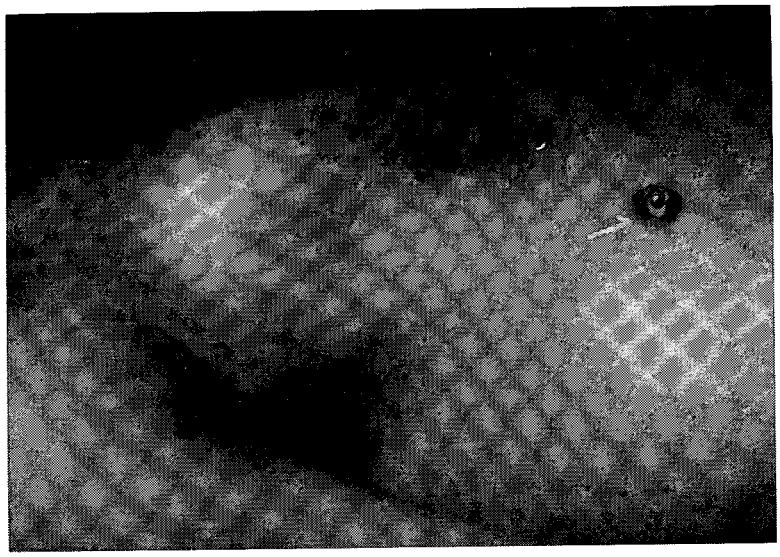

Figure 2.

Entrance wound of bullet which produced injury to liver shown in Fig. 1. The exit wound in the left side of the chest was only slightly larger than the entrance.

and in the scalp above the left ear was a small lacerated exit hole. The blood stains in and around the entrance wound obscured the tissue-fouling which is characteristic of contact entrance wounds, and before the wounds were cleaned it was believed that the entrance wound was probably the wound of exit.

Entrance wounds in unusual places may cause confusion. The body of a man who was believed to have committed suicide by shooting himself in the mouth was sent to the morgue. There were numerous blood stains around the mouth. Careful examination at the morgue revealed the entrance wound hidden in the hair at the top of the head, and autopsy resulted in the finding of a deformed .22 calibre rifle bullet in the tissues of the neck. The bullet had passed downward through the throat, causing the bleeding from the mouth. Thus, what had been believed to be a suicide was proved in fact to be a murder, the victim having been shot through the top of the head.

The possibility that wounds made by bullets which graze the skin but do not enter it may be mistaken for slash or stab wounds has long been recognized. Another type of bullet wound which simulates an incised wound is occasionally seen. This is an exit wound produced by a bullet of relatively low velocity tumbling in the tissues and tearing its way out sidewise through

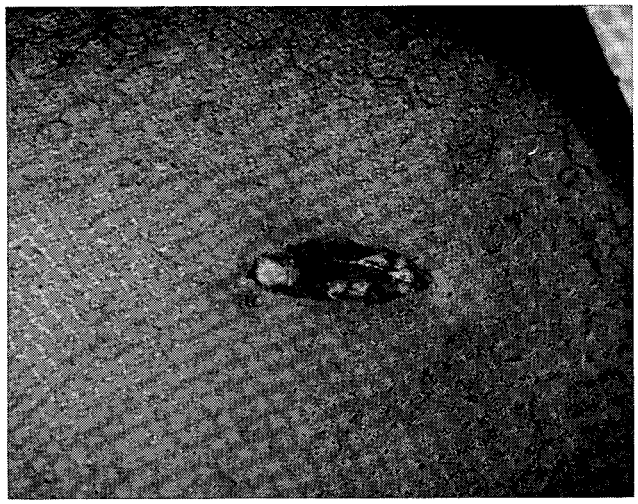

Figure 3.

Projectile exit wound of thigh, simulating stab wound. The bullet which produced this wound was fired from a Colt .38 revolver. The entrance wound was on the back of the hip, and the bullet had not struck any bones.

the skin rather than nose first[2] (Fig. 3).

Special photography has a place in the investigation of gunshot wounds. An entrance wound can be differentiated from an exit wound by photographing both by means of film that is sensitive to infra-red light. As a bullet enters the skin or clothing, its residue of oil and powder are rubbed off on the surface immediately adjacent to its point of entrance, producing a contact ring. The contact ring is readily visible in these photographs, even though skin color or blood stains have prevented its observation by other methods. Infra-red photographs are also utilized by police laboratories in examining bullet holes in dark or blood-stained clothing[3] (Figs. 4 and 5).

X-ray examination may be valuable in facilitating the recovery of a fatal bullet from a body during the autopsy. Bullets of small calibre are often almost impossible to recover unless X-ray examination can be utilized. X-rays can also be used in some cases to distinguish between entrance and exit wounds. In one recent case there was a bullet hole near the middle of the back and another in the front of the left shoulder. The left collar bone had been broken. The hole in the back appeared quite like that of an entrance, and the lacerated wound of the

2 Other unusual wounds are described by Moritz, A. R., and Dutra, F. R.: Scientific evidence in cases of injury by gunfire, Archives of Pathology, *37*:340, 1944.

3 Walker, J. T.: Bullet holes and chemical residues in shooting cases, Journal of Criminal Law and Criminology, *31*:497, 1940.

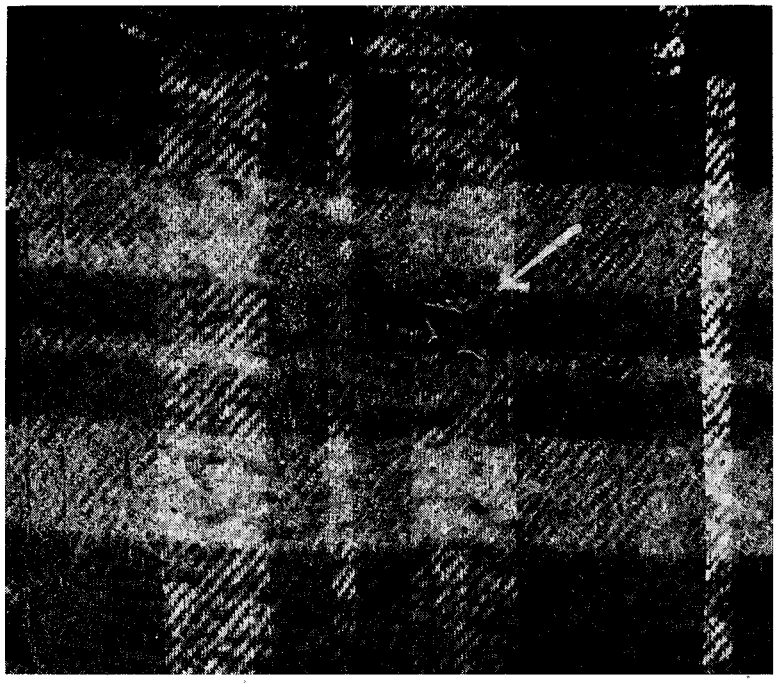

Figure 4.

Hole in wool shirt produced by entrance of a bullet. Contact ring practically invisible due to blood stain and shirt color. Panchromatic film. (Courtesy of Dr. Joseph T. Walker.)

shoulder like that of an exit. It was anticipated, however, that the defendant might contest these deductions made on appearances alone, since the implication of an entrance wound in the back would negate the possibility of a plea of self-defense. With this in mind, the holes and surrounding tissues were widely excised and roentgenograms of them were made. The hole in the back had no visible deposits around it, while the hole in the shoulder had numerous metallic particles and a fragment of bone embedded in the adjacent tissues (Fig. 6). This proved that before making the hole in the shoulder, the bullet had struck the collar bone, thereby breaking off small bits of metal from itself and fragments from the bone. These then became secondary missiles that lodged in the skin around the *exit wound* of the shoulder.

Chemical tests for powder residues can be used by police to reveal the pattern of fouling about a wound made at close range, as the first step in determining the actual distance between muzzle and clothing.

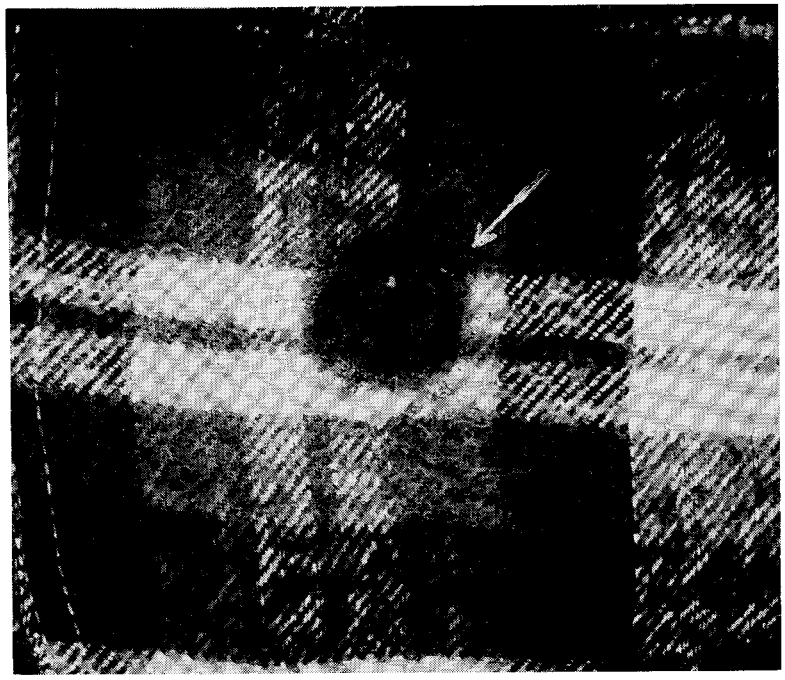

Figure 5.

The same bullet wound, photographed with infra-red sensitive film. Note that infra-red reflection may not be the same as for visible light so that the two narrow dark colored bands running both horizontally and vertically in the center (see Fig. 6) photograph as white with infra-red. (Courtesy of Dr. Joseph T. Walker.)

The paraffin-glove test is a chemical test which should be familiar to all medico-legal investigators. This occasionally is of value in differentiating suicide from murder. The chambers of some revolvers do not fit snugly against the barrels in firing position, and when these are fired, the hand holding the gun may be spattered with unburned or partially burned powder. Suicides also sometimes steady the muzzle by grasping the barrel with the hand not being used to pull the trigger. The muzzle blast may then spread powder on the hand holding the barrel. The spread of powder granules usually can be seen with the naked eye or through a hand lens. When the powder cannot be seen, fine-mesh gauze can be laid over the hands and between the fingers. Melted paraffin can then be smeared on with a paint brush, and after this has hardened another layer of gauze is applied. More paraffin is applied and these procedures are repeated until a thickness of about ¼ inch is present. A sharp blade or scissors is used to cut around the case and it is removed in two parts, a front section and a back section. Diphenylamine

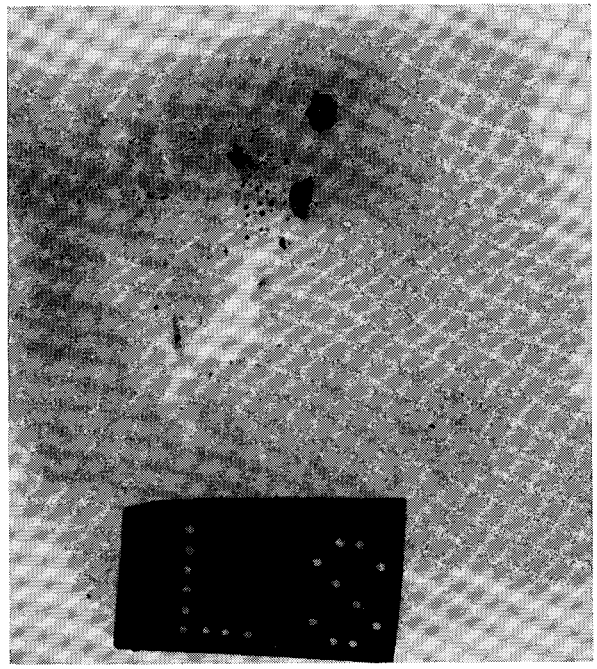

Figure 6.

X-ray of a skin wound from the victim of a shooting. The bullet left the body through skin in front of the left shoulder (L.S.) after shattering collar bone and driving bits of detached bone and metal into the skin. These show as the black deposits.

reagent (diphenylamine, 0.5% in concentrated sulfuric acid) is then painted on the casts with a glasswool brush or is sprayed on with an atomizer. Any granules of powder will cause the reagent to turn blue.

Everyone who has worked with paraffin gloves knows that a number of other substances will also cause the reagent to turn blue. For this reason, significant findings are only those where there is a distribution of reacting substances which fits with powder blown from a revolver cylinder upon the trigger-pulling hand, or from the muzzle upon the hand which steadied the barrel.

The paraffin-glove test was of great value recently in freeing a man who was unjustly suspected of murdering his mother. The dead woman had been shot through the abdomen at close range, and the son stated that he had been holding a revolver and several other objects in his hand when the mother attempted to take the gun from him by grasping its barrel. He stated that his finger had been through the trigger guard,

and the gun discharged as the mother attempted to take it. There were some black smudges on the palm around the base of the little finger of the mother's left hand, and these gave a positive reaction with the diphenylamine reagent, after a paraffin cast had been made. This was enough to substantiate the son's story and to result in a verdict of accidental death.

Summary

Certain applications of science to the medico-legal investigation of gunshot wounds are discussed. The uses of infra-red photography, X-ray, and chemical tests in the postmortem examination of gunshot victims are illustrated.