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Shots Fired with Silencers—A Report on Four Cases and Experimental Testing

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ABSTRACT: Four cases of homicide, in which silenced firearms were used, are reported and supplemented by data from experimental investigations regarding wound features, marks, traces, and ballistic behavior. Wound features are largely determined by the construction of the silencer. In one case, even a muzzle imprint was produced by a silenced weapon fired at contact range. In general, silencers are likely to result in a decrease in bullet energy and accelerated energy release in the target (tissue). In terms of wound morphology, silencers produced a reduction in or even a lack of the contact ring (ring of dirt). In close-range and contact wounds, any features indicative of shots fired at close range were missing (such as soot deposit and powder tattooing). It is also worth mentioning that biological matter may get into the silencer in shots fired at contact range.

KEYWORDS: criminalistics, ballistics, silencers, wound ballistics

General Remarks on Silencers

When a shot is fired, the noise generated is mainly produced by the muzzle blast, and for supersonic bullets, it is produced by the missile blast. The muzzle blast is caused by the expansion of gases at the muzzle under high pressure and can be muffled (attenuated) by silencers. Silencers are thus only practical for pistols and rifles and not for revolvers, where large quantities of powder gases tend to escape between the drum magazine and the barrel. The present report will not discuss the technical principles of silencers; such information can be obtained from the relevant literature on weaponry [*1,2*].

The advantage of using a silencer is that a shot remains unheard or that the noise produced is attenuated to such an extent that it can be mistaken for everyday noise. If somebody fires a shot in open terrain, his position can be identified auditorily. However, if a silencer is used and no missile blast occurs, it is impossible to determine where exactly the shot was fired from. Silencers bear upon the accuracy of a weapon. In silenced pistols, aiming over a notch and bead sight is not possible, they require "pointed" shots (aiming over the outstretched arm, which points at the target); hence, shooters prefer short distances. Possession of silencers is not permitted in Austria.

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Materials and Methods

The study is based on experiments, on the one hand, and on the casuistics of four cases in which silenced weapons were used, on the other. Three of the decedents were killed in a politically motivated assassination [*3*]. The weapons involved were semiautomatic 7.65-mm caliber, Llama and Beretta PB Model 70 pistols and a Beretta MP M submachine gun of para 9-mm caliber. In a comparative experiment, weapons with and without silencers were used in 55 test firings. The shots were fired at cadaveric skin (fired at contact range, from close range to distant range, and assessed in morphological terms), at white pieces of fabric, and at soap used as a tissue simulator. Moreover, the testing included speed measurements, checking the stability behavior of bullets, and sound pressure measurements. These tests were supplemented by an examination of the silencers for biological material and of the firing hands for powder particles.

In addition, a fourth case is presented in which the involved silencer produced an unexpected muzzle imprint.

Description of the Silencers Used (Cases 1 Through 3)

The silencers were not factory-made but expertly homemade, which suggests appropriate training. They consisted of cylindrical aluminium tubes, with a length of 125 mm for the pistols (that of the submachine gun was longer), a diameter of 37 mm, with a wall thickness of 3 mm (Fig. 1), and were subdivided inside by a number of felt, cardboard, and plastic disks, with the hollow spaces in between packed with steel wool. At the distal end, the plastic material featured an approximately 3-mm (diameter) gap through which the projectiles left the weapon. In technical terms, the arrangement of the packing materials operated on the principle of absorption and expansion.

Ballistic Findings, Shots Fired at Soap, and Sound Pressure Measurements

Missile Velocity and Energy

For all three weapons, there was a clear reduction of missile velocity and hence a corresponding reduction of energy (Table 1). Using indicator paper disks did not produce any evidence of an instability in the missile trajectory.

FIG. 1—*Semiautomatic Llama pistol with silencer.*

TABLE 1—*Velocity and energy of missiles from unmodified and silenced weapons.*

Velocity and Energy	Presence of Silencer	Llama, 7.65 mm	Beretta, 7.65 mm	Beretta MP, 9 mm
V_5, m/s	without	245	289	365
	with	208	264	351
E_5, J	without	180	195	536
	with	151	163	492

Temporary Cavities

As an alternative material to ballistic gelatin, which is mainly used in the United States, soap can be used as a suitable model substance to imitate temporary cavities in the muscle tissue [*4,5*]. It was used, therefore, because of its stability for these experiments. The results of shots fired at soap are illustrated in Table 2. With all three weapons, the use of silencers produced a shortened narrow channel, and with pistols, the maximum diameter of the "temporary cavity" was also increased. Obviously, shots fired from silenced weapons resulted in an earlier and greater release of energy per distance.

Sound Reduction

The muzzle blast was reduced from 133 dB to 108 dB for the Beretta pistol, from 132 dB to 106 dB for the Llama pistol, and from 135 dB to 118 dB for the submachine gun.

Morphological Findings in the Entrance Wound Area

Cases 1 Through 3

In the examined cases, the shape of the entry wounds was quite normal. They were round and had contusion rings of the usual width (Fig. 2*a*). Some entrance wounds, however, were of elliptical shape and had eccentrically widened abrasion borders. The reduction and, in some instances, the complete lack of a contact ring were conspicuous. The two shots fired at contact range produced fine, radial lacerations originating from the defect (Fig. 2*b*). However, such minor lacerations could also be observed in two other entry wounds caused by distant shots.

TABLE 2—*Results of shots fired at soap, in millimetres.*

Result	Presence of Silencer	Llama, 7.65 mm	Beretta, 7.65 mm	Beretta MP, 9 mm
Narrow channel	without	90	150	240
	with	60	100	70
Maximum diameter[a]	without	9	13	29
	with	12	15	20

[a]Maximum diameter of temporary cavity.

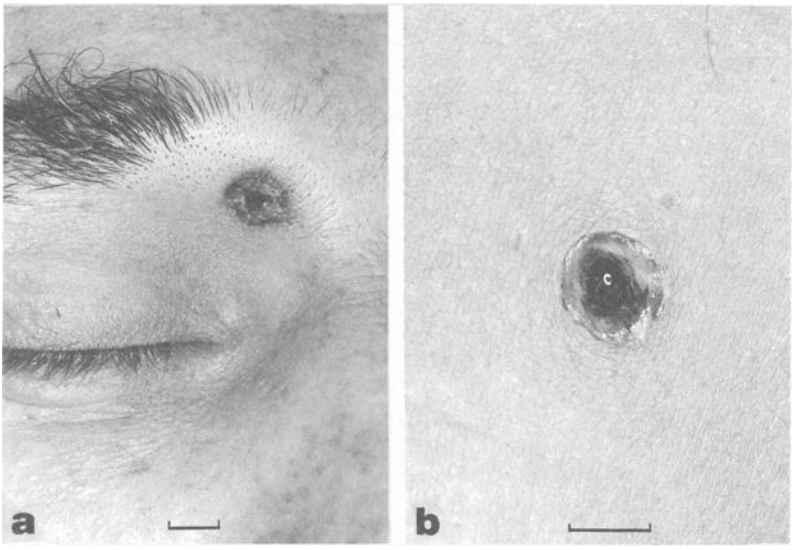

FIG. 2—(a) *Contact wound in the eye region;* (b) *wound of entrance in the thorax. The bar illustrates the length of 1 cm.*

Experimental Dermal Gunshot Wounds

Here again, the complete lack, or a marked reduction, of the contact ring in silenced shots was striking. Also, the characteristic features produced by shots fired at close range (Fig. 3), such as soot and powder deposition or tattooing, were missing. Occasionally, one to three powder particles were found around and close to the entrance of a gunshot wound. In test firing at cadaveric skin, we were unable to generate any major entrance gunshot laceration. We also noted that no powder was carried off to the initial part of the bullet track; the typical soot cavity was missing.

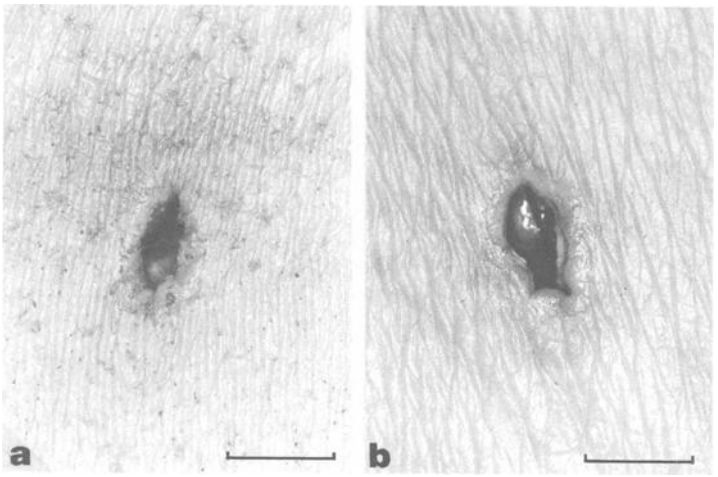

FIG. 3—*Experimental dermal gunshot wounds (semiautomatic Beretta pistol) at a distance of 25 cm:* (a) *without silencer,* (b) *with silencer (lack of a contact ring, no soot, and powder deposition). The bar illustrates the length of 1 cm.*

Experimental Firing at Textiles

For textiles, we obtained analog findings (Fig. 4). Again, there was a marked reduction of the contact ring. It is worth mentioning that in two instances of shots fired at textiles we observed that particles from the silencer (plastic particles) were deposited on the target medium.

Marks and Traces

Chemical Determination of the Firing Distance

Despite the lack of visible close-range gunshot marks from silenced weapons fired at textiles, it was possible, by means of flameless atomic absorption (FAA) and the recovery of lead and antimony, to determine the firing distance chemically within the 50-cm range and to differentiate roughly within this close range. Hence, the FAA technique is to be recommended in any case.

Silencers

In the silencer fitted to the Llama pistol, foreign material from Case 2 was found, namely, 1 larger (4.2-mm) piece and 11 smaller (0.5-1 mm) pieces of skin and 11 hair fragments (the gunshot wound was in the region of the eyebrow) (Fig. 5). Examination under the operating microscope revealed that the skin particles were tattooed with powder residue (Fig. 5*b*). Also, the victim's blood group, Group B, could be identified from the tissue. Hence, these particles came from the contact wound in the eye region. Also, test firing at muzzle-to-skin contact range repeatedly resulted in foreign bodies (skin particles) being transported into the silencer.

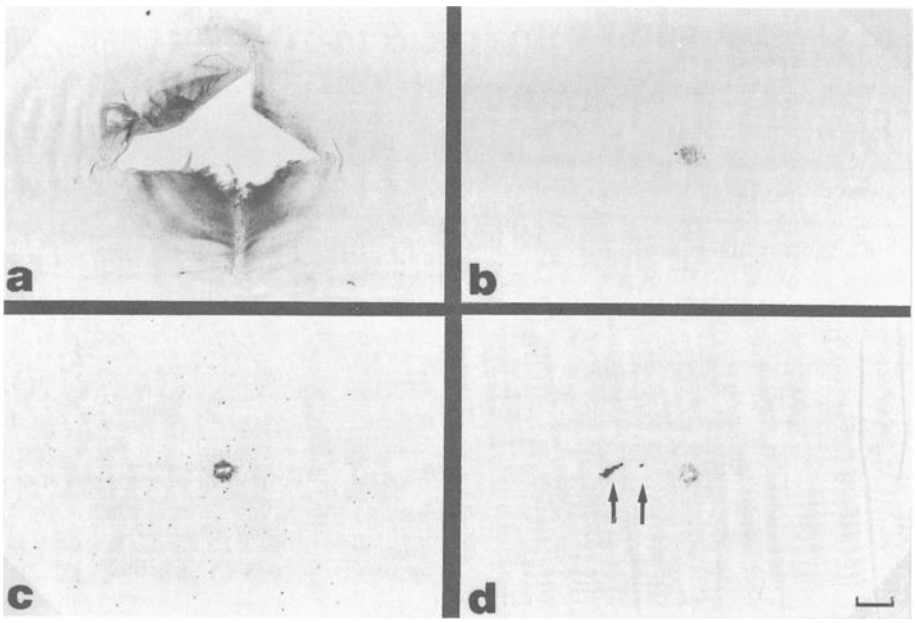

FIG. 4—*Experimental firing at textiles (Beretta MP M submachine gun):* (a) *at 0 cm without silencer (cross-like laceration);* (b) *at 0 cm with silencer:* (c) *at 50 cm without silencer (contact ring, powder tattooing);* (d) *at 50 cm with silencer (arrows show particles from the silencer). The bar illustrates the length of 1 cm.*

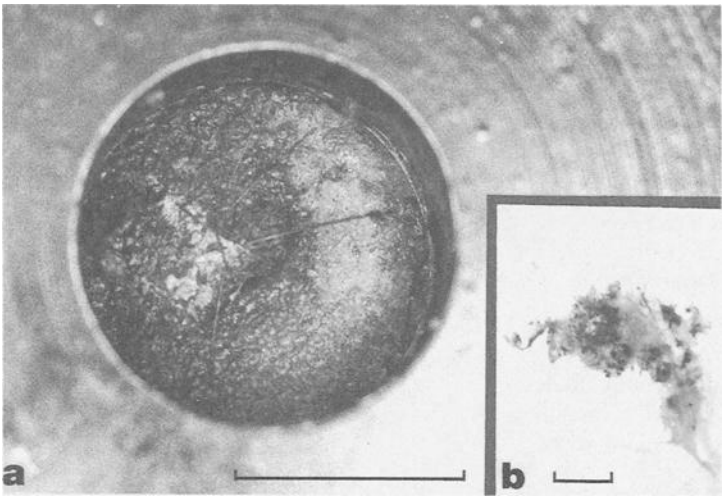

FIG. 5—(a) *Silencer of the Llama pistol, showing foreign material (pieces of skin and hair fragments) in the silencer. The bar illustrates the length of 1 cm.* (b) *Skin fragment and powder residues under the operating microscope. The bar illustrates the length of 1 mm.*

Macroscopic Findings of the Firing Hand

Apparently, these findings were not influenced by the silencer. In shots fired with and without a silencer it was equally possible to detect powder particles that had a positive diphenylamine sulfuric (DS) reaction.

Case 4—Muzzle Imprint Produced by a Silenced Weapon

In March 1989, 33-year-old constable J.H. was found dead near his patrol car. Two bullets had passed clean through his head. A gunshot wound in the right buccal region, covered by beard hair, was conspicuous (Fig. 6*a*). The defect, 5 mm in diameter, exhibited a total of five ray-like, 1 to 2-mm-long fissures surrounded by an approximately 3-mm-wide, brownish-red rim of abrasion. A particularly striking feature was an arc-like brownish-red abrasion, which was some 9 to 10 mm away from the center of the entry wound and did not seem closed but had two mirror-inverted scratch-type terminations that were parallel to each other and 5 mm apart from each other. The gunshot wound showed a marked soot-grey coloration both in the border region and in the initial part of the bullet track—in other words, a soot cavity! The described entry wound was interpreted as being a typical muzzle imprint resulting from a shot fired at contact range. But, we were unable to attribute the shape of the muzzle imprint to any known weapon.

Nine months later, a suspect was apprehended who admitted having fired the shots with a silenced weapon. The second shot was fired at contact range into the buccal region. The silencer used, which also operated on the expansion principle, did not have any straight, circular, flat metal surface at the distal end but had two mirror-inverted, comparatively sharp-edged grooves that were 4 mm wide and 3 mm deep. The inner diameter of the tube end was 17 mm, and the rubber seal with the firing hole was some 7 mm deeper inside (Fig. 6*b*). The noticed muzzle imprint thus could be brought to coincide with the silencer, both in terms of its shape and in terms of its dimensions (with a 1-mm difference).

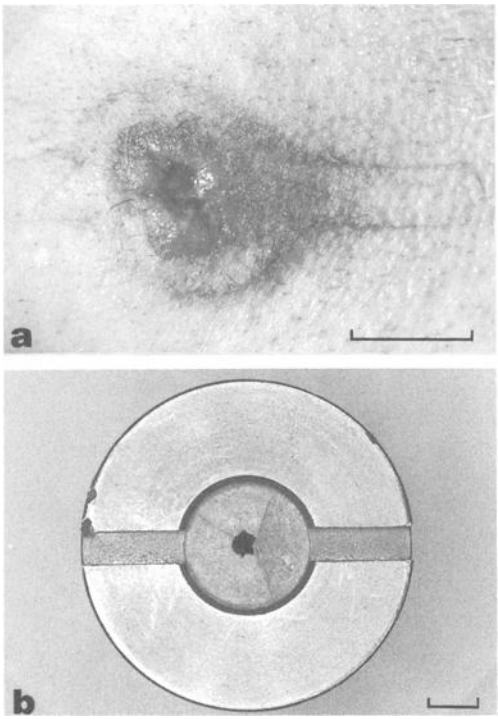

FIG. 6—*Case 4:* (a) *dermal gunshot wound with muzzle imprint;* (b) *silencer that produced this imprint. The bar illustrates the length of 1 cm.*

Discussion

Data on injuries caused by silenced weapons are scarce in the medical literature [*6–9*]. We thus present our own findings and discuss primarily the findings that differ from those of other authors.

Ronchi and Ugolini [*8*] examined a great number of silencer-equipped weapons and stressed that shots fired from such weapons would result not in round, but rather in oval or ragged-entry wounds, which may even be larger than normal entry wounds. According to their interpretation, these wound features are attributable to missile instability. Our test material did not reveal any such instability, which might be due to the specific design of the silencers. Technically imperfect silencers are more likely to influence the stability of the missile.

Menzies and his colleagues [*7*] undertook extensive tests with a total of 16 silenced weapons. The authors—just as Sellier [*9*] and Di Maio [*6*] stated—stressed that silencers had the tendency to reduce close-range gunshot marks, to diminish soot deposits, and to reduce both the density and the diameter of powder tattooing. Our observations corroborated these findings. The fact that both contact ring and close-range gunshot marks are reduced can lead to mistakes in assessment. If the examining party does not know that a silencer was involved, he may interpret an intermediate-range gunshot wound as being a distant gunshot wound, or a primary entry wound as being a secondary entry wound, with an intermediary target having been hit first.

Di Maio [*6*] explained, among other things, that, for silencers packed with steel wool, fragments of this silencer material stippled the skin and caused skin injuries. We made similar observations (plastic particles being deposited on the target) in our own experi-

mental testing. Hence, looking for atypical foreign bodies is of particular importance, because they may serve as evidence that a silencer was involved in the shooting incident.

Typical larger gunshot wound lacerations could not be generated in test firings. The rather discrete radial lacerations at the wound edges were not limited to contact wounds. Menzies et al. [7] refer to contusion rings in loose contact wounds inflicted by silencers, where both soot and powder particles were found in the wound tract, and to soot deposits as "muzzle imprint." We could not detect any such changes in our tests.

If it is known that a weapon with a silencer was used, and if this weapon plus the silencer is available for comparative analysis, the firing distance can be determined within a certain range through flameless atomic absorption spectrometry. In our view, this is an important finding of the study.

The demonstration of biological material in the silencer proves that such a silencer was used to fire shots at contact range.

Our findings partly differ from those of other authors (also with regard to wound morphology), which can be explained by the use of different silencers. In general, one may say that there is no homogeneous "injury pattern for silencers" but that morphological features of the wound differ, depending on the kind of silencer used and its design. Any assessment beyond doubt would only be possible if the used silencer were recovered for examination. This statement is substantiated by information from a case in which a typical muzzle imprint was obtained from a silencer [7], which was entirely unexpected according to previous scientific research findings. The presented case also shows how easily a shot fired with a silencer can be mistaken for a shot fired without silencer when neither weapon nor the silencer are available for examination and when there are no particles of the silencer deposited on the wound surface. In many cases, however, the findings presented in this paper will help to attribute injuries to the correct source.

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