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Injuries Due to Letter Bombs

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ABSTRACT: In Austria in late 1993 ten letter bombs were sent to outstanding persons who have been engaged in the care of foreigners. Four of these bombs detonated, when they were opened by the addressee. The remaining six bombs were discovered in time and could be deactivated by specialists. The construction of these bombs and the lesions sustained by the four victims will be discussed. The injuries mainly concerned the left hand, i.e., the hand used by right-handed persons to hold a letter when opening it. The way holding the letter was of crucial influence on the degree of injury, as with the same explosive charge (which can be assumed deducing from the investigation of the deactivated bombs) injuries varied considerably. They ranged from minor tissue-lesions to mutilated fingers and the risk of exsanguination.

KEYWORDS: forensic science, criminalistics, forensic pathology letter bomb, construction of bombs, injuries

In Austria from 1993 to 1995 five series of letter bombs have been mailed. The letters were sent to outstanding persons, who have been engaged in the care of foreigners, and also to naturalized foreigners and even to some addressees in Germany. The letters of the first series were of most severe consequences, as at that time the public was not introduced to the recognition of such devices at all. This paper describes the construction of the letter bombs of the first series and the nature of the injuries sustained by four persons who have been injured in this series. Forensic literature on injuries caused by explosives is sparse. Examples can be found in a few papers (1–6). Bombs made by terrorists are only discussed in detail in one textbook (7,8). Therefore it appears to be reasonable to report the case of these letter bombs.

Construction of the Bombs of the First Letter Bombs Series

Six of the ten letter-bombs of the first series were deactivated by specialists. The construction of these bombs was analyzed. They were all built in the same way. The letter bombs consist of the following main components, which will be described in detail: the detonating fuse, the explosive, and the electronics for initiation and the energy source.

Detonating Fuse

The unique features of the construction of the bombs is the implementation of two types of fuses in each bomb. This ignition-system was described in one confessing letter as a combination of a "warning-fuse" and a "detonating-fuse." Both types were built by using the same system of modular construction. The primary unit consisted of a filament, which had been removed from a low-current-lamp. This heating-unit was fixed within a plastic straw by hardened epoxy-resin. The straw was filled with about 40 mg of initial explosive. The remaining open side of the straw was sealed by epoxy-resin, too. This primary fuse was introduced into a piece of straw with a slightly larger diameter. This second straw was filled with the secondary load of initial explosive. The end was sealed with epoxy-resin as well. A metal sleeve, which had been taken from a ballpoint-pen, was slid over these prepared pieces of straw. This sleeve obviously should provide some confinement of the ignition-charge. The sleeve was additionally taped by a fishing-line.

The warning fuse had a primary load of 40 mg Mercuryfulminate and a secondary load of approximately 400 mg Mercuryfulminate. This fuse should not cause a detonation-reaction of the Nitroglycerine but only produce the effect of a rattling sound and blistering of the letter. This behavior of the warning-fuse could partly be confirmed with reconstructions of the bombs, as Nitroglycerine was not initiated by this fuse, though the described effects of sound and blister could not be observed.

The detonating fuse was meant to blow up with some delay, providing sufficient time for the victim to drop the letter before the very detonation. It contained about 40 mg Silverfulminat as the primary load and approximately 400 mg Mercuryfulminate as the secondary load. This fuse was capable of detonative ignition of the Nitroglycerine. Experiments with reconstructions of this fuse confirmed the capability to initiate detonation of the Nitroglycerine.

The whole assembly was attached to another drinking-straw, filled with Nitroglycerine. The straw was divided into two chambers of unequal volume, with the larger linked to the so called detonating fuse and containing the main portion of the Nitroglycerine loading. The connections between the fuses and the straws, which contained the Nitroglycerine, were covered by some windings of the fishing-line. This connection provided proper confinement for the explosives and guaranteed the safe propagation of the detonation from the fuses to the Nitroglycerine. Bombs, which were reconstructed without such additional confinement, did not lead to a detonation of the Nitroglycerine, but only to spraying of the liquid.

The initial explosives Mercury-fulminate and Silver-fulminate, which were used in the detonating fuses of the letter-bombs, were investigated by Scanning Electron Microscopy and X-Ray-Diffraction, which revealed the morphology and structure of the crystals.

Pure mercury fulminate forms rhombic crystals, but in the presence of impurities rhombic leaflets are precipitated. The X-ray-diffraction pattern of samples extracted from different bombs were

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very similar (Fig. 1). Neither of them showed the presence of mercury- or copperchlorid, which are sometimes added in industrial production to form white instead of gray crystals.

Silver fulminate usually precipitates in form of needles, which sometimes tend to develop leaf-like clusters. In our own experiments these types of crystals could be produced. The silver fulminate crystals of the letterbombs however, showed a significant different flaky character. The leaflets revealed the structure of a cross with a cobweblike system of dendrits (Fig. 2). From the results it was concluded that the initial explosives were manufactured by several identical batch processes.

Explosive

The explosive used was Nitroglycerine with a total amount of approximately 4 g. Nitroglycerine is a yellowish, oily liquid. The analysis of four different Nitroglycerine-probes of this series by liquid chromatography (HPLC) showed identical concentrations for the side-products 1,2-Dinitroglycerine and 1,3-Dinitroglycerine and a remarkably high purity. As Nitroglycerine cannot be obtained in that quality by commercial sources, it must have been produced by the constructors. The identical concentrations of the side-products indicate, that the Nitroglycerine used in the letter-bombs was synthesized in one batch.

Electronics and Energy Source

The electronic assembly consisted of a two-step transistor circuit. A very thin copper-wire (0.05 mm diameter) was placed in the envelope in a way, that it had to be cut inevitably, when the letter was opened.

The cutting of this wire caused a switch in the transistor circuit, directing a current into the filament of the warning-fuse, which caused initiation of the primary explosive. The delay of ignition between the two fuses was achieved by using different diameters of filament for warning-fuse and detonating-fuse. The larger diameter was used with the detonating fuse, the smaller with the warning fuse. The filament with the smaller diameter heated up more rapidly and caused the ignition of the primary explosive. Not till the interruption of this circuit, the current provided by the energy source was able to heat up the filament of the detonating fuse ending up in the detonation after some parts of a second.

In principle the performance of this electric control system could be verified. But the differences in the moments of ignition of the two fuses, which could be achieved in some experiments with reconstructed bombs, proved to be too short (<0.4 sec) to have any meaning to the victim who is opening such a letter bomb. Energy for ignition was supplied by lithium button cells CR 2032 and CR 2430. The no-load current was 0.25 mA, which corresponds to an operational life of 40 days for the letter bombs.

Conclusions

From these results and the remaining fragments of the four exploded letter-bombs it can be concluded that all ten bombs were built in the same way, containing comparable amounts of the explosive Nitroglycerine. Figure 3 shows the scheme of construction. Therefore the varying degree of injuries of the victims has to be explained by differences in the way they were holding the letter in their hands while opening it.

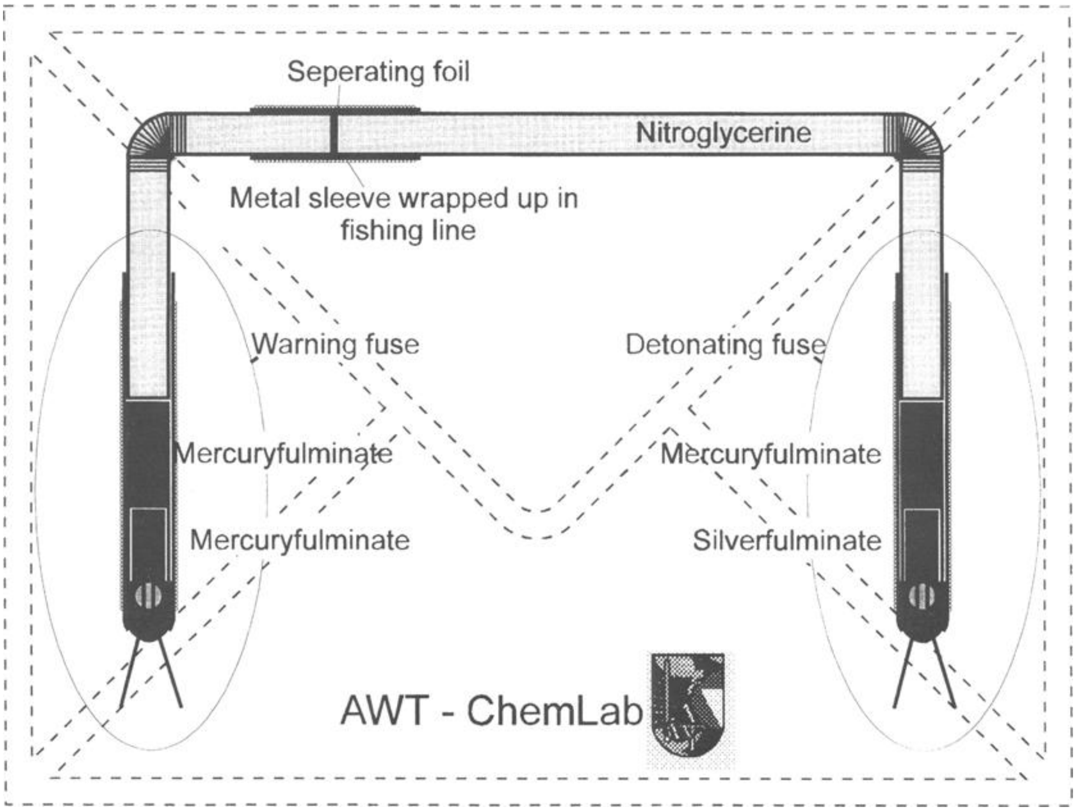

FIG. 1—*Construction of the letterbombs.*

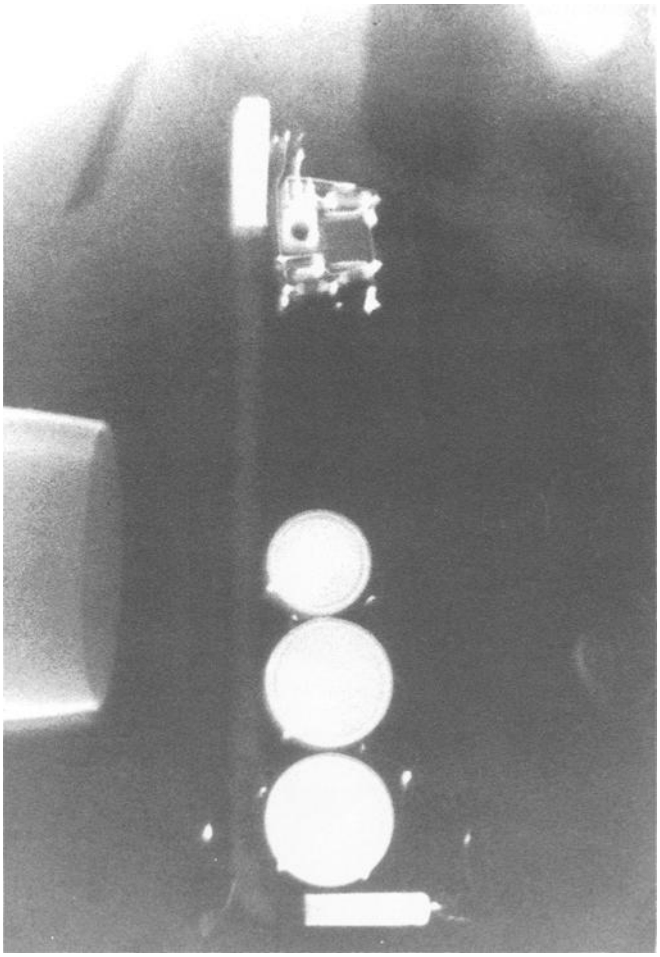

FIG. 2—*X-Ray of the bomb showing button cell batteries and metal sleave of the fuse.*

Injuries due to Bombs of the First Letter Bombs Series

Case 1

The victim was a 66-year old man, who held the letter in his left hand very firmly and opened it by means of a ballpoint pen with his right hand. The left thumb was completely torn away, the other fingers as well as the rest of the left hand were mangled, with bones exposed, multiple complicated fractures, and penetration of individual fragments (Figs. 4–6). These injuries were life-threatening because of a hypovolemic shock due to excessive blood loss, and necessitated the application of one liter infusion fluid and six units of banked blood. Altogether five operations were necessary, including plastic surgery. The injuries caused a sick-leave of six weeks. The operations lead to the reconstruction of the left hand with four finger stumps with the ability of wobbling movements.

Case 2

The victim was a 36-year old woman who said that she intended to put the letter aside just the moment when she had opened it as she had remembered an appointment. The detonation caused an oblique fracture of the middle phalanx of the left ring finger and a fissure of its distal phalanx. The subtotal amputation of this part was necessary. In addition the victim sustained multiple lacerations and penetrations of fragments in the left hand, minor injuries on the left hand and multiple small lacerations in the face and in the thorax region. Three operations had to be done and the sick-leave was 10 weeks. A malposition of the left ring finger remained due to a tendon injury.

Case 3

The victim was an 18-year old employee who opened the letter addressed to her chief. She was holding the letter with her left hand while opening it with her right. The bomb caused an open fracture of the distal phalanx of the left thumb, an open transverse fracture of the proximal phalanx of the left index finger, a fissure of the proximal phalanx of the left middle-finger, and the penetration of several fragments. The face was wounded by two lacerations. The victim had been on sick-leave for 7 weeks. A malposition of the left index finger remained due to tendon injury.

Case 4

The victim was a 51-year old man who said that he had hold the letter loosely with two fingers of the left hand, while opening it with a letter opener, held in the right. The explosion caused multiple small lacerations of the left hand without any injury to the bone. The victim took a sick-leave of four weeks due to injuries. The victim was healed completely.

Summary

In all four cases there were no internal lesions in the thorax region (e.g., pneumothorax, lung contusions), which are characteristic injuries due to blast waves. The detonation of a letter bomb of the described construction caused a blast wave which was far below the 1%-lethality curve for pressure as mentioned in the literature (9). The blast traumas, which could be observed, were restricted to a 1–2 day reduction of power of hearing without any permanent damage or eardrum lesions. Table 1 summarizes the four case-studies.

Discussion

Explanation and Categorization of Injuries

Injuries due to explosives may vary considerably (5,6,10,11). The following items have to be taken into consideration when explaining and categorizing the various injuries sustained by the victims: construction of the bomb, quantity of explosive, and distance between site of detonation and victim.

In the cases described above, the injuries caused by the letter bombs are fairly uniform (see Table 1) though of varying degree dependent on the additional confinement by holding the letter. Most injuries occurred on the hand, which held the letter, i.e., the left hand with right-handed persons.

If the letter is held firmly and enclosed by the hand, the explosive is confined, which enhances the impact of the explosive (Case 1). If, on the other hand, the letter is only held loosely with two fingers, and the distance to the letter-bomb is enlarged by using some opening tool, the injuries sustained are less severe (Case 4). The lack of blast injuries of the eardrums and the lungs can be explained by the small amounts of explosive used. As the bombs contained hardly any metal parts, injuries due to splinters were negligible.

The Question of Lethality

Two suspects were arrested and charged with murder, but finally acquitted. Because of the murder charge the experts had to comment if the letter bombs had the potential to cause fatal injuries under predictable circumstances.

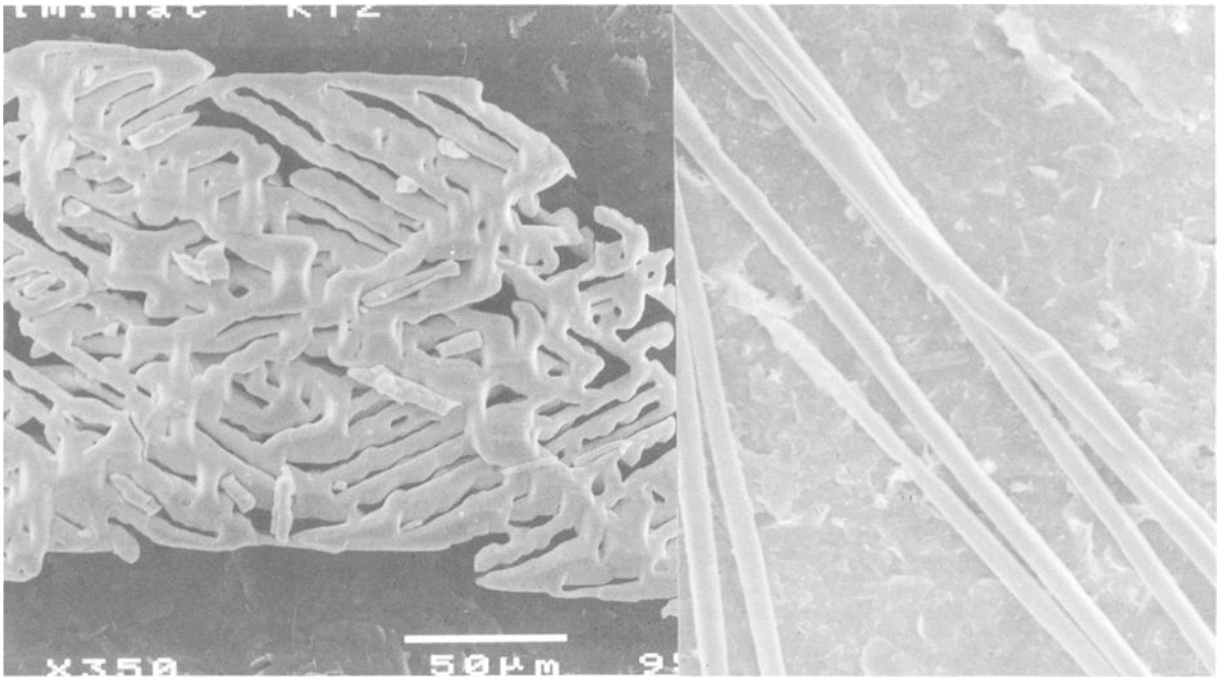

FIG. 3—*Silver fulminate; structure of crystals found in letterbombs (on the left, flaky and cobweblike, similar in all cases) and in crystals of own production (on the right, needles).*

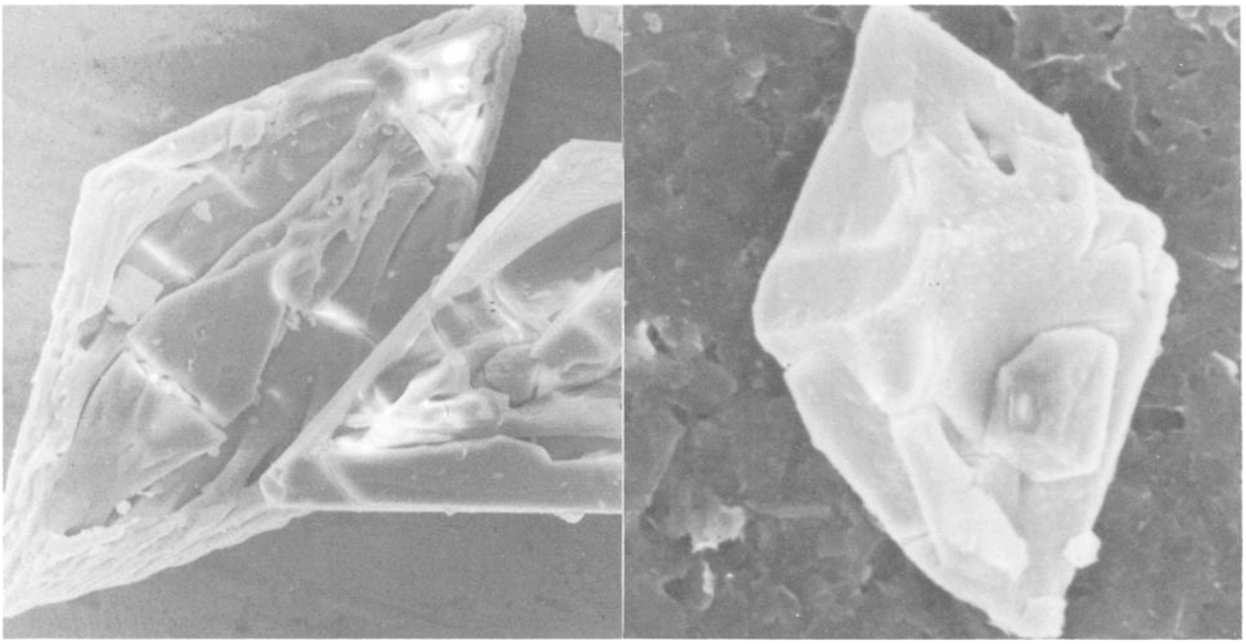

FIG. 4—*Mercury fulminate: structure of crystals found in letterbombs (on the left) and of own production (on the right).*

As Case 1 shows, life was potentially in danger, as there occurred the risk of exsanguination as the left thumb was completely avulsed. But in the majority of the reported cases life had not actually been in danger. The same conclusions have been drawn of some case studies in Northern Ireland (7). According to military experts, anti-personnel-mines, which contain about a tenfold amount of explosive, compared to the letter bombs, have a lethality rate of about 3%.

This also points out the very low lethality of the letter bombs in this series. The construction-feature of the warning-fuse indicates also that the perpetrators did not intend to kill their victims.

Conclusions

These considerations demonstrate that valuations of such case studies can only be achieved by cooperation of forensic pathologists and technical experts. Only the combination of the facts provided by each of them can fully explain a pattern of injuries caused by explosions. There have been attempts on systematic reconstruction of such cases

FIG. 5—*Case 1. X-ray of the left hand with torn away thumb, multiple fractures and penetration of individual fragments.*

FIG. 6—*Case 3. X-ray of the left hand with fractures of the thumb and index finger, fissure of the middle-finger and penetration of several fragments.*

TABLE 1—*Injuries due to letter-bombs.*

	Left Hand	Right Hand	Face Torso	Wounds	Amputations	Fractures	Tendon Injury	Ear Air Blast Trauma
Case 1	+++		+	+++	++	+++	++	+
Case 2	++	+/−	+	++	+	+	+	
Case 3	++		+	++	++	+	+	
Case 4	+			+				+

(12). Letter bombs are an effective and insidious form of terrorism. The task of the experts is to provide a basis of objective facts to catch the perpetrators and a tool to assess the cases in court.

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