

## The Medico-Legal Investigation of the El Aqsah Intifada

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**Key words:** terrorism, suicide bombing, Intifada, forensic sciences, identification

### Abstract

**Background:** The majority (n = 445) of the Israeli and Palestinian fatal victims of the El Aqsah Intifada was examined at the National Center of Forensic Medicine in Tel Aviv. Analysis of the trauma sustained and the anthropologic profile of both the victims and the perpetrators elucidates the trends and contrasts them with the phenomenon in the past.

**Objectives:** The purpose of the forensic investigation of mass casualty incidents is manifold: establishing the minimal number of individuals involved, identifying the victims and perpetrators, collecting material evidence, and determining the *modus operandi*.

**Methods:** The postmortem examination includes external description of the bodies and their injuries, photo-documentation, and sampling of tissues. Radiography, dental examination, and a ten-print card of each cadaver are also recorded.

**Results:** The *modus operandi* of the current Intifada is somewhat different from that of the previous wave of terrorism and includes more road shootings and vehicular terrorism. In addition, three suicide bombers who detonated explosive devices within crowded areas were young women, and the age of the perpetrators has increased from up to 35 years to individuals as old as 47, thus greatly enlarging the potential number of suicide terrorists. Virologic and biologic tests have been introduced to examine the tissues of the suicide bombers since they are possible sources of contagion to the wounded victims.

**Conclusion:** The results of the medico-legal investigation of victims and perpetrators of terrorism enable us to establish the *modus operandi* and the profile of potential perpetrators, which can help in the prevention of similar attacks. Documentation of the different types of injuries in fatal victims of explosion and shooting contributes to improving the awareness of the medical staff treating the wounded of similar attacks. Further investigation into the reliability of virologic and biologic tests conducted on postmortem tissue is recommended.

IMAJ 2002;4:549-553

The purpose of the forensic investigation of mass casualty incidents is manifold; it includes establishing the minimal number of individuals involved, rapid identification of the victims and perpetrators, recovering bullets and shrapnel, and elucidating the *modus operandi*. This undertaking is accomplished by the medico-legal inspection of victims and perpetrators, together with data collected at the scene of the event, and examination in the various laboratories of the Division of Identification and Forensic Science of the Israel Police [1].

Close collaboration with medical centers attending the wounded victims of the attack is fundamental. The National Center of Forensic Medicine not only helps to identify the victims and establish the true number of casualties but also provides samples of body fluids and tissue from the perpetrators to be examined as possible sources of contagion to the wounded victims.

In the present report we discuss the mass disaster management procedures and investigation at the Forensic Center, where forensic pathologists and biologists from the Ministry of Health together with experts from various agencies (Police, Israel Defense Forces, and Intelligence) collaborate in the identification process.

### Materials and Methods

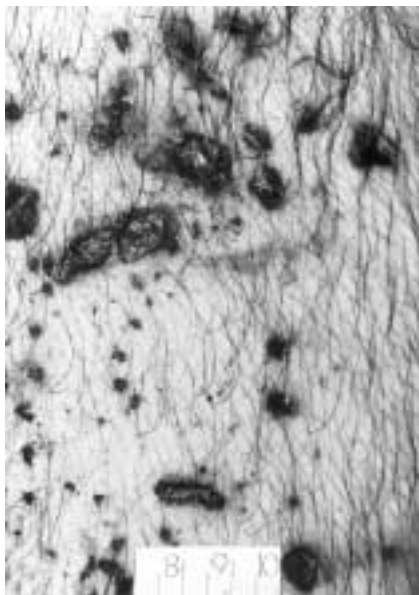
A total of 445 victims and perpetrators of the Palestinian riots were examined over a period of 20 months (October 2000 to June 2002) at the National Center of Forensic Medicine. The mass casualty established procedure commences with the opening of an Information Center in a governmental working area adjacent to the Forensic Center in order to facilitate the centralization and flow of information. The Information Center is supervised by a special unit of the Division of Identification and Forensic Science of the Israel Police and is manned by local police investigators, social workers and psychologists. The main task of the Information Center is to obtain and catalogue antemortem data from individuals searching for missing persons and to exchange the information with the forensic teams that examine the cadavers [1]. The relevant information regarding physiognomic characteristics, medical data, clothing and other identifying features of the missing person are recorded on an "antemortem" form while the same information regarding the cadavers is noted on a "postmortem" form. During

The El Aqsah Intifada began in Jerusalem in October 2000, when clashes between Israeli security forces and Palestinian demonstrators on the Temple Mount developed into a full-blown riot. Since then, and until June 2002, 445 Israeli victims and Palestinian perpetrators who died in 144 terrorist attacks have been examined at the National Center of Forensic Medicine. Some victims were not submitted to the Forensic Center due to religious reasons. In Israel, this is the only forensic institution in charge of tanatologic investigations. Located in Tel Aviv, it carries out all medico-legal examinations and identifications of sudden unexpected deaths.

data processing the bereaved are provided with psychological assistance by municipality health services.

The tanatologic examination includes external description of the bodies as well as evaluation of various injuries sustained and of individualizing characteristics, photographing the clothing and personal belongings, and sampling of tissues. Furthermore, radiography, dental examination and a ten-print card of each cadaver are recorded. All surgical intervention signs, any other acquired or congenital pathology, cutaneous nevi, tattoos and body piercing, especially relevant to identification are documented [2]. When possible, the facial tissues are restored in order to spare the families additional distress during the viewing of the cadaver.

After all the complete and partially complete bodies have been processed, the forensic teams address dozens and sometimes hundreds of body parts. The forensic pathologists and anthropologist classify all present parts, describe and photograph them, and finally take tissue samples from relevant body fragments for DNA analysis. Anatomic reconstruction of the shattered bodies is



**Figure 1.** “Peppering,” consisting of small abrasions, hemorrhages and lacerations on the skin of the chest of a suicide bombing victim. Note the debris embedded within the wounds, consisting of minute fragments of metal and tissue from the perpetrator.

accomplished through physical matching of the torn parts [3]. Those segments that cannot be approximated by gross anatomic morphology are analyzed at the tissue level.

Communication with the various trauma centers that are treating the wounded from the same attack is of paramount importance. All admitted amputees have to be reported to the Information Center in order to avoid overestimation of fatalities based on body fragments.

In cases of suicide bombings where tissue fragments from the perpetrator are blown in a centrifugal fashion towards the wounded [Figure 1], blood (when available) or muscle samples of the bomber are taken for hepatitis B, C and human immunodeficiency virus testing. Serologic tests are performed at a gastroenterology laboratory (Tel Aviv Sourasky Medical Center) and molecular biologic analysis at a liver unit (Hadassah University Hospital, Jerusalem).

The comparison of antemortem and postmortem data for positive identification is performed by the relevant experts and ratified by a senior forensic pathologist, following rabbinical assent. Positive identification is established through at least one of the commonly recognized techniques, i.e., fingerprints; dental, radiographic, medical or genetic methods; or visual recognition of relatively well-preserved facial morphology [Table 1].

The ten-print card of each victim and the prints of disassociated digits are submitted to a fingerprint comparison expert from the Automatic Fingerprint Identification System laboratory for identification. The police computerized system contains the fingerprints of all individuals with a criminal record, and of police and security personnel. In addition, since the year 2000, this laboratory has begun storing palm prints along the ten-prints, augmenting the database matching possibilities. The Israel Defense Forces also has a large data bank of fingerprints of enrolled personnel since 1973. Latent fingerprints can also be obtained from the personal effects of individuals presumed to be dead [4].

Antemortem dental information can be obtained from the data bank of the IDF, which contains panoramic radiographs, dental records, and in some instances Polaroid photographs of the dentition of all enrolled personnel [5]. Dental clinics all over the country readily collaborate in providing data on their patients. Radiographs of presumed victims are obtained either from medical centers or from the individual’s relatives. By law, medical records have to be stored in medical facilities for at least 7 years.

**Table 1.** Distribution of identification methods

	Visual	Dental	Medical	DNA	Intelligence	Fingerprints	Unidentified	Total
<b>Victims</b>								
No.	119	39	72	41	–	49	1	321
%	37.2	12.1	22.5	12.7	–	15.2	0.3	100
<b>Perpetrators</b>								
No.	12	–	1	9	10	12	80 *	124
%	27.3	–	2.3	20.4	22.7	27.2		100
<b>Total</b>								
No.	131	39	73	50	10	61	81	445
%	29.4	8.8	16.4	11.2	2.2	13.7	18.2	100

The percentages for perpetrators are calculated for the total identified number (n = 44). The total number of cadavers identified is 364.

Muscle samples from the cadavers and body parts, and blood or buccal cells from next of kin of the missing persons are collected for DNA analysis. In cases where no adequate family members can be located, personal belongings (comb, hairbrush, shaving razor, etc.) may provide the antemortem source for the DNA of the missing person. Moreover, dry bloodstains can be obtained from the IDF data bank in cases of military personnel casualties. DNA is extracted using a modified short method [6]. The extracted DNA is then amplified using the Promega GenePrint STR multiplex system for the following loci: TH01-TPOX-CSF1PO; vWA-FESFPS-F13A01; D13S317-D7S820-D16S539. The polymerase chain reaction products are separated on vertical, denaturing, polyacrylamide gels according to the manufacturer's manual (Promega Technical Manual 1999) and typed using silver stain detection.

## Results

### Visual recognition

In forensic sciences, recognition of the deceased by family members or friends falls within the realm of presumptive identification [7]. Under Jewish traditional Law (*Halacha*), visual identification in itself is acceptable provided that the face or a unique external body feature is completely or partially preserved in such a way as to comply with Halachic laws [1].

In multi-victim situations such as reported here, visual recognition should not play an important role in the resolution of the identification process; nevertheless, 29.4% of the cadavers of the Palestinian riots were visually identified [Table 1]. Based on information collected at the scene such as documents and personal effects, and postmortem data recorded at the Forensic Center, and contrasted to details from antemortem records, the visual recognition process is often the confirmation of the probable identity of the victim by the next of kin.

### Scientific identification methods

From a total of 321 victims, 39 were identified by dental means, 72 by medical intervention and tattoos, 41 by DNA profiling, and 49 by finger and palm-print comparison (one remains unidentified).

In suicide bombings, the close proximity of the bomber to the epicenter of the explosion renders the cadaver extremely fragmented. Of the 124 perpetrators that underwent autopsy at the Forensic Center, 80 remain unidentified (through June 2002), and the other 44 were identified either by the Intelligence Services [10] or by scientific methods. Nine of these were identified by DNA profiling, 12 by fingerprints, 1 by medical data, and 12 by visual recognition [Table 1].

The advances in molecular biology in recent years have resulted in the development of a more rapid and more accurate DNA technology. Nowadays, more cases are resolved by DNA analysis of the victim's next of kin than in the past [8].

### Modus operandi

The great majority of victims examined died as a result of explosive injuries from bombings. These attacks were perpetrated either by suicide bombers carrying the device strapped to their bodies, or by bombs placed in public areas. The detonations were not always



**Figure 2.** Radiograph of a victim of a suicide bombing. Within the thoracic cavity, detonators from the explosive device and metallic shrapnel were detected.

controlled directly by the bomber, and in some instances the mechanism was triggered through a cellular phone distant from the scene of the bombing. Remnants of the explosive device are blown in centrifugal fashion and sometimes undetonated parts of the contrivance are found within the body cavities of the victims [Figure 2].

A less common modality, which resulted in fewer victims, is the use of automatic guns to shoot at passing vehicles, with the gunmen driving by or by ambush. In some cases, the shooting took place in a crowded area by a single or two gunmen on foot.

Finally, vehicular terrorism took the lives of seven pedestrians when a Palestinian bus driver ran over a group of soldiers on a main road.

### Profile of the perpetrators

By law, autopsies at the National Center of Forensic Medicine are performed only on cadavers whose family members authorize the procedure or when a Court order is issued. In the case of perpetrators of terrorist acts, the Supreme Court considered issuing a comprehensive order to perform complete necropsies.

From the postmortem examination of the terrorists, a slightly different profile to that encountered during the previous wave of terrorism has been observed. The age range of the suicide bombers during the years 1987–1993 was 17 to 34 years, while during the present uprising, individuals as old as 47 years of age committed acts of terrorism.

Body fluids (when available) and tissue samples are taken routinely from all perpetrators. Toxicology tests (conducted at Sheba Medical Center) have shown negative results for opiates, cannabinoids, alkaloids (cocaine), barbiturates, amphetamines and alcohol. Tests (serology and molecular biology) for viral infectious agents of the examined samples revealed several positive hepatitis B cases, although these results require further validation since in most cases the tests were conducted on muscle samples and postmortem blood and not as routinely required on fresh plasma.

## Discussion

The forensic examination of victims and perpetrators of these terror acts is an integral part of the medical and criminal investigation of the phenomenon. The main tasks of the medico-legal teams are:

identifying the victims, establishing the causes and manners of death [Figure 3] for the purpose of ensuing legal action, and interpreting the *modus operandi* of the terrorists in order to devise efficient preventive measures [3].

In the daily routine of a medical examiner's practice, most of the cadavers examined are identified by personal recognition on the part of relatives [9]. In mass casualty incidents this is not practiced, as the psychological state of mind of the population as a whole and of the next of kin in particular is precarious. In the past, visual recognition constituted about 50% of all identifications in suicide bombings. Today – as a result of the experience of the National Center of Forensic Medicine, the Israel Police and the IDF, and the recommendations of the forensic community – scientific techniques of identification are used in all cases of mass disaster situations [7]. Despite the recommended protocol adopted by the Forensic Center in the last few years, almost 30% of the cadavers' identification relied on visual inspection.

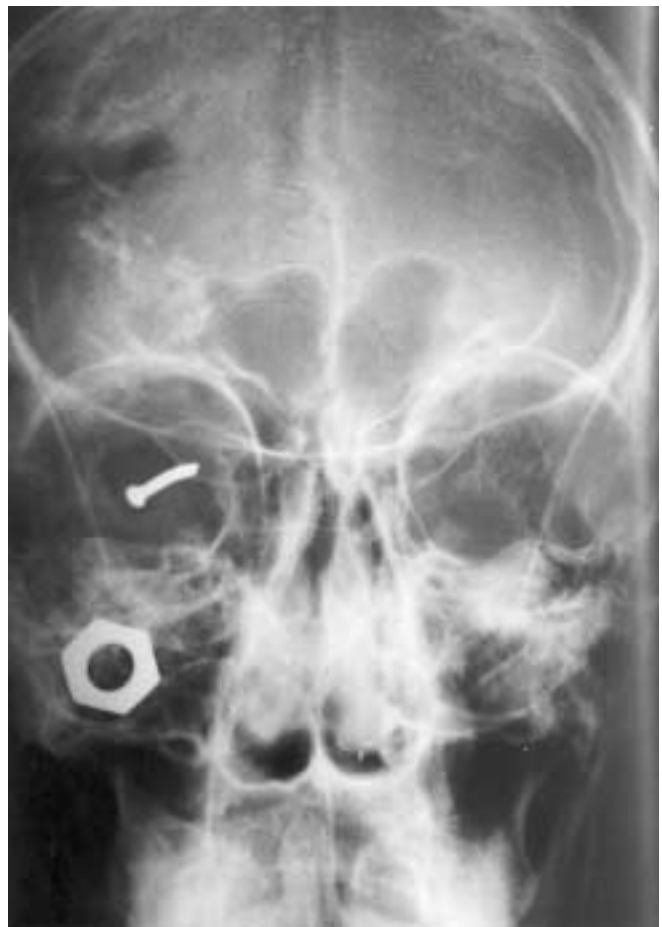
Of the various scientific techniques for positive identification of cadavers, DNA profiling advanced the most rapidly and steadily in the last decade of the twentieth century [8]. The first genetic analysis for identification of victims of a terrorist attack in Israel was carried out in October 1994, where DNA typing helped in the identification of one of the victims and of the perpetrator of the suicide bombing [1]. At the time, only one DNA locus was typed along with some other genetic markers (i.e., isoenzymes). Since then, DNA technology has developed significantly and today provides the answer for even the most difficult identification cases.

In a recent attack, the two victims of a suicide bombing were identified in less than 24 hours by DNA analysis using nine STR loci. In the same suicide bombing, the perpetrator was identified by comparing his DNA profile with three family members, although his family refused to accept the identification despite the high statistical results. This type of denial is common not only among the next of kin of the perpetrators but also among the victims' family members who are unable to accept the magnitude of their tragedy. In some instances, even though the cadaver has been identified by other scientific means, the family of the victim insists on a genetic identification considered by the public as "infallible."

The genetic identification procedure has been considerably shortened due to a modification in the DNA extraction. Instead of the 24 hours needed for the organic extraction used routinely in criminal cases, the modified method is completed within 1 hour, thus enabling the laboratory to obtain the DNA profiles within 6 to 9 hours.

Additionally, DNA technology is instrumental in the re-association of body fragments required for the determination of the minimal number of individuals who died in the attack. The number of perpetrators of a specific event is one of the most important criminal investigation issues, which can be solved either by anatomic approximation or by DNA testing since their bodies are usually extremely fragmented. The re-association of body parts is also essential for the burial process.

The extreme fragmentation of the body of the perpetrator and the explosive forces that disperse the shrapnel within the explosive device affixed to his or her body [10] pose a further danger to the



**Figure 3.** Cranial radiograph depicting metallic shrapnel consisting of a bolt and a nail added to the explosive device to upgrade its lethality. The cause of death was determined as severe injuries to the brain.

wounded victims, not only from the mechanical trauma but also from biologic agents carried in the bomber's tissues. In one of the early suicide attacks of the El Aqsa Intifada, one of the casualties treated in an emergency room presented extraneous fragments of bone embedded in a wound. The attending physician raised the question of a possible contagion from the perpetrator's tissues to the wounded victims. Since then, as a routine procedure, samples of blood and tissue from the terrorist are submitted for detection of hepatitis B and C virus and human immunodeficiency virus. Furthermore, as a preventive measure, the Ministry of Health has ordered that an active vaccine (Engerix B) against hepatitis B virus be administered to all casualties.

A further threat posed by the centrifugally expanding wave of the blast is the presence of undetonated components of the device that may remain embedded within the body cavities of the victims. An unsuspecting clinical practitioner or forensic pathologist might detonate these parts by manipulating them during treatment or body examination [Figure 3].

Although positive identification by scientific means is advocated in mass casualty situations, the denial of death of a relative is more frequent in these cases. For the next of kin, it is easier to accept the sudden and unexpected death of their beloved when they view the

body, and only a proper explanation of the identification methods by the forensic team may help the families to accept the death of their loved one.

The worldwide escalation of terror has also been evinced in the present Intifada. Despite the tight security measures at border posts and on roads outside the “green line” (the border between the Palestinian Authority and the State of Israel), Palestinian radical groups have developed new and more sophisticated means of destruction. Road shooting, where the perpetrator usually escapes unharmed, has become increasingly more frequent. Recent suicide bombings have involved more than one perpetrator – separated by a short distance, they detonate their device at slightly different times, thus increasing the number of casualties among the rescue forces as well. Finally, attacks surprising in their simplicity, like a terrorist dressed as an Israeli soldier shooting in a crowded area or a perpetrator driving an innocent-looking vehicle and running over pedestrians, have resulted in large numbers of victims.

The findings of the medico-legal investigation of victims and perpetrators of terrorism enable us to establish the *modus operandi* and the profile of potential perpetrators, which can help us in the prevention of similar attacks. Documentation of the different types of injuries found in fatal victims of explosion and shooting contributes to the knowledge of the medical staff treating the wounded of similar attacks.

## References

1. Kahana T, Freund M, Hiss, J. Suicidal terrorist bombing in Israel – Identification of human remains. *J Forensic Sci* 1997;42:260–4.
2. Fierro M. Identification of human remains. In: Spitz WU, Fisher RS, eds. *Medicolegal Investigation of Death*. Third edn. Springfield, IL: Charles C Thomas, 1993:71–117.
3. Hiss J, Kahana T. Trauma and identification of victims of suicidal terrorism in Israel. *Milit Med* 2000;165:889–93.
4. Kahana T, Grande A, Tancredi DM, Penalver J, Hiss J. Fingerprinting the deceased: traditional and new techniques. *J Forensic Sci* 2001;46:908–12.
5. Buchner A. The identification of human remains. *Int Dent J* 1985;35:307–11.
6. Chen S, Evans GA. Use of polymerase chain reaction for screening transgenic mice. In: White BA ed. *Methods in Molecular Biology*. Vol. 15. Totowa NJ: Humana Press Inc., 1993:75–80.
7. Jensen RA. *Mass Fatality and Casualty Incidents*. Boca Raton, FL: CRC Press, 1999:ix–xii.
8. Motro U, Oz C, Adelman R, et al. Allele frequencies of nine STR loci of Jewish and Arab populations in Israel. *Int J Legal Med* 2002; (In press).
9. Delattre VF. Forensic dental identification in the greater Houston area. *J Forensic Sci* 2001;46:1379–84.
10. Hiss J, Kahana T. Modern war wounds. In: Mason JK, Purdue BN, eds. *The Pathology of Trauma*. Third edn. London: Arnold, 2000:89–102.

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*Act only on that maxim which you can at the same time will that it should become a universal law*

*Immanuel Kant (1724-1804), German philosopher known for his theory of the categorical imperative*