

ROLE OF FORENSIC ODONTOLOGY IN THE INVESTIGATION OF TERRORISM

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ABSTRACT

The latest threat to the mankind is from terrorism which is showing its ugly face to the all the nations of the world. It is a matter of time before it will engulf the whole world sooner or later if no effective steps are taken to combat and contain it.

Different branches of science have their own role to curtail the menace of terrorism but forensic odontology have its own unique role to play in mitigating the effects of terrorism by identifying the suicide bombers, terrorists, and victims of terrorism including mass disasters caused by terrorists.

Forensic odontology has taken huge strides since its inception and plays a big role to identify the persons whether living or dead. Due to terrorist activities especially mass shootings, bomb blasts, plane hijacking and destruction of planes; identification of victims and terrorists is a big issue.

Usually, teeth remain intact in such incidents due to its hardness and well-protected position anatomically. Right from physical examination, their eruption and calcification patterns, and study of changes due to aging e.g. Gustafson methods and its modification and study of the DNA profiling, partial to absolute identification can be established of victims and perpetrators of terrorism.

Key Words: terrorism; forensic odontology; forensic dentistry; small arms; mass disasters; crime scene; forensic odontology team.

INTRODUCTION:

Terrorism has been defined differently by different organizations and it is

the violence which is motivated politically or socially¹ and is usually against non-combatants². The UN has still to reach a

consensus to define it³. Forensic odontology is the application of knowledge of dentistry for the judicial purposes⁴.

Common means used by terrorists are small firearms⁵, grenades and explosive material⁶ which includes suicide bombing^{7,8}, plane s hijacking and later on plane is blown off or meets an accident⁹, drive heavy vehicles over the crowd^{10,11} and bioterrorism, chemical)and nuclear weapons.^{5, 12}

In terrorist bombings usually there are blast injuries along with complete disruption of the body and injuries by flying missiles and identification is a difficult proces and in this forensic odontology plays an important part along with other parameters for identification⁸.

Photographs and personal belongings do help in identification but should be used with a caution as under circumstance of mass disasters relatives may be under enormous pressure with emotional instability of mind and misidentifications may occur under such circumstances⁶.

Fingerprints are the established means of identification because they show polymorphism and have a unique feature that they remain unchanged in life and even they can differentiate the monozygotic twins⁶.

if hands are also mutilated dental examination and creating dental records and comparing with antemortem dental records can do wonders in identification⁶.

When explosive grenades and explosive material are used in terrorist activities with a lot of mutilation identifications have been done by DNA samples and which also have the advantage that these can also be preserved for future comparison and have helped in identification of the victims after bomb and explosive material used with crash of buildings and human remain discovered even after 10 months of the incidence after removal of the debris in Buenos Aires City and later on in Trade center in USA⁶.

Planes are hijacked by terrorists and then deaths have occurred in 10 different hijacking incidents in the USA from 1971 to 2001 and all this poses a challenge for identification of the victims and terrorists⁹.

Vehicles are now used as means of terrorism and it started in 2008 in Israel¹³ and has spread to other parts of the world and such incidents have occurred in Barcelona, London, New York which is difficult for the police to find out which is killing innocent people¹³. A major incidence of Nice occurred in 2016 in which 86 people died and 430 people were injured when a vehicle was used for terrorism. Other such

incidents have occurred in Vienna, Ohio, Stockholm, and Paris¹⁰.

Use of biological weapons has been well mentioned in history starting from 600 BC and continued to be used in this century¹⁴ and terrorist activities may also be done using biological agents¹⁵ and incidences of bioterrorism have been reported in Oregon, Tokyo¹⁴ and USA¹⁶. It has been emphasized that bioterrorism may kill more persons than nuclear wars¹⁷. Electronic information center which can link medical care providers into a network so that adequate treatment can be provided for the mass distribution of the medicines in bioterrorism attacks¹⁸.

In addition to bioterrorism, terrorists may use chemical, radiological or nuclear explosive materials¹⁹. Chemical weapons have been used by terrorists in 2015 in Syria and used it more than 76 times²⁰ and details of different incidences are given using different chemicals²¹ and international cooperation is usually required to tackle such cases²². When radiation from decaying radioactive material is used for terrorism it is radiological terrorism which may be used to inflict damage to people²³. Radiological weapons can be the potential weapons of mass destruction²⁴. Dirty bombs can be prepared and used by terrorists by combining the radioactive material and conventional explosives²⁵. There will be many challenges

in dealing with the explosions of dirty bombs²⁶. Nuclear terrorism is launching a nuclear warhead on a ballistic missile by a terrorist²⁷. It can be a very worst situation when thousands of people will be endangered and it is preventable and should be prevented²⁸.

The crimes by terrorists may be done on ships and bodies of victims may go under water. Most of the people may think that when bodies go underwater useful forensic evidence may not be available but if proper protocols are followed useful evidence can always be retrieved even under such circumstances²⁹.

In addition to individual casualties, mass disasters do occur by the activities of the terrorist's forensic odontology plays an important role in the management of mass disasters³⁰. Due to terrorism, we have more cadavers which need to be identified³¹.

Mass disasters have been defined by different ways but when available resources are not sufficient locally to locate, deal and identify the dead bodies it is a mass disaster³².

The practices to deal with the mass disasters may be different in different areas and different countries³³.

Multidisciplinary teams are needed to take care of the proper investigation of terrorists incidents and to collect various evidence and establish the identity of the

victims. Crime scene investigator³⁰ is usually the in charge of the crime scene or it may be a medical examiner. In this Forensic pathologist play an important role in triage and recovery of bodies and biological evidence³⁴. After the crime scene has been cleared by the bomb squad, forensic pathologist and forensic odontologists can work there⁸. Forensic odontologist and Forensic anthropologist are the important part of the team³⁰. Radiologist and his technician are also required to help the forensic pathologist, forensic anthropologist and forensic odontologist³⁰.

Where the hands are intact fingerprint experts have their role to play. If some other parts of the body are intact which have been handled by the terrorists, identification of the terrorists is possible by comparing these fingerprints in the database. Even the DNA can be extracted from these fingerprints which can help further in the identification of the terrorists³⁵.

Forensic photographer and forensic DNA analysts, physical evidence recovery experts and dental hygienist may be other important members of this multidisciplinary team³⁰.

A forensic psychiatrist may be needed to take care of the post-traumatic stress of the survivors and to find out their

conflicts and spiritual beliefs diversity to get them relief from this stress³⁶.

Forensic Odontology Team

Forensic odontologist has a big role to play in the mass disasters caused by terrorists³⁷ and they can be of immense use to the team³⁸. Forensic odontology team can have different sub-teams which have been named as Go Team which will do the postmortem examination, support team which collects the antemortem dental records and comparison team which compare the antemortem and postmortem records (37).

Go team or the post-mortem team: it usually constitutes a forensic odontologist and anthropologist (8). Observations will be easy if the body is in the primary stage of relaxation. For accurate recording of the dental observation if rigor mortis has set in, oral autopsy is needed and it can be performed after taking permission from investigating officer and forensic pathologist after they have completed their jobs; by giving an incision from the angle of the mouth to the tragus on both sides and making the flaps to get visualization of the teeth. Removing the muscles and ligaments of the temporomandibular joints will help in better visualization³⁹. The findings can be recorded on a pink form as per the INTERPOL norms⁴⁰. Dental radiographs

can be taken as required⁸. Removal of the jaw bones if required was an accepted norm but it had its own problems that when relatives get the body without jaws, it left traumatic emotional effects on the family and as per DVI protocol of INTERPOL jaws should not be removed unless it is utmost necessary after taking the national laws into consideration⁴⁰.

When incineration occurs secondary to fires in various terrorist activities fingerprinting of the endodontic obturation material can help in the identification⁴¹. Palatal rugae can also help in the identification when considered along with the dental arches⁴². Lip prints can also be successfully used for identification if terrorists or their victims have left marks of their lip prints anywhere and samples for DNA profiling can also be extracted from these lip prints⁴³.

Support team or the antemortem team: dental hygienist can play an important role in the collection of the antemortem records because of their experience in dental charting³⁰. It is also known as the home team⁴⁴. They can transfer all the examination, treatment and radiographic records on a yellow form which a standard form having other identification features which can help in identification⁴⁰. If there is a centralized dental record it greatly facilitates the support team⁸.

The comparison team: functions to compare the antemortem and post-mortem records to make final identifications and report the results³⁷. Radiographs provide one of the good sources of comparison and all types of radiographs including bitewings, orthopantograms or periapical can be used for this purpose⁴⁵. Computer-assisted postmortem identification [CAPMI] was developed to assist in fast identification of victims of mass disasters and is available free to the government agencies and nonprofit humanitarian organizations⁴⁶. Different users have developed soft wares like David ® used by Australia, DVI System International® which is used by Disaster Mortuary Operational Response team in the USA and WinID software system used by International Police Organization⁴⁷. Unified Victim Identification System [UVIS] has the advantage that the desired language can be selected which makes it easy to use and has also the data of the missing persons so comparison becomes easy⁴⁷.

Intelligent Dental identification system [IDIS] is quite helpful in identification from teeth even when they have been altered artificially or naturally with a success rate of 82.6% to 100% with just an error rate of up to 1.12%. This system has the advantage that it consumes less time and

electronic images can be stored making a database for further use⁴⁸.

Final opinion is given in a white form. Different colors are used for antemortem records, postmortem records and while giving a final opinion so that there may not be any confusion while comparing⁴⁰.

Training of forensic odontologists and mock rehearsal of participation in a mass disaster is important³⁷ and it is observed that forensic odontologists who are experienced always perform better than other dentists .⁴⁵

In incidents of terrorism bodies are usually fragmented and mutilated and in such types of remains teeth are the important source of DNA in addition to the bones but teeth are the preferred source⁵⁰ and sometimes this may be the only source⁵¹. DNA is a very reliable source for identification in such cases⁵². Intact and disease free teeth with intact roots should be preferred and DNA free instruments should be used⁵³. Premolars and molars are the good source of DNA⁵⁴ but canines and incisors can be used if molars and premolars are not available⁵³.

Teeth can be contaminated by bacteria and exogenous DNA⁵³. Contamination of the teeth can interfere with DNA profiling⁵⁵ therefore use of personal protective equipment is preferred and

should be used and use of Sodium hypochlorite can take care of bacterial contamination for better extraction of DNA and use of L⁻¹ liquid soap and bleach will take care of exogenous DNA and bacteria. Suitable Tooth Decontamination will increase the chance of DNA extraction and proper protocols should be followed for this for better identification.

Dental pulp in the roots of the teeth provides a good source of DNA though it can be detected in the crown body, root body and the tip of the root⁵⁶. Extraction of pulp for DNA is best done by horizontal sectioning though it can be done by crushing, endodontic access and vertical sectioning and it also allows rotary instruments and it has the advantage that morphology of tooth is retained to help in identification⁵⁷. A sample code must be provided when sending the sample for DNA profiling⁵⁸. Proper preservation and labeling should be done⁵⁹.

Mitochondrial DNA helps in identification when only distant relatives are available for comparison and teeth is a good source of mitochondrial DNA⁵⁷

By analyzing the ²H, ¹³C, ¹⁵N, ¹⁸O isotopic composition in teeth along with hair, nails & bone human provenance based on stable isotope forensic intelligence will be possible when used in conjunction with forensic anthropology. This can also help to

know the recent geographic movement of the terrorist as well as victims⁶⁰.

Bomb blasts can result in fire which can lead to incineration of the bodies and this can pose problems to the forensic odontologists as the coronal restorations may be destroyed by the high and persistent temperature and in these circumstances elemental fingerprinting the root canal obturation material fillings may be helpful in identification using scanning electron microscopy/energy dispersive X-ray spectroscopy [SEM/EDS]⁴¹.

In case of terrorist activity if help is needed then it can be obtained from the INTERPOL and their experts in various fields can tell us the best practices including that of forensic odontology and information can also be taken the DVI Guide of the INTERPOL⁶¹.

In one of the studies of terrorist violence involving suicidal bomb attacks visual identification was in 43% of cases, 25% were identified by finger prints and 23.28% of visually identified were confirmed by finger prints, 11.11% were identified by dental comparison and 21% of visual identifications were confirmed by dental comparison; 7% were identified by distinctive physical medical characteristics or anatomical variation and 12% of visual recognitions were confirmed by these features; 2.33% of victims identified by

genetic markers and another 5.47% cases of visual identification it was confirmed; where as 56% of terrorist perpetrators were identified by genetic markers.⁸

DISCUSSION

Terrorism is the act in which violence is used to eliminate victims but simultaneously aim is to create fear in a section of the society². It is important for the forensic odontologist to know that what means can be used by terrorists so that they can prepare themselves to handle the different situations to which they are going to be exposed when they are part of the multidisciplinary team dealing with incidences of terrorism, and how they can be helpful to the teams dealing with incidences of terrorisms.

When other means of identification is not helping in the identification of the victim's application of forensic odontology can be a very important tool as has been shown in the study done in Israel⁸. For this, The Forensic Odontology Team should be constituted and the most experienced person should be appointed its leader.

When small arms are used there occur multiple entries and exit wounds and usually, facial features remain intact and in such cases, visual recognition is most commonly used and is the most practical method as has been observed by the author during routine postmortem examinations.

The identification process is facilitated by documents or personal possessions.

If the victim is unknown at the time of postmortem examination the photographs should be taken and if face mutilated then fingerprints can help; but if hands are also mutilated dental examination and creating postmortem dental records and comparing with antemortem records help in identification of victims and terrorists killed in such incidents.

Dentists can also play a part in case of attacks in bioterrorism by helping in the mass distribution of medicine as they are related to the medical field.

When psychiatrist can take care of the stress of the survivors ³⁶ they can also be helpful in managing the stress of the team members some of whom may be the part of the team for the first time and seeing the death and devastation on a large scale, even may affect the team members including forensic dentists.

It is best to have universally accepted practices when dealing with the terrorist violence especially if it is resulting in mass disasters and the best practice is the evidence-based practice and that followed by INTERPOL DVI response which is followed in 188 countries. ⁴⁰ There is strong need to have protocols about the organization of DVI to avoid duplication and delay. ⁶²

If we follow the guidelines for preserving the material for DNA analysis routinely, better results can be obtained for identification ⁶.

It is better that each team develops its own Standard Operating Procedures [SOP] in advance depending upon the availability of team members and facilities and this will help in getting better results in such eventualities.

CONCLUSION

Small firearms used by terrorists cause less mutilation whereas grenades and explosive material cause a lot of mutilation. Mutilation of the dead bodies is also common when planes are hijacked and is blown off or it meets an accident. When terrorists drive heavy vehicles over the crowd mutilations occur to the various extents. In bioterrorism problem of mutilations is not there and identification of the victims is a not a big problem. Dirty bombs and nuclear weapons if used by terrorist will create damage on a larger scale and a massive problem of identification

When mutilation is less, visual identification serves the purpose but if mutilation is extensive other methods are helpful and forensic odontology is one of those methods where postmortem dental observation can be matched with antemortem observation to help in

identification. For successful prosecution of the cases, it is important to identify the victims and perpetrators. Forensic odontology also helps to successfully prosecute terrorists and curb the crimes committed by terrorists.

In terrorist activities where body may be fragmented or may be recovered in decomposed conditions DNA Profiling or DNA fingerprinting which is based upon comparing the short tandem repeats of DNA from the dead bodies and that of the relatives and this facility where available is likely to replace other methods and is almost mandatory in developed nations and those countries who can afford it and where facility for this test is present. Samples for this DNA profiling can be collected from teeth by the forensic odontologists.

But this can be possible only if the investigation agencies are aware of the role of forensic odontologists and especially if forensic odontologists become part of the investigation teams and they are well trained. In addition to this, forensic odontology units need to be set up in the universities to train the dentists and in the home departments to apply the services of forensic odontologists to fully utilize their services in terrorists related incidents.

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