Review Research Paper

Mass Disaster: Identification of Victims with Special Emphasis on Dental Evidences

[1]A K Srivastava, [2]Amit Kumar, [3]Abhishek Kumar, [4]Ankita Srivastava

Abstract

Mass disaster is a destructive episode in which so many persons are injured and or/died that it become beyond the management of local emergency medical services. The mass disaster is primarily investigated to establish identity of the victims. The investigation starts with the photography of the site and collection of evidences. Attempt should be made to identify the dead bodies first by their relatives and friends and if not identified, fingerprints and clothing & personal belongings should be collected and preserved. In autopsy features such as sex, age, race, stature, complexion & features, moles, birth mark, scars and dental peculiarities etc. should be noted in the post mortem report or in pink DVI form. In identification from teeth by comparative method, postmortem dental records are compared with ante mortem records of suspected person from their dentists either manually or through certain computerized programs such as WinlD4, Plass Data, CAPMI etc. Age, sex, race, socioeconomic status, occupation, habits etc. can also established by teeth that also help in identification. If identity is still not established teeth are sent for DNA profiling and skull for superimposed photography.

Key Words: Mass disaster, Identification, Dental profiling, DVI form

Introduction:

Mass disaster is an unexpected event that causes serious injury and death to a large number of people. Webster's New International Dictionary defines disaster as a "sudden calamitous event producing great material damage, loss & distress".

The term "disaster" originated from French words, 'des' means bad or evil and 'astre'-star. The word disaster denotes bad star or bad luck, act of God as most of the disasters such as floods, earthquakes; volcanoes, tsunami etc. are natural. [1]

But now large numbers of disasters are also caused by human beings accidentally as air-crash & transportation accidents or willful riots, terrorist attack etc.

Corresponding Author:

[1]Prof& HOD,
Department of Forensic Medicine,
Subharti Medical College Meerut 250005
E-mail: aksformed@yahoo.co.in
[2]Prof, Department of Forensic Medicine
Sri Arbindo Institute of Medical Sciences, Indore
[3]Junior Resident, Dept. of Anesthesiology and Critical Care, SRMS IMS Bareilly 243201
[4]Junior Resident, Dept. of Pathology,
Subharti Medical College Meerut 250005
DOR: 22.12.2014   DOA; 03.04.2015
DOI: 10.5958/0974-0848.2015.00047.0

WHO defined it as an event, natural or manmade, sudden or progressive, which impacts with such severity that the affected community has to respond taking exceptional measures? When a death of 12 or more persons occurs in a single episode, it is accepted as a mass disaster. Natural disasters are usually more enormous, killing hundred to thousand or more of the people, sometimes whole of the communities are wiped out.

Millions of the people are affected every year. It is estimated that approximately 250,000 deaths occur globally every year in disastrous events costing about 50,000 million US dollar. Most of the countries have "Mass Casualty Plan" which includes medical and hospital services, fire service and police to deal the cases of mass disaster. These plans are mostly clinically orientated; often ignore provision for dead persons. In this paper, attempt is made to discuss the methodology and problems in investigation of deaths in mass disaster.

Investigation of Mass Disaster:

The objects of investigation of death in mass disasters are:

- To retrieve and reconstruct bodies and fragmented bodies decently
- To establish personal identity
- To conduct autopsies and establish the cause of death to some or all and to assist in reconstructing the cause of disaster

- To collect evidences and materials for toxicological analysis (especially alcohol and carbon monoxide) to establish cause of the disaster. [2]

Investigation of mass disaster is a team work usually consists of Police officer, Forensic Pathologist, Photographer and Technical Assistants. Norway was probably the first country to develop a model of investigation procedure in mass disaster and included dentist also in the team for identification of victims.

This is now practiced in all Scandinavian countries, Europe, USA, and Australia. In India, no such practice is followed; collection of evidence at the site of disaster and shifting the dead bodies to the morgue for autopsy is done by the police officials. Post-mortem examination is conducted by General duty medical officers.

Medico-legal autopsy may not require in all the cases of mass disaster especially where the bodies are identified and their cause of death is apparent. Investigating officer, after summarizing the case, hands over the dead body to relatives for last rituals. The service of dentist is generally not taken in investigation.

Investigation/management of mass disaster is conducted in three phases;

- First at the site of accident for collection of evidences,
- Second in mortuary for medico-legal autopsy and
- Third, the last one in the laboratory for comparison of records and reconstruction of events. [3]

First Phase (At the Site of Accident):

Priority should be given to the survivors. All efforts should be made to save the life of injured person first, without unduly endangering rescuers from the various continuing dangers e.g., fire, explosion etc. The place should be barricaded with rope and do not allow outsiders inside the covered area.

The dead bodies should be located, photographed in situ and tagged with a number. Sketch the plan of disaster site showing main spot of destruction and exact position of bodies.

If bodies are mutilated, separate them by matching dismembered parts. Make sure that things belong to one body should not mixed to others. Place individual body in a suitable container preferably in a transparent polythene sheet & transfer them in the mortuary for medico-legal autopsy.

A temporary media room should be started close to the site of disaster for news regarding the victims injured/dead for relatives and to the press and these information should be flashed at regular intervals. An arrangement for counseling of relatives of the victims should also be started at the site and if not feasible, it should be near the mortuary.

Second Phase (In the Mortuary):

Problem arises in keeping large number of dead bodies and in conducting post-mortem examination especially in major disasters. It is better to assign a building of suitable size as temporary mortuary and if feasible, arrange refrigerated cooling chambers.

For early disposal, a number of autopsy booths can be made temporarily in a hall so more post mortems can be conducted at a time.

The arrangements of embalming and casketing room for interviewing relatives and viewing bodies should also be made in the mortuary.

Post-mortem Examination:

Identification of deceased is the first and foremost objective of investigation of mass disaster. The dead body, in India, is usually identified by police with the help of local people/relatives present at the site of accident or in the mortuary. If body is mutilated, arrange all the pieces of packet in anatomical position and look for any duplication or misfit of the part /organ and photograph them. In unknown cases, all attempts should be made to record fingerprints of all the ten fingers before medico-legal autopsy.

Clothing, Jewelry & Other Personal Belongings should be removed from the body, examined for brand, size, color & design, laundry mark, tear and stains; photographed them, make a bundle and handed over to accompanying police constable for future identification. Stains if present should be collected and send to FSL for investigation.

External Examination:

If the dead body is not identified, features helpful in establishing identity such as sex, probable age, stature, weight, complexion & features, length & color of hair, color of eyes; moles, birth mark, tattoos, scars, occupational mark, habit, congenital or acquired abnormalities such as super-numeric fingers or toes, cleft lip &/or palate, amputation, polio, diseases etc. and noted in the post-mortem report.

All the injuries should be examined to find out the cause of death and cause of the disaster. If there is any bullet or splinters in the wound, it should be collected, preserved and sent them to FSL for investigation.

Ideally, complete radiological examination should be done for each victim to find out any clue for new/old bony injuries or

sabotage. Radiographs are also helpful in identification in case of extremely burnt body and in revealing the presence of articles embedded deeply in charred muscle that may be overlooked otherwise.

If identification of victims is established and bodies are not contributing in any way in the reconstruction of the accident, only external examination is sufficient.

Internal Examination:

No post-mortem is complete without internal examination. It not only helps to find out cause of death and in collection of organs and tissue for histological, bio-chemical and toxicological analysis but also in collection of evidences relevant to identification such as preexisting disease, surgical absence of internal organs, presence of postsurgical states like gastroenterostomy etc. All the details of post mortem are recorded on the prescribed format.

Dental Examination:

At the end of the autopsy, jaws and teeth are examined to collect dental evidences.

Being one of the hardest substance teeth are very helpful in establishing identity of unknown victims of mass disaster especially when other parameters of identification such as stature, finger prints, clothing and personal belongings etc. are damaged due to fire, explosion, corrosives etc. or in advanced decomposition. [4]

In mass disaster identification of the victims from teeth can be established either by [5]:

1. Comparative dental identification or
2. Reconstructive postmortem dental profiling

1. **Comparative Identification:**

When dental records such as dental chart, model, radiograph & photograph of suspected/ missing person is available with his/her dentist, dental characteristics of the deceased is collected from the remains & matched with the ante mortem dental records in comparative identification. To facilitate dental examination, bilateral incision is made from upper anterior neck to the back of the ears.

The skin and underlying tissues are then reflected upward over the face to expose the mandible and maxilla. The teeth are brushed to clean and photographs are taken, one from frontal view of anterior teeth, and two occlusal views of the upper and lower jaws.

The peculiarities of teeth are inspected in both upper and lower jaws. All the teeth are examined individually for size, shape, color & stains, diseases & treatment such as caries, cavity, filling, RCT, fracture, crown, bridge, implant, artificial denture etc. and developmental

anomalies like impacted or un-erupted third molar, retained deciduous teeth and super-numeric cusps/teeth. (Fig. 1)

Jaws are also looked for its size & shape, protrusion or reversion; teeth are crowded or widely spaced and missing of teeth.

If any tooth is missing, note down their number and situation; approximate time of missing, recent or old; ante mortem or postmortem and cause of missing, trauma, extraction or natural fall etc. should also be noted. Artificial denture, if present, looked for full or partial; upper, lower or both; base, material, technical mark and presence of any personal dental identifier or encoded information chip. All the characteristics are recorded on dental chart using International Dental Charting System.

Fig. a: Dental Charting
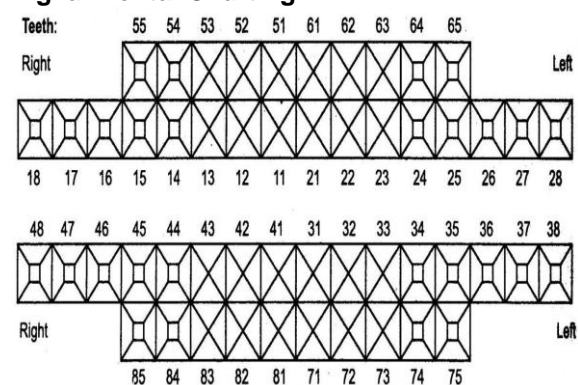
X-ray of both jaws & teeth are taken and information revealed by these radiographs is further added in the chart. Numerous Disaster Victim Identification (DVI) protocols such as US Department of Health & Human Services (DMORT), National Crime Information Center USA (NSIC data collection entry guide) are available to record ante-mortem and postmortem dental records.

Australian Police and Interpol have prepared colored (pink, yellow & white) Disaster Victim Identification (DVI) forms. [6] (Fig. 2) Pink DVI form is for the post mortem records of victims of mass disaster and yellow form for ante mortem record when he was living.

All the data collected from autopsy are recorded in pink DVI form.

Reconstructive PM Dental Profiling:

When ante-mortem dental records of deceased are not available, the person can be segregated from the population on the basis of post mortem dental profiling i.e. information of age, sex, race & geographical distribution, socioeconomic status occupation, habits etc. from the teeth. This is more helpful when victim has to identify in a group of known persons as in

house fires; rail or aircraft accidents etc. from the list of person/ passengers.

Age of the victim is usually accessed by eruption of teeth and calcification of root. But, by this method, age can be estimated only up to 25 years. Age, in older person, can be estimated by patho-physiological changes in teeth such as attrition, secondary dentine formation, incremental lines, root transparency etc. in ground sectioning of teeth. [7-10]

Age can be also estimated by racemization of Aspartic acid from human dentin [11] and radioactive C14. [12]

Sex can be determined by Barr bodies in pulp tissue, Devidson bodies in polymorphs and Y chromosomes. DNA examination of pulp tissue using PCR analysis of the amelogenin gene is also a reliable method of sex determination.

Race and Continental affiliation can be ascertained from teeth as Carabellic cusp (ranges from a slight groove to a full size cusp on the mesiolingual cusp of the maxillary first molar tooth) (Fig. 3), bilobate chin, undulating mandibular border and deep canine fossae in Europeans; multicusped and multiple premolars, maxillary midline diastemas, straight mandibular border and prognathism in Africans and shovel-shaped incisors (Fig. 4), buccal pits & extension of the enamel below the general contour of the enamel border on the buccal surface of mandibular molars in Asians are commonly present. [13]

As to the socio-economic, poor oral hygiene and/or inferior dental restorative quality indicates low socio-economic status and gold filling of solvent class. Silver or gold color metal crowns on anterior teeth seen in Mexico and Central America, mottled teeth due to dental fluorosis seen in SW Texas, SE New Mexico, Rural United States, China & Africa; Black teeth in Japanese and Southeast Asians, black or brown stains of betel leaf & nut chewing in Indian subcontinent; frequent caries & acidic erosion, tooth fracture & advanced periodontal disease seen in addicts of cocaine, heroin, methadone or methamphetine and unilateral attrition and staining seen in pipe smokers.

Attrition of anterior teeth is seen in traffic police & flute players; notched incisors in carpenters, cobblers, electrician & hairdressers (Fig. 5); blue lines in gum in printers, painters & goldsmiths etc. green, yellow or black stains in metal workers using copper, nickel, tin or iron due to chronic inhalation and phossy jaw in chronic phosphorus poisoning.

Mulberry molars and Huchinson's incisors are seen in congenital syphilis, multiple supernumerary teeth in Cleidocranial dysplasia, endogenous brownish-blue discoloration of dentin in Dentinogenisis imperfect, endogenous brown yellow, white "snowcapped" discoloration of enamel in Amelogenesis imperfect, congenitally missing teeth, peg teeth, sparse hair in Ectodermal dysplasia and endogenous discoloration of the dentin which appears as yellow/brown/green bands in ingestion of tetracycline during tooth formation.

For DNA profiling teeth preferably molars are extracted, place in sterile plastic containers and send to a DNA laboratory.

All these information are recorded on pink DVI form. If skull and photograph of suspected person is available superimposition technique can be used to establish identity.

Third Phase (Comparison of Records and Reconstruction of event):

In certain countries there is a separate team for collection of ante mortem information of victims of disaster and missing person.

They collect the information regarding victim's age, sex, stature, complexion & features, mole, birth mark, tattoos, scar, occupation, habit, clothing, diseases including dental history etc. from their family members and friends just after the incident.

The member of the team especially a dentist contact all the dentists whom the person visited in their lifetimes for treatment and gathers all the radiographs, charts, photographs, notes, and anything generated through the course of their treatment. They also collect a recent photograph of the deceased; fingerprints if available and buccal smears or blood sample of next-of-kin for his/her DNA profiles and all this information are recorded on yellow DVI form.

The comparing ante-mortem records to post-mortem data manually may take weeks to months in major disaster. Now matching is easy & time saving through certain computer software programs. The first dental software program "Computer Assisted Postmortem identification" CAPMI was developed by Lorton, Langley and Weed in 1980 and used by US Military and other agencies in many disasters.

Other computer-assisted applications are WinID3 developed by Dr. James McMivney and widely used in the United States, Plass Data developed by DVI System International and used by INTERPOL and UVIS/UDIM developed by Dr Kenneth Aschheim in consultation with New York City Office of the Chief Medical Examiner in 2007. [13]

These programs narrow down the area of comparison by exclusion method and the final identification is done by a qualified dentist.

If more than 7-8 points of deceased matched exactly with ante mortem dental records of a missing person, the identity can be established with certainty. In India no such programs are used and all the information related to dental examination is also recorded in postmortem report and matched with ante mortem records if available.

Record Keeping:

Although computers can be used to maintain the files and records of victims of mass disaster and to track human remains, there must also be a paper trail in which the data and information are taken from and put into a data management system.

All files and records, both ante-mortem and postmortem, become the property of the investigatory agency after the incident. These records are important because in some situations individuals are being identified by DNA and it will take days, months, or years before all of samples are identified. All records and files should be handled properly, and the chain of custody should be followed on all reports, photographs, and specimens.

Conclusion:

Teeth are the hardest substance in the body and no two sets of teeth are exactly alike. When other organs and identifying features such as stature, finger prints, clothing and personal belongings etc. are destroyed due to advanced decomposition, mutilation, fire, explosion or by corrosives, teeth are well preserved. That's why teeth are an important tool for establishing identification especially in mass disaster.

The services of dentists are now used in large number of countries in investigation of mass disaster but not in India and developing world. For better results, it is advised that the dentists must preserve dental records of their patients and make them available to investigation agencies for identification purposes. The services of dentist should be taken in investigation of mass disaster or doctors should be trained in collection and charting of dental evidences and in matching with ante mortem dental records.

References:

1. **Dave PK, Gupta S, Parmar NK, Kant S.** Emergency Medical Services & Disaster Management A Holistic Approach. 1st edition. New Delhi: Jaypee brothers Medical Publishers (P) Ltd; 2001. 252.
2. **Saukko P and Knight B.** Knight's Forensic pathology. 3rd edition. Boca Ratan London New York: CRC Press; 2013. 42
3. **Aggrawal Anil.** Essentials of Forensic Medicine and Toxicology. 1st ed. Sirmour (HP): Avichal Publishing Company; 2014. 84.
4. **Pretty IA & Sweet D.** A Look at Forensic Dentistry–Part 1: The Role of Teeth in Determination of Human Identity. Br Dent J. 2001; 190(7): 359-366.
5. **Masthan KMK.** Textbook of Forensic Odontology.1st Ed. New Delhi: Jaypee Brothers Medical Publishers (P) LTD; 2009. 13-17.
6. **Michael C Bowers.** Forensic Dental Evidences. 2nd ed. Amsterdam Boston Tokyo: Elsevier Academic Press; 2011. 213, 242.
7. **Dalitz GD.** Age determination of adult human remains by teeth examination. Forensic Science Soc. 1962; 3: 11–21.
8. **Johanson G.** Age determination from human teeth: A critical evaluation with special consideration of changes after fourteen years of age. Odontologisk Revy, 1971; 22: 1-126.
9. **Maples WR.** An improved technique using dental histology for estimation of adult age. Jl Forensic Sciences, 1978; 23(4): 764 –70.
10. **Lamendin H. et al.** A simple technique for age estimation in adult corpses: The two criteria dental method. J. Forensic Sciences, 1992; 37(5): 1373-1379.
11. **Ohtani S, Yamamoto T.** Age estimation by amino acid racemization in human teeth. J. Forensic Sciences, 2010; 55 (6): 1630-1633.
12. **Ubelaker DH, Parra RC.** Radiocarbon analysis of dental enamel and bone to evaluate date of birth and death: Perspective from the southern hemisphere. Forensic Science International, 2010; 208 (1-3): 103 –107.
13. **David R Senn, Richard A Weems.** Manual of Forensic Odontology. Vth ed. Boca Ratan London New York: CRC Press; 2013. 81-189.

Fig. 1: Super-numeric Cusps in Molar

Fig. 3: Carabellic Cusp in Maxillary Molar

Fig. 4: Shovel-shaped Incisors

Fig. 5: Notched Incisors

Fig. 2: Disaster Victim Identification (DVI) Forms