

### **Prosthodontist - A Proficient Hand in Mass Disaster Management**

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#### **Abstract**

Disasters are inevitable conditions and causes loss of life and property. Most of the lives which are lost in the event of disaster remain unidentified as because of extensive soft tissue destruction it is impossible to identify deceased by visual identification. Dental surgeon plays a vital role in individual identification in the event of disaster. There is lack of proper information regarding role and importance of forensic odontology in individual identification. This article provides review on latest methods and techniques used for individual identification.

**Keywords :** Disaster, Ante mortem Records, Post mortem Records, Victim identification, Forensic Odontology

#### **Introduction**

As we all are living in a advanced era, which is full of new inventions and technologies around us. These technologies were made to help us and they are doing indeed but technology alone is not sufficient for complex things to do, man intervention along with technology is must.

Almost every day, newspapers, radio and television channels carry reports on disaster striking several parts of the world causing destruction and damage to human life , environment and property and leaving large areas full of chaos, dead lives and a thought in mind, what to do now ?. But what is a disaster? The term disaster owes its origin to the French word “Desastre” which means ‘Bad or Evil star’. According to UNDHA 2001, a disaster can be defined as a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of affected society to cope on its own resources. Disasters can be natural or manmade, natural, accidental or deliberate. Mass disaster causes trauma, loss of life and devastation. Such types of trauma may sometimes make visual identification of the deceased impossible due to extensive soft tissue destruction and role of dental surgeon comes in to play.

In recent times, forensic odontology has evolved as a new ray of hope in assisting forensic medicine in individual identification. The advantage of dental identification is that the teeth are the hardest and most resistant tissues in the body and can survive total decomposition and even severe fire.

**Discussion**

But the main question arises why we need to identify human remains in the event of such disasters. Individual identification is important and required for underlying reasons. Dental identification of humans occurs for a number of different reasons and in number of different situations (Table 1)[1]

s.no.		Common reasons for identification of found human remains
1.	Criminal	Typically an investigation to a criminal death cannot begin until the victim has been positively identified
2.	Marriage	Individuals from many religious backgrounds cannot remarry unless their partners are confirmed deceased
3.	Monetary	The payment of pensions, life assurance and other benefits relies upon positive confirmation of death
4.	Burial	Many religions require that a positive identification be made prior to burial in geographical sites
5.	Social	Society's duty to preserve human rights and dignity beyond life begins with the basic premise of an identity
6.	Closure	The identification of individuals missing for prolonged periods can bring sorrowful relief to family members

Table 1 : Need Of Dental Identification

**Methods of Dental Identification**

Following are the commonly used methods of dental identification in the event of mass disaster:

1. Comparative dental identification
2. Post mortem dental profiling
3. Other methods :
  - a. Rugoscopy
  - b. Cheiloscopy
  - c. Dental biometrics
  - d. DNA in dental identification
  - e. Reconstructive identification /dental profiling
  - f. Bite mark analysis
  - g. Prosthodontic aspect of identification

**Comparative Dental Identification**

Ante Mortem records

Ante mortem records are very crucial and important records for individual identification during mass disaster. These ante mortem records can be compared with the post-mortem dental remains for the final conclusion about the deceased individual .These ante mortem records includes a) Written notes of dentition b) Study casts c) Radiographs. Following a methodical and systematic comparison of the ante-mortem and post-mortem records of each tooth and surrounding structures such as bony prominences and congenital defects followed by dental restorations, similarities and discrepancies are noted. [1-3] The sources for ante-mortem records are a) Local agencies b) State agencies c) Federal agencies d) International resources e) Insurance carriers f) Other sources.[4]

Similarities and discrepancies should be noted during the comparison process. There are two types of discrepancy, those that can be explained and those that cannot. Explainable discrepancies normally relate to the time elapsed between the ante mortem and post mortem records. Examples include teeth extracted or restorations placed or enlarged. If a discrepancy is unexplainable, for

example a tooth is not present on ante mortem record but is present on the post mortem record then exclusion must be made. [1] Irrespective of the method used to identify a person, the results of comparison of ante-mortem and post-mortem data lead to 1 of these 4 situations [4]:

1. **Positive identification** : the ante-mortem and post-mortem match in details with no unexplainable discrepancies.
2. **Possible identification** : the ante-mortem and post-mortem have consistent features but due to poor quality , identity cannot be positively established.
3. **Insufficient evidence** : available information is insufficient to form basis for a conclusion.
4. **Exclusion** : the ante-mortem and post-mortem are clearly inconsistent.

It is important to note that there is no minimum number of concordant points or features that are required for a positive identification. In many cases a single tooth can be used for identification if it contains sufficient unique features. Equally, a full mouth series of radiographs may not reveal sufficient details to render a positive conclusion.[1]

### Dental Features To Be Examined During The Comparative Dental Identification

Dental features which are evaluated during the process of comparative dental identification are (Table 2):[1]

S.no.	Features	Finding
1	Teeth present	Erupted, Unerupted, Impacted
2	Missing teeth	Congenitally, Lost antemortem, Lost post-mortem
3	Tooth type	Permanent, Deciduous, Mixed, Retained primary, Supernumerary
4	Tooth position	Malposition

5	Crown morphology	Size and shape, Enamel thickness, Contact points, Racial variations
6	Crown pathology	Caries, Attrition, abrasion, erosion, Atypical variations, enamel pearls, peg laterals etc., Dentigerous cyst
7	Root morphology	Size, Shape, Number, Divergence of roots
8	Root morphology	Dilaceration, Root fracture, Hypercementosis, Root resorption, Root hemisections
9	Pulp chamber/root canal morphology	size, shape and number, Secondary dentine
10	Pulp chamber/root canal pathology	Pulp stones, dystrophic calcification, Root canal therapy, Retrofills, Apicectomy
11	Periapical pathology	Abscess, granuloma or cysts, Cementomas, Condensing osteitis
12	Dental restorations	1. Metallic- amalgam gold, implants, gold , metal crowns, pins, fixed prosthesis 2. Non-metallic – tooth colored materials, acrylics, silicates, composites 3. Bridges, Partial and full removable prosthesis
13	Gingival morphology and pathology	a. Contour, recession, focal/diffuse, enlargements, interproximal craters

		b. Colour – inflammatory changes, physiological (racial) or pathological pigmentations c. Plaque and calculus deposits
14	Periodontal ligament morphology and pathology	Thickness, Widening, Lateral periodontal cysts and Similar
15	Alveolar process and lamina dura	Height, contour, density of crestal bone, Thickness of interradicular bone, Exostoses, tori, Pattern of lamina dura, Bone loss (horizontal/vertical), Trabecular bone pattern and bone islands, Residual root fragments
16	Maxillary sinus	Size, shape, cysts, Foreign bodies, fistula, Relationship to teeth
17	Anterior nasal spine	Incisive canal (size, shape, cyst), Median palatal suture
18	Mandibular canal	Mental foramen, Diameter, anomalous, Relationship to adjacent Structures
19	Coronoid and condylar processes	Size and shape, Pathology
20	Temperomandibular joint	Size, shape, Hypertrophy/atrophy, Ankylosis, fracture, Arthritic changes
21	Other pathologies	Developmental cysts,

		Salivary gland pathology, Reactive/neoplastic, Metabolic bone disease, Focal or diffuse radiopacities, Evidence of surgery, Trauma – wires, surgical pins etc.
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Table 2: Dental features for comparative dental identification

### Post Mortem Dental Profiling

In post mortem dental profiling, the dental officer try to locate the population pool to which the deceased is likely to belong which further increases the possibility of locating ante mortem records when such records and other methods of identification are unavailable[1,4].

The post mortem dental profiling helps in getting important informations regarding the deceased such as age , sex, socioeconomic status , dietary habits , systemic and dental diseases , habitual behaviour etc.[1]

i) **Ancestry** : generally , from the skull appearance, forensic dentists can determine race between the three major groups [1]:

- a) Caucasoid
- b) Mongloid
- c) Negroid

Additional characteristics such as cusps of Carabelli, shovel shaped incisors and multi cusped premolars, can also assist in determination of ancestry.

ii) **Sex** : Cranial appearance is more evident in sex identification as tooth morphology is least informative in sex identification. However , microscopic examination of teeth can confirm sex by presence and absence of Y chromatin[1].

iii) **Age** : Dental structures can provide useful indicators to the individual’s chronological age. With the analysis of dental status & subsequent comparision with

standard developmental charts chronological age can be identified. Conclusions are usually accurate to approximate  $\pm$  1.5 yrs. However eruption dates are variable & actual developmental stage are more accurate in case of sub-adults[1].

Those who advocate third molar development to assign age claim an accuracy of  $\pm$  4 yrs as variability in eruption pattern of these teeth[1].

As compared to child, adults have more periodontal diseases, restorations, bone pathology & extractions.

Tooth wear pattern also differ in child, youth, & adults. Although this wear is undoubtedly due to combination of erosion, abrasion & attrition but erosion is the major factor in child & young[1,5].

Some odontologists advocate use of aspartic acid racemisation, claiming an accuracy of  $\pm$  4 yrs. Additional methods includes the use of SEM-EDXA, a method used to examine dentine in relation to age determination[1].

The conclusion on the age of the individual can also be drawn by using charts such as those developed by Ubelaker which graphically give an illustration of the dentition (deciduous, mixed or permanent) right from the age of around 05 months in utero to 35 yrs after birth.

iv) **Occupation & Habits** : the occupation & habits of the deceased can be identified by different wear pattern and stains resulting from smoking, hair pins, previous orthodontic treatment, cigarette holders, betel nut chewing etc.

v) **Socioeconomic status** : the quality, quantity and presence or absence of dental treatment may give an indication of socioeconomic status or likely country of residence[1-3].

### **Rugoscopy**

The study of the patterns of the grooves & ridges (rugae) of the palate to identify individual patterns is called as rugoscopy. Rugae pattern are considered unique to an

individual same as of fingerprints & can be used as reliable method in post mortem cases. Palatal rugae comprise about 3 to 7 ridges radiating out tangentially from incisive papilla.

Lysell measured rugae in a straight line from medial to lateral and categorized as[6]

- a) Primary rugae :  $>$ 5 mm
- b) Secondary rugae : 3-5 mm
- c) Fragmentary rugae : 2-3 mm

Rugae less than 2mm are not taken in to consideration.

### **Cheiloscopy**

Lip prints are normal lines & fissures in the form of wrinkles and grooves present in the zone of transition of human lip, between the inner labia mucosa and outer skin, examination of which is known as cheiloscopy[7,8]. Same as of rugae pattern & finger prints, lip prints are also particular individual hence plays a vital role in individual identification.

Suzuki and Tsuchihashi, in 1970 classified lip prints as follows [8,9]:

- Type I : a clear cut groove running vertically across the lip.
- Type II : Partial-length groove of Type I.
- Type III : A branched groove.
- Type IV : An intersected groove.
- Type V : A reticular pattern.
- Type VI : Other patterns.

### **Reconstructive Identification / Dental Profiling**

In this method facial reconstruction of an individual is being done from its skeletal remains with the help of anthropology, anatomy, osteology & forensic science. It includes 2 techniques :[10-13]

- 2-D facial reconstruction :

It is a commonly used methods of 2-D reconstruction. It was pioneered by Karen T.Taylor of Austin, Texas during

1980s. This technique includes the use of ante mortem photograph & photograph of skull.

- 3-D facial reconstruction :

Three dimensional facial reconstructions are either

- a) Sculptures : created with modelling clay and other materials.
- b) High resolution, three dimensional computer images.

**Prosthodontic Aspect Of Individual Identification** :[14]

Labelling of prostheses and orthodontic appliances is an innovative concept in the individual identification especially in mass disasters. It serves to identify unknown denture wearers in cases involving amnesia or senility, homicide, suicide, explosion, floods, victims of fire. Acrylic resin appliance can be marked easily during its fabrication with full name of recipient over paper/metal incorporated in it. The methods commonly used for denture marking are a) Surface marking b) Lenticular cards c) Bar Coding d) Engraving e) Microchips.

Surface marking involved labelling prosthesis with personal details of the patient such as name, age, sex or identification / registration number printed on a paper or engraved on the surface of denture. Labelling is done usually on the palatal aspect of maxillary denture and distolingual aspect of lower denture by creating a depression of 1mm. The label is placed in the depression and covering it by clear autopolymerising acrylic resin (Fig no 1).[15,16]

Denture marking by using lenticular cards is similar to surface marking. In this two or more images were engraved over the denture surface covered with lenticular lens. This is a multi step process in which different images were interlaced with the help of a software and printed which can be viewed in different planes by a lenticular lens (Fig no 2).[17]

Bar code can also be incorporated on the palatal aspect of the upper denture (Fig no 3). Bar code contains plenty of

information which needs to be scanned by a bar code scanner. But the main limitation lies with the opacity of acrylic used which impede with the scanning of bar code. Therefore a layer of clear acrylic was suggested over it.[18]

Microchip is another new method of denture identification. It works on the principle of radio frequency identification (RFID), which was commonly used in the hospital set up for patient identification. It consists of a tag which is a data carrier and a receiver with an antenna. The patient information is added to the tag which was embedded in to denture acrylic (Fig no 4). The patient information can be retrieved by scanning of microchip using a receiver.[19]

Engraving is another method of denture marking which will be helpful in victim identification. In this method patient details are either engraved over the surface of the patient denture or casted along with the framework in case of cast partial denture (Fig no 5). Various other methods are also described in denture marking but those are the modifications of above explained methods.

**Role of Dental Implants In Victim Identification**

Now days, dental implants were used in the daily clinical practice. Being a metallic substance implants are resistant to extreme temperatures and can withstand high temperatures without distortion in the event of mass disaster. So implants can be predictable tool in victim identification. Berketa et al has conducted a study to check the effect of cremation on the dental implants in the mandible of sheep. They recorded the batch no of implant by photographs and implants were placed surgically in the mandible of sheep. After placement, the sheep head was cremated in a cremator. After cremation, implants were retrieved and batch no of implants were again noted down. No effect on the surface of dental implant was found in

the study which can be used for the purpose of victim identification.[20]

#### **Role of DNA In Dental Identification:**[9]

Recent advanced scientific studies supported by National Institute of Dental Research shows the major protein found in human enamel (amelogenin, or AMEL) has a slightly different signature (or size and pattern of the nucleotide sequence) in male and female enamel. The AMEL gene that encodes for female amelogenin is located on the X chromosome and the AMEL gene that encodes for the male amelogenin is located on the Y chromosome. Hence female has two identical AMEL genes, whereas male has two different AMEL genes.

Small amounts of DNA are relatively well preserved in fossils, buried mummies and various remnants of human dental and skeletal tissues. Such small amounts of DNA can be amplified by the help of “polymerase chain reaction” or PCR. The other source of DNA used for identification purposes is Mitochondrial DNA or mtDNA and is present in high-copy number in all cells. It survives for prolonged periods, compared to chromosomal DNA. MtDNA is very useful for forensic identification, as it is inherited only from the maternal line and is best way to test relatedness if there are several generations between ancestor and living descendants.

#### **Conclusion**

Dental surgeon plays a vital role in providing dental cover to the troops and families deployed in the field, peace, and high altitude areas. Apart from providing dental cover, dental surgeons can help medical officer in individual identification during mass disasters and bioterrorism, when identification by visual or any other methods like finger printing fails.

Now a day, terrorism, floods, earth quakes, landslides, tsunami etc. are frequent from time to time causing damage to troops, families and property. In recent times,

forensic odontology has evolved as a new ray of hope in assisting forensic medicine. Dental identification of a person is based on the unique dental characteristics such as ante mortem, post mortem records, rugoscopy, cheiloscopy, facial reconstruction technique, denture markings. Some dental restorations also help in individual identification which can withstand harsh environmental extremes such as conditions of temperature and violent physical forces.

Dental identification depends largely on the availability of ante- mortem records. So an attempt should be made to reinforce awareness among dental surgeon about the role of dental surgeon in person identification and to awaken the social responsibility of maintaining dental records of all patients. This is very essential for identification of individuals in the event of any disaster.

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### Legends of Figure



Figure 1: Surface marking



Figure 2 : Lenticular card marking



Figure 3: Bar Code incorporated in to denture



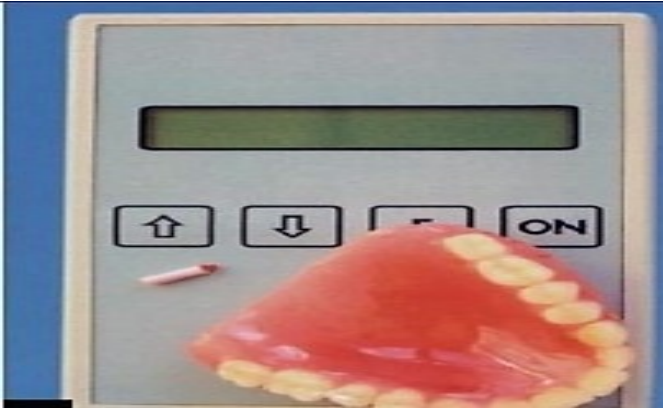


Figure 4: RFID technique



Figure 5 : Engraving of partial denture framework