

## Role of Dentists in Manmade disasters: A Review

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### Abstract

It is true that we have landed up in a very sophisticated and modernised era where the technology has outraged or excelled in every walk of life. But still, we are facing many new challenges especially in putting up a halt for the ever growing crime rates. Forensic dentistry proves out to be the major ray of hope where the conventional means of identification goes in vain. Forensic dental identifications, especially in times of manmade disasters, depend mainly on the availability of ante mortem dental records so it is the social responsibility of each and every dentist to maintain dental records of their patients for the noble cause of identification in the event of manmade disasters.

**Keywords:** Manmade disaster; Comparative identification; Reconstructive identification; Cheiloscopy; Denture marking systems; Rugae pattern.

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### Introduction

The disasters are the worst happenings and one of the least anticipated events. They shatter the lives of the victims. Disasters are of two types namely natural and manmade disasters. It is quite evident from the recent catastrophic events that the manmade disasters have overwhelmed the naturally occurring disasters. When conventional means of identifications (facial forms & finger prints) fail; dentition enters the scene as it can sustain very high temperatures. The professional obligation of us being the dentists is just not only to rehabilitate the patients that we come across with but it's our basic duty to be a part and parcel of maintenance of law and order in the community.

#### Basic role of Dentists in the identification of victims and suspects:-

In the year 66 A.D, Nero's mistress Sabina got his wife killed by her soldiers and she recognized her body by a black anterior tooth<sup>1</sup>. Forensic odontology may have been born at the Battle of Nancy in 1477 wherein the body

of Charles Bold has been identified by dental means<sup>2</sup>. The countess of Salisbury was burnt at Hatfield house in 1835. The body was charred beyond recognition by visual means. She was identified by her gold denture<sup>1, 2</sup>.

Paul Revere identified his friend's dead body by the ivory work which he had done for his friend when alive (first case of identification by a dentist)<sup>1</sup>. M. Raja Jayachandra Rathore's body has been identified by his false anterior teeth in the year 1995<sup>1</sup>. This was probably the first case of identification using dentition from India. Dr. Parkman's dentist, Dr. Nathan C Keep played a significant role in identifying Dr. Parkman's mutilated dead body in the year 1894. This was the first dental identification accepted by law<sup>1</sup>. DNA extracts from tooth brushes of the victims were used in identification of victims in WTC disaster in U.S in September 11, 2001. According to (CNN NEWS) dental identification was used to confirm the identities of the bodies of Saddam Hussain's two sons. Dental identification of Tsunami<sup>3</sup> victims in Thailand accounts for up to 80%. Scandinavia star ferry disaster, in 1990, the forensic odontologist identified 107 cases out of 158 victims<sup>3</sup>.

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### *Dental Identification Procedures*

#### Comparative identification

- a) Bite mark analysis
- b) Lip prints and
- c) Radiographic analysis.

#### Reconstructive identification

- a) 2D profiling and
- b) 3D profiling.

#### Other techniques

- a) Denture marking
- b) Rugae pattern

### *Comparative identification<sup>4, 5</sup>*

Attempts conclusive identification by comparing the dead individual's teeth with presumed dental records of the individual. Comparative method of dental identification involves establishment to the highest degree of certainty that the remains of the decedent at the site of mishap or death and details in the ante mortem dental records are of the same individual to confirm identity of the individual. The similarities and discrepancies should be carefully noted at the time of comparison of the records. The discrepancies are of two types – explainable and unexplainable.<sup>1,5</sup> Explainable discrepancies are the ones for which an explanation can be reasonably accepted. Eg: -A tooth noted to be present in the ante mortem records which is missing in the post mortem records. Unexplainable discrepancies are the ones for which the explanation cannot be provided and hence need to be excluded. Eg:- A permanent tooth recorded to be extracted in the ante mortem finding to be present in the post mortem record. The manual of American Society of Forensic Odontology (ASFO)<sup>1</sup> and the guidelines for body identification by American Board of Forensic Odontology (ABFO) provides numerous additional features to be looked for in the identification process.

### *Range of conclusions that can be drawn<sup>4, 5</sup>*

1. Positive identification: When the ante mortem and post mortem findings match in sufficient details, without any unexplainable discrepancy.

2. Possible identification: Here ante mortem findings may be consistent with post mortem findings, but a positive identification with certainty may not be established owing to the poor quality of either the post mortem remains or ante mortem dental records.

3. Insufficient evidence: Information in the ante mortem and post mortem dental records are insufficient to draw a conclusion of any sort.

4. Exclusion: The findings in the ante mortem and post mortem dental records are clearly inconsistent with respect to many features

### *Reconstructive identification or Dental Profiling<sup>4, 5</sup>*

Attempts to elicit the ethnicity or race, gender, age, and occupation of the dead individual. This is undertaken when virtually no clue exists about the identity of the deceased. The identity of the race and sex to some extent can be made by careful examination of the skull for its shape and form. These features of the skull may enable a forensic dentist put the individual into one among the three major racial groups Negroid, Mongoloid or Caucasoid. Along with shape and form of the skull, other features like cusps of Carrabelle, Shovel shaped incisors, multi cusped premolars, talon's cusp, taurodonts etc. may assist in determination of the race. Sex determination is made most of the times with thorough examination of the skull as the sex differences in the morphology of the teeth are not very significant. The microscopic examination of teeth for the presence or absence of Y-chromatin and DNA analysis can reveal the sex with certainty.

### *Other methods of dental identification<sup>5</sup>*

The two processes described above, comparative identification and post-mortem profiling, represent the most common methods of dental identification. However, in some instances more novel and innovative techniques have been applied. There have been a number of requests from individuals and dental organizations over the years to insist that dental prostheses are labelled with the patient's name or a unique number. Labelled dentures can be of great assistance.

Unlabelled dentures<sup>5</sup> have been recovered from patients and then fitted to casts retained by the treating dentist or laboratory, and this has been an accepted method of identification. Other dental appliances, such as removable orthodontic braces have also been used for identification purposes. Whittaker describes a case where a removable orthodontic appliance was used to identify a victim of a house fire. Authors have also described the use of palatal rugae<sup>4,5</sup> patterns rendered on dental casts to compare with found remains. Positive identifications have resulted from this technique useful in edentulous persons. Rugae patterns like teeth are considered unique to an individual. Rugae patterns on the decedent's maxilla or maxillary dentures may be compared to old dentures that may be recovered from the decedent's residence or plaster model from dental office.

### *Classification of Palatal Rugae<sup>4</sup>*

Lysell measured rugae in a straight line from medial to lateral and categorized as Primary rugae (>5mm), Secondary rugae (3-5mm), Fragmentary rugae (2-3mm). (Rugae <2mm is not taken in to consideration). Thomas & Kotze have further detailed various patterns of primary rugae - branched, unified, cross linked, annular & papillary.

Analysis of Rugae patterns<sup>4</sup>: Thomas and Van Wyk have manually traced rugae pattern on photographs of plaster model. Recently Limson and Julian have developed a computer soft ware program, '*rugfp-id match*' (same principle of finger printing). So the above

mentioned identification procedures are the basis for the identification of victims in manmade disasters. Discussion of comparative and reconstructive identification procedures in detail is important for the dentist to have a better idea.

### *Comparative identification*

#### *a) Bite mark analysis<sup>6</sup>*

Bite marks have been defined by MacDonald "a mark caused by the teeth either alone or in combination with other mouth parts". Biting is considered to be a primitive type of assault and result when teeth are employed as a weapon in an act of dominance or desperation. Bite marks can be caused by humans or animals; they may be on tissue, food items, or other objects.

MacDonald<sup>4</sup> Etiologic classification pertinent to human bite marks by

#### *Tooth pressure marks*

Direct application of pressure by teeth.

#### *Tongue pressure marks*

Combination of sucking and tongue thrusting involved.

#### *Tooth scrape marks*

Anterior teeth, and present as scratches or superficial abrasions.

#### *Bite Mark Appearance<sup>4</sup>*

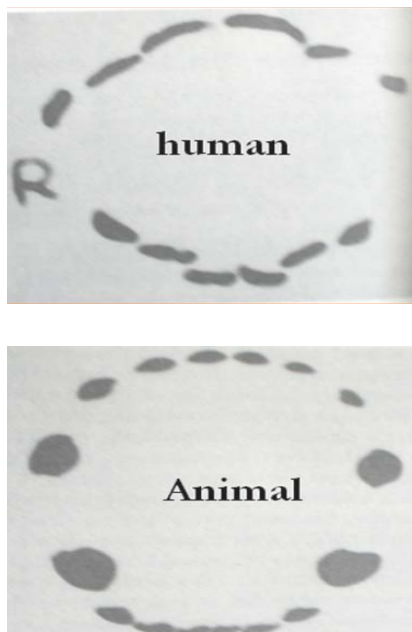
Compression of the skin surface due to tooth pressure during a bite causes indentations initially. Indentations, while ideal for bite mark analysis, seldom persist for more than a few minutes unless the victim is dead. Owing to the elastic nature of skin, indentations soon disappear as the skin regains its original contour. This is followed by a brief period of edema over the bite area, which usually obscures the bite mark completely. Once the

edema subsides, subcutaneous bleeding is apparent. These are referred to as contusions or bruises, and are the most common presentation of bite marks in criminal investigations. They appear as reddish/purplish discolorations on the skin surface, a result of blood escaping into the subcutaneous tissue from ruptured vessels. When the intensity of the bite is great, there may be a break in the integrity of skin surface, resulting in lacerations. The most extreme form of bite mark injury is avulsion, where part of the tissue is bitten off.

**Table 1. Notifies the significant difference between human and animal bite mark**

Human	Animal
Human bite marks is broad, U shaped and somewhat circular or oval	Bite mark of the animal is narrow in anterior aspect and is V shaped and deep
Human bite marks have broad central and relatively narrow lateral incisors and are blunt despicul	Bite marks caused by animal's exhibit broad lateral, narrow central and sharp
Present on breast, abdomen, nipple, thigh, back and stockings in case of sexual assault and life extremities in fight and violence	Present on exposed skin surfaces and extremities

**Fig 1a. and 1b. Difference between human and animal bite marks**



*b) Lip Prints (Cheiloscopy)* <sup>4, 7</sup>

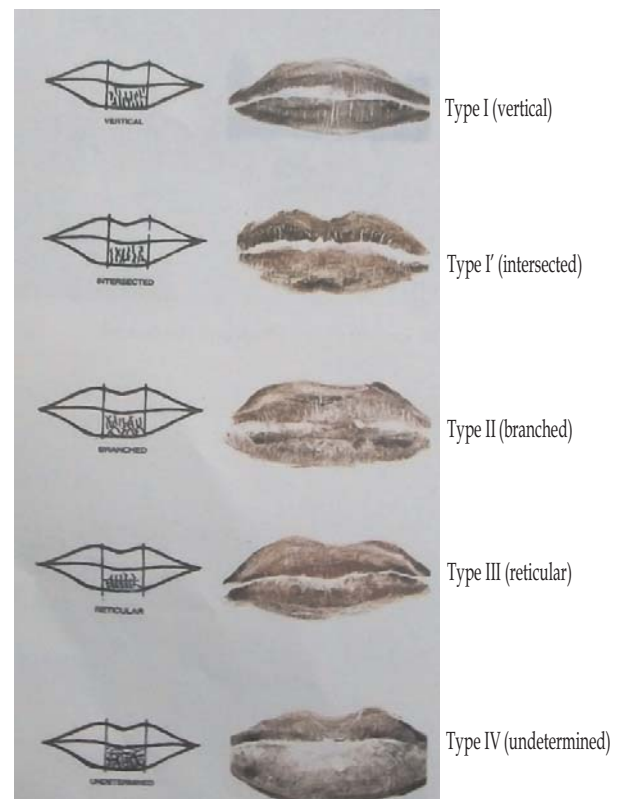
Tsuchihashi named the wrinkles and grooves visible on the lips as 'sulci labiorum rubrorum'. Type I, I' and II patterns dominant in females. Type III and IV present in males. A combination of these grooves may be found in any given set of lips. Lip prints are usually left at crime scenes, and can provide a direct link to the suspect. In recent years lipsticks have been developed that do not leave any

visible trace after contact with surfaces such as glass, clothing, cutlery, or cigarette butts. Alvarez and associates have drawn attention to these prints, which are characterized by their permanence and are, therefore, referred to as 'persistent' lip prints. Although invisible, these prints can be 'lifted' using materials such as aluminum powder and magnetic powder. Ball states that the vermilion border has minor salivary glands, and the edges of the lips have sebaceous glands, with sweat glands in between. One may, therefore, assume that secretions of oil and moisture from these enable development of 'latent' lip prints, analogous to latent fingerprints, in most crime scenes where close contact between the victim and culprit has occurred. However, a major disadvantage pertains to uncertainty about the permanence of lip patterns.

*c) Radiographic analysis*<sup>5</sup>

The forensic dentist produces the post-mortem record by careful charting and written descriptions of the dental structures and radiographs. If the ante mortem records are

**Fig 2. Various types of lip patterns**



available at this time, post-mortem radiographs should be taken to replicate the type and angle of these. Radiographs should be marked with a rubber dam punch to indicate ante mortem and post mortem to prevent confusion. One hole for ante mortem films and two holes for post mortem films to be placed. Once the post mortem record is complete, a comparison between the two records can be carried out.

### ***Reconstructive identification/Dental profiling***

#### *Facial reconstruction /forensic facial approximation<sup>8</sup>*

Process of recreating the face of an individual (whose identity is often not known) from their skeletal remains through an amalgamation of artistry, forensic science, anthropology, osteology and anatomy.

#### *a) 2-D facial reconstruction<sup>8</sup>*

Two-dimensional facial reconstructions are based on ante mortem photographs, and the skull. Occasionally skull radiographs are used but this is not ideal since many cranial structures are not visible or at the correct scale. A commonly used method of 2D facial reconstruction was pioneered by Karen T. Taylor of Austin, Texas during the 1980s.

#### *b) 3-D facial reconstruction<sup>8</sup>*

Three-dimensional facial reconstructions are either

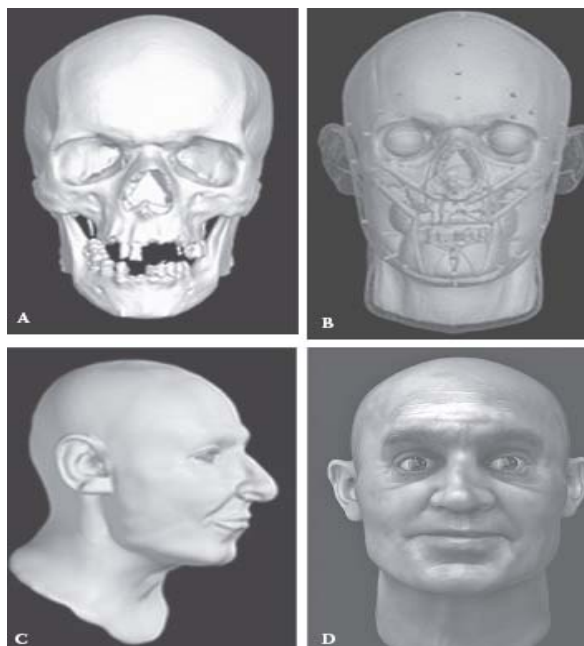
### **Fig 3A, 3B, 3C explains 2-D profiling**



1) Sculptures (made from casts of cranial remains) created with modelling clay and other materials or

2) High-resolution, three-dimensional computer images.

### **Fig 4A, 4B, 4C, 4D. Illustrates 3-D reconstruction**



#### *Other innovative methods of identification-The Prosthodontic Way*

One of the most widely used methods of marking the dentures is the I denture system<sup>2</sup>. Ryan described numerical identification of the state in which prosthesis was made, as well as the dentist's state registration number and patients name and sex<sup>2</sup>. Jerman suggested patient's social security number<sup>2</sup>.

#### *Denture marking systems<sup>2, 3</sup>*

Two principal methods of marking dentures are engraving methods

#### *Inclusion technique*

#### *Engraving methods/surface marking<sup>2, 3</sup>*

It is the simplest way to establish durable identity on metal and acrylic resin. Marking the denture with a bur is the most common method of engraving. Wecker<sup>2</sup> described an

Electro pen which engraves metal partial dentures and crowns. An invisible ink rendered visible by UV light useful on acrylic resin dentures of those patients who object to normally visible identification marks.

Identification marks are scratched, engraved or written on the surface of the denture. Heath<sup>3</sup> (Fig 5) introduced spirit based pen or pencil before covering the ID mark with a clear base polymer dissolved in chloroform. This method has disadvantages such as poor abrasion resistance, unaesthetic, chances of loosing the ID if the denture needs relining and moreover chloroform is a known carcinogen. Later on Heath modified his technique by application of dental sealants instead of chloroform.

Another economic technique introduced by Stevenson<sup>3</sup> (Fig 6) where in a scalpel blade was used to make an ID on the distobuccal flange of the denture the mark was then highlighted with a graphite pencil.

#### *Inclusion technique*

It encloses the ID mark within the denture base material, hence rendering them relatively permanent. Lose<sup>2,3</sup> (Fig 7) described a technique wherein the patients name was typed on a piece of "onion skin" paper and incorporated within the fitting surface of the denture, during the packing procedure.

Young<sup>3</sup> (Fig 8) proposed a post fabrication technique which involves cutting a groove 0.5-1 mm deep into the buccal flange of the denture, the length of which would correspond to the length of the patients name an ordinary ball point pen or felt tip pen was then used to print the patients name in the recess before it was sealed with fissure sealant. Oliver<sup>3,9</sup> (Fig 9) introduced the technique of producing a label comprising a 0.3mm thin strip of heat cure resin. Dippennar<sup>3</sup> (Fig 10) introduced the technique of soft metal band that was either typed or engraved with the patients details which is inserted into the predrilled cavity of 2-3 mm width. Reeson<sup>3,9</sup> (Fig 11) used 0.125 mm thick stainless steel tape and incorporated it in to the fitting surface of the denture during trial packing.

Millet and Jeannin implanted a radiofrequency ID (RFID)<sup>3,10</sup> transponder (Fig 12) into a complete upper denture. This system consists of a data carrier, generally known as a tag or a transponder, and an electronic hand held reader. Tag contains a microchip with a coiled antenna. The reader energises the transponder by means of an electromagnetic field emitted by the readers antenna. It then receives the coded signal returned by the transponder and converts it into readable data. Disadvantage is that it's not fire proof. Jerman introduced the use of a thin 0.0001 inch metal strip of stainless steel known as shim stock<sup>2,3</sup>. It has a melting temperature of 1500<sup>o</sup>c.

Venkat and Shenoy<sup>3</sup> introduced a radiographic technique (Fig 13) wherein a lead foil with the patient's details is sandwiched between two layers of resin during the processing of the denture. It's fire resistant. This method is simple, quick, durable and cosmetically acceptable fulfilling all the requirements of ADA.

**Fig 5. Heath's Method**



**Fig 6. Stevenson's Method**



**Fig 7. Lose Inclusion Method**



**Fig 8. Young's Method****Fig 9. Oliver's Method****Fig 10. Dippennar's Method****Fig 11. Resson's Method****Fig 12. RFID Method****Fig 13. Venkat Nag's Method**

## Conclusion

Dental identification procedures are very useful in forensic investigation and personal identification. The comparative identification procedure which involves bite mark analysis, lip printing and radiographic analysis play a major role in the task of identification. Bite mark analysis clearly demonstrates the efficiency in crime investigations. Researchers have worked on lip prints with the idea that a gender difference does exist in lip prints. According to study by Senat and Nlyah type I, patterns to be present in females and type III and type IV in males. Radiographic analysis proved itself important in manmade disasters. Radiographic comparison of ante and post mortem records hold a potential promise to recognise the culprits. Teeth can be used as a weapon of attack or defence. Dentistry has much to offer to law enforcement agencies in the uncovering and solution of crime. It is the role of the dentist to help extract this information and use it in the identification of the unknown body. Analysis of bite marks is the second major responsibility of the forensic dentist. The general practitioner has a major role to play in providing the accurate dental records on which much of forensic activity is based.

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