



Forensic Dentistry: A Charismatic Role In Disaster Victim Identification

Ritu Mishra¹, Shilpa Srivastava², Garima Singh³, Rajshree Borah⁴, Md Kalim Ullah⁵, Shipra
Rohatgi⁶, Jaskaran Singh⁷, Ekampreet Kaur^{8*}

Abstract:

Forensic dentistry plays an immense role in the mass disasters in the identification of victims. Forensic dentists or odontologists utilize their expertise and skills in identifying the victims and interpreting their age. This field deals with evaluation, handling and presentation of dental evidences in the court of law. The identification of deceased includes dental record matching, genetic fingerprinting, postmortem profiling etc. This review paper focuses on the role of forensic dentists in disaster victim identification and also outlines the newer advancements & methodologies that are arriving into the main stream.

Keywords: Forensic odontology, Disaster victim identification, human identification, DNA, Dental Record.

DOI Number: 10.48047/nq.2022.20.22.NQ10238

NeuroQuantology 2022;20(22):2478-2483

INTRODUCTION:

Forensic dentistry or forensic odontology is the application of the dental knowledge in the field of criminal & civil laws [1]. Dentists who work in forensic fields give their opinion in variety of case related to the human identification age estimation & even in bite marks analysis. The forensic odontologists help in investigation process by using certain methods such as DNA profiling of the deceased when ante mortem dental records are not available [2]. Recent advancements in the field of molecular biology & genetics have contributed a lot to rapid developments in forensic odontology field. Dental evidences usually gain much importance because the dental tissues can be used in determining the age, gender as well as ethnicity of the person. [3] During the investigation, if there is difficulty in the identification of the deceased by the family or if the DNA is not retrieved easily, in their case, dental identification serves as an excellent method [1].

Lately, the field of forensic odontology has refined as a new ray of hope in the discipline of forensic medicine but this dynamic and coalescent field is still in infant stage in India [4]. Federation Dentaire Internationale defined forensic odontology as a branch of dentistry which in the interest of justice, that deals with the proper examination and handling of the dental evidences, along with proper evaluation and presentation of the dental findings [3, 5]. Forensic odontologists or Forensic dentist is assiduously involved in variety of situations such as mass disaster, civil and criminal investigation as well as child abuse etc.

***Corresponding Author:** - Ekampreet Kaur

Address: - ¹Assistant Professor, Department of Oral Pathology and Microbiology, New Horizon Dental college, Bilaspur.

^{2,3}Reader, Oral and Maxillofacial Pathology and Microbiology, Mahatma Gandhi Dental College and Hospital, Jaipur.

⁴Assistant Professor, Department of Dentistry, Assam Medical College and Hospital, Dibrugarh, Assam.

⁵Associate Professor, Department of Dentistry, Tezpur Medical College and Hospital, Tezpur, Assam.

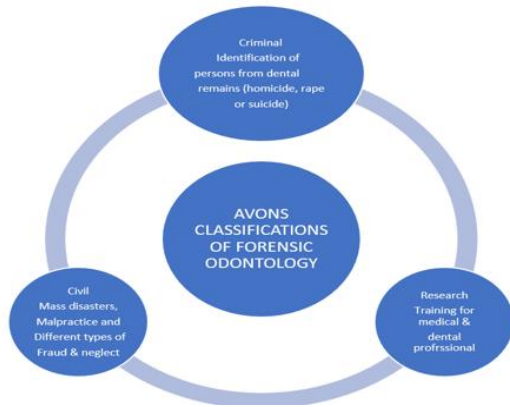
⁶Assistant Professor, Amity Institute of Forensic Sciences, Amity University, Noida.

⁷Associate Professor, Department of Forensic Science, Geeta University, NH 71A Naultha Panipat, 132145 Haryana, India

^{8*}Intern, State Forensic Science Laboratory, DNA division, Mohali, India, E-mail: ekampreet2409@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.





The odontologists make use of variety of dental features such as anatomy, no. & position of teeth, bite marks, palate, lip print, prosthetic restoration etc. for investigation. Mouth usually acts as a key feature as it gives no. of details for victim identification [5].

There are majorly 3 thrust areas or applications of forensic odontology [2, 3, 7].

- Therapeutic and diagnostic examinations
- Identification of the individuals especially victims in criminal investigator mass disaster
- Identification examinations & evaluations.

The American Board of forensic odontologists has provided guidelines for reporting dental identification. (6, 8, 9)

DENTAL IDENTIFICATION	CHARACTERISTICS
Positive Identification	Sufficient matching of ante-mortem & post mortem records and there is absence of unexplainable discrepancies
Possible Identifications	Consistent features in both ante-mortem & post-mortem data but these are of poor quality and hence the identity can be established positively.
Insufficient Evidence	Insufficient characteristics for positive identification
Exclusion	Clearly inconsistent data of ante-mortem & post-mortem records.

In the catastrophic events especially, the forensic odontology shows uniqueness and proves to be the most important discipline. This discipline performs variety of functions ranging from human identification to the management of man disaster including the examination and evaluation of bite marks and skin injuries as well as use of dental materials in evidence examination [10, 11]. A dental record is usually a systematized document having the record and details associated with the history of illness, diagnosis, physical examination as well as the management of patient. The dental practitioners are impelled by the legislation to maintain & produce

adequate dental records of patients. These records are helpful in forensic investigations, teachings & research work [10, 12].

TEETH AS A FORENSIC EVIDENCE:

Teeth is the regarded as robust tissue in the human body and is impervious to the postmortem decay and can survive through almost all the conditions encountered during death and during the later decomposition changes. Teeth are also resistant to extreme force and temperature [3, 13]. The dental characteristics method is the elementary and rapid method of identification. The heterogeneity of dental characters is quite extensive and hence, making the dentitions peculiar. Therefore, teeth are considered as wonderful material for identification [2, 3, 14, 5].

The dental profile comprises of various individual characteristics related to hard as well as soft tissue. This record helps in the estimation of age, gender, race, socioeconomic status, health occupation, personal habits as well as the food habits of an individual [15, 17].

IDENTIFICATION:

Dentistry or odontology plays a vital role in human identification when there is severe tissue damage or there is loss of fingerprints data. Dental remains are of key importance, in cases when the deceased/corpse is skeletonized, burnt, decomposed. The major benefit of dental evidence is that it is always retained after death. Odontologists also make use of photographs, lip prints, radio graphs, bite marks amalographyphies etc. for the identification [18, 19, 20].

Forensic odontology encompasses all the dental specialties and is also called “forensic dentistry” [5]. The diversity of possible combinations of characteristics in the human dentition can provide trillions of possible dental patterns that aids in the identification, the dental characteristics are neither independent nor occur with equal probability, therefore the empirical comparison of dental pattern is commendable method for forensic identification [21].



AGE ESTIMATION:

Age estimation is one of the key tools in the identification of an individual [2]. Dentition is employed for estimation of age in majorly 3 groups namely,

- Prenatal
- Natal & postnatal
- Children, adolescent & adults

The eruption of third molar has great importance in order to differentiate juvenile and an adult [16, 5]. Development of crown, phase of eruption as well as root arrangement is important parameters in age estimation. Various radiographic methods are used in age estimation [22]. The regressive changes in the teeth aids in the identification of age [23]. There are certain factors which help in the dental age estimation [5]:

- Tooth germs appearance
- Traces of mineralization
- Degree of eruption & uneruption of teeth
- Rate of formation of enamel
- Formation of neonatal line
- Attrition of crown
- Degree of completion of roots
- Formation of cementum
- Root surface resorption

GENDER AND RACE:

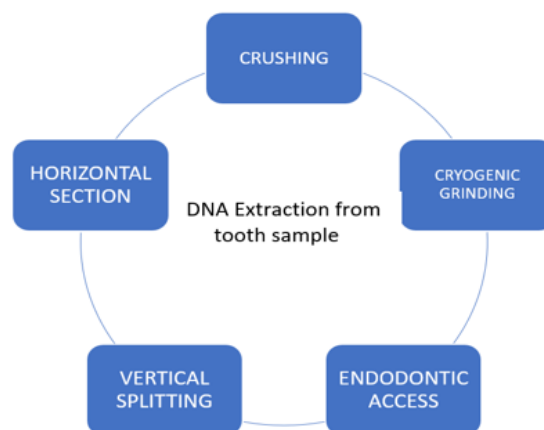
Forensic odontologists can determine the race of an individual within three major groups. (Caucasoid, Mongoloid and Negroid) Experts differentiate the race from skull shape and tooth features. These tooth features include:

- Cusp of Carrabelle
- Shoal shaped incisors
- Multicusped premolars

Microscopic examination of teeth can also confirm sex by presence or absence of Y-chromatin and furthermore, DNA analysis can also reveal gender [8, 24].

TEETH AS A SOURCE OF DNA:

Hydroxyapatite crystals, a component of enamel binds with the DNA and hence, stabilizes it. Hence, teeth can act as a key source for DNA as there is immense amount of DNA in teeth. The extraction of DNA from tooth sample can be done by various methods [3, 7].



Crushing is the commendable method for the DNA extraction because it gives better results as compared to other methods and moreover, more amount of DNA can be obtained. (3)

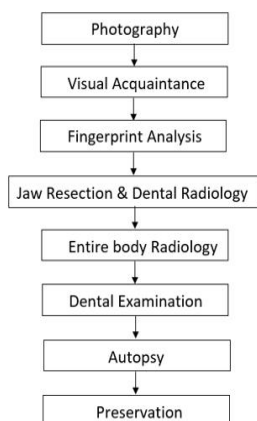
FORENSIC DENTISTRY AND ITS RELATION WITH DISASTER VICTIM IDENTIFICATION:

There are several reasons behind the occurrence of mass disasters these reasons might be natural or may be because of human activities [8]. The major task of police and the investigation team is to rescue and take proper care of the victims of disaster. Other paramount task is to establish the identity of the victims of mass disasters and this task is named as disaster victim identification. This identification is based on certain parameters such as fingerprints, physical features such as tattoos or belongings but these parameters are not conclusive in the case when the body is completely destroyed or decomposed, anthropological and dental evidences play a major role in the identifications of individuals. [10]. The International Criminal Police Organization (INTERPOL) has provided proper guidelines regarding the protocols to be followed while investigating the human remains in a mass disaster [25, 26]. The main objective of DVI is to provide scientific and logical basis for the identification of the victims in correct manner. The chief duty of the forensic odontologist in the victim identification process is done by matching the ante-mortem records with post-mortem dental records and other method is the estimation of age of the deceased from dental evidences [25]. Any individual having a missing tooth can also be identified by examining the anatomy of jaw bone or dentures, shape, size, manufacturers

and composition of the dentures. Moreover, dental anomalies also play an imperative role in the identification process [10, 27]. Presence of any disease or unusual tooth arrangement in the dental arch can also help in individualization [25].

Role of Forensic Dentist:

Forensic odontologist or dentist examines and evaluates the dental evidences such as tooth sample, dental cast, bite marks, saliva etc. They are also involved in establishment link of the victim with his/her respective family member by making use of DNA fingerprinting [8]. All these methods are used for the identification. Therefore, there is the utmost need to collect & preserve these samples meticulously. Chain of custody of all the samples should be maintained properly so that their integrity remains intact. Documentation of the crime scene is foremost duty of the investigators as well as the forensic team. Process to be followed is mentioned below:



The collection of the evidences begins with the physical examination of oral structures which includes the examination of dental implants, anomalies, anatomy etc. Photography should be done during the examination because it can be used to show as well as demonstrate the conditions of the human remains prior to and after examination. Moreover, photography is also helpful in facial reconstruction of the putrefied body [28].

DENTURE IDENTIFICATION METHODS:

The positive identity of the individual can be revealed by the help of dentures. The dentures are marked for the analysis purpose. There are

2 types of markings done for denture identification.

- Surface marking method
- Inclusion method

Out of these two methods, inclusion method provides far better predictable results and hence is used most often in identification process. (3)

CHEILOSCOPY:

The identification of humans on the basis of their lip prints is called cheiloscropy. In the cases when there is difficulty in matching antemortem and postmortem dental records then lip prints can provide adequate information. Like fingerprints, palmprints and footprints, lip prints also have grooves and furrows. Lip prints are also unique and they remain intact in the entire life of an individual. To reduce the inaccurate knowledge, it is advised to collect lip prints within 24 hours of time of death. Lip prints also help in gender identification. (2, 7)

RUGOSCOPY:

Palatal Rugoscopy or Palatoscopy is the study of palatal rugae. These are wrinkles or anatomical ridges or folds that are present on the anterior side of the palate. Rugae are protected by teeth, Bichat's fat pad and lips and hence, they are less affected by incineration & decomposition. Palatal rugae are considered for identification of an individual. (2, 7) A study has shown that identification through palatal rugae has accuracy of 94%. (7)

TONGUE PRINTS:

Like lip prints, the morphological aspect of tongue dorsal surface is quite unique for every individual. Photograph and tongue impressions are taken for identifications. Physical examination of tongue is done which includes color, surface and other specific characteristics are noted down. Digital images of the tongue are taken by making use of digital software. Other methods like cast preparation, sublingual vein analysis etc. (3)

METHODOLOGIES IN FORENSIC ODONTOLOGY:

The conventional methods employed in the forensic odontology are:-



- Maintenance of dental record
- Dental imaging
- Cheiloscopy
- Rugoscopy
- Bite marks analysis

There are many recent advancements in the odontology field which aid in the investigation and these include techniques.

DNA Analysis:

DNA in forensic odontology offer a never technology and is far better & reliable technique than conventional methods. Teeth are commendable source of genomic DNA and hence by making use of both genomic and mitochondrial DNA, the victim identification can be done easily DNA can also be extracted from dentin, cementum, pulp tissue etc. (3, 7)

RFID Tags:

Radio frequency identification tags are used for identifying and locating tagged human or non-humans. The main role is of the microchip which stores information and provides a number called 'tag'. (26)

Dental Radiographs:

Radiographs or X-rays are used nowadays in form of dental records. These radiographs provide valuable information which can't be seen through naked eye. (25)

Facial Reconstruction:

Nowadays 2-D and 3-D reconstruction of facial features can be done which aims to give rise to the likeness that is close to the victim's facial features. Computer aided reconstruction proves an excellent way of reconstructing facial features of the deceased. This method provides high resolution & quality of anatomy & pathology. (3)

CONCLUSION:

Forensic dentistry is a potent tool in disaster victim identification. This discipline is continuously strengthened by modern advancements and newer methodologies. Forensic dentistry is upgrading it to a newer version with the passage of time. Every disaster is unique, therefore no specific universal statement can be made regarding the investigation process. In the cases where ante

mortem dental rewards are present, there is a large benefaction from forensic dentistry in the identification process. Forensic dentistry field is growing rapidly in routine casework and also in mass disaster cases and the practitioners are also enhancing their skills and learning new methodologies. Such activities must be encouraged and supported by forensic societies at higher levels.

REFERENCES:

- Manica, S. and Forgie, A., 2017. Forensic dentistry now and in the future. *Dental Update*, 44(6), pp.522-530.
- Ata-Ali, J. and Ata-Ali, F., 2014. Forensic dentistry in human identification: A review of the literature. *Journal of clinical and experimental dentistry*, 6(2), p.e162.
- Menon, P.A. and Kumar, N.A., 2021. Recent advances in forensic odontology: An overview. *Journal of Forensic Science and Medicine*, 7(3), p.105.
- Wadhwan, V., Shetty, D.C., Jain, A., Khanna, K.S. and Gupta, A., 2014. A call for a new speciality: Forensic odontology as a subject. *Journal of forensic dental sciences*, 6(2), p.97.
- Jayakrishnan, J.M., Reddy, J. and Kumar, R.V., 2021. Role of forensic odontology and anthropology in the identification of human remains. *Journal of Oral and Maxillofacial Pathology: JOMFP*, 25(3), p.543.
- Kosa, F., Antal, A. and Farkas, I., 1990. Electron probe microanalysis of human teeth for the determination of individual age. *Medicine, Science and the Law*, 30(2), pp.109-114.
- Sweet, D. and Pretty, I.A., 2001. A look at forensic dentistry-Part 2: Teeth as weapons of violence-identification of bitemark perpetrators. *British dental journal*, 190(8), pp.415-418.
- Kolude, B., Adeyemi, B.F., Taiwo, J.O., Sigbeku, O.F. and Eze, U.O., 2010. The role of forensic dentist following mass disaster. *Annals of Ibadan Postgraduate Medicine*, 8(2), pp.111-117.
- American Board of Forensic Odontology, I., 1994. Body identification guidelines. *The Journal of the American Dental Association*, 125(9), pp.1244-1254.
- Dutta, S.R., Singh, P., Passi, D., Varghese, D. and Sharma, S., 2016. The role of dentistry in disaster management and victim identification: an overview of challenges in Indo-Nepal scenario. *Journal of maxillofacial and oral surgery*, 15(4), pp.442-448.
- Nuzzolese, E. and Di Vella, G., 2007. Future project concerning mass disaster management: a forensic odontology prospectus. *International dental journal*, 57(4), pp.261-266.
- Clark, D.H., 1994. An analysis of the value of forensic odontology in ten mass disasters. *International Dental Journal*, 44(3), pp.241-250.
- Sweet, D., 2010. Forensic dental identification. *Forensic science international*, 201(1-3), pp.3-4.
- Nishanth, G., Malathi, L., Babu, N.A. and Anitha, N., 2020. An overview on the role of dentists during mass disasters. *European Journal of Molecular & Clinical Medicine*, 7(10), p.2020.
- Pramod, J.B., Marya, A. and Sharma, V., 2012. Role of



- Ritu Mishra, Shilpa Shrivastava, Garima Singh, Rajshree Borah, Md Kalim Ullah, Shipra Rohatgi, Jaskaran Singh, Ekampreet Kaur, Forensic Dentistry: A Charismatic Role In Disaster Victim Identification forensic odontologist in post mortem person identification. *Dental research journal*, 9(5), p.522.
- Smitha, T., Sheethal, H.S., Hema, K.N. and Franklin, R., 2019. Forensic odontology as a humanitarian tool. *Journal of oral and maxillofacial pathology: JOMFP*, 23(1), p.164.
- Vodanović, M. and Brkić, H., 2012. Dental profiling in forensic sciences. *Rad Hrvatske akademije znanosti i umjetnosti. Medicinske znanosti*, (514= 38), pp.153-162.
- Kuthe, S., Ambad, R., Nagrale, N. and Patond, S., 2020. Forensic Odontology: A Potent Tool for Human Identification. *Indian Journal of Forensic Medicine & Toxicology*, 14(4).
- Prajapati, G., Sarode, S.C., Sarode, G.S., Shelke, P., Awan, K.H. and Patil, S., 2018. Role of forensic odontology in the identification of victims of major mass disasters across the world: A systematic review. *PLoS One*, 13(6), p.e0199791.
- Shenoy, M., 2022. Role of Forensic Odontology in the Identification of Victims of Mass Disaster: A Systematic Review. *Journal of Research in Medical Sciences*, 10(5), p.1
- Martin-de-Las-Heras, S., Valenzuela, A., de Dios Luna, J. and Bravo, M., 2010. The utility of dental patterns in forensic dentistry. *Forensic science international*, 195(1-3), pp.166-e1.
- Hachem, M., Mohamed, A., Othayammadath, A., Gaikwad, J. and Hassanline, T., 2020. Emerging Applications of Dentistry in Medico-Legal Practice-Forensic Odontology. *International Journal on Emerging Technologies*, 11(2), pp.66-70.
- Nayak, S.D., George, R. and Shenoy, A., 2014. Age Estimation in Forensic Dentistry-A. *Medical Science*, 3(4).
- Verma, A.K., Kumar, S., Rathore, S. and Pandey, A., 2014. Role of dental expert in forensic odontology. *National journal of maxillofacial surgery*, 5(1), p.2.
- Forrest, A., 2019. Forensic odontology in DVI: current practice and recent advances. *Forensic sciences research*, 4(4), pp.316-330.
- Kaur, E., Singh, J., Belhaj, M., Chadly, A. and Awasthi, S., 2022. Investigation of Disaster Victim Identification. In *Crime Scene Management within Forensic Science* (pp. 185-210). Springer, Singapore.
- Patil, S., Doni, B., Kaswan, S. and Rahman, F., 2013. Prevalence of dental anomalies in Indian population. *Journal of clinical and experimental dentistry*, 5(4), p.e183.
- Sever, M.S. and Vanholder, R., 2013. Management of crush victims in mass disasters: highlights from recently published recommendations. *Clinical Journal of the American Society of Nephrology*, 8(2), pp.328-335.

