

Forensic Odontology: An Important Tool in Mass Disasters and Crime Investigations

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ABSTRACT

Forensic odontology is a branch of dentistry that is concerned with the investigation and proper handling of dental evidences and demonstration of dental findings in the interest of justice. This article summarizes the latest progress in the field of forensic odontology, which highlights the role of the dentist in the investigation of dental remains, human remains as well as crime investigation. Dental age estimation, forensic data from soft tissues of the oral cavity, clinical features of forensic odontology have been discussed.

Keywords: Bite mark, Demirjian method, Forensic odontology, Gustafson's method, Palatal rugae, Premortem.

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INTRODUCTION

Forensic odontology or forensic dentistry was defined by the FDI as that branch of dentistry that is concerned with investigation and proper handling of dental evidence and demonstration of dental findings in the interest of justice. It is concerned with postmortem identification based on the identification of unique characteristics in an individual's oral structures. Teeth can help determine in a person's age, race, and sex. Identification can be done by using patient's history, such as radiograph, DNA analysis, premortem, and postmortem photographs.¹

OBJECTIVES AND SCOPE

Identifying unidentified human remains through comparison of postmortem dental evidence has been limited to hypothetical dental records.

- To assist in the identification at the site of a mass disaster.
- Gender determination.
- Estimate of age both alive and at death.
- Collection and analysis of tooth marks found on victims, animal tissues, and foodstuff.²

OBTAINING DENTAL REPORT AS A LEGAL DOCUMENT

The dental reports are legal document prepared by the dentist which contains personal and objective information about the patients. The results of the adequate examination of the oral and surrounding teeth structures need to be recorded. Furthermore, the results of clinical laboratory tests and radiographs record must be kept for at least 7–10 years.^{2,3}

Disasters Identification

The most common role of a forensic odontologist is to identify the dead person. Identification can be done by dental examination, clinical examination, fingerprinting, and bone anatomy. This process includes comparison of antemortem information of missing person and postmortem dental data information from deceased person.

Following are the conclusions regarding the tooth identification.⁴

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There is adequate distinctiveness between similar objects before death, and no major difference was observed in the postmortem databases.

There is a high degree of concordance between the data but there is no radiographic support.

Dental identification procedures are considered to be of two types:

1. Comparing a deceased person's teeth with his or her estimated dental records.
2. An attempt to uncover a deceased person's ethnicity or "race," gender, age, and occupation. This is done when virtually no clue exists.

Identifying the Use of Individual Teeth

Dentistry plays an important role in identifying human remains whenever there is damage to fingerprints database or severe tissue damage that invalidates the traditional method. When a deceased person has been skeletonized, decomposed, burned or separated from the body, it is very important to identify the dental remains. The advantage of dental evidence is that it remains intact even after death like many hard tissue. Teeth is one the strongest part of the

body and can withstand high temperatures without microstructural damage. Teeth remain relatively intact even after wear or decay but cause damage to many soft tissues and skeletal tissues.^{5,6} The morphology and arrangement of teeth varies from person to person. The dental identification is a process by which dental evidence, such as, number of teeth, prosthetic appliances, restoration, dental caries, microdontia, fusion, enamel hyperplasia, a condition which changes the appearances of tooth enamel, that is, dental fluorosis which is collected from human remain will be compared with previous records to establish the identity of the deceased person. This makes every dentist feel the need to maintain the records of patients. The dental profiling is an important part of forensic dentistry that helps in identifying a person by age, sex, and race.^{7,8}

Facial Superposition and Reconstruction

When the postmortem details do not actually provide provisional identification of the deceased, it may also be necessary to reconstruct an individual's image throughout lifetime. It is the duty of forensic experts, who are using the oral image, to help reconstruct their faces. The need for pre-mortem images to enable facial superposition of skeletal and dental characteristics has been used for verification purposes.⁹

Sex Determination

It is done by forensic experts using four methods:

1. *Craniofacial dimension or morphology*: The morphology and pattern of skull and mandible is composed of six characteristics which include glabella, supraorbital margin, mastoid process, mental eminence, skull size and architecture, and zygomatic extensions which are taken into consideration.
2. *Sex difference in tooth size*: Teeth can be used to differentiate gender by measuring their mesial, distal, buccal, and lingual dimensions, which is the easy and definitive method for sex determination.
3. *Morphology of teeth*: There is greatest dimensional differences in the mandibular canine in males because they are larger. The number of cusps in mandibular first molar is less in women. These features may be due to a development reduction in the size of the female lower jaw.
4. *Determination of sex by genetic analysis*: Forensic DNA analysis can provide definitive results for sex determination, which can be determined by using very small amount of DNA from old samples of teeth.

SOFT TISSUE ANALYSIS

Palatal Rugae

The ridges present on both sides of the median palatine raphe in the anterior part of the palate are called as palatal rugae. The palatal rugae are unique in every individuals and are well protected from any kind of disruption or trauma, as they are surrounded by teeth, buccal mucosa, lips, etc.

Classification of Palatal Rugae Pattern

- Furcated
- Converge
- Curve
- Wavy, straight, and circular^{10,11}

Limitation of the use palatal rugae for person identification in edentulous patients.

- Changes in palatal height
- Easy pattern of rugae
- Poor demarcation of palatal rugae.¹²⁻¹⁴

Lip Prints

Like fingerprints, lip prints are also an important forensic evidence at crime scene. The lips have six different type of groove pattern which are used for identifying a person in crime investigation. They are:

- Type 1: Complete vertical groove
- Type 1': Partial straight groove
- Type 2: Branched groove
- Type 3: Intersecting groove
- Type 4: Reticular grooves
- Type 5: Undifferentiated groove¹⁵

Bite Mark

Bite mark are the marks made by the teeth either singly/in association with other part of the mouth. Bite mark may be caused by humans or animal; they can occur on tissue, food items, or on objects. Bite marks have also been recovered from scenes of theft sites. Therefore, matching bite mark with a suspect's teeth can help investigating authorities to link the suspect to the crime. The shape and pattern of biting surfaces of upper and lower anterior teeth is limited to one individual.

Classification

- Tongue scratching marks
- Pressure marks on tongue
- Tooth pressure marks¹⁶

Appearance of Bite Marks

Bite marks are formed due to the pressure of teeth during biting (lasting for a few minutes). Edema and subcutaneous hemorrhage may be seen at the bitten site and is called as skin discoloration. On the basis of skin color, the bite mark appears as red or purple spots.¹⁷

Investigation of Bite Marks

The procedures which are used to examine bite mark are visual examination, double saliva swab, case demographic, close up photograph, the images of the suspected teeth which is taken in occlusion or in open bite positions, impression of upper and lower arch teeth which is made with elastomeric-based material, a swab of saliva from the oral vestibule should be taken for comparison to the saliva swab that has been collected from the bite mark; furthermore, bite samples, that is, by using a base plate wax wafer sample or silicone putty material, the bite of suspected teeth is recorded in centric occlusion.¹⁸

Estimation of Age

Estimation of age is one of the most important parts of forensic evidences and it plays vital role in the identification process. Tooth eruption follows an authentic and probable growth pattern that generally begins in the fourth month and continues until the eruption of permanent teeth is completed. By using radiographs, the stage of mineralization is observed. Abrasion and eruption of third molars has been suggested as means of aging in people over the age of 18 years.^{19,20}

Following are the method of determining age:

- Gustafson's method

- Dentin translucency method
- Demirjian method
- Amino acid racemization.^{21,22}

Radiographic Examination

Radiograph are the important part of forensic odontology. Radiographs are valuable medico legal devices. Through diligent documentation and written description of a tooth structure and radiographic images. A variety of solutions have been proposed by recording a dental identity. The American board of forensic dentistry recommends that some of these are limited to only two findings.²³

Correct Identification

Antemortem and postmortem information without any obvious of differences fit in great detail to determine that they are similar to each other.

Potential Identification

There is similarity in antemortem and postmortem information but it is not able to determine the identity with confidence due to the possibility of postmortem or even antemortem evidence to positively establish the identity.

CONCLUSION

Forensic odontology serves an important role in identifying certain individuals who are not visibly identifiable and at crime scene, it plays an important role in investigation and collection of dental evidences. The investigation can be done by using several methods like bite marks analysis, saliva swab, radiographic images, lip marks analysis, dental age estimation, soft tissue analysis, such as palatal rugae, antemortem, and postmortem photographs by using dental records.

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