

Forensic odontology - A diagnostic eye of oral physicians

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Abstract

Forensic dentistry is an integral part of forensic science over the past 100 years that utilizes orofacial findings to serve the judicial system. Due to commitment of people like Gustafson, Keiser Nelson and Suzuki this has become possible. The essential role of forensic dentistry has been established by them mainly in identification of human remains. Dental professionals have a major role to play in maintaining accurate dental records and providing all necessary information so that legal authorities may recognize malpractice, negligence, fraud or abuse and identity of unknown individuals. This paper

will recapitulate the role of dental experts in forensic medicine.

Keywords: Forensic, Bite marks, Lip prints, DNA analysis.

Introduction

Forensic odontology (dentistry) is a novel section of forensic medicine. The journey of forensic dentistry is very old. Agripinna the mother of Roman emperor Nero in 49 AD recognized her rival Lollia Paulinas discolored front teeth after her assassination.¹

Forensic odontology was defined by Keiser Nielson in 1970 as that branch of forensic medicine in which interest of justice deals with proper handling and

examination of dental evidence and with proper evaluation and presentation of dental findings.²

Forensic science refers to areas of endeavor that can be used in a judicial setting and accepted by court and general scientific committee to separate truth from untruth.^{1,2}

Identification of unknown individuals always has been of importance to society. It is important to identify deceased to ensure appropriate obsequies also there are issues like criminal investigations, insurance settlements and military proceedings which can be resolved only with a positive identification. Forensic dentists are playing a remarkable role in human identification, bite mark analysis, maxillofacial trauma and malpractice.³

Identification

Dental identification plays an important role in identification of remains of post mortem changes, traumatic tissue injury or lack of finger prints records invalidate the use of visual or fingerprint methods. Identification of dental remains are of importance when deceased person is skeletonized, decomposed, burnt or dismembered. Dental hard tissues are preserved after death.⁴ The status of persons teeth change throughout life and combination of decayed, filled and missing teeth is measurable and comparable to any fixed point in time. Teeth can be heated to 1600 degree Celsius without loss of microstructure. Teeth can survive for longer period even after the destruction of soft tissue and skeletal tissues. Identification by dentition is not a new technique. Even in past people have been identified by teeth. Even in a fire breakdown in the past people were identified by dentition.⁵

Determination of species

Dental fluids contain special species information. These fluids may be compared using counter current

electrophoresis with artificial antisera. Technique can determine species up to at least 12 months after death.⁶

Determination of gender and race

We can assess ancestry by studying facial skeleton and comparing features with main characteristics of three racial groups Mongoloid, Negroid and Caucasoid. If gender of bone is determined successfully approximately 50% of population is immediately eliminated from process of identification.^{5,6} If complete skeleton is available determination of gender is not difficult. If bones are broken into small fragments and only a small fragment is available for identification the tools of microbiology like DNA typing of genomic or mitochondrial DNA for detection of gene polymorphism and a specific repetitive sequence of DNA in order to match these results with putative antemortem findings gains importance.^{7,8}

DNA analysis in forensic dentistry

It is possible to establish the sample that is isolated from biological materials like blood, semen, hair roots, tissue, teeth, bone and saliva using DNA analysis. Successful isolation of DNA from both saliva and salivary stained material happened in 1992. A potential source of DNA in saliva is sloughed epithelial cells from inner surface of lips and oral mucosa. Many enzymes are also present in saliva.⁹

Streptococcus mutans and *Streptococcus salivarius* are present in saliva and on teeth. Polymerase chain reaction (PCR) technology provides a means to identify the bacterial composition from bite marks from DNA sequence and can be matched exclusively to those from teeth responsible.¹⁰

Dental pulp from a given specimen of tooth can be used for DNA analysis. Recent tooth specimens are expected to be good sources of blood group determination. Presence of ABO blood grouping in soft and hard dental

tissues helps in determining blood group typing and assists in identifying even a highly decomposed body. Sometimes autolysis, dehydration, loss of pulp antigens or high number of errors due to foreign antigen borne by bacteria in carious teeth may cause variation in the study.^{5,6}

It has been advocated that antigenicity of powdered cementum and dentine remains unaltered for a period of 1-6 months after extraction i.e., reaction of antigen with a fixed amount of serum containing antibody to assess the origin of tooth fragments found like in area of natural disasters.⁸

Facial reconstruction

Sometimes the post mortem profile does not elicit the tentative identity of deceased it may be essential to reconstruct the individuals appearance during life. Forensic artists utilize dental profile to help face reconstruction. Use of ante mortem photos to permit facial superimposition of skeletal and dental features have been used for identification. Technique requires availability of proper ante mortem photos displaying teeth. Angulations and magnifications pose difficulty in positioning images.¹¹

Age determination

Age determination is an important part of forensic odontology. Human dentition has a development sequence beginning about 4 months after conception and continuing to beginning of third decade of life when development of all permanent teeth is complete. Use of radiographs is characteristic of techniques that involve observations of morphologically distinct stages of mineralization. Determinations also used on degree of formation of root and crown structures, stages of eruption and inter mixture of primary and adult dentitions.^{3,4}

Two criteria that can be used for age determination in adults are assessment of volume of pulp cavity and development of third molar. Reduction in size of pulp chamber due to secondary dentine formation with aging can be used to estimate age of individuals. Newer techniques like asparaticacid racemization and translucent dentine have been proposed and are highly accurate in adult age assessment.⁶

Matching of teeth image by cbct and xray microfocus ct

Both are used to obtain pulp and tooth volume ratio. X-ray provides two-dimensional information at low resolution while CBCT allows three-dimensional structure of root canal of extracted tooth. Coronal pulp cavity ratio is a reliable biomarker for age assessment in forensic context especially in living individuals of unknown data.¹²

Radiographic examination

Radiographs and dental casts are useful tools for medicolegal records. Forensic odontologist produces post mortem records by careful charting and written description of dental structures and radiographs. Radiographs are marked with holes to prevent confusion one hole for ante mortem films and two holes for post mortem films.

American board of forensic odontology recommends four conclusions:

1. Positive identification-The ante and post mortem data match in sufficient detail with no discrepancies to establish they are from same individual.
2. Possible identification-The ante and post mortem records have consistent features but because of quality of either post mortem remains or antemortem evidence its not possible to establish identity positively.
3. Insufficient Evidence-Available information is insufficient to form a conclusion.

4.Exclusion-The ante and post mortem data is clearly inconsistent.^{6,7,8}

Bite marks and lip prints

Bite marks consist of superficial abrasions or sub surface haemorrhage or bruising of skin because of bite. Bite mark examination is an aspect of forensic odontology requiring immediate response by forensic odontologist.

The bite mark may be a result of either physical alteration in a medium caused by teeth contact or a pattern left in an object or tissue by dentition of humans or animals. The marks may be single or multiple ranging in severity from mild marking of tissues to deep perforation of epidermis and dermis. American Board of Forensic Odontologist (ABFO) has created a bite mark methodology to collect and preserve the marks. To record a bite, mark an exact photographic documentation and a one-to-one transfer to transparent paper or acetate sheet are indispensable. Swabbing of bite injury is important to recover trace evidence.¹³

Stains of saliva or human cells for a DNA analysis should be collected whenever possible.

The use of LIP PRINTS for human identification was suggested in 1950. Cheiloscopy is study of lip prints. It is not very reliable due to its deformable nature. Classification of lip prints has been done as Type 1 (vertical), Type 2 (branched), Type 3 (intersected), Type 4 (reticular) and Type 5 (other). Gender differences with certain types are predominant in females (Type 1 and 2) and in males (3 and 4) are found.⁸

Study and investigations on of bite marks and lip prints requires specialized techniques of photography, impression taking and electric microscopy. Proper collection and handling of materials is important for security of chain of evidence for legal requirements to be accepted as evidence in court.

Healing process

Healing process of a bite mark can be useful in determining the time of bite mark inflicted to time of death in cases where death has occurred due to strangulation. The redness of bite mark relative to redness of bruises on neck indicate time of infliction of bite mark relative to murder.⁹

Conclusion

The role of forensic odontology plays a major role in identification of those individuals who cannot be identified visually or other means. The dental anatomy and placement of custom restorations ensure accuracy when correct techniques are employed.

Unfortunately, in India the forensic odontology is not so developed and services of forensic odontologist are not being utilized.

The government should instruct the IDA and other responsible agencies to direct dental surgeons of the country to maintain dental records and debris of tooth material in case of restorations of patients treated by them as the preserved material may be used in identification of deceased individuals.

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