Review Article

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Current Trends in Forensic Odontology

Ankit Patel[1*] Monali Shah[2] Shreyansh Sutaria[3] Vasudha Sodani[4]

[1]PhD Scholar, Gujarat University, Ahmedabad, Gujarat, India.
[2]Professor and Head, Department of Oral Pathology and Microbiology, Ahmedabad Dental College and Hospital, Ahmedabad, Gujarat, India.
[3]PhD Scholar, Gujarat University, Ahmedabad, Gujarat, India.
[4]Professor, Department of Pedodontics and Preventive Dentistry, Ahmedabad Dental College and Hospital, Ahmedabad, Gujarat, India.

ABSTRACT

Background: Forensic Odontology is a branch of forensic medicine which plays an important role in mass disasters, child/elder/spouse abuse cases, bite mark analysis, criminal and natural deaths and injuries, bioterrorism, etc., It also helps in identification of decomposed and charred bodies like that of drowned persons, burns and victims of motor vehicle accidents. The human body becomes disfigured to a great extent in case of burns, accidents and mass disasters like earthquake so much so that identification of the individual becomes a challenge. However dental remains can be used for identification as using them is cost effective, reliable and fast. The current trends employed in forensic odontology include rugoscopy, cheiloscopy, bite marks, tooth prints, radiographs, photographic study and molecular methods. of teeth in forensic investigations and need for further research in establishing their potency.

Keywords: Forensic odontology, Bite Marks, Rugoscopy, Cheiloscopy, tooth print, molecular methods.

INTRODUCTION

Forensic Odontology, or forensic dentistry was defined by Keiser-Neilson in 1970as "that branch of forensic medicine which, in the interest of justice deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of the dental findings". Forensic dentistry plays an important role in mass disasters, child/elder/spouse abuse cases, bite mark analysis, criminal and natural deaths and injuries, bioterrorism, etc., It also helps in identification of decomposed and charred bodies like that of drowned persons, burns and victims of motor vehicle accidents. The human body becomes disfigured to a great extent in case of burns, accidents and mass disasters like earthquake so much so that identification of the individual becomes a challenge. However dental remains can be used for identification as using them is cost effective, reliable and fast. The various methods employed in forensic odontology include rugoscopy, cheiloscopy, bite marks, tooth prints, radiographs, photographic study and molecular methods. of teeth in forensic investigations and need for further research in establishing their potency. [1]

History of forensic odontology

The use of teeth for identification goes back to Roman times. In the first century A.D., the Roman Emperor Claudius had his mistress, Lollia Paulina, beheaded and then demanded to examine the teeth on the body to ensure the right woman had been put to death. He knew she had a discoloured front tooth.

Forensic dentistry has also been used to identify some notorious figures from the Nazi era, including Adolf Hitler, Martin Bormann, Eva Braun, and Joseph Mengele. The identity of John F. Kennedy's assassin, Lee Harvey Oswald, was confirmed through dental records. The remains of Czar Nicholas II and his family, who were shot during the

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*Correspondence **Dr. Ankit Patel.**
Gujarat University, Ahmedabad, Gujarat, India.
Email: ankit.patel68@yahoo.com

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1917 Russian Revolution, were also initially identified from their teeth.

In 1775, Paul Revere, identified Dr. Joseph Warren, who was killed at the Battle of Bunker Hill by his denture.

The first use of dental records in the identification of victims of mass disaster was probably the fire at the Vienna Opera House in 1878. Also in 1897 in the great fire in Paris 126 dead identify by odontology. In the attacks on the World Trade Canter on September 11, 2001, only around half of the estimated 2,749 victims were ever identified, through a mixture of DNA , jewelry, and dental records.

A more famous case is that of serial killer Ted Bundy who left a bite mark on the buttock of a victim, which helped secure his conviction in 1978.[2]

Tooth as a tool for forensic evidence

Use of teeth in identification of person:

Morphology and arrangement of teeth is unique for every individual. Comparative dental identification is a procedure by which dental evidence such as dental caries, missing teeth, restored teeth, prosthesis, alterations in shape of teeth such as taurodontism, talons cusp, developmental defects such as amelogenesis imperfecta, dentinogenesis imperfecta, changes in colour of teeth like dental flurosis collected from human remains is compared with previous records for establishing identity of the decedent. This necessitates the importance of every dentist to maintain records of their patients. Acharya et al have demonstrated that dental profiling is another integral part of forensic dentistry which aids in person identification by identifying ethnicity, gender and age.[3]

Examination of tooth prints (Ameloglyphics)

Ameloblasts lay down the enamel rods in an undulating and intertwining path. This is reflected on the outer surface of the enamel as patterns of the ends of series of adjacent enamel rods. This study of the enamel rod end patterns is termed as ameloglyphics by Manjunath et al and could aid as an identification tool in decomposed or burned bodies as enamel can resist decomposition. This study needs ante mortem records. Though enamel is the hardest mineralized substance in human body, the enamel surface is usually subjected to micro and macrowearing. Fractured, decayed, attrited, abraded, and eroded teeth cannot be included in this method. Ameloglyphics is still in its infancy and whether the tooth prints are the same at different depths of enamel has to be evaluated with further studies.[4]

Study of palatal rugae (Rugoscopy)

Palatal rugae comprise about three to seven ridges radiating out tangentially from the incisive papilla. These ridges can be classified as curved, straight, wavy, and branched. The pattern of these rugae is considered unique to an individual. In instances where postmortem dental identification is not possible, as in edentulous mouths, palatal rugae can be used as a supplement. The shortcomings in applying rugoscopy as a definitive tool in forensic odontology are many. Post- mortem identification is not possible without the ante mortem records. Complex rugae patterns (patterns that cannot be classified under one particular group) can cause intra or inter observer errors. Kapali et al. have observed that denture wear, tooth malposition, and palatal pathology can cause alterations in rugae patterns. Further, Thomas et al have stated that rugae patterns are genetically determined, and so can be rather used in population differentiation than individual identification. In a situation involving fire, palatal rugae are often destroyed, and also since decomposition and skeletonization can occur in less than six weeks in summer and four months in winter, rugoscopy does not have application after this stipulated period.[5,6,7]

Examination of lip prints (Cheiloscopy)

The external surface of the lip has numerous elevations and depressions that form a characteristic pattern, referred to as lip prints. Lip prints can be obtained at the crime scene from clothing, cups, glasses, cigarettes, windows and doors. Using lip prints for personal identification in forensic odontology is an accepted method in the criminal justice system worldwide. Impressions are made from the middle portion of the lower lip, an area always visible in any trace made, and the characteristic patterns are studied. The various patterns identified include vertical, intersected,

branched, reticular, and undetermined. The anatomical landmarks of the lip include chelion (the lateral most point in mouth opening), stomion (the contact of upper and lower lips in mid-sagital plane), and labrale superius and labrale inferius (the highest and lowest points of upper and lower lip margins in the mid-sagital plane, respectively).Various factors can alter lip print recording. Lip prints have to be obtained within24 hours of the time of death to prevent erroneous data that would result from post-mortem alterations of lip. Lip print pattern depends on whether the mouth is opened or closed. In closed-mouth position lip exhibits well-defined grooves, whereas in open position the grooves are relatively ill defined and difficult to interpret. Any pathology of the lip such as mucocele or any postsurgical alteration of the lip can change the lip print pattern. Also, loss of support due to loss of anterior teeth can cause changes in lip prints. Any debris or fluid on the lip surface, application of a thick layer of lipstick, or over stretching of cellophane tape can alter lip print recording. Although lip prints are unique to an individual, when the lines are not clear, individual identification based on this trace is extremely difficult unless the trace contains more individual characteristics like scars, clefs, etc.[8,9]

Use of teeth in crime investigation:

A bite mark is defined as 'a mark caused by teeth either alone or in combination with other mouth parts' and serves as a good source of forensic evidence in crime investigation. Bite marks can be human or animal and can be on human or on objects. Bite marks can also be used in investigation of child abuse. The Cameron and Sim classification of bite marks is based on agent and material. Based on etiology McDonald has classified bite marks as tooth pressure, tongue pressure and tooth scrape marks. Various steps in bite mark investigation include preliminary questions, evidence collection from the victim, case demographics, visual examination, photography, saliva swab, impression making, evidence collection from suspect, bite mark analysis, comparison and drawing conclusion. Vander Veldon. A et al have reported the use of image perception technology for bite mark analysis and investigation of crime. Advantages of this technique include additional colouring of images, pseudo three dimension imaging all of which improves accuracy.[10]

Molecular aspects in forensic odontology

Teeth and DNA

The tooth often serves as the most valuable source of DNA since it is cast in a sealed box protecting the DNA from extreme environmental conditions.

Different techniques to extract DNA from the teeth

1 crushing entire tooth

2 conventional endodontic access

3 vertical split of entire tooth

4 horizontal sectioning

5 cryogenic grinding

6 orthograde entrance technique [11,12]

Teeth and Blood Grouping

A unique blood group is a characteristic of every individual. Besides blood, the blood group antigens are secreted in various body secretions such as semen, sweat, amniotic fluid, and saliva. Moreover, these substances are also present in the teeth. Since tooth pulp contains a lot of blood vessels, blood group antigens are most certainly bound to be present in tooth pulp. The distribution of ABO substances from the pulp cavity wall to the dentin edge and to the enamel gradually decreases because of fewer possibilities of diffusion of antigens from both blood and saliva. Moreover, postmortem changes in pulp are seen very late, and also pulp remains one of the most protected tissues and therefore could be readily available for examination.[13,14]

Therapeutic aspects of forensic odontology

Denture marking:

broadly into two categories namely surface marking and inclusion methods. Surface marking simply means scratching or engraving an identity mark onto the surface of the denture using a spirit based pen before covering them with a denture based acylic. Inclusion methods involve the use of paper, onion skin or label which are included into the denture base prior to polymerisation. Also lead foils marked with patient details can be sandwiched in

the denture base to enhance person identification.[15]

Scope for research in forensic odontology:

The use of molecular techniques and ameloglyphics for person identification, biochemical methods of age estimation requires standardization. Moreover very few studies have been carried out in the Indian population. This warrants further studies to be carried out in our country so that regional variations could be assessed.

Limitations of research in forensic odontology

Limitations of research include

- Ethical issues in sample collection in crime investigation.
- The application of molecular and biochemical techniques in Forensic Odontology are expensive.

Challenges in the indian scenario

- In our country awareness about the importance of record maintenance among Dental Professionals is not satisfactory which poses a great challenge for person identification both in crime investigation and mass disasters.
- Most of the dental professionals in our country do not pursue research or career in this field due to social and cultural reasons.

CONCLUSION

Teeth prove to be very helpful adjuncts in forensic dentistry. Owing to their properties and characteristics, they can be readily available and easily processed for several investigations. A great amount of research is in progress which in the coming years would prove extremely beneficial.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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