

REVIEW PAPER

Different Aspect of Forensic Odontology

Kalita Chandana¹, Mahanta P²

Received on January 30, 2017; editorial approval on April 30, 2017

ABSTRACT

Introduction: Expert testimony is very much essential in any civil as well as criminal trials. Forensic medicine experts, those who are called to the court for their professional view must be amply qualified for the job. If there is any dental injury relating to a crime or dental malpractice, forensic dentist are also called for expert opinion. **Objectives:** Collecting different anecdotes from different journals and other source, this paper has reviewed the role and importance of forensic dentists in the field of forensic investigation. **Discussion:** In any massacre of natural disaster or any crime scene involving single or multiple murders, identification of the deceased as well as the person involved is very much essential. Teeth and its associated structure help to achieve estimation of age, sex, race, reconstruction of facial anatomy, lip print, DNA fingerprinting, etc. **Conclusion:** Forensic dentistry is the study and practice of different aspects of dentistry that are relevant to legal problems. Identification of a person from different dental records by a forensic dentist has been already established and accepted in court.

Keywords: Forensic dentistry, Age estimation, Rugoscopy, Cheiloscopy, Radiograph

INTRODUCTION

Earliest document regarding death investigation was discovered from Chi'in Dynasty (221-207 BC) in an archeological excavation, where instruction was given to do the examination of a corpse found dead in suspicious situation.¹

Forensic odontology or forensic dentistry is an indispensable branch of science used for identification of a person that may be living or dead that needs lot of exploration in an organized way on scientific basis. Demand for the expertise of the knowledge in forensic dentistry is increasing day by day, as there is rapid growth of crime scenes in our society keeping aside the natural calamity.

These science originated in 49 AD when Roman empire Nero's

mother Agrippina asked her soldier to cut the head of her rival Lollia Poullina and to bring it on a plate. She recognized it to be Lollia's head from misaligned and discolored front teeth.² Keiser-Nielson in 1970 defined forensic dentistry as "that branch of forensic medicine which in the interest of justice deals with the proper handling and examination of dental evidence and with proper evaluation and presentation of the dental findings."³

Teeth and jaw bones remains unchanged for long periods of time and can withstand extreme conditions of environment. It may remain unaffected, if immersed under water for long time, buried in soil, exposed to fire and numerous biological agents found in nature. Teeth have some unique characteristics due to which it is stronger than other tissues of the body. Except fingerprint analysis, dental record analysis is the most important method for identification of a victim either living or dead.

DISCUSSION

Various methods employed

Exploring dental tissues or teeth of the deceased may give information regarding socioeconomic condition, age, food habits of the person involved. As some of the dental treatment like bridge, implant, cosmetic restoration, full veneer crown are expensive and may not be easily affordable for person from low socioeconomic background, this may give clue to the examiner about his/her financial condition. A person with a good oral hygiene usually reflects an educated individual with good family background. A young boy will have prominent anatomical landmark like cusp, ridge with deep fissure, whereas an aged

Address for Correspondence

¹Reader (Corresponding Author)

Reader, Department of Conservative Dentistry & Endodontics
Regional Dental College, Guwahati-32

Email: kalita_chandana@yahoo.com

Mobile: +919435045632

²Associate Professor of Forensic Medicine
Tezpur Medical College, Tezpur, Assam

individual will show wears and tears on the tooth surface. People taking non vegetarian or hard food shows more attrition in the occlusal surface or the grinding surface than those who take soft food. Person used to take more carbohydrate in their diet may have more dental caries than a person used to have hard fibrous food. Various methods used by Forensic Odontologist are:

Reconstruction of face: Face can be reconstructed by sculpture with the help of clay on the basis of anthropological knowledge and can be digitized and transfer to a computer screen. Computer permits addition of components and with facial superimposition, the underlying skeletal structure can be viewed to check accurately.

Teeth as a means of age estimation: Age estimation is essential of a direct victim involved in mass casualties, terrorist attack, and natural disaster or any misdeed, it is very important to know the age of the patient as every age has specific significance from medico-legal point. In some cases birth records are poorly maintained and in some records are falsified. Teeth play a vital role in identification of age estimation of a person. From development to mineralization, eruption and root completion every tooth travels a specific time line. Forensic Odontologist may help in age estimation by using various methods.⁴

Rugoscopy: Rugoscopy is the study of palatal rugae patterns. In any crime scene, road accident, plane crash, fire fingerprint may get destroyed, but rugae found to be intact. Because of its uniqueness it is considered as one of the important methods for identification.⁵⁻⁸

Cheiloscopy: It is the study of lip prints. Uniqueness of lip tracing is used to identify a person. Cheiloscopy word comes from the Greek word cheilos means lips. Anthropologist first introduced the possibility of lip furrows in individual identification. In 1902 Fisher first described the method of Cheiloscopy, which can be done as early as 6th week of intrauterine life.⁹⁻¹¹

Radiographs: Used in forensic odontology to a great extent for estimation of age. It may help in determining the cause of death by revealing the evidence of Bullet or fragmented part of any foreign body. It is also a very important tool in diagnosis of child abuse. Radiograph of skull may help in identification by superimposing it with ante mortem radiograph or photograph.

The objectives of using radiographs in identification are to compare and evaluate similarities between ante mortem and post mortem films. These include six steps:

- Securing ante mortem radiographs
- Making post mortem radiographs
- Comparing meaningful features (those which are stable and distinctive)
- Accounting for discrepancies
- Assembling uniqueness

- Verbalizing the degree of confidence in the identification.

Bite mark: Analysis of a bite-mark case was published first by “Sorup”. He used the term “odontoscopy,” analogous to the term “dactyloscopy” used for fingerprint identification. Print of the bite mark is taken on a cast. After applying varnish, occlusal surface of the teeth are coated with printer’s ink. Over the ink coated surface a moistened paper is pressed and this print is transferred to a transparent paper. Bite-mark is then compared by placing it over a life-size photograph of the suspect or victim.¹¹ One of the primary means of preserving and recording bite mark is photography, which is often round or elliptical and associated with contusion or abrasion or sometime with indentation.^{12, 13}

Photographic study: Few techniques used in forensic photography are:

1. Visible light photography:-
 - Digital
 - Visible light color
 - Visible light black and white
2. Alternate light imaging and fluorescent technique.
3. Non visible light photography:-
 - Reflective long wavelength ultraviolet
 - Infrared

Keeping the record of the photograph of the injuries of the victim may become an essential part of lawful system and subject to chain of evidence rule. It is a duty of the forensic photographer to mark each photograph with a confidential system which consists of figures or letters including case number and the identification of the forensic photographer. Photographer should always store the original negatives and should not loose or part with it.¹⁴

Saliva: It has been found that saliva can be regained from bite marks, but of cigarette, envelop and postal stamp, and other items too.¹⁵⁻²¹ Though it is difficult to collect dried saliva from the injured site, amylase essay may help in confirmation of its existence.¹³ Saliva Polymerase chain reaction (PCR) allows replication of thousands of copies of a specific DNA sequence enabling the study from small amounts of DNA which can be taken from dental tissues.

Genomics and proteomics: Various scientific and technical details are involved in the process of DNA analysis in the process of identification.²² For this process of identification, role of genomic and mitochondrial DNA from the pulp, dentin or cementum of teeth or desquamated cells in saliva are very important.²³ Contamination may lead whole process ineffective, that may occur at scene, during packaging, purification, storage or even analysis of the sample.

Dental records kept by dental surgeon are a legal document. Dental surgeon during their check up of oral cavity used to write

or should write the detail medical history, Patient's chief complaint, treatment need, previous treatment done, any history of trauma, or communicable disease where extra precaution may be called for. Forensic Odontologist should be aware of format and terminology used by dentist for dental patient record.^{24, 25}

Importance from medico legal point of each age group: In forensic science every age group has importance from medico legal point. Forensic Odontologist must be aware of the importance of different age from medico legal view.¹⁴

As the human body ages, lot of biological and physical changes occur. Some are prominent and visible to our naked eye. When a child mature he or she gains weight, height etc., which may not always correspond to their actual age. This variation may lead to a wrong conclusion regarding victim's or criminal's age. Tooth plays a very important role because it leads a specific pattern in growth and development. Forensic Odontologist can verify or come to a conclusion about the age by studying the various developmental stages of tooth position. Radiographically the age can be determined of these children.

Another important point to observe is the knowledge of tooth anatomy to know the difference between deciduous and permanent dentition. Deciduous can often detected from wide pulp canal, short crown and root length, contact area situating more cervical, etc. In permanent teeth also person may have unique anatomical landmark like cusp of carabelli, peg lateral, denseindente, dilacerated root, fused teeth, neonatal tooth, paramolar and supernumerary tooth. With this anatomical knowledge not only we can ensure the type of teeth, but also we can diagnose different types of developmental anomaly like microdontia, macrodontia, hypoglossia, hyperglossia, dentinogenesis imperfecta, amelogenesis imperfect, anodontia, etc. Different acquired dental problems like mottled enamel, hypoplastic tooth, tetracycline staining, pink tooth, etc can also be determined from examination of the structures.

DNA Identification: Dental structures are relatively more resistant to higher temperatures. Techniques involving DNA in forensic dentistry offers a new tool when traditional identification methods fail due to the effects of heat, traumatism or autolytic processes, as well as in distortions and difficulties in analysis. They can provide a source of DNA for easy identification.²⁶

Digital Forensics: With advanced technology, computers have taken a leap into the forensic world and the digital revolution has impacted all aspects of forensic odontology. The digital forensic process encompasses the seizure, forensic imaging and analysis of digital media and the production of a report into collected evidence of a crime. This also can be used to attribute evidence to specific suspects, confirm statements, determine intent, identify sources or authenticate the documents.²⁷

LIMITATIONS

Forensic odontology has played a key role in identification of

persons in mass disasters (aviation, earthquakes, tsunamis), in crime investigations, in ethnic studies and victims of motor vehicle accidents. All the methods described above have some or the other shortcomings. The discrepancies associated with them are to be weighed cautiously to make forensic odontology a more accurate, reliable and reproducible investigatory science. As dental features change over time, changes can occur after obtaining antemortem records. Extraction, trauma, exfoliation, periodontal disease, caries and prosthesis work can change the configuration of teeth.²⁶

CONCLUSION

Thus forensic Odontologist must

- Have sufficient knowledge on dental anatomy
- be aware of every newer techniques involved in the process for identification
- Take the precautions to avoid contamination during sample collection
- Be observant enough to collect every necessary detail from the crime scene as early as possible
- Diligent enough to use the evidence, narrowing down to the possibilities and to come to a conclusion after comparing, adding, deducting the gathered information in a systematic manner.

REFERENCES

1. Grady R. Personnel identity established by teeth: The dentist as a scientific expert. *Am J Dent Sc* 1884;17:384-405.
2. Cassious Dio C, Earnest F, Ballawin H. *Dio's Roman History*. London: W. Heinemann. 1714.
3. Vij K. *Textbook of Forensic Medicine and Toxicology*. 2nd ed. New Delhi: Elsevier; 2002. p.71–2.
4. Aggarwal A. Estimation of age in the living: in matters civil and criminal: Review. *Journal of Anatomy* 2009;1469-580.
5. Nayak P, Acharya AB, Padmini AT, Kaveri H. Differences in the palatal rugae shape in two population of India. *Arch oral Biol* 2007;52:977-82.
6. Kapali S, Townsend G, Richard L, Parish T. Palatal rugae patterns in Australian aborigines and Caucasians. *Aus dent J* 1997;42:129-33.
7. Aparna Palliwal, Sangeeta Walneri, Rajkumar Parwani Palatal rugoscopy: establishing identity. *J Forensic Dent Sci* 2010;2(1);27-31.
8. Jain A, Choudhary R. Palatal ruga and their role in forensic odontology. *J Investig Clin Dent* 2014;5(3):171-8.
9. Caldas IM, Magalhaes T, Afonso A. Establishing identity using Cheiloscopy and palatoscopy. *Forensic Sci Int* 2007;165:1-9.
10. Sivapathasundharam B, Prakash PA, Sivakumar G. Cheiloscopy. *Indian J Dent Res* 2001;12:234-237.

11. Ball J. The current status of lip prints and their use for identification. *J Forensic Odontostomatol* 2002;20:43-6.
12. Rothwell BR. Bite marks in forensic dentistry: A review of legal, scientific issues. *J Am Dent Assoc* 1995;126:223–32.
13. Valerie JR, Souviron RR. Dusting and lifting the bite prints. A new technique. *J Forensic Sci* 1984;19:326–30.
14. Ferdinand Storm, Investigation of bite marks. *Journal of Dental Research* 1963;42:312-315.
15. Anil Aggarwal. Estimation of age in the living: in matters civil and criminal. *Journal of anatomy* 2009; [cited June 1 2017]; Available from: URL: <https://www.scribd.com/document/74057880/Estimation-of-Age-in-the-Living-Journal-of-Anatomy-2009>
16. Bernitz H, van Niekerk PJ. Bungled bite mark evidence collection: a proposed protocol for the prevention thereof. *SADJ* 2003;58:16-9.
17. Borgula LM, Robinson FG, Rahimi M, Chew KE, Birchmeier KR, Owens SG, et.al. Isolation and genotypic comparison of oral streptococci from experimental bitemarks. *J Forensic Odontostomatol* 2003;21(2):23-30.
18. Clark DH. *Practical forensic odontology*. Oxford: Wright; 1992.
19. Hochmeister MN, Rudin O, Ambach E. PCR analysis from cigarette butts, postage stamps, envelope sealing flaps, and other saliva-stained material. In: Lincoln PJ, Thomson J, editors. *Forensic DNA profiling protocols*. Totowa: Humana Press; 1998. p. 27-32.
20. Sweet D, Hildebrand D. Saliva from cheese bite yields DNA profile of burglar: a case report. *Int J Legal Med* 1999;112:201-3.
21. Sweet D, Lorente M, Lorente JA, Valenzuela A, Villanueva E. An improved method to recover saliva from human skin: The double swab technique. *J Forensic Sci* 1997;42(2):320-322.
22. Muruganandhan J and SivakumarG. Practical aspects of DNA-based forensic studies in dentistry. *J forensic dental science* 2011;3(1):38–45.
23. De Silva R H A, Peres S A, DeOliviera R N, DeOliviera F T, Peres S H D C. Use of DNA technology in forensic dentistry. *J Appl Oral Sci* 2007;15(3):156-61.
24. Charangowda B K. Dental records: An overview. *J forensic dental science* 2010;2(1):5-10.
25. Preethi S, Einstein A, Sivapathasundharam B. Awareness of forensic odontology among dental practitioners in Chennai. A knowledge, attitude, practice study 2011;3(2):63-66.
26. Mahanta P. *Forensic Odontology*. In: *Modern Textbook of Forensic Medicine and Toxicology*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 2014. p. 142-170.
27. Digital Forensics. [cited 2017 May 27]; Available from: URL:<http://www.digitalforensics/wikipedia.com>