Methods of Human Identification in Forensic Dentistry

Akhilanand Chaurasia*, Divayjeet Goel**

*Assistant Professor, **Junior Resident, Department of Oral medicine & Radiology, Faculty of Dental Sciences, King George Medical University, Lucknow-226003, Uttar-Pradesh (India).

Abstract

With the passage of time, forensic odontology has emerged as leading branch in forensic science for human identification as in older days teeth and dental restorations are the only means of identification in both ante mortem and post mortem cases. The most important role of the forensic odontologist is the identification of deceased individuals. The dental evidence is now considered as important tool and accepted in court of law for jurisprudence. This article describes different methodologies used in identification of humans by means of forensic dental evidence.

Keywords: Forensic Odontology; Lip Prints; Bite Mark; Forensic Science.

Introduction

Human identification by use of dental maneuver is one of the most challenging aspects in forensic science that forensic odontologists have been confronted with. As the new innovations and technologies in human identification are flourishing importance of dental identification is on the rise year after year. With the passage of time, forensic odontology has emerged as leading branch in forensic science for human identification as in older days teeth and dental restorations are the only means of identification in both ante mortem and post mortem cases [1]. The most important role of the forensic odontologist is the identification of deceased individuals ante mortem and post mortem [2]. The identification of individuals by dental maneuver is done in two ways. First method involves comparative examination which is performed by comparison of ante mortem and post mortem dental records of particular deceased individuals. The second method

Corresponding author: Dr. Akhilanand Chaurasia, Assistant Professor, Department of Oral medicine & Radiology, Faculty of Dental Sciences, King George Medical University, Lucknow-226003, Uttar-Pradesh (India).

E-mail: ChaurasiaAkhilanand49@gmail.com

is performed in cases where ante mortem records are not available. The post mortem dental identification of such individuals is done by other characteristics of individuals to narrow the search for the ante mortem materials [3]. The scientific advent of forensic odontology as a unique discipline has been attributed to Dr. Oscar Amoeda who identified the victims of a fire accident in Paris in 1898 [4]. The key advantage of using dental evidence in identification of individuals is that dental tissues are well preserved even after death. The dental status of an individual changes with passage of time throughout the life. The data regarding decayed, missing and filled teeth is measurable and can be compared at any point of time [5]. In the last half-century, forensic odontology has made great strides and developed as a separate specialty. The soul of forensic odontology relies in sound knowledge of forensic odontologists related to dental anatomy, histology, radiography, pathology, dental materials, and developmental anomalies [6, 7]. The identification of individuals depends on comparative analysis between known characteristics of a missing individual (ante-mortem data) with recovered characteristics from an unknown body (post-mortem data). Identification of the deceased individual is most commonly achieved by a relative visually or a person who knew the deceased person during the life. The individual

identification is performed by characteristics of the face, body features or personal belongings. However this method of identification is considered as undesirable and unreliable when the body features are lost due to post / peri-mortem changes [8]. Disaster victim identification is an intensive and demanding maneuver which needs multi-disciplinary approach. The forensic dentist plays an important and key role in the disaster victim identification process. It involves the collection and digitization of ante-mortem and post mortem data followed by search for best possible matches by central computer database [9].

There are several methods which are used as tool in identification of diseased individuals in forensic odontology.

Postmortem Dental Profiling

The central dogma of individual dental identification consists of comparison of postmortem and antemortem dental records which consists of written notes, study casts and radiographs. The service of forensic odontologist is highly needed when there is unavailability of ante mortem dental records. The forensic dentist plays an important role in narrowing the population pool to which the deceased is likely to belong. In this way forensic odontologist helps in localizing and quantifying ante-mortem dental records [2]. This process is known as post mortem dental profiling [3]. A postmortem dental profiling retrieves all information related to deceased's age, ancestry background, sex and socio-economic status.

Radiographs

The radiographs has key role in both ante-mortem and post-mortem dental identification. They are very valuable tool in identification of individuals where ante-mortem records are not available. The radiographs help in identification by changes in morphological and pathological features, crown and root morphology, presence of decayed, missed, filled, and fractured teeth, various stages of wound healing in extraction sockets, degree of root formation and bone trabecular pattern [10].

Age Estimation

Several methods for the age determination from radiographs have been described from time to time. In children and adolescents, age estimations are based on the developmental stage of the deciduous and permanent dentition [11, 12]. Most of these are based on a comparison of the radiographic development of teeth with standard diagrams collected from a large number of persons, usually in a well-defined geographic region [13]. Tooth wear has been widely used as a tool of age estimation.

Rugoscopy

The study of palatal folding is called as palatoscopy. However the study of patterns of the grooves and ridges of the palate to identify individual patterns is called as Rugoscopy. Palatal rugae comprise about three to seven ridges radiating out tangentially from the incisive papilla. Venegas et al described the detail morphology of shape, size, number and position of the palatal rugae [15, 16].

Lip Printing

Lip prints are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of human lip between the inner labial mucosa and outer skin. The study of the wrinkles and groove pattern of lip is known as cheiloscopy [6]. Lip prints are unique and individualized feature like the finger prints [17]. Lip prints are not only useful for individual identification but they are also very useful tool in sex identification of an individual. In a comparative study of cheiloscopy versus palatoscopy for the sex identification, a statistically significant difference was found between males and females for the lip prints while no significant difference was found between them for the rugae patterns [18].

Bite-Mark Evidence

The bite mark analysis or individual bite mark identification is a vital contribution of dentistry to forensic science. The bite-mark pattern is compared with the dental characteristics of the dentition of a suspect. The bite-mark pattern can be retrieved from foodstuffs [19], victim of an assault or homicide depending on the circumstances [13]. Bite-mark evidence can also be recovered from deceased living assailant [20]. The forensic odontologist plays a key role to determine whether the bite pattern is truly the result of teeth biting, a tool, instrument and piece of clothing, any kind of cutaneous lesion, infection or injury. The bite pattern of deceased can be compared with the suspect's dentition for identification purposes [16].

Facial Reconstruction

The ultimate aim of all facial reconstructions for forensic purposes is to recreate an in vitro simulation of an individual when there is no evidence of identification. In absence of any identifying evidence, if there is any sufficient visual resemblance to the missing or deceased person, it may contribute to recognition and identification. With passage of time numerous techniques have been evolved for facial reconstruction onto simulated skull all of which rely on the reproduction of a potentially recognizable face using the published soft tissue thicknesses in different racial groups. The facial model can also be reconstructed using 3D computer technology. Computerized methods for 3D facial reconstruction have been attempted to be established. These methods employ computer programs to transform laser-scanned 3D skull images into faces [21].

DNA Technology

Until the 1980's, the science of identification of individual for criminal cases was based only on serological analyses of protein polymorphism, blood groups and few genetic markers. A new era in development of forensic sciences for human identification started in 1985 with a study conducted by Jeffrey's et al who investigated radioactive molecular probes that could recognize mini-satellites, a highly sensitive region of human DNA that produced a type of DNA fingerprint. In the same year (1985) molecular typing of the genetic material was officially employed for the first time in England by Jeffrey's et al for resolution of immigration problem [22]. Teeth are an excellent source of DNA and it may provide the necessary information for identification of an individual in case of failure of conventional methods for dental identification [23]. In forensic samples the study of DNA (genomic and mitochondrial) is usually performed by short tandem repeat analysis which can be defined as hyper variable regions of DNA that present consecutive repetitions of fragments that have 2 to 7 base pairs [24]. The ease of procedure for extracting good amount of preserved DNA has led to extensive use of teeth in forensic human identification.

Conclusion

Forensic odontology is an emerging branch of forensic science for gathering and evaluating dental evidence in ante-mortem and postmortem cases for identification of individuals in mass disaster and criminal cases in which suspect cannot be identified.

A new era of human identification has started with advancement of technology and awareness which has great impact in jurisprudence and changed the human perspective significantly. In modern age with increasing number of crimes disaster and natural calamities, human identification is of dire need of time. The dental evidence is now considered as important tool and accepted in court of law for jurisprudence. It is now possible to identify sex, age, place of deceased through various forensic odontology investigations. But still a lot of work has to be done to combat the necessity of dental jurisprudence as per demand of the time.

References

1. Saxena S, Sharma P, Gupta N. Experimental studies of forensic odontology to aid in the identification process. J Forensic Dent Sci, 2010; 2(2): 69-76.

2. Jones DG. Odontology often is final piece to grim puzzle. J Calif Dent Assoc. 1998; 28: 650-1.

3. Sweet D, DiZinno JA. Personal identification through dental evidence—tooth fragments to DNA. J Calif Dent Assoc.1996; 24(5): 35-42.

4. K. V. Textbook of Forensic Medicine and Toxicology. 2nd ed. Livingstone C, ed. 2002; 71-2 .

5. Nevile BW, Damm DD, Allen CM BJ. Oral and maxillofacial pathology. 2nd ed. saunders, edinburgh; 2001; p775 .

6. Caldas IM, Magalhães T, Afonso A. Establishing identity using cheiloscopy and palatoscopy. Forensic Science International. 2007; 1-9.

7. Rajendran R SB. Shafer's Textbook of Oral Pathology. 6th ed. Elsevier; 2009; p 871

8. Hansen JP. Forensic odontology. Ugeskr Laeger.1969; 131(10): 440-3.

9. Pittayapat P, Jacobs R, De Valck E, Vandermeulen D, Willems G. Forensic odontology in the disaster victim identification process. J Forensic Odontostomatol. 2012; 30(1): 1-12.

10. Sholl SA, Moody GH. Evaluation of dental radiographic identification: An experimental study. Forensic Sci Int. 2001; 115(3): 165-9.

11. Mörnstad H, Staaf V, Welander U. Age estimation with the aid of tooth development: a new method based on objective measurements. Scand J Dent Res.1994; 102(3): 137-43.

12. Gustafson G. Age determination on teeth. J Am Dent Assoc.1950; 41(1): 45-54.

13. Koshy S, Tandon S. Dental age assessment: The applicability of Demirjian's method in South Indian children. Forensic Sci Int.1998; 94(1-2): 73-85.

14. Kvaal SI, Kolltveit KM, Thomsen IO, Solheim T. Age estimation of adults from dental radiographs. Forensic Sci Int.1995; 74(3): 175-85.

15. Ratnakar P. Methods of Identification in Forensic Dentistry. Ann Essences Dent. 2010; 2(1): 26-8.

16. Venegas et al. Palatal Rugae: Systematic Analysis of its Shape and Dimensions for Use in Human Identification. Int J Morphol. 2009; 7(3): 819-25.

17. Utsuno H, Kanoh T, Tadokoro O, Inoue K. Preliminary study of post mortem identification using lip prints. Forensic Science International. 2005; 129-32.

18. Sharma P, Saxena S, Rathod V. Cheiloscopy: The study of lip prints in sex identification. Journal of Forensic Dental Sciences. 2009; p. 24.

19. Aksu MN, Gobetti JP. The past and present legal weight of bite marks as evidence. Am J forensic Med Pathol Off Publ Natl Assoc Med Exam.1996; 17(2): 136-40.

20. Brown KA, Elliot TR, Rogers AH, Thonard JC. The survival of oral streptococci on human skin and its implication in bite-mark investigation. Forensic Sci Int. 1984; 26(3): 193-7.

21. Stavrianos C, Kokkas a, Andreopoulos E, Eliades a. Application of Forensic Dentistry: Part-I. Res J. Med Sci. 2010; 179-86.

22. Jeffreys AJ, Brookfild JFY SF. Positive identification of an immigration test-case using human DNA fingerprint. Nature.1985; 317: 818-9.

23. Pretty IA, Sweet D. A look at forensic dentistry—Part 1: The role of teeth in the determination of human identity. Br Dent J. 2001; 190(7): 359-66.

24. Da Silva RHA, Sales-Peres A, de Oliveira RN, de Oliveira FT, Sales-Peres SHDC. Use of DNA technology in forensic dentistry. J Appl Oral Sci. 2007; 15(3): 156-61.