REVIEW ARTICLE

FORENSIC ODONTOLOGY AND ITS PREVAILING ADVANCEMENT

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ABSTRACT

Forensic odontology is a branch of dentistry which deals with proper handling, examination and evaluation of dental evidence, with proper presentation of dental findings in the interest of justice. Tooth is the hardest tissue in the body and is most resistant to post-mortem deterioration. Dental pattern for each individual is distinct and helps in identification of victims during mass disasters, abuse and crimes.

Conventional methods used in identification are dental record maintenance, dental imaging, bite marks analysis, Cheiloscopy and Rugoscopy. In addition, recent concepts have been introduced such as facial reconstruction, denture identification, DNA profiling, tongue prints and comparison microscopy.

DNA analysis is a technique which involves DNA which is either mitochondrial DNA or genomic DNA. The common methods used in DNA analysis are PCR, restrictions fragments length polymorphism method, short tandem repeats typing, etc.

Key words: Post-mortem, DNA profiling, Cheiloscopy, tongue prints

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INTRODUCTION

The word forensic is derived from the ancient roman "forum" the home of law, and means 'relating to the law'. In case of disfigured and mutilated body identification, forensic anthropology, forensic odontology, radiology and DNA typing can be used. As tooth is considered as the hardest and strongest structure of the body, dental identification methods plays a major role in this aspect because the dental structures survives even after the postmortem. [1] The dental patterns are unique for each and every individual, even after the major accident, crime, burial, they remain the same. [2] The common methods used for identification are visual identification, personal information, medical information, footprint records, clothing, finger print, DNA profiling and dental identification. The conventional methods that were used in dental identification are data collection and supplementary technologies such as dental imaging technique, bite mark analysis, DNA analysis using oral tissues, Cheiloscopy and Rugoscopy. The prevailing advancement that where, made in the recent years are facial reconstruction, denture identification, comparison microscope and tongue prints.

CONVENTIONAL METHODS USED IN FORENSIC ODONTOLOGY:

Dental record maintenance:
Dental records maintained by the dentist are the essential component and it is the information source for the dentist and the patients in the medico legal, administrative and forensic purpose. The use of dental identification depends on the availability, adequacy, and accuracy of antemortem dental records. The dental record maintained were very useful in many disasters such as the gas explosion in the world trade center disasters 2001, Indian Ocean tsunami disaster in December 2004, Victorian bush fire 2009, Mangalore flight crash 2010, etc. [2, 3]. A dental record includes dental notes, dental charts, radiographs, photographs, models and recently computer-generated dental records play a major role.

Dental imaging:
In absence of previous dental records, the alternate method used is radiographic identification. The radiographic images of the deceased can be obtained and compared with the available antemortem radiographic images of the suspected person. The parameters used to compare the radiographs are shape of the teeth and roots, supernumerary teeth, non-carious lesions, bone resorption, diastema, endodontic treatment, intra radicular posts, intracoronal posts, and dental prostheses. [4]

Bite mark analysis:
Bite mark analysis are used in case of sex related crimes, child abuse cases and offenses involving homicide. The bitten surface is unique with individual characteristic such as fractures, rotations, missing or extra tooth. Male victims are more often bitten on the arms and shoulders whereas females bitten on the breast arms and legs. [2]

Cheiloscopy:
It is the method of identification of a person based on the characteristic arrangement of lines appearing on the red part of lips. According to the groove pattern Tsuchihashi proposed a classification, which includes type 1 to 5. Cheiloscopy and dermatoglyphics have an immense potential in gender determination and identification. [5, 6]

Rugoscopy:
Palatal Rugoscopy is the study of palatal rugae in order to establish a person identity. Variations of rugae pattern can be seen in ethnic groups. It is well protected by the surrounding Para oral tissues such as cheeks, lips,

tongue, buccal pad of fat, teeth and bone even at trauma and high temperature. Muthu Subramanian and colleagues (2005) examined extend of palatal rugae preservation for the use as an identification tool in burn victims and cadavers, thus stimulating forensic case of incineration and decomposition. [7]

PREVELLING ADVANCEMENT IN FORENSIC ODONTOLOGY:

DNA profiling:
Analysis of DNA in forensic odontology is an alternate when the traditional method fails.

Source of DNA: Teeth are considered as a main source of DNA. It is resistant against extreme condition.
Methods to collect DNA from tooth are:
- Crushing of teeth or cryogenic grinding
- Horizontal sectioning of tooth
- Conventional endodontic access [8, 9]

Various types of DNA typing systems:
1. Restriction fragment length polymorphism typing
2. Short tandem repeat typing
3. Polymerase chain reaction
4. Mitochondrial DNA analysis
5. Y chromosome analysis
6. S chromosome short tandem repeat
7. Single nucleotide polymorphism
8. Gender typing [9]

Facial reconstruction:
The property of human identification is the face. It plays a major role in forensic science.

Concept: The mechanical support is given by the skull and the facial appearance is defined by the overlying soft tissues. The thickness of the soft tissue in the landmark of hard tissues leads to generation of metric and non-metric data.

Elements of reconstruction technique: According to Wilkinson C. et al the reconstruction technique has three elements:
1. Anatomical modeling
2. Morphology determination
3. Depiction of resulting face to determination

Methods of facial reconstruction:
- Manual method
- Computer aided method [10]

Denture identification methods:
In edentulous case, only victim's denture remains for identification. The denture are resistant to high temperature and the details remain preserved so it can be used in identification process. [2] The American dental association has specified certain criteria's for denture marking:
- The identification should be specific
- The technique should be simple
- The mark should be fire and solvent resistant
- The denture should not be weakened

- The mark should be cosmetically acceptable. [11]

METHODS IN DENTURE MARKING: (TABLE 1)

Surface making methods: For complete denture	Inclusion method: For complete denture	Oliver's method
- Engraving method - Embossing method - Invisible ink method - Fiber tip pen method - Heaths method - Stevenson's method - Weckers electro pen method - Laser etching method - Onion skin method - Denture bar coding method	- Lose inclusion method - Young's method - Dippenars method - Reeson's method - Clear acrylic T bar method	- Lenticular card method - Bar coding method - Radio frequency identification tag - Lead foil method - Metallic band according to Swedish guidelines - Photograph inclusion method - Min I dent method - Data matrix code - Micro-labeling - Cast embossed identification plate - Ceramic crown engraving method.

Comparison microscope:
The presence and absence of Y chromatin can be confirmed by the examination of the tooth under the microscope provides an accuracy report. For analysis of Cemental annulations in age estimation, the phase contrast microscope is used. The comparison microscope is a device which helps in analyzing the specimen simultaneously. [2, 8]

Tongue print:
The impression of tongue is unique for everyone; they have different shape and texture. The tongue is well protecting by the surrounding hard tissues during trauma. The analysis of lingual aspect of the surface of the tongue can provide valuable information in identifying the person. [12], (Table 2)

CLASSIFICATION IN TONGUE PATTERNS: (TABLE 2)

According to the shape:	According to texture
- square or rectangular - triangular - circular	- Normal - Fissural - Cleft/ bifid - Plaqued - Geographic

Methods: Taking impression of dorsal surface and lingual lateral surface. Then the impression is filled with type 3 dental stone to have positive image for identification. [12]

UPCOMING ADVANCEMENTS UNDER RESEARCH:

Salivary utility in diagnostics, WinID, Stereolithographic printing in forensic odontology, Artificial intelligence in forensic odontology, Laser microetching in metal prothesis for personal identification, reflected ultraviolet-photograph in forensic odontology, Virtopsy in forensic odontology, Forensic bio-robots, Racemization of aspartic acid, 14C levels, Circular excision of T-cell receptors, etc. [13]

CONCLUSION:

The upcoming branch of dentistry is forensic Odontology with a lot of scope in future. The unique identity of the dental tissue helps in accurate victim identification. The entire dental professional has the responsibility to acquire knowledge in forensic dentistry to help in victim identification. Every dental professional should maintain dental records of their patients. Further research has to be encouraged in the discipline of forensic dentistry which will pave ways for establishing newer techniques in human identification.

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