Your Teeth Your Unique Identity: Forensic Dentistry (A Review)

Gurpreet Kaur*

Senior General Dental Surgeon, Bahrain

Corresponding Author: Gurpreet Kaur, Senior General Dental Surgeon, Bahrain.

Abstract

As per FDI Forensic Odontology is a branch of dentistry which in the interest of justice, deals with proper handling and examination of dental evidence and with proper evaluation and presentation of dental findings.

Human dentition is never same in two individuals. Morphology of teeth varies from person to person. Human dentition is considered as hard tissue analogue to the fingerprint. It is almost as unique as finger print. Teeth are excellent source of DNA because of their resistant against environmental attack. The biological link may provide the necessary information when conventional methods fail. Teeth are most indestructible components of the human body. Dental hard tissues (Enamel) are highly resistant to environmental effects like decay, fire, natural calamities. Usually, they are only remains after extended period of burial.

Body of the victim during violent crimes, natural disaster, road traffic accidents, and work place accidents can be disfigured to the extent that identification by a family member is neither reliable nor desirable. Same way body of people who are deceased for some reason before discovering them and those found in water also have unpleasant difficulties in identification.

In these cases where habitual methods of identification such as finger printing, visual recognition cannot be performed, dentist can play crucial role in identification of deceased.

Forensic dentistry mainly aims:

1. To identify the deceased by identify mutilated, burned, decomposed or skeletonised human remains from mass disaster (Air plane crash, natural disaster war, organised crimes).

2. To identify an assailant who has used his/her teeth as weapon by analysing and/or identification of bite marks (i.e. sex abuses, homicides and other types of child abuse).

3. Analysis of facial injuries.

4. Litigation related to malpractice.

5. Age estimation.

Keywords: *Odontology; Tooth Prints; Ameloglyphics; Bite Marks; Tongue Prints; Rugae; Rugoscopy; Chelioscopy*

Abbreviations

FDI: Federation Dentair International (World Dental Federation); DNA: Deoxy Ribonucleic Acid; USA: United State of America

Introduction

History

Dr. Oscar Anoedo Paris is known as father of forensic Odontology. Forensic dentistry was dormant till 1960. In 1968 FDI recommended to include forensic Odontology in teaching curriculum. First functional instructional programme of forensic dentistry was given in USA at the armed forces institute of pathology [1,2].

Forensic Odontology had played important role historical cases of identification.

- The one of earliest use forensic dentistry in 49 BC was by Agrippina who identified her rival Lollia Paulina by her unique discoloured front teeth [3,12].

- In 1775, Paul Revere a dentist constructed a silver wire bridge for Warren who was his friend and a medical practitioner and later killed by British. He was recognised by his Ivory tooth work by Paul Revere. This was first case of forensic dentistry identified by a dentist and presented by Luntz [4,5].

- For Adolf Hitler who died in 1945 his dental findings were compared with ante mortem dental records and photographs to identify him [6,13].

- Ted Bundy a psychopath serial killer in 1970s was identified by his bite marks and sentenced to death [7].

- Dentition was an important lead in identification of Zia Ul Haq, former president of Pakistan who was dead in air plane crash in 1988. First dental identification for mass disaster was done in Paris in fire accident in charity bazaar [8,12].

- Rajiv Gandhi, former prime minister of India who was dead in terrorist attack in 1991 was identified by his dentition [9].

- Forensic Odontology played a major role in identification of victims of Mass disaster September 11 2001in USA [10].

- In Indian Ocean tsunami disaster in December 2004 Forensic Odontologist along with other forensic scientist helped in victim's identification [11,12].

- Bite marks were one of the main evidences to identify suspects by Dr. Ashith Acharya in Nirbaya sexual assault case (India) in December 2012 [14].

Importance of forensic dentistry

There are three fields of activity in forensic dentistry:

1. Non criminal or civil: Malpractice and other aspects of fraud and negligence in which compensation is sought. Identification of dead or living also comes in this category.

2. Criminal: Bite marks identification that may be present on victims, or on some inanimate objects such as food items.

3. Research field: Encompasses academic courses for undergraduate and postgraduate training, teaching forensic dentistry to police and new research workers.

Methods of identification

- **Teeth:** Dental filing can be used to identify race, gender, occupation, socioeconomic status and age of victims [16,17]:

- **Race:** As per Anthropologist there are mainly three kind of human race Caucasus, Mongolian and Negroid in the world. These races can be identified by their unique mid facial skeleton features which includes nose, mouth and check bones.

- **Gender:** Forensic Odontologist with the help of other forensic scientists can identify the gender of deceased. Different topographies of teeth like crown shape, size, and root length of tooth are physiognomies of the gender and there are also difference in skeletal patterns and their qualities in different genders. The presence of non compliance Y chromatin and DNA analysis also confirm the gender of deceased.

Pretty and Sweet states that Teeth are excellent source of DNA. This facilitates comparison with a known biological ante mortem sample of deceased such as hair from a comb, epithelial cells from a toothbrush or biopsy specimen. DNA pattern can be compared to the parents or siblings thus facilitating positive identification [15].

Methods of DNA extraction from teeth:

- **Cytogenic grinding:** This method is given by Sweet and Hildebrand. In this tooth is cooled in extremely low temperature using liquid nitrogen then mechanically crushed to fine powder and DNA is extirpated. Sufficient amount of DNA is obtained from intact, carious as well as from root filled teeth. Disadvantage of this method is tooth need to be crushed completely.

- **Pulp extirpation:** This method is given by Trivedi and co-workers. In this method pulp is extirpated with fine needles and tissue debris is flushed. In this method morphology and physiology of teeth are preserved.

Age: Tooth development is a crucial technique of determination of chronological age. There are different methods of chronological age estimation for accurate results:

- **Eruption sequence:** Human dentition follows steady and anticipated developmental sequence starting from four months in utero to mid thirties of life when formation of all permanent teeth are complete.

- **Dental imaging:** Age estimation with dental imaging assessment not only less invasive method then osseous analysis but also it gives more reliable, accurate and even superior results in adults. In this method age is estimated by progressive physiological and degenerative changes which occur in dental tissues with age. Pulp dentinal complex shows modification with age, pulp size decreases with age due to continuous deposition of secondary dentin.

- **Crown and root:** Age determination also formulated on basis of degree of crown root formation, (paediatric patients +/- 1.5 years accuracy) their colour, attrition, their resorption, root radiolucency etc.

- **Socioeconomic status:** Dental treatment is an important tool in identifying the socioeconomic status of victim or suspect. Filling material, crowns, implants and other expensive treatment can reveal the socioeconomic status of human remains.

Palatal rugae (Rugoscopy): This method of identification is used in edentate individuals. Palatal rugae are ridges on anterior part of the palate on either side of mid palatine raphe behind incisive papilla. These are unique for every individual and resistant to decomposition to some extend and seldom change their shape and can reappear after trauma and surgeries. These can be directly compared with palatine rugae impressions on old dentures (most accurate), by computer software (with 97 % accuracy) or by superimposing tracing from plaster models [22].

Bite marks: According to Sweet and Pretty the shape, size and pattern of the biting edges of the anterior teeth in the upper/lower dental arches are considered to be specific to an individual thus can be used as one of the biometric measure in individual identification [19].

Cheiloscopy: It is a forensic investigation technique that deals with the identification of human being on lips traces. Lip pattern depends whether the lip is closed or open. Lip prints are usually left at crime scenes and can provide direct link to suspect. Lip prints have to be obtained within 24 hours of the time of death to prevent erroneous would result from post mortem alteration of lips [20,22].

Ameloglyphics (Tooth prints): Tooth prints are unique for every individual and can be used as forensic tool for identification of an individual. Ameloglyphics is the study of enamel rods end pattern. Enamel rods are basic structure unit of enamel known as enamel prisms. The uniqueness of these tooth prints may be utilised as a successful identification tool in forensic science. As per Manjunath these are important tool in identification of burned bodies where enamel resistant to fire [18,21,32].

Tongue prints: The tongue is only organ of human body which can be drawn out for inspection and palpation. The dorsal surface of tongue is unique for each and everyone and lingual impression is consistent and physiological texture is invariable. Moreover, it is surrounded by oral cavity (lips, buccal pad of fat and teeth) so protected by external environment. The analysis of lingual morphological aspect using alginate impression moulding technique is most reliable technique to duplicate most minute details which can be used in forensic evidences for identifying an individual with predictive values. Some unique features even can help in gender identification [35].

Radiographs: They are only measure to identify victims where other measures failed due to complete destruction of human remains. Root features of teeth are more reliable then crown of tooth as they go under less morphological changes due to protected environment. Apart from routine radio graphical features of teeth, healing of extracted tooth socket, bone trabecular patterns, jaw morphology aids in identification. Dental features change over the period of time due to morphological changes with age and pathological changes, so they are less reliable then other biometric tools but only measure where other identification methods not available [20,31].

Photographs: Photographs are valuable aids in forensic dentistry. They can be used where language comes as a barrier. Dentist often takes Pre treatment and post treatment photographs which are valuable aid in human identification. While taking photographs camera should be perpendicular to long axis of the object. As photographs are two dimensional images of three dimensional objects. A proper ABFO scale no 2 should be used to take them for accuracy [20,34].

Limitations of the Study

Forensic Odontology mainly depends on ante mortem records. Teeth morphology can change after taking ante mortem records due to extractions, exfoliation, periodontal disease, attrition, abrasion, parafunctional habits and due to age related changes etc. thus there are limitation in human remains identification. Tooth prints are unique for every individual but fractured, decayed, attracted abraded teeth cannot be included in this method.

Kapail., *et al*. Have observed denture wear, tooth malposition and palatal pathology can cause alternation in palatal rugae pattern leads to false results. Thomas., *et al*. stated rugae patterns are genetically determined so rather can be used in population identification than in individual identification. In case of fire accidents rugae often destroyed after this stipulated period, moreover decomposition and skeletonization can occur in less than six weeks in summers and four months in winter so Rugoscopy is less reliable biometric method then other methods [23-25].

Lip prints should be recorded within twenty four hours of death to prevent erroneous records due to post-mortem alternation of lips. Lip patterns depend on open/close mouth position. In close mouth position well defined grooves are seen but in open mouth grooves are ill defined and difficult to interpret. Any pathology on lip, loss of anterior teeth support, any debris or thick layer of cosmetics (lipstick) can alter the lip prints. Although Lip pattern are unique for an individual but when lines are not clear individual identification on this trace is very difficult unless there is unique character is present like scar or cleft [26,27].

Bite marks on skin is of prime importance but need to be weighed with caution as due to its intrinsic property of distortion it leads to considerable variability. More over skin is poor impression medium. Bite marks in shape and colour can change in both living and dead in relatively short duration so should be recorded at the earliest after the incident. Minimum four to five teeth have to be present for complete bite mark analysis. Incomplete bite marks are inconclusive. These can be associated with post trauma oedema, haemorrhage. Sometime ECG electrodes pattern can looks like bite marks and need to be differentiated [28-31].

Conclusion

Forensic Dentistry plays a crucial role in circumstances where habitual methods of identification such as finger printing, visual recognization cannot be performed. The unique nature of our dental anatomy and placement of custom restorations ensures accuracy when techniques are correctly employed. Forensic dental identification mostly depends on availability, adequacy and accuracy of ante mortem dental records. Dental records that are used to provide to patients and kept for clinic records during their optimal dental services could be very beneficial in medico legal, administrative and forensic purposes therefore all forms of dental treatments should be recorded and kept properly. It's a duty of dentist to maintain proper dental records of all the patients. A dentist should document any Perioral abnormality, scar or bruising as it could be of par importance in legal or accident investigation. Forensic dentistry has established itself as an important and indispensable support in medico legal matters.

Source of Support

Nil.

Conflict of Interest

None declared.

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