

Forensic Dentistry: An Aid in Criminal Investigation

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ABSTRACT

Forensic dentistry is an upcoming branch of dentistry that utilizes the dentist's knowledge to serve the legal system. Around the world, the dental practitioners qualified in forensic science are playing as a key part in the identification of human for criminal purposes or in any accidental case, etc. The dental structure in any individual apart from providing aesthetics, and functionality in a sense of speech or mastication also gives a unique identity to that individual. This uniqueness of individuality allows the Forensic odontologists to form a strong opinion of association in cases of identification and bite mark analysis. These analysis thus helps in identification of the main culprit with the help of evidence related to dental structures. The increasing number of criminal activities such as child abuse, domestic violence, rape cases gets the long-term delay in the legal systems due to unavailability of the evidences. So the forensic odontologists along with other health care providers help in detection, identification, and management of the cases. So a dental practitioner should be aware of the legal technicalities of the cases and should be decisive in referring the cases to the appropriate authorities for the required action.

KEYWORDS: Forensic, Dentistry, Criminal, Investigation.

INTRODUCTION

Forensic Odontology or forensic dentistry by Keiser-Neilson in 1970 is defined as "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 display of the dental findings".¹ Forensic odontology has three major areas namely:

- The inspection and analysis of trauma to jaws, teeth, and oral structures.
- The inspection of marks to eliminate or identification of a suspect as the executioner.
- The inspection of dental (involving all forms of dental restorations and prosthesis) from anonymous persons or bodies.¹

Human identification relies on the quality of dental records. Forensic odontology wasn't there prior to 1897 when doctoral thesis entitled "L'Art Dentaire en MedecineLegale" written by Dr. Oscar Amoedo describing the utility of dentistry in forensic medicine with particular emphasis on identification. Dental identification plays an indispensable part in many conditions such as natural and man-made disaster specially aviation disaster. Dental structure are firm and most resilient tissues of the human body.²

Forensic Odontology to serve the judicial system by the help of dentist's knowledge. In forensic science, the

dental practitioners are giving their opinion in relation to bitemarks interpretation, craniofacial trauma and malpractice and human identification. The forensic experts are to collect, preserve and analyze the evidences, and then to present the results to the legal authority in a report form. Forensic Odontology show topics that can be classified: human identification and injury analysis. However, Forensic Odontologists have shown issues in relation to child abuse and protection of human rights, professional ethics and domestic violence.³

Radiographs are an essential part of dental practice. Intraoral and extraoral radiographs are an essential part in clinical dentistry to diagnose dental disease and treatment planning. X-ray films are part of practice used mainly in identification and age estimation in forensic odontology. The dental records involve dental X-ray films, statistical dental charts, and written records.⁴

Typically, this effort includes the cooperation & coordination of law enforcement officials, forensic anthropologists, forensic odontologists, forensic pathologists, & other specialists as per required. Bite marks also play important role in detection of criminals or the culprit.⁵

Forensic odontology comprises the inspection, management, analysis and presentation of dental evidences or proofs in civil or criminal hearings. The

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subject can be separated roughly into 3 major fields of activity: civil, criminal and research.⁶

HISTORY

There were historical evidences that prosthodontic appliances help in identification of individuals.²

Forensic odontology has been with us since the beginning when, the first human Adam was convinced by Eve to have put a 'bite mark' on apple. The first reported case in 1453 in dental identification was that of the 80 years old warrior John Talbot, Earl of Shrews bury, who was traumatized in the Castillon battle. In 1897 a paper was presented by Dr. Oscar Amoedo entitled, "The role of the Dentists in the identification of the victims of the catastrophe of the Bazar de la Charite, Paris in 4th May, 1897", at the international Medical Congress of Moscow. The bodies of those killed in the fire were brought to the industrial place for identification. Visual identification is inappropriate as many were destroyed and burned severely. The first treatise on forensic odontology was written by Dr. Oscar Amoedo in 1898 and was entitled *L'Art Dentaire en Medicine Legale*. Dr. Oscar is also known as father of Forensic Odontology.⁵

The forensic science helps in identification of criminal cases was established only on blood groups, serological analyzes of protein polymorphism, and some genetic markers up to 1980's. At the beginning of the twentieth century, forensic examination of biological samples initiated by application of the ABO blood group system in relation to crimes or human identification. A significant phase in the development of forensic sciences conducted at human identification started with the publication of the papers by Jeffreys et al (1985), who investigated radioactive molecular probes that could identify certain highly sensitive regions of DNA (*mini satellites* in human genome) that processed a type of DNA "fingerprint". For the first time in England, molecular typing of the genetic material was officially utilized by Jeffreys et al. (1985), for determining the immigration problem.⁷

In forensic DNA system, the DNA profiling is mainly used in human identification, criminal cases as well as paternity testing worldwide.⁸

FORENSIC SCIENCES ORGANIZATIONS

Three major forensic dental organizations are taken in the North American Continent. The American Society of Forensic odontology was regulated by Colonel Robert Boyers, and then chief of Dental & oral pathology division at the Armed Forces Institute of Pathology (AFIP) in Washington, D.C in November, 1970. The Canadian Society of Forensic Science (CSFS) is a non-profit professional organization integrated to study and excel the forensic science. It is carried into different sections for forensic examination such as Chemistry, Biology, Medical, Anthropology, Odontology, Toxicology, Firearms, Documents, Engineering.

The American Academy of Forensic Sciences is a multi-disciplinary professional organization that allows the leadership to advance science and its application to legal system. The goal of the organization is to promote and excel the research, education, improve practice, and promote coalitions in the forensic sciences.⁵

HUMAN IDENTIFICATION

With the help of comparison, the identification is established between known aspects of a missing individual (termed as antemortem data) with recovered aspects from an unknown body (termed as post-mortem data). In human identification DNA, fingerprints, dental and medical characteristics are admitted as scientific methods. A dental aspect, the identification methods are easiest and quick to carry out. In Forensic Odontology can still present to establishing the identity by creating a profile of how the deceased person was during life when the dental records are not available in cases. This shows any parafunctional oral habits, socio-economic status, and importantly age of the person at time of death.³

Dental identification of humans occur for a number of different purpose and in varying number of different conditions. Dental identifications have always played an important role in natural and manmade disaster situations and mass casualties normally associated with aviation disasters.⁵

The primary importance of dental identification occurs when the deceased person is, decomposed, cremated or skeletonised. The dental evidence provides main benefit in the sense is that, like other hard tissues of the body, dental tissues are even preserved after death. The combination of decayed, missing and filled teeth is significant and comparable at any fixed point in time when the status of a person's teeth changes throughout life.⁶

DNA IN FORENSIC DENTISTRY

In environmental assaults ensure that teeth represent an excellent source of DNA material when the dental hard tissues are resilient nature. With the help of biological material can contribute the necessary link to prove identity, when conventional dental identification methods fail. Comparison of DNA from the teeth of an unidentified individual can be made to a known ante mortem sample like stored blood, hairbrush, clothing or a parent or sibling.¹ In large scale, DNA identification is costly, technique sensitive, and logistically difficult in application. DNA identification should not be examined as a first live method of identification, but preferably should only be carried out when dental methods, fingerprint, physical methods have been failed.²

By comparing victims' DNA profiles with those of relatives when the DNA analysis has been utilized in a number of large accidents to relate body parts.⁵ Main exogenous factors that may control the retrieval of information from body remnants and limit the processes of human identification are the components related to

fire, such as flames, heat and bomb blasts. In this way, the teeth play a key role in identification.⁷

In the tooth, the rich sources of DNA are dentin and pulp which can be extracted. Total extracted genomic DNA from a dental sample may range from 6 µg to 50 µg DNA. Sweet stated that the PCR (polymer chain reaction) method enabled separation of an individual from another, with reliability level of about 1 ng (one one-billionth of a gram) of the target DNA.⁸

BITE MARK ANALYSIS

Bite marks can be due to brawl between adults or kids, as a part of sexual or physically attack by an adult on a child, in an attempt to rape where bitemarks are likely to be seen on the breasts and even on other body parts. The marks can be of varying degrees of extremity, ranging from a mild marks over the tissues to deep perforation of the skin, and may be found on body parts such as breasts, abdomen, shoulder, face/head, buttocks, female genitalia and upper extremity. There is a one feature of forensic odontology is bite mark examination which require an instant response by the forensic dentist. The marks disappear quickly, both in the living and dead, changing appearance in within the span of hours and being late in examining may lead to loss of evidence.¹

Those patterned injuries (bitemarks) they help in reorganizing past events that adjoined the biting process because they are useful to legal authorities. For an instance, bite mark might reveal something about the criminal purpose of the executioner, whether sexual attack, child exploit or other form of assaults between the culprit and the victim. Forensic Odontologists can help in identifying the person responsible for the bite marks by differentiating the measurements and the locations of teeth marks in a bite mark with those of the suspect.³

The term 'bite mark' is being used in this branch significant that the marks are the result of the tooth impression in different materials. Bite marks can be found in foodstuffs, flesh and less oftenly in a variety of other materials.⁵

By variation in arch alignments and specific tooth, morphology helps in animal bites are usually distinguished from human bite injuries.⁶

AGE ESTIMATION

The age of an individual is decided by a number of medico-legal reasons. Dental structures can provide useful to the individual's age. The analysis of tooth development can help in determining the age of the child. Dental structures can provide measure to the individual's chronological age.¹

The age estimation for forensic purposes by the determination of D- and L-aspartic acid content from teeth. It was first initiated to evaluate the age from tooth enamel and later from dentin and cementum. As the racemization reaction advancement is more rapidly

reported in root than in the crown when dentin seems to be most definitive.⁵

Small changes in tooth formation and eruption among persons has made a dental estimation of chronological age as the primary method of age determination for younger persons. Such determinations are also established on the degree of formation of root and crown, eruption age, and the primary and adult dentition periods.⁶

LIP PRINTS

Cheiloscopy is termed as the study of lip print. The importance of cheiloscopy is associated with the fact that lip prints are specific to one person, except in monozygotic twins. Lip prints can be used to confirm the presence or absence of a person in any scene of a crime and can be involved in the identification of the definite person. The morphological wrinkles and grooves on labial mucosa termed as sulci labiorum forms the lip prints and the study of which is termed as cheiloscopy.⁵

RUGAE PRINT IDENTIFICATION, ANALYSIS AND COMPARISON

The pattern of these rugae can be used as definitive method in post-mortem cases and is considered special to an individual. The morphological position of the rugae inside the mouth surrounded by other oral structures keeps them well-protected from high temperatures and trauma. Thus, they can be used definitely as a reference landmark during forensic identification.²

Dental evidence can be used as the sole method of identifying a deceased person. The palatal rugae may be examined as an alternative source in case the *finger prints* or dental records poses the problem in the identification of an individual. Palatal rugae in every individual maintain the shape and consistency throughout life.⁵

DENTURE IDENTIFICATION

Marking dentures has been well described as a useful support in the identification of the following: Victims of fatal accidents, misplaced dentures in hospitals, nursing homes, as well as patients suffering from any psychiatric problems such as traumatic or senile loss of memory.²

Labelled dentures have a great support in the identification of individuals. Unlabelled dentures have been recaptured from patients, then fitted to casts maintain by the treating dentist or lab, and is opted for a method of identification.⁵

SEX DETERMINATION BY DNA AND TEETH

Sex is the first step of characteristic identification in forensic science. The recent advances in gene analysis techniques, sex determination methods using X and Y chromosome DNA analysis have been evolved.⁵

DOMESTIC VIOLENCE AND CHILD ABUSE

Child abuse is a non-accidental trauma tried on a child by a caretaker. In such cases, the head and facial areas are frequently offended. These areas are approachable, and the face and mouth are analyzed mainly. In abuse cases, human bite marks are mainly seen and followed by other injuries. Those found in infants are on different locations from older children or adults. Bites from adults will often only mark one arch while a child who has bitten will frequently mark with both arches.¹

The WHO differentiates four types of violence; sexual, neglect, physical and psychological. All forms of violence can exhibit in the oro-facial region. Prevalence of physical violence, due to maxillofacial injuries, ranges from 3.3% to 41% in different countries.³

The dentist should be informed of child, elderly or spousal attack when with unusual oral injuries, in cases of persons with accompanying head or body injuries. Injuries due to exploit can exhibit in the oral-facial region includes traumatized teeth, lacerated labial or lingual frenum, fractured maxilla or mandible, missing or displaced teeth, and scarred lips.⁶

DISASTER VICTIM IDENTIFICATION PROCESS

Dental identification has been assessed as one of the primary identifiers in the INTERPOL disaster victim identification protocol. The dental structures and dental restorations may be the only parts of the body that are ruined and can be used for detection. When ante-mortem dental records are not obtained and other methods of identifications are not possible, the forensic odontologist may help in identifying the relatives of to whom the deceased is likely to belong and thus increase the likelihood of locating ante-mortem dental records. The process is termed as post-mortem profiling. A post-mortem dental profile can allocate information on the age, sex and socio-economic status, ancestry background, of the deceased.¹

The four main steps are there; finger printing, body tagging and bagging, forensic pathology, and forensic dentistry. Forensic dentistry team was sub-divided into two parts; dental examination and dental radiology. Prosthodontist can play an important role in forensic dentistry team.²

The identification of deceased victims in those situations necessitates putting a hierarchy system involving an ante-mortem, post-mortem and reconciliation teams. When victim has no dental records were either recognized by photographic superimposition, if a picture of the upper anterior teeth was given or by narrowing down possible matches for the DNA and fingerprint teams through dental aging.³

Determining the nature of the disaster, the forensic odontologist is normally a member of the investigating

team. Mainly, the team includes a coordinator of the team, a pathologist and other specialists with experience associated with the particular type of a disaster, in addition to the forensic odontologist. Physical features are often ruined when involving fire or severe trauma in any situation. Because teeth are calcified structures and can oppose fire as well as other trauma.⁶

CONCLUSION

Forensic dentistry plays a key role in the identification of those individuals who are not identified visually. Denture marking or labelling has been suggested by forensic dentists internationally and not a new concept in either prosthetic or forensic dentistry for many years.² Dental practitioners should be familiar with the forensic application of dentistry. During an identification process, dental records are used to give patients with optimal dental service and beneficial to legal authorities. Therefore, all the form of dental treatments should be documented and kept suitably.³ The importance of forensic dentistry has increased awareness about identification of victims during recent tragedies and past and present situations.⁵

The forensic field has knowledge to give the dental clinician for another reason to maintain legible and legally acceptable records, and support legal authorities in the identification of victims and suspects.⁶ In such cases, the finding of the various studies assessed in this article indicates that the teeth represents an excellent source of DNA, which is saved by epithelial, connective, muscular and bone tissues in case of an incineration. Therefore, dental professionals working in the field of Forensic Dentistry should include these new technologies in their work, as various methods are accessible for DNA extraction from different biological materials.⁷

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