Forensic Odontology: A Potent Tool for Human Identification

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Abstract

Throughout the last 100 years, Forensic Odontology is becoming an integralpart of Medico Legal research which uses dental as well as oro-facial studies to aid in the investigation for judicial system. It can be used in legal investigations which involve the identification of human remains, bite marks and age estimation & the list goes on. Dental practitioners have a significant responsibility of keeping correct dental records and supplying the relevant details to law enforcement authorities'. This paper will attempt to sum up the current positions of Forensic Medicine dental experts.

Keywords: *Age Estimation, Bite Mark, Rugoscopy, Cheiloscopy.*

Introduction

Forensic Dentistry is a fresh increasing segment of Forensic Medicine. The history of Forensic Odontology begins in 49 A.D. with Agrippina, the mother in Roman Emperor Nero. She identified the discoloration of front teeth of her rival, Lollia-Paulina[1]. In 1970, Keiser Nielson identified Forensic Odontology as well as Forensic Dentistry as "branches of Forensic Medicine which, in the interest of justice, dealing with the safe handling and analysis of dental proof & with the proper assessment and presentation of dental results." Forensic science applies to fields of research that can be used in the judiciary and approved by courts and the basic scientific panel to distinguish reality from outright lie[2].

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Individual's identity is the foundation of civilization and has always been of essential value for humanity. It is not only necessary to recognize the individual to ensure proper identification but there are also concerns such as criminal inquiries, insurance claims and legal trials that could only be addressed with a successful identifications. Identifying a missing person will aid family and friends enormously in their dispute resolution process. Finally to sum up, in a current scenario; forensic dentists play a significant role in victim identification, study of biting marks, maxillofacial damage and negligence and so on.

Identification: Dentistry plays a key role in identifying human remains whenever severe tissue damage or loss of a fingerprints database invalidate the use of traditional method. Whenever the dead person is skeletonized, decomposed, burned or disemboweled, the recognition of dental remains is of prime importance. The key benefit of the dental evidence is that it is always retained after death, like many hard tissue. Even a human's teeth status changes during lifetime and the texture of declined, missed and filled tooth is observable and equivalent to any fixed time mark. Teeth seem to be the strongest sections of a bodies and it can be heated to higher temperatures without even any noticeable loss of micro–structural[3,4]. Teeth may remain relatively intact

even after deterioration or decomposition has damaged many soft tissues and skeletal tissues.

Species Identification: Species identification generally does not pose any problems because only uneven evidence is discovered at crime scene. Fragment of lower jaw, impacted teeth or, at the very worst, a tiny portion of a single tooth with no more than a few mm in size may exist. It's been shown recent times which dentinal fluids generate special information about the species. Such fluids can be contrasted with artificial antisera utilizing counter - current electrophoresis. The whole method is capable of identifying species up to twelve months afterdeath[5].

Gender and race determination: Parentage can be obtained by examining a facial anatomy by matching the characteristics of three ethnic groups' with primary features: Mongoloid, Negroid and Caucasoid[6]. Even before ethnic group is described, the sexuality of a person is the most vital of variables to be determined from a skeletal system. If a bone's sex is correctly determined, the identification process automatically removes almost 50 per cent of the total bias. In particular, gender identification is not a complicated question when the full skeleton is present but there are not always bony remains were found in this state. For eg, bones can indeed be fractured into many fragments during aircraft accidents but only a tiny proportion can be made usable for recognition. Techniques, such as DNA analysis of genetic material or molecular DNA for genetic mutation identification and a limited repeated series of DNA to fit such results with presumed serologic research results, are becoming very common.[7,8]

DNA research of dental forensics: Utilizing DNA testing, the sample which is derived from biological matter like blood, semen, hair root, skin, teeth, bone and saliva may be determined. DNA was successfully isolated on both saliva including salivary-stained content in 1992.[9] Saliva includes sloughed epithelialcell from the internal layer of a lip and mucous membrane; It is probable DNA reference.[10] Multiple enzymes are found in saliva from a multitude of outlets. There are Streptococcus salivarius & Streptococcus mutans in the saliva as well as on the teeth. In the science of polymerase chain reaction (PCR), a streptococcal DNA sequence gives us a way of distinguishing the bacterial composition through bite mark and it can be compared specifically with those in the teeth.[11] The dental pulp taken from given tooth specimen may be used to test DNA. Latest tooth test may be considered to have better sources for blood group determinations. The involvement of ABO blood categorizing antigens in hard and soft oral tissues allows us to determine the typing of the blood group and help identify a highly decapitated body. However, The impact for proteolysis, starvation and lack of pulp antigens or even a higher amount of overseas antigen-borne defects on root canal teeth that result in variations throughout the analysis.[12] Whittaker as well as Rawle endorse that even for a duration of 1-6 months after removal, the antigenicity of crushed dentin as well as cement of extracted human teeth remains unchanged regardless of social circumstances.[13]

Facial Reconstruction and facial superposition: When the post mortem description doesn't really elicit tentative recognition of the deceased, it may even be necessary to recreate the image of a person throughout lifetime. That's the duty of forensic experts who are using the oral image to support recreate their facials. The need for pre mortem images to enable facial superposition of skeletal and dental characteristics has been used for verification purposes. The procedure demands that appropriate perimortem images showing the dental be made available. Assigned work and distortion also place problems in placement of a pictures[14].

Determining the age based on the dental records: The assessment of age forms essential portion of forensic dentistry. Human dentition continues to follow the consistent and sustainable pattern of development. Once all the permanent teeth are fully developed,use of X rays is reflective of processes involving findings from distinct cell mineralization stages. These determinations are often used mostly on level of roots & crown structure development, eruption stages.[15] Children's age could be obtained by evaluating the growth of the tooth as well as consequent compare with the growth graphs, generally to a consistency of about 1.6 year. Usage of the third molar attrition and growth has been proposed as a means for aging for all those persons over the age of 18 and both are ineffective. The use of attrition and development of the 3rd molar have been suggested as means of ageing for those individuals over 18 years of age, but both are unreliable. New strategies such as aspartic racemization and transparent dentin have also been suggested and also have proven highly effective in the assessment of adulthood.[16,17] Two factors which can be used to determine age in adult are the evaluation of a pulp cavity quantity as well as the 3rd molar of growth. The decrease in the volume of the pulp cavity arising

from either a deposit of secondary dentin with ageing as measured by radiology can be used as a guideline for estimating an individual's personal age.[18,19,20]

Teeth image matching via cone beam computational tomograph & X-ray micro-focus CT: Beam of the cone[21] Computed Tomograph(CT) and X-ray micro- focus CT can also be used on the proportion of pulp as well as teeth volume.[22] X-ray offers low-resolution, two dimensional information whereas cone-beam CT technique enables the extracted tooth's root canal to be constructed in three dimensions. It appears to work with much the same monitoring concept as used in medical computed tomography (CT); even then, order of magnitude greater was its high resolution. A coronal pulp cavity proportion is indeed a useful measure for age assessment in the forensic context, particularly in persons with different datasets. The coronal pulp cavity ratio is a reliable biomarker for age study in the forensic control, especially in the living individuals of unknown information.[22]

Radiographic Examination: Radiograph and dental cast are valuable medico legal recording devices. Through diligent documenting and written explanations of a tooth structure as well as radiographs, the forensic odontologist provides the post mortem documents. Radiograph must be labelled with holes to prevents ambiguity-one gap in ante mortem film with double holes in post-mortem films.[23] By recording a dental identity a variety of solutions have been proposed. The US forensic dentistry board recommends that some of these are restricted to just the four main conclusion:[24]

- **Accurate identity:** Ante- as well as post-mortem information fit in great detail, without any unexplained differences, to determine that they have been identical to each other.
- **Probable identity:** Ante-as well as post-mortem information have similar characteristics however it is not able to determine the identification confidently because of its consistency from either the post-mortem remain or even the ante mortemproof possible to establish the identity positively.
- **Lack of evidence:** The information available is inadequate to provide the foundation for just a summary.
- **Exclusion:** The information from ante-mortem and post-mortem are obviously incoherent.

Bite mark evidence: Biting is always a symbol of an offender trying to ensure maximum dominant position.[25] Bite mark consist mainly of surface deformation, and/or subsurface hemorrhage, or skin bruise due to biting.[26] Bite mark analysis is one element of forensic dentistry which requires the forensic dentist to respond immediately. The bite mark may result from either a physical alterations in a channel triggered by teeth interaction, or from a representational sequence remaining during an entity or tissue by either a human or animal's tooth structure. The markings, individual or numerous in nature, can range in intensity, varies from minor tissue creating to extreme epidermis and dermis disruption.[27] To prevent inconsistency and improve the quality of bite marks analysis, the American Board of Forensic Odontologist (ABFO) has developed a manual on bite mark technique to acquire and maintain the mark. The advice is not really a directive but a compilation of approaches universally acknowledged.[28] An exact digital file with a one to one move to clear sheet or acetate paper are invaluable for capturing a bite marks. Bite trauma rinsing is critical in recovering proof of residue. Wherever necessary, stain of saliva or human tissue must be obtained for just a DNA evidence.[29] The investigation of an identification of bite mark and lip print, that can be created in sexually and nonsexual attacks, murders, as well as in non biological material and artifacts left in scene of crimes, includes the use of advanced photographic technique or even electron microscopy. In these procedures, careful selection and handling of information is necessary in order to ensure that the chain of evidence meets legal criteria for its appropriateness of court evidence.[17] Process of Healing

The recovery process of bite mark may be helpful in assessing a period of a bite marks, is applied prior to the time of deaths in situations where suffocation has caused death. The discoloration of a bite marks compared to the redness of the bruises also on neck suggests the duration of the imposition of a bite marks prior to the assassination.[30]

Recent advances in forensic dentistry:

Rugoscopy: Palatal rugae comprise about three to seven ridges radiating out tangentially from the incisive papilla. These ridges can be classified as curved, straight, wavy and branched. The pattern of these rugae is considered unique to an individual.[31] Identification is not possible, as in edentulous mouths, palatal rugae can be used as a supplement. In case of teeth loss, due

to reasons such as trauma, palatal rugae pattern serves as an alternative method for identification because of its uniqueness. As rugae is internally placed in the oral cavity and is protected by tongue and buccal pad of fat, it remains undisturbed from heat and other assaults. Rugae patterns change with age and other environmental influences such as orthodontic movements, tooth extraction, cleft palate surgery, periodontal surgery and impacted canine eruption. Materials and Method used to analyze the rugae patterns includes, photographs and impression of maxillary arch, computer software programs (for e.g., RUGFP-ID), calcorrugoscopy or overlay print, stereoscopy (through which three-dimensional [3D] image of palatal rugae can be made), stereophotogrammetry (which is comparatively accurate).[32,33]

Cheiloscopy: Cheiloscopy is a forensic investigation technique that deals with identification of humans based on lips traces. Lip prints have to be obtained within 24 hours of time of death to prevent erroneous data that would result from post mortem alterations of lip. Lip print pattern depends on whether mouth is opened or closed. In closed mouth position lip exhibits well defined grooves, where as in open position the groves are relatively ill defined and difficult to interpret. The foundations of cheiloscopy, however, are the same as that of dactylography, that is to say, lip prints are invariable, permanent & allow establishing a classification[34,35].

Ameloglyphics: [Study of patterns of enamel rods] Ameloblasts lay down the enamel rods in an undulating and intertwining path. This is reflected on the outer surface of the enamel as patterns of the ends of a series of adjacent enamel rods. This study of the enamel rod end patterns is termed as ameloglyphics by Manjunath et al[36].and could aid as an identification tool in decomposed or burned bodies as enamel can resist decomposition.

Conclusions

Forensic dentistry plays an important task in identifying certain individuals those are not visibly or otherwise recognizable. The special design of our tooth development and the positioning of design restorements guarantee precision whenever the rules are employed correctly. Sadly, forensic dentistry also isn't practiced in countries such as India up to the global standards and facilities of forensic dentists haven't been used. The policy will order the Indian Dental Association and other provided by government to guide the country's dental surgeons to preserve the dental data and debris of teeth substance in the case of dental surgeon-treated patient restoration work. Therefore the stored content may be used to identify deceased individual.

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