

Original Review Article

Justice through Forensic Odontology

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Abstract: Forensic odontology is a relatively new science that utilizes the dentist's knowledge to serve the judicial system. The dentists with the thorough knowledge of forensic odontology plays the major role in criminal investigations by giving their expert advice on human identification, bite mark analysis, craniofacial trauma and malpractice. The unique nature of dental anatomy and placement of custom restorations helps the dentists to eventually identify an individual in case of accidents, mass disasters, malpractices, child abuse etc. So the dental professionals should maintain accurate dental records and provide all necessary information to legal authorities for recognizing malpractice, negligence, fraud or abuse and identity of unknown individual. Dentists should also be aware of the legal impact of their strong opinion in criminal, civil as well as research cases.

Keywords: Forensic odontology, bite mark analysis, human identification, dental records.

INTRODUCTION

Forensic dentistry or Forensic odontology is the application of dental knowledge to the criminal and civil laws that are enforced by police agencies in a criminal justice system. Forensic odontology has established itself as an important and often indispensable science in medico-legal matters and in particular in identification of the dead. Much of its expertise is drawn from its clinical experience based on basic research and advances in knowledge in dentistry. There has also been an increase in body of research specifically in forensic dental matters. Forensic dentistry is viewed as the use of dentistry in criminal and civil laws that are employed by police agencies in a criminal justice system. Forensic dentists have significant roles in determining various parameters including age, occupation and previous dental history of unidentified human beings.

The forensic odontostomatological investigation of bite marks is rare among the routine casework in forensic sciences. The term 'bite mark' is used in this field knowing that the marks are the result of the tooth impression in different materials. Bite marks can be found in cases of sexual violence in typical areas of the human body – genitals and breasts, but also in cases of child abuse. In such cases the number of the bites

obtained can be very high. Occasionally bite marks are obtained in various types of food like chocolate, chewing gum, fruits, vegetables etc.

Forensic odontology is a legal field of dentistry, which deals with the proper handling and examination of dental evidence and with proper evaluation and presentation of dental findings in the interest of justice. It includes examining elements of oral cavity such as teeth, periodontal tissues and anatomical structures. There is a broad scope of forensic odontology and each case is different and even the regular case can test dentist's ingenuity in applying his dental knowledge.

Forensic odontology has three major areas of utilization as follows: (Auerkari, E. 2008) diagnostic and therapeutic examination and evaluation of injuries to jaws, teeth, and oral soft tissues (Singh, N. N. *et al*., 2014) The identification of individuals, especially casualties in criminal investigations and/or mass disasters (Balachander, N. *et al*., 2015) Identification, examination, and evaluation of bite marks which occur with some frequency in sexual assaults, child abuse cases, and in personal defense situations.

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PURPOSE OF FORENSIC ODONTOLOGY

Forensic odontologist play a crucial role in seeking justice by providing the legal department the right information in the following cases:-

- Management and maintenance of dental records to assist legal departments with unique dental information in various situations. The data maintained by the dentist act as a key evidence in especially in case of mass fatality.
- Collection and analysis of bite marks from the victim by forensic odontologist can be compared to the suspected person's dentition. Hence can act as solid evidence in justice determination.
- Lip prints (cheiloscropy) can also be used in human identification in case of abuse.
- Determination of gender and race.
- Determination of the age of the person.

CONVENTIONAL CONCEPTS IN FORENSIC ODONTOLOGY

Dental Record Maintenance

Dental records are documents owned by dentists that contain subjective as well as objective information about the patient .every dentist must play his part of recording every oral examination details, study casts, laboratory tests, radiographs and photographs as these records may act as a key evidence in human identification as well as assisting legal department. Nowadays computer-aided technology is popular among dentists for recording and maintaining patient's data as it is easy to store, manipulate or transfer the data to other professionals for consultation or legal assistance.

Bite Mark Analysis

Bite marks have been defined by MacDonald as "a mark caused by the teeth either alone or in combination with other mouth parts". Bite marks are important in criminal cases in which suspect have left marks on victim or any other non-living object such as apple, chocolate bar etc. These marks may be single or multiple in nature, may be of varying degree of severity .In case of non-human bite injuries, marks are identified by differences in arch alignments and tooth morphology. Animal bites often produce lacerations and open wounds.

A typical human bite is elliptical or circular shaped injury that records the specific characteristics of the teeth .it is possible to identify specific types of teeth by their class characteristics and individual features.

Class features-incisors produce rectangular marks, canines are triangular or rectangular based on amount of attrition, premolars and molars are spherical or point shaped.

Individual features-class features may in turn have specific characteristics such as fractures, rotations or spacings etc. Such distinct features make bite marks unique for an individual.

Bite mark examination requires quick response by the forensic dentist as these marks fade away rapidly both in dead and in the living in the matter of hours. So any sort of delay in evidence collection results in loss of valuable information.

DNA Analysis

DNA analysis methods are applied to forensic cases. Forensic dental record comparison has been used for human identification in cases where destruction of bodily tissues or prolonged exposure to the environment has made other means of identification impractical, i.e., after fire exposure or mass disaster. Teeth play an important role in identification and criminology, due to their unique characteristics and relatively high degree of physical and chemical resistance. The use of DNA profile test in forensic dentistry offers a new perspective in human identification. DNA is responsible for storing all the genetic material and is unique to each individual. The currently available DNA tests have high reliability and are accepted as legal proofs in courts. DNA analysis is a new tool used in the field of forensic odontology, gains importance when conventional identification methods fail due to the effects of heat, traumatism or autolytic processes, distortions, and difficulties in analysis. There are many biological materials such as blood, semen, bones, teeth, hair, and saliva that can be used to accomplish DNA typing.

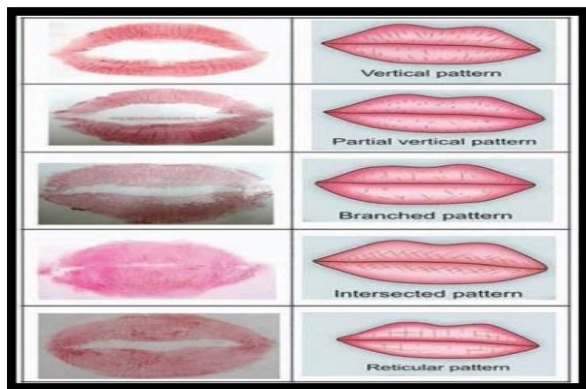
Cheiloscropy

"Cheilos" is a Greek word meaning lip and "scopy" means to examine. Cheiloscropy is the study of lip prints. It is defined as a method of identification of a person based on characteristic arrangement of lines appearing on the red part of the lips or as a science dealing with the lines on the red part of the lips. Cheiloscropy is a forensic investigation technique which deals with identification of humans based on their lip traces. It is defined as a method of identification of person based on characteristic arrangement of lines appearing on the red part of the lips or as a science dealing with lines appearing on the red part of the lips.

Lip prints can be obtained at the crime scene either directly from the lips of the deceased or from the clothing, cups, glasses, cigarettes, windows, or doors. Lip prints have to be obtained within 24 h of death to prevent erroneous data that would result from postmortem alterations of lip. Lip print pattern depends on whether mouth is opened or closed. In closed mouth position, lip shows well-defined grooves; whereas in open mouth position, the grooves are relatively ill defined and hard to interpret. Lip prints can be obtained using cellophane tape or a scotch tape which are pressure sensitive. It is the most interesting method of

human identification in forensic science. Lip prints are unique and remain unchanged throughout the life. According to the classification of lip prints (Suzuki and Tsuchihashi 1970):-

- Class 1-Clear cut vertical grooves that run across the entire lips
- Class 2-similar to type 1 but grooves do not run across the entire lips
- Class 3-branched grooves Y Pattern
- Class 4-intersected grooves
- Class 5-reticular grooves
- Class 6-undetermined



Rugoscopy

Palatal rugae are three to seven anatomical folds called “plica palatine”, the irregular connective tissue located on the anterior third of the palate behind the incisive papilla. As they are stable landmarks, once formed do not undergo any change except in length (due to normal growth) and remain in position throughout person’s life.

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. Some of the methods that can be used to analyze the rugae patterns are photographs and impression of maxillary arch, computer software programs (for e.g., RUGFP-ID), calcarrugoscopy or overlay print, stereophotogrammetry (which is comparatively accurate) and stereoscopy through which three-dimensional [3D] image of palatal rugae can be made.

RECENT CONCEPTS IN FORENSIC ODONTOLOGY

Facial Reconstruction

Forensic facial reconstruction is a three-dimensional recreation of face of an entity from skull remains which adequately resembles deceased person to allow identification of individual. Facial reconstruction

involves an assimilation of anatomy, forensic science, anthropology, osteology and above all craftsmanship to artistically recreate the identity of the deceased. Facial reconstruction utilizes blending of various disciplines including anthropology, anatomy, dentistry and most importantly craftsmanship to artistically recreate facial structures. It plays a major role in forensic sciences because of the fact that if the face of the deceased person remains unchanged, the identity of the person can be easily made without any need for forensic professionals. Forensic dentistry functions only in cases where the face of the person is destroyed by some means. Forensic professionals work for identifying the recovered human remains (identification of whole or fragmented bodies). Most often in major disasters and in accidents, the body of the dead person may be decomposed or skeletonized.

Denture Identification Methods

Victims possessing all or most of their dentition can be identified using their teeth through various methods, whereas those missing all of their teeth lack such information. In such circumstances, the only identifiable remains are the victim's dentures. A denture as such without any markings is of less or no use in forensic dentistry. The dentures can reveal the positive identity of a person, only if it is marked. Labeling the denture is one of the easiest and reliable methods of identification. Methods of denture labeling falls under two categories: the surface marking method and the inclusion method. The surface marking methods include scribbling or engraving the denture and marking with embossed letters. Inclusion methods include metal identification bands, computer-printed denture micro-labeling system, lead paper labeling, embedding the patient photograph, denture bar coding, T-bar, laser etching etc.

Comparison Microscopes

The use of microscopes in forensic sciences has an impact on the accuracy. Examination of teeth under microscope can confirm sex by the presence or absence of Y-chromatin. The phase contrast microscope is useful in analyzing the cemental annulations for age estimation. In case of comparison of the samples, the conventional microscope consumes more time in readjusting the focus and in achieving different views. Moreover, the observer has to rely on memory when comparing two objects. To avoid these problems, the forensic technology has developed a prototype Virtual Comparison Microscope (VCM). The comparison microscope is a device which helps in analyzing the specimens simultaneously. It consists of two microscopes connected by an optical bridge, which has a split view window. VCM utilizes images of deformed bullets, bullet fragments, and various types of rifling from the company's BulletTrax-3D system. With the VCM, it is easy to find significant markings in any direction while maintaining a consistent appearance.

Tongue Prints

Tongue is unique to each person in its shape and surface textures and is the only internal organ that can be protruded from the body and easily exposed for inspection. Use of tongue prints for forensic identification is at budding stage now. For this technique to be successful, the ante-mortem photograph or impression of the tongue should be available. The lingual morphological aspects can be preserved using the alginate molding technique for duplicating the minute details which are unique for each and every individual. The lingual impression, together with its photographic image, may constitute secure methods for forensic dentistry identification. The tongue prints present in the human tongue recently becomes a new member of the biometrics family.

CONCLUSION

Forensic odontology is an upcoming branch of dentistry with a lot of scope for development. At the crime scene, the forensic odontologists play a major role in investigating and interpreting the dental evidence. The unique nature of the dental anatomy and the custom restorations ensure accuracy when the techniques are appropriately employed. A consistent effort has to be made to computerize all the data available to facilitate comparison. Efforts have to be made to maintain the dental records which will serve as ante mortem data. Each dental professional has a responsibility to understand the forensic involvements associated with their dental practice. The practicing dentists and the dental students should be made aware of the available technologies and its use in forensic dentistry. New researches have to be encouraged in the field of forensic dentistry which will pave way for incorporating newer technologies in establishing the human identity.

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