Role and Importance of Forensic Odontology in Identification

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Abstract
The forensic odontologists play a very important role in assisting the forensic team and investigating team in identification of corpuses found in natural disasters and homicides where fragmentation and thermal injuries are common. Since tooth is a calcified structure and is resistant to high or low temperatures and is adequately strong to resist trauma, the teeth maybe the only structures left behind intact in most of the cases.

Introduction

With the world wide increase in the act of terrorism and frequent wars between countries for political reason and to top it all increase in day to day crimes and road traffic accidents, forensic odontologists are frequently called upon to assist in identification of deceased persons. The forensic odontology is a branch of dentistry that deals with the application of dental knowledge to those criminal and civil laws that are enforced by the investigative agencies in a criminal justice system. They assist the investigative agencies to identify the recovered human remains and also help in identification of whole or fragmented bodies. The forensic odontologists also help in determining the age, sex, race and characteristic features in dentition of the culprit.

But however the forensic odontologists cannot by themselves come to a conclusion regarding the identification of the individual based on the limited evidences obtained. A multidisciplinary approach is a must for all cases.
It is a known fact that the identification of the deceased person is most commonly done by the relatives or friends who knew the person well. But in certain situations where establishing identity is not possible because of the physical status of the deceased body, decomposition or incineration, the dental records obtained from the deceased is compared with the records of the individual during life. .
For the comparison of such dental records and for dental identification to be successful, the forensic odontologist needs to get access to the premortem records of the patient and hence it is necessary that forensic odontologist motivates and reinforces the clinician regarding maintenance of proper dental records, notes, radiographs and study models of every patient.

It is accepted that whenever sufficient characteristic features between the premortem and postmortem data are available and are identical with explainable differences if any, then it is considered as a positive identification. Now since the report given by the forensic odontologist will be considered as a legal document and needs to be produced in court as evidence, a standardized identification and classification system needs to be followed. Several authors and investigators have published individual classification criteria for identification. More recently, the American Board of Forensic Odontology (ABFO) and the International Organization for Forensic Odonto-Stomatology (IOFOS) have produced recommended standard definitions[1].

Classification[1]

Table 1: ABFO Classifications

Positive Identification – The antemortem and postmortem data match in sufficient detail to establish that they are from the same individual. In addition, there are no irreconcilable discrepancies.

Possible Identification – The antemortem and postmortem data have consistent features, but due to the quality of either the postmortem remains or the antemortem evidence, it is not possible to positively establish dental identification.

Insufficient Evidence – The available information is insufficient to form the basis for a conclusion.

Exclusion – The antemortem and postmortem data are clearly inconsistent.

Table 2: IOFOS Classifications[1]

Identity established - less than 1:10,000 other persons may fit the details; this conclusion may stand alone as evidence of identity.

Identity probable - the conclusion needs to be supported by other evidence.

Identity Possible - more than 1:100 persons may fit the details; the conclusion needs to be supported by other strong evidence.

Collection of First Hand Information

The usual forensic protocol suggests that the evidence needs to be collected as soon as possible. Hence the forensic team including the forensic odontologist plays a very essential role in data collection before any changes or distractions occur in the crime scene.

In this respect the forensic odontologist takes multiple photographs of the subject's face both before and after cleaning. The photographs are then sent for evaluation and also for recognition by the family members before the inflammation sets in, which hinders identification.

As soon as the body reaches the morgue, the forensic odontologist takes the dental radiographs and photographs and completes the dental chart for the subject.

The forensic odontologist also performs various other important roles of gathering evidences by recording the impressions and preparing models in case of possible bite marks.[2] It might be very important in certain situations to make models of both the victim's and suspect's teeth for clearer understanding of the events that took place during the crime.

In case the suspect of sexual assault is in custody, it is the responsibility of the forensic odontologist to collect saliva samples of the suspect and make swab of the area of the bite mark in the victim so as to compare the DNA.

Age Determination

Forensic odontology helps in the determination of age of persons whose age is under question. The incremental lines that are naturally seen on the teeth when viewed under microscope help in the determination of age particularly in young children. Here the age determination can be assessed by evaluating if teeth are temporary or permanent and from chronology of eruption of teeth.

Radiological examination of the tooth roots is considered as a very useful guide in determination of approximate age of the individual. After the eruption of all permanent teeth, the age determination can be done by examining the fusion of the calcospherites which are the calcified structures that are found in globular dentin.

Based on the severity of attrition, amount of root resorption and root transparency, degree of the secondary dentine formation, cementum apposition and severity of periodontitis, the determination of age of the person can be done.

Identification in Mass Disasters

In mass disasters, based on dental records there is high probability of identification of deceased persons, like in case of aircraft accidents, teeth usually escape injuries and can be of help in identification. Here the identification of the dead persons is possible if their ante mortem records are available.

If the person has died due to severe burns, the body as such may not be identifiable, but examination of teeth may provide adequate information required for identification as they may remain intact because they are well protected in oral cavity. Teeth are strong structures of the body and they resist decomposition. Examination of teeth in such bodies can provide very useful evidence for identification. DNA analysis of tooth pulp in such cases may provide the absolute basis of identification.

The size and contour of the teeth are used by the forensic odontologists to identify the sex of the individual. It is believed that males have larger teeth with prominent cusps and incisal angels, whereas females have comparatively smaller teeth with more rounded incisal angles. Measurements of canines too are particularly helpful in finding out the sex of the individual.

Social status of the individual is indicated from the type and material used for restoration for dental defects. Rich people used gold restorations in olden days and average people used silver restorations.

In present day various new esthetic materials have been incorporated into dentistry and usually only people of higher economic status can afford those. Like for example replacement of missing teeth with implants is a new option in prosthodontics but usually only the rich go for such options.
Developmental features like shoveling, Carabelli's traits, dentinogenesis imperfect, damelogenesis imperfecta help in determination of the race of the deceased person.

Identification based on Teeth Discoloration

In some cases, teeth that are obtained from the corpse or from the crime scene provide a lot of information regarding the individual's identity. In cases involving teeth discoloration, a detailed examination of the teeth by the forensic odontologist helps the investigators in identifying the root cause of poisoning.
Fluorosis is a common condition seen in individuals living in areas that have very high fluoride content in their drinking water. The condition is characterized by the characteristic yellow brown pigmentations on the calcified structures of the body. Fluorosis is commonly identified by the mottled appearance of enamel surface of teeth.
Yellow orange discoloration of the teeth is seen in individuals with high intake of the drug tetracycline during childhood.
In chronic lead poisoning a characteristic blue lead line is seen on the tooth surface.
Green line is characteristic of copper poisoning.
Blackish discoloration is seen in case of silver poisoning.
Many times the teeth may be the only structures remaining intact after destruction of other parts of the body due to trauma, decomposition or burns. Hence by detailed examination of the teeth, the poisoning may be ascertained.

Evaluation of the Bite Mark

In recent times the forensic teams including the forensic odontologists are playing a very important role in cases involving malpractices and physical abuses. Based on the bite marks seen on the patient, the forensic odontologists can gather valuable information from the abused sites that can act as evidences in investigative procedures.
In cases involving homicide, the forensic odontologist studies the bruises and bite marks on the body of the victim which helps in identifying the culprits. Only a forensic odontologist with good practical experience can identify these bite marks and use them as important evidence against the culprit.
In cases of sexual assaults, the role of forensic odontologist comes in very handy because in many cases evidence of bite marks may be present on various parts of the body. The assailants in such crimes can be identified on the basis of bite mark evidences. The forensic odontologist thus analyses the pattern of bite marks, individual characteristics of the bite marks and DNA evidence from saliva of the culprit thus assisting the crime scene investigators in providing justice and maintaining law and order[2,3].
In this aspect the bite mark analysis on the traumatized individuals have turned out to be one of the most important tools in recent times in providing justice to the abused persons and also in solving cases involving culpable homicide.
With the help of various chemical and serological studies that are conducted on the bite marks, the forensic odontologist can identify and analyze the injuries as the one caused due to bite. In such cases, the identification of the bite mark with respect to the biter's sex, race and individuality also is performed by the forensic odontologist.

Determination of the Time Of Death

Establishing the time of bite mark in relation to the time of death is an important information provided by the forensic odontologist. Based on the pattern of bite mark the forensic odontologist can analyze the time of bite.[3,8]

Usually the forensic odontologist is called upon by the investigating team several hours after the death of the individual and the forensic odontologist has to deal with the condition called the rigor mortis which is characterized by stiffening of the muscles and the joints. Hence the forensic odontologist might have to manually force open the jaws to gain access into oral cavity for examination.[2,3]

Based on the knowledge that the rigor mortis affects the muscles of mastication first and then spreads to other body parts and that the onset of rigor mortis may range from 10 minutes to couple of hours with maximum stiffness at around 12 to 24 hours after death, rigor mortis is usually used to establish the approximate time of death. It is believed that after around three days, once the decomposition sets in, the muscles tend to relax.

Determination of the Age, Race and Sex

The forensic odontologist through his knowledge of dentistry including the human anatomy, biochemistry and human physiology plays a very important role in determination of the age, race and sex of the individual.

The clinical, radiographical and biochemical evaluations are done by the forensic odontologist to understand the forensic aspect of human dentition for determination of age, sex, race and individualization.[3]

The size and genetic peculiarities those were prevalent in a family helps in evaluating the hereditary aspects. Wear characteristics too are identified to differentiate individuals in mass disaster cases and in sexual assault, child abuse and personal protection.

The forensic odontologist also makes use of the craniofacial characteristics like lower nasal border features, lower facial prognathism, palatal form, cheek bone contours, incisor shoveling, proportion of orbital and nasal areas etc for the racial determination.

Assistance in Antropology

The forensic odontologists often work with the specialists in other fields of forensic sciences. In this respect the forensic anthropologists and forensic pathologists are probably the most common collaborating colleagues. The forensic anthropologists often seek assistance of the forensic odontologists in identification of the sample obtained that are necessary to evaluate the sex, age, race, population and most importantly the characteristic features that prevailed in the population.

New concepts in forensic odontology

With lot of recent advancements being done in the field of forensic science a lot of investigations and tests are being done on teeth obtained from the subjects exposed to a variety of environmental conditions for DNA profiling.

The field of forensic odontology has come a long way and newer techniques of identification of the subjects are being tested. One aspect of this concept is the study of lip print commonly called as the cheiloscopy. According to this concept it is believed that similar to the finger print and DNA report, the lip print is unique to an individual and can be used in obtaining positive identity of a person. The same technology can also be used to determine the presence or absence of a person in the crime scene.

The other new concept in the field of forensic odontology is the study of the palatal rugae of the deceased individuals. This field is commonly referred to as the rugoscopy. The believers of this concept propose that

the rugae patterns of any individual are unique and hence in situations where finger printing and DNA profiling are not possible, the rugae patterns can be used as a useful aid.

Discussion

There has been drastic increase in act of terrorism and violence in recent years and culprits are finding never ways and techniques to get away with the offence. Hence newer ways and techniques are essential to bring the culprits to book and provide justice to the victims. In this aspect the branch of forensic odontology can help the investigating officers in a number of cases and variety of situations. It varies from mass disasters to identification of individual case and can help solve cases of assault and accidents. Hence the police officials and investigating teams need to be properly oriented regarding the changing knowledge and skills of forensic odontology.

Conclusion

Forensic odontology is an upcoming branch of dentistry which has a great scope for development. It has been accepted as a dental specialty and is routinely used in many developed countries but is yet to be included in routine investigative procedures in many developing counties. Combined efforts by the government, investigative agencies and health care professionals are necessary to educate the general population regarding its importance.

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