

Review Article

Forensic Odontology: A Medico Legal Guide for Police Personnel

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ABSTRACT

Globally, the recent spate of terrorist attacks and natural disasters in which there have been multiple fatalities has reinforced the need for trained, experienced forensic odontologists and a police officer to coordinate the response to such events promptly and properly. The article reviews basic procedures and advances of dental identification and reports where dental identification played a vital role in the identification of the person.

KEY WORDS: *Forensic dentistry, investigation, odontology, person identification police*

INTRODUCTION

The world of crime is complex. A crime scenario often has hidden informations that need to be probed to reveals the true nature of the criminal activity and the identities of those persons involved.

Forensic investigations are usually performed by trained forensic scientists, sometimes might be conducted by a law enforcement officer or by untrained police officials with no scientific credentials, other than experience. Eventually, if evidence and laboratory tests are mishandled or improperly analyzed or if the scientific evidence carries a false sense of significance; or if there is bias, the court can be misled, and this could lead to wrongful conviction. If juries lose confidence in the reliability of forensic testimony, valid evidence might be discounted, and some innocent persons might be convicted or guilty individuals acquitted.

Forensic odontology, or forensic dentistry was defined by Keiser-Neilson in 1970 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 presentation of the dental findings.^[1] In recent years, considerable advances have taken place India a number of concerted efforts were taken by forensic dental organizations to strengthen the foundations of many areas of testimony.

OBJECTIVE

This article is an attempt to reinforce the awareness among police personals about their role in person identification and the importance of collecting preserving dental records and also reviews basic procedures of dental identification, a few cases where dental identification played a significant role and advances in the field of forensic dental science.

LAND MARKS IN FORENSIC DENTISTRY

EARLIEST DENTAL IDENTIFICATION

The earliest recorded case was in the year of 66 AD,

concerns a female associated with Emperor Nero, who was identified after her death through the unique arrangement of her teeth.^[3]

FIRST DENTAL IDENTIFICATION

Luntz L and Luntz P presented a case of 1775 in 1972. Paul Revere constructed a bridge for his friend Dr. Joseph Warren. Eventually, Warren was killed and was buried by the British in a mass grave. A year later, when the people of Massachusetts wished to give a proper burial to Dr. Joseph Warren, they could not identify his body. Later Paul Revere identified by Paul Evere by the ivory denture work which he had done for Warren. This was thought to be the first case of identification by a dentist.^[2]

FIRST DENTAL IDENTIFICATION REPORTED FROM INDIA

In 1995, Sansare and Dayal in their review have mentioned the first case of identification using dentition from India. Elphinstine, M. Raja Jayachandra Rathore of Canouj, died on the battlefield in 1191. His body was identified by his false anterior teeth.^[3]

FIRST DENTAL IDENTIFICATION ACCEPTED BY LAW

Dental evidence was first accepted in the United States in the Webster-Parkman case in 1849. Webster, Professor Chemistry in Boston Medical School, borrowed money from Dr. Parkman who was relentless in demanding the repayment. Hence, Webster killed Dr. Parkman. On investigation, the authorities searched Webster's laboratory, where mutilated remains of human body few bones and some artificial teeth were found. Dr. Parkman's dentist, Dr. Nathan C played a major role in identifying Dr. Parkman.^[4]

FIRST DENTAL IDENTIFICATION IN A MASS DISASTER

The first case of dental identification in which a great number of victims lost their lives occurred in Paris in

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1897, Dr. Oscar Amoedo, Professor, Dental School at Paris, considered to be the father of forensic odontology, compared antemortem dental records with postmortem dental records for identification of the dead.^[5]

IDENTIFICATION OF HITLER

In 1977, Bagi BS mentioned that the bodies of Hitler and his mistress Eva Brauma were identified by his dentist, (Kathe Hensrman Fritz Echtmann) using dental records.^[6]

IDENTIFICATION OF GENERAL ZIA-UL-HAQ

Sansare mentioned in 1995 that General Zia-Ul-Haq, late president of Pakistan, died in 1988 in a plane crash. His body was identified by his dentition.^[7]

IDENTIFICATION USING TOOTHBRUSH IN THE WORLD TRADE CENTER DISASTER

Thousands of people lost their lives in the world trade center disaster in the U. S. on September 11, 2001. DNA extracts from toothbrushes of the victims were used in the identification of some victims.

IDENTIFICATION OF SADDAM HUSSAIN'S SONS

According to the website of the United States, (CNN NEWS), dental identification was used to confirm the identities of the bodies of Saddam Hussain's two sons.

DENTAL IDENTIFICATION PROCEDURES

Dental identification of an individual can be made mainly by two methods, namely, comparative method of dental identification and postmortem dental profiling.^[8]

COMPARATIVE METHOD OF DENTAL IDENTIFICATION

Here, the forensic dentist prepares a postmortem dental record by careful examination, charting and written descriptions of all the dental structures along with the radiographs. Later, a systematic comparison has to be made between the antemortem and postmortem dental records. The similarities and discrepancies should be carefully noted at the time of comparison of the records.^[9]

POSTMORTEM DENTAL PROFILING

This is a method used when comparative methods of identification are not sufficient to establish the identity. Here, the authorities taper down the search for antemortem records by gathering information by systematic examination of the deceased individuals race, age, sex, socioeconomic status, occupation, dietary habits, dental, and some systemic diseases.

SEX DETERMINATION

The male skull is larger than the female has better-marked muscle attachment areas (nuchal and temporal lines); larger and blunter mastoid processes, more superciliary arch development, much blunter superior orbital margins, heavier zygomatic arches, larger jaws, and more sloping foreheads. Males may show everted or neutral gonial angles, whereas female usually shows inverted or neutral gonial angles. The anterior mandible (chin) may be squared or rounded

in males but is usually pointed or rounded in females. The microscopic examination of teeth for the presence or absence of Y-chromatin and DNA analysis can reveal the sex with certainty.^[10,11]

ASSESSMENT OF AGE

The age of the individual can be gauged by examination of the teeth and surrounding dental structures and their subsequent comparison with the developmental charts. Some authors recommend the use of aspartic acid racemization method for determination of the age, which can reveal the age to an accuracy of plus/minus 4 years. The conclusion on the age of the individual can also be drawn by using charts such as those developed by Ubelaker, Schour and Massler (1940), Moorees *et al.*, (1963), Gustafson (1974) *et al.*, (1976), Demirjian *et al.*^[12-19]

PERSONAL IDENTIFICATION

Erosions can be due to many factors such as alcohol or substance abuse, working in the chemical industry, consumption of beverages or disorders such as anorexia nervosa. Stains on the teeth may suggest smoking habit, betel nut, chewing of smokeless tobacco or even dental fluorosis.^[20-29] Habitual placement of nails in between the teeth (carpenters and cobblers), the opening of bobby pins and cutting of threads (tailors) or due to the placement of pipe stems, cigarette holders, hairpins, etc., may lead to incisal notching. The unusual wear pattern of the teeth may give a clue of the history of orthodontic treatment.^[30] The presence or absence of dental treatment, as well as the type of restoration, prostheses or appliance, may reveal their identity.

IDENTIFICATION OF RACE

The shape of the upper dental arch (V shaped in caucasian, U shaped in african/negroid and horseshoe shaped in Mongoloid), the width and shape of the nasal aperture, the development of the nasal spine and the shape of the lower margin of the nasal aperture, orbital and supraorbital shapes, relative length and height of the braincase, and the shape of the occipital bone are some of the cranial features that are useful in the identification of racial affinity. Alveolar prognathism, defined by anthropologists as the anterior projection of the jaws, is also a good trait for race determination. Along with shape and form of the skull, other features such as cusps of carabelli, shovel-shaped incisors, multi-cusped premolars; talons cusp, taurodontism, etc., may assist in the determination of the race.

SPECIES DETERMINATION

Occasions arise in forensic identifications where fragments of teeth are discovered in isolation, and species determination assumes importance. Dentin contains species-specific antigen. By using serological method mixing sera prepared from powdered dentin and anti-sera of various animals and humans species determination can be done.

GENETIC MARKERS IN THE OROFACIAL TISSUES

BLOOD

Oral tissues such as a tooth, alveolar bone, oral epithelium and saliva may be used for determination of blood group. Blood

groups can be determined from dental pulp and pulverized hard tissues with <10 mg samples. It is possible to do this even after 2 years of death.

SALIVA: AN IDENTIFICATION TOOL

A number of drugs such as phenobarbital, amphetamine and morphine have been detected in saliva and saliva stains by radioimmunoassay by a number of investigators. Certain types of proteins and enzymes of saliva may be used to determine race or ethnic group of an individual. Saliva proline-rich proteins show polymorphism and may be used to differentiate various races.

DNA IDENTIFICATION

DNA comparison is legally admissible in a growing number of jurisdictions. Tooth serves as a source of DNA. DNA is a robust molecule which can tolerate a remarkable range of temperature, pH, salt, and other factors that destroy classical serological markers. This ruggedness allows DNA longevity and has permitted DNA typing of Egyptian mummies and 30-million-year-old insects preserved in amber.^[31] With the advent of polymerase chain reaction technique that allows amplification of DNA at preselected sites will be useful to make a conclusion on the identity of a person.^[32] DNA extracted from human remains at the site of disaster is matched with the antemortem sample derived from any of the sources of DNA such as a toothbrush, hair brush, blood sample, biopsy material, clothing, or any other personal belonging of the deceased. If the genomic DNA is not in sufficient concentration to draw a conclusion on the identity, analysis of mitochondrial DNA is a powerful tool.^[33]

ADVANCES IN FORENSIC DENTISTRY

FORENSIC DENTAL PHOTOGRAPHY

Photographs if properly taken they are one of the most reliable and useful tools. Relationships of size and shape can be depicted, McKenna *et al.* described a method to match skulls with photographic portraits using landmarks and measurements of the dentition and concluded that the photographic superimposition can be established as a method of identification complimentary to fingerprinting.^[34]

RADIOGRAPHS

Radiographs play a vital role in the determination of the age of an individual by assessing the stage of the eruption of teeth. Skull radiographs can be superimposed on the antemortem radiographs or photographs. Dental radiographs may be compared from ante and postmortem records for congenital and acquired abnormalities such as malformed tooth, caries, restorations, and root canal fillings. They may provide evidence of bullets or foreign bodies in the soft tissues. Radiographs must be taken at the scene of trauma or crime.

SCANNING ELECTRON MICROSCOPY

SEM is used for detailed examination of the surface configuration of bite marks, fractured surface of the tooth, restorations and other materials. Since SEM photomicrograph

provides a highly magnified three dimensional image of minute surface structure, it may be used for comparison purpose. It is also used to identify teeth by dentinal tubules and evidence of previous restorations, especially in incinerated remains.

RUGOSCOPY

The study by English *et al.* showed that palatal rugae patterns are characteristics to individuals and they do not change due to the growth of an individual and reappears after trauma or surgical removal. This uniqueness to individuals can provide a reliable source of identification. Males have better-developed rugae when compared to females.

CHEILOSCOPY

It refers to the utilization of lip prints as means of personal identification. Lip prints are genetically determined, remain unchanged from birth. More characteristic groove patterns are vertical, branch, intersected, and reticular types. Lip prints are usually left at crime scenes and can provide a direct link to the suspect. In recent years, lipsticks have been developed that do not leave any visible trace after contact with surfaces such as glass, clothing, cutlery, or cigarette butts and have been called persistent lip prints. Although invisible, these prints can be lifted using materials such as aluminum powder and magnetic powder.

RECONSTRUCTION OF THE FACIAL TISSUE

Positive identification is achievable when the skull and facial bones are used as a foundation to reconstruct the facial soft tissues with the aid of three-dimensional computer images, computed tomography images, and radiographs. With knowledge of the anatomic relationships between the skull and face, antemortem facial photographs, or radiographs soft tissues of disfigured faces can be assembled on a mock skull and facial casting methods can be utilized for identification.

ANALYSIS OF BITE MARKS:

A bite mark may be defined as having occurred as a result of either a physical alteration in a medium caused by the contact of the teeth or a representative pattern left in an object or tissue by the dental structures of an animal or human.^[35] These marks can be used forensically for law enforcement purposes. It is common to find more than one bite mark on a victim, often in different anatomical locations. Bite marks occur primarily in sex-related crimes, child abuse cases and cases involving physical altercations of various types. Female victims are most commonly bitten on the breasts, arms and legs in descending order of frequency and males most frequently on the arms, back and hands. Patterns of distribution of bite marks are discernable and variable and are based in part by the type of crime involved, the age and sex of the victim, whether the bite marks are on the victim or the attacker and the sex and age of the perpetrator.

DENTURE IDENTIFICATION:

After major disasters such as earthquakes, fires or flood, accurate and early identification of the dead and injured becomes of utmost importance. At times only identifiable remains are a victim's partial or complete dentures.^[36] Resin prosthesis used in the oral cavity and left at room temperature

for as long as approximately 200 days could be used for DNA extraction followed by DNA analysis.

COMPUTER--ASSISTED POSTMORTEM IDENTIFICATION SYSTEM

On May 9, 1987, a Soviet made IL-62M Polish Airliner, LOT Flight 5055 crashed, exploded and burned, killing the crew and 183 passengers. A Computer-assisted Postmortem Identification System (CAPMI) designed by Colonel Lewis Lorton and Mr. William H. Langley, was introduced to compare remains against an antemortem database. Due to its inherent high selectivity, it can also overcome many human errors in the database. The CAPMI System, Northwestern University system and the Mertz and Purtilo system are examples of available computer programs in forensic dentistry.

RECOGNITION OF DOMESTIC VIOLENCE, ABUSE AND NEGLECT

Dr. Kempe in 1961 coined the term "Battered child syndrome" to describe the children with multiple unexplained bruises, fractures, and head injuries. Suspicion of child abuse should be particularly strong when new injuries are present along with older injuries. When one suspects child abuse, it is important to document the findings thoroughly. Documentation may involve written notes, videotapes or audiotapes, photographs, and radiographs.

RESOLUTION OF MISSING AND UNIDENTIFIED PERSONS IN MASS DISASTERS

Forensic dentistry plays a significant role in identifying victims using dental comparison. Valenzuela *et al.* presented a comparative study to prove the efficiency of dental methods for identification of burn victims in two bus accidents in Spain. The authors concluded that preplanning, organization and exercise were essential keys for successful management of the disaster.^[37] Mühlemann *et al.* described the role of the Swiss identification system in the identification of mass disaster victims were an encoded information chip seated within the enamel of the tooth with a fire resistant filling of red composite material on the lingual surface of a molar in the natural or artificial tooth.^[38] Budimlija *et al.* are preferred conducted a study to identify individual body remains in World Trade Center Mass disaster on September 11, 2001. More than 500 samples were tested using polymerase chain reaction amplification and short tandem repeat typing. Soft tissue was preferentially used for DNA profiling and later hard tissue was analyzed and conflicting results were obtained.^[39]

CONCLUSION

Today, it is true to say that forensic dentistry is an important part of forensic medicine. The dental structures generally are not damaged in cases of disasters because of the protection afforded by the soft tissues of the oral cavity and tissues of the head. Thus, marked dental findings would lead to rapid identification in the event of accidents and disaster. Hence, substantial training has to be given to police officials involved in the investigation to preserve the dental findings at the

crime site to enhance law enforcement. This review reinforces Indian police about the role of dentist and dental evidence in personal identification and the importance of maintaining dental records of all cases.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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