Evolution of forensic odontology: An overview

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ABSTRACT

Forensic dentistry or forensic odontology admits dentists’ participation or identification of the victim and assisting legal and criminal issues. It refers to the proper handling, examination, identification and evaluation of dental evidence. This article summarizes the evolution of forensic odontology that started right from Garden of Eden to the modern scenario in identification of the gang rape case which happened in the state capital. Forensic dentistry plays a significant role in identifying the victims of crime, deceased individuals through the examination of anatomical structures, dental appliances and dental restorations.

KEY WORDS: Bite mark, forensic odontology, victim

Forensic odontology or forensic dentistry is the application of dental knowledge to those criminal and civil laws that are enforced by police agencies in the criminal justice system.

Keiser-Neilson defined forensic dentistry as “that branch of forensic dentistry that in the interest of justice deals with the proper handling and examination of dental evidence and the proper evaluation and presentation of dental findings”.1

The Holy Scripture (bible) says ‘Hate evil, love good and maintain justice in courts.’ in reality the judicial system seeks the ardent help of forensic science especially the forensic odontologist to provide dental expertise in courts and legal systems in the administration of law.

We human beings are separated from other animals by a number of essential characteristics and have certain uniqueness. One of the unique characteristics of human morphology is the human dentition that withstands the test of time and temperature. Treatment given by a dentist is the biggest contribution to the uniqueness of an individual dentition and is the key in the identification of the oral cavity.

Teeth are the most indestructible part of the human body. They survive not only after death but remain unchanged for many thousands of years. A well-known example is the teeth found in the mandible of Tabun man for aged about 35,000 years old.2

There are three important areas of activity embracing the modern forensic odontology.3 First, comes the evaluation and examination of injuries to the jaws, oral tissues and to teeth resulting from various causes. Secondly, with a view of the examination of marks to possible identification or subsequent elimination of a suspect as the predator. Thirdly, examination of fragments or complete dental remains (including all types of dental restoration) to a possible identification of the latter. So in simplest terms there are two aims in forensic dentistry. Simple one is the identification of the dead and complex one is the identification of an assailant who has used his or her teeth as weapon.4

The technique applied in modern dentistry has evolved through the evolution of humankind, starting way back from the Garden
of Eden to the modern scenario in the identification of the accused in the rape case in state capital.

Historical Background

The evolution of forensic odontology started right back in the Garden of Eden. According to the Old Testament, Eve convinced Adam to put a bite mark in apple. It was told that “It is always tempting to suggest that the history of bite mark evidence (forensic dentistry) began with the eating of forbidden fruit in the Garden of Eden.” But the dentist or forensic odontologist were rare at that time. There is no record of events, comparisons or analysis, and it is in addition there were a limited number of suspects and the suspects reportedly confessed.

But well-documented evidence to the use of teeth for identification began during 66 AD with Agrippina and Lollia Pauline case. Agrippina after her marriage with Claudius, emperor of Rome, Agrippina tries to secure her position. She feared about rich divorcee Lollia Paulina may still be a rival for her husband. She decided that it would be safer if Lollia Paulina was dead. She instructed her soldier to kill Lollia Paulina and further instructed to bring the head back. She was satisfied by Lollia Paulina death by the identification of dental alignments and certain distinctive characteristics. It was the first use of dental identification where there is a record.

The first forensic identification in India started in 1193 were Jai Chand, a great Indian monarch was destroyed by Muhammad’s army and Jai Chand, Raja of Kanaui was murdered and he was identified by his false teeth.

Peter Halket was killed in 1758 during French and Indian wars in a battle near Fort Duquesne. Halket son identified his father’s skeleton by an artificial tooth.

At the battle for Breed’s Hill in Boston, Dr. Joseph Waren was killed in the year 1776. His face was not able to identify as he suffered from a fatal head wound. A dentist, Paul Revere, identified Dr. Warren, dead body by a small denture that he had fabricated for him. The identification made by Paul Revere made it possible to bury Dr. Warren on April 8th, 1776 with a full military honor.

Dentist as an Expert Witness

First use of dental evidence in a court case

Use of a dentist as an expert witness was well documented in 1814 in the case of Mrs. Janet Mc Alister in Scotland. A lecturer of anatomy Dr. Granville Sheep Pattison and two of his students was charged at the high court in Edinburgh for the violation of Mrs. Mc Alister grave. They have moved the body of Mrs. Alister after the burial to the nearby college. It was found by dental evidence in the form of the maxillary denture that was found in the heads in the dissecting room. Dr. James Alexander, Mrs. Alister’s dentist, was the witness for the prosecution. He tested that a set of her denture fit in only one of the head in the dissection room.

In 1831 Caroline Walsh moved in with Irish married couple after that she was never seen again. It was stated that the missing women was found on the streets in a ‘squalin’ condition, and it was stated that her name was Caroline Walsh. In the trial, it was pointed that Caroline Walsh had perfect teeth. But this Caroline Walsh had lost her front teeth many years ago. Mrs. Walsh was never found, and the accused was convicted.

Forensic dental age estimation

Prince Louis XVII died in prison at the age of 10 years 2 months in Paris on 1795 due to tuberculosis of lymph nodes. A plan was made to erect a monument to the young prince. But many rumors were generated regarding the prince that he was still alive, and another child was buried in his place. The story continued in 1846, in the reconstruction of a church. A skeletal of a child containing a lead coffin was found near the side entrance. A physician, Dr. Milicent examined the bone of the body and concluded that he had died of bad breath and neglect. Examination of the bones by Dr. Recamier said that they were those of an individual, of aged 15 or 16 years. The age assessment made by Dr. Recamier’s was accepted. A relation of Louis XVII in 1897 gained permission to again research for the coffin. A skeletal of a young male was found containing a coffin. As a base of the tooth development, three experts aged the skeleton at between 16 plus and 15 plus years. Finally, it was concluded the remains was not Dauphin. It is documented as the first cases of forensic dental age estimation.

Dentist as an expert testimony in courts

A professor, a physician of Harvard university Dr. George Parkman in the period of 18th century, in addition he was also an real estate speculator and money lender who failed to return from dinner on November 23rd 1849. A suspicion was made on John White Webster as it was known that he owed some amount of money from Dr. Parkman. When his laboratory was searched, remains of the human body were found. Dr. Parkman’s dentist, Dr. Nathen Cooley Keep identified Dr. Parkman body, by his teeth as a part of upper and lower denture which he was made for Dr. Parkman 3 years earlier. Dr. Keep showed the court, and he fitted the portions of the lower denture to the models and also showed that grinding adjustment of the lower denture that he had made for Dr. Parkman. Dr. Webster was found guilty and hanged over. This was the first case of a dentist in giving an expert testimony in courts of United States.

William, the conquer fell from his horse and died at the age of forty-four. His tomb was erected in 1685. Those who are presented stated that bones and teeth are in very good condition, as if the king William I had died only yesterday, instead of 768 years ago. So the forensic dentist made the identification on the basis of durability and longetively of teeth even though the bodies are severely damaged or long buried.
In 1870, Mrs. Robinson was murdered, and the suspicion was made on Mr. A. I. Robinson of murdering his mistress. A comparison was made on the basis of bite marks. Mr. Robinson had five maxillary teeth and the suspect was identified but was not found guilty.\[16\]

In 1873, the body was found in the ashes of burned cottage in Maryland. The body was identified as Winfield S. Gross tentatively by Mrs. Gross and ten witnesses. Mr. Winfield S. gross has insured him for $25,000 prior to fire. The insurance company refused to pay Mrs. Gross. A forensic dentist was needed in time. It was stated by Mrs. Gross that Mr. Gross had never complained of pain or decayed tooth in his lifetime and there were no artificial teeth to her knowledge. He had never had a visit to a dentist in her lifetime. The body was found in the ashes was examined at Baltimore college of dental surgery. A detailed description was given by Dr. F. J. S. Gorgas of the jaws and the remaining teeth. It was stated that there was no misalignment in the lower jaw, and there were two teeth in the upper jaw. Variance was observed between Mrs. Gross and the forensic dentist. It was proven that the remains do not belong to Mrs. Gross. The body of the murdered man was found in Pennsylvania. Mr. Udderzook, who was the brother in law for Mrs. Gross, and was seen travelling with an unnamed friend to Pennsylvania. The victim was identified, and all the other characteristics were very similar to Mr. Gross. So Finally Udderzook was charged and prosecuted in 1874. The fate of Mrs. Gross was not known.\[19\]

Abraham Lincoln was the 16th president of the United States, was shot dead on April 14th, 1865. John Wilkes Booth shot the president and escaped to Virginia. The US Calvary surrounded the barn and set in on fire. Booth was shot dead at the spot. But after many years, the rumors spread that Booth was escaped and was still alive. So the body was disinterred and examined again in 1893. The family dentist identified Booth body by the peculiar formation of the jaw that has been noted in the dental records made by the dentist during a dental visit for restoration of a filling.\[17\]

**Father of forensic odontologist**

Dr. Oscar Amoedo was considered as the father of the forensic odontologist. The thesis done by him entitled ‘L’Art Dentaire en Medicine Leagale’ to the faculty of medicine earned him a doctorate. This book is the first comprehensive text on forensic odontologist.\[18\]

The famous Iroquois theatre in Chicago was burned in 1903 and for about 602 of the 1,842 patrons was died in the theatre. But no records of the identification are found today. But, Dr. Cigrant quoted in his article that hundreds were unmistakably identified from the dental records.\[19\]

First work in facial reconstruction was done by Kollman and Buchley. The technique that is proposed by Kollmen and Buchley is still used with modification today. Although computerized methods are gaining interest today. Beltly Pat Gatliff of Oklahoma has trained a number of forensic dentists in facial reconstruction techniques.\[20\]

**Forensic dentistry to the one man show-Adolf Hitler**

At the end of the World War II, rumors were rampant that Adolf Hitler had escaped with Eva Braun, his wife. But it is a fact that they both died together in 1945, and their bodies were burned and buried by Russian soldier. It was a challenge to dispel the rumor, due to lack of antemortem and postmortem records. Finally, remnants of a bridge were identified in the pieces of Hitler’s jaw because of the unusual form of reconstruction and evidence of periodontal diseases. Hitler’s dentist Hugo Blaschke record work was matched with dental work of Hitler and was confirmed the death of Hitler.\[21\]

**Forensic odontologist in tsunami victims**

The great disaster was seen in Indian Ocean earthquake in 2004. The earthquake was known by the scientific community as the Sumantra Andaman earthquake, and the waves are so-called Tsunami waves. The ‘Tsunami victims in south East Asia in December 2004 was successfully identified by forensic odontology. More than 92% of non-Thai is been identified out of which 80% were identified by dental formation.\[22\]

**Bite mark analysis**

It is very obvious that the human animal is capable of biting. The marks made by human teeth in human skin have been reported in both ancient and modern history. Bite mark analysis play an important role in the criminal justice system. Advanced development of the technology such as laser scanning, scanning electron microscopy or cone beam computed tomography forensic odontologist may be able to identify more details in bite marks and in the individual teeth of the bite.\[23\] Unlike fingerprints and DNA, bite mark lack the specificity and durability, as the human teeth may change over time. However, bite mark evidence has other advantages in the criminal justice system which differentiates from linking a specific individual to the crime or victim. For a bite mark analysis, it must contain abundant information and the teeth that made the mark must be quite distinctive.

The bite mark made in human skin is the area in which bite mark evidence may prove to be valuable. In 1975, the famous Marx case was seen with the bite mark on the nose and other cases where that the three dimensional nature of the marks played a prominent role. The advances in science when used or applied in bite mark analysis provide greater assistance to examination and enhance the value of evidence in specific cases.\[24\]

**Lip print analysis**

Fingerprints, dental records and DNA comparisons are the most common technique which allows fast and secure identification processes. But they cannot be used always, so sometimes it is necessary to apply less known technique such as lip prints. Lip prints can be used in the verification of presence or absence of the person at the scene of the crime. Wrinkles and grooves seen on the labial mucosa forms a pattern called sulci labiorum. The study of lip prints is known as cheiloscopy.\[25\]
The use of lip prints was first recommended in 1932 by Edmond Locard in France.[26] Usually at crime scene lip prints are usually found, which can provide a direct link to the suspect. Lipstickst have been developed in recent years that do not leave any visible trace after contact with the glass surface, clothing or cigarette butts. They are referred as persistent lip prints for the permanence. However, they are invisible; they can be lifted by using materials such as aluminum powder and magnetic bonds.[27,28] Lips have a sebaceous gland along with sweat glands in between at the edges of the lips. Secretions from these glands enable development of ‘latent’ lip which is similar to latent fingerprints.[29]

**Rugae print identification**

In many circumstances fingerprint or dental record identification is difficult, so the alternate sources may be the palatal rugae, which are used in human identification. The study of palatal rugae pattern for identification is described as rugoscopy. Palatal rugae are well preserved even after severe burns. Rugoscopy was proposed by Trobo Hermosa in 1932.[10] It was stated by Sassouni that there is no two alternate palate, which are alike in their configuration.[11] The use of rugoscopy was very useful in mass disaster where identification by other methods like fingerprinting, DNA analysis is not possible.

**DNA profiling process**

DNA evidence analysis by polymerase chain reaction (PCR) is a technique utilized by most countries. PCR is the fast, reliable and sensitive method of analysis. The genomic and mitochondrial DNA technique allows to associate one person DNA with the other. The DNA differences between two people are an extremely useful tool.

**Dental investigations in mass disaster accidents**

Air crash occurred in which all the passengers died along with the crew at the distance about 8 miles away from the coast of California. All the bodies except a few were fragmented. Out of 88 victims, eighty-five was identified, and 65 persons were eventually identified by conventional means. Conventional means include the routine examination, dental comparisons, tattoos and fingerprints. The 23 victims were identified by DNA testing as there were not initially identified by conventional means. Many fragment of the body was found by the fisherman, navy and the use of fishnets. The fragments were identified and compared with the DNA extracted from the biopsies.[32]

**History of Forensics’ in India**

**Rajiv Gandhi assassination**

In May 21*, 1991, the assassination of Rajiv Gandhi, a leading and dynamic person of India took place. The murdered of Rajiv Gandhi was compared with the assassination of John F Kennedy of USA. In the investigation out of 18 bodies, 17 bodies inclusive of Rajiv Gandhi body were identified. The one body of dismembered parts which was correlated with skin, absence of body hair, same nail polish color on fingers and toe nails, and finally concluded that it was a female, who was the human bomb. And it also gave an indication the female carried the bomb in the abdominal belt.

The Dr. P. Chandrasekaran, Director, Tamil Nadu Forensic Science Laboratory, Madras who took 6 months for him to generate a full crime scene reconstruction document stated that DNA found in the charred muscle pieces and the skull on the suicide bomber, Dhanu showed identical pattern. So it was then provided the Dhanu was the bomber.[33]

**Veerappan identity confirmed**

The trademark of Veerappan was the handlebar moustache on his face, which was missing when he was shot dead by Special Task Force personnel in Dharmapuri District of Tamil Nadu. This led to led to great confusion. But the experts of forensic are confirmed by the study of the external ear. Prof. P. Chandra shekhar, a principal investigator in Rajiv Gandhi assassination case, said that the anatomical structure of the external ear differs from person to person. He studied the structures of the external ear from ante and post-mortem photographs of Veerappan, compared them and confirmed that it was sandalwood smuggler. There is a unique structure in Veerappan ear, which has flat tragus formation, and the tragus is continuous with a curved portion of helix.[34]

**Dental Forensics to Death Sentences**

**Delhi gang rape case**

First time in the Indian history of criminal prosecution in India, dental forensics has played a vital role in providing evidence leading to death sentences. In the Delhi gang rape case, a forensic dentist was able to link two of the accused to the crime. It was done by comparing the arrangement of the teeth with the bite mark which is left on the poor young victim. It was stated by a dental expert that photographs of bite mark seen on the victim and structure of the dentition of the two accused proved with some accuracy. Totally, six men were arrested, and one among them were juvenile. Consequently, among the five accused, two of the dentition matched with a bite mark. So it was finally stated by the dental expert that no two persons will have a similar arrangement of teeth.

**Conclusion**

This article focuses on the evolution of forensic odontology that is not a new to the present world. Forensic odontology and forensic medicine should go hand in hand. Extensive interactions with the law enforcers (police), the judiciary (the judges) and the forensic fraternity (forensic medicine experts) at various forums, such as hands-on workshops and conferences and continual education programs, have increased the subject’s understanding, awareness and importance.[35] DNA profiling provides information regarding physical characteristics,
ethnicity and sex determination. Forensic odontology that is the branch forensic medicine has established itself as an important and indispensable service in medico legal matters toward the creation of just and secure society for the future inhabitants.

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