

Forensic Odontology and Legality

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ABSTRACT

Forensic Odontology is the branch of science effectively utilised in identification of person in the court. Dental formation is distinct from all person. Identification of person is determined by bite marks and skull formation. This paper reviews importance of demonstration of dental evidence and examination of dental molds by the expert testimony for the legal purpose. Methods for the identification of sex, race determination, age estimation and bite mark analysis. This article brings about collection techniques used in extracting the dental records. Application of forensic dentistry in the court room especially reviews admissibility of forensic evidence in the sexual assault cases in India. In determining the dental cast, photograph and wax impression it highlights about challenges faced by expert community in the legal field.

Keywords: Forensic Odontology, Identification, Bite Mark, Methods, Analysis of Dental Records, Legal Field, Challenges

1. INTRODUCTION

Forensic odontology, also known as forensic dentistry, is a specialized branch of forensic science that deals with the application of dental knowledge and expertise in legal and criminal investigations. It involves the examination, evaluation, and presentation of dental evidence in the context of civil and criminal cases. Dr. Oscar Amodeo was considered as the father of the forensic odontologist his one of the works was case document of dental identification in which more individual lost their lives in a disaster¹. Forensic means legal, a word that comes from the Latin word meaning ‘to the forum’ literal meaning ‘to the court’, Odontology means ‘study of teeth’. According to professor Keiser Neilson in 1970 as forensic odontology is the branch of dentistry which in the interest of justice, addresses how dental evidence should be handled, examined, and with the proper evaluation and presentation of dental findings². The unique characteristics of the human dentition, such as dental anatomy, dental records, and dental materials, make teeth a valuable source of evidence in forensic investigations.

Forensic odontologists utilize their dental knowledge to assist in identifying human remains, establishing the age and sex of individuals, and providing information about the dental history and oral health of the deceased or the perpetrator.

2. HISTORICAL DEVELOPMENT OF THE FORENSIC ODONTOLOGY

Forensic odontology can be traced to back to significant events form the ancient times to modern period in the development of field: First forensic Identification in India started in 1193, Raja of Kanauji Jai Chand

¹Balachander N, Babu NA, Jimson S, Priyadharshini, Masthan K.M.K, “Evolution of forensic odontology: An overview”, J Pharm Bioallied Sci, 2015, 7 (Suppl 1), 176 – 180.

²K.P. Divakar, “Forensic Odontology: The New Dimension in Dental Analysis”, Int J Biomed Sci, 2017, 13(1), 1-5.

was identified by his false teeth. Dentist as an expert witness in the case of Mrs. Janet Mc Alister in Scotland is documented in 1814. Forensic Dental Record played vital in identifying body of Abraham Lincoln. He was dead in 1865 by John Wilkes Booth and who escaped to Virginia. Booth was also dead on the spot by US cavalry, but after many years rumours spread that Booth was still alive. Thus, in 1893, the body was exhumed and re-examined. The family dentist identified booth body by the jaw formation that has been noted in the dental records made during restoration of filing. Odontology report of Adolf Hitler. There was unfounded Rumours about Adolf Hitler death. However, it is a fact Hitler and hie wife passed away at the same time in 1945, and a Russian soldier burnt and buried their bodies. Due to a lack of antemortem and postmortem records, it was difficult to disprove the contention. Furthermore, evidence of records of Hitler's body fragments in the reconstructing techniques. Hilter's dentist, confirmed his demise by dental records.

In India, Forensic odontology continues to be emerging field and relatively involving science in the area of legal process. In the beginning we not used to the implementation of science identification or in criminal justice administration. It reveals that forensic odontology dynamic role from the earlier times the Garden of Eden biting apple considered as a record of bite mark³ to Nirbhaya case dental cast of accused bite mark placed crucial contribution in specific identification in administration of justice. Now in the generation of time with all evolution forensic Odontology is highly beneficial in the legal field.

3. IDENTIFICATION OF DENTAL RECORDS

Teeth is the hardest and most robust tissues of the human body it can hold out against heat, trauma, water, decomposition, desiccation than the other parts, even after the death of the person is not destroyed or damaged. This makes dental evidence a valuable source of information for forensic investigation. Primary role in the identification of remains when postmortem changes, traumatic tissue injury, a lack of fingerprint record invalidate the use of visual or fingerprint method. Oral cavity is a useful source of DNA later is obtained from saliva, oral mucosal cells and teeth. Professor Nielsen, elaborating on Forensic Odontology, further states: "There are three reasons for considering forensic odontology a well-defined and more or less independent subject: 1) it has objectives different from those at which conventional dental education aims; 2) forensic dental work requires investigations and considerations different from those required in ordinary dental practice; and 3) forensic dental reports and statements have to be presented in accordance with certain legal formalities in order to be of value to those requesting aid.

The area of forensic odontology consists of three major fields of activity: 1) the examination and evaluation of injuries to teeth, jaws, and oral tissues from various causes; 2) the examination of bite marks with a view to the subsequent elimination or possible identification of a suspect as the originator; and 3) the examination of dental remains (whether fragmentary or complete, and including all types of dental restoration) from unknown persons or bodies for the purpose of identification."⁴ Class features of identification

³ Kaur KP, Kundu S, Bagchi S, Gayen S, Pal M, "Bite Mark Analysis- A Crucial Forensic Evidence", Oral and Maxillofacial Pathology Journal, 2022, 13(2).

⁴Law Web, Leading Supreme Court Judgment on appreciation of evidence of Bite mark analysis, <https://www.lawweb.in/2023/04/leading-supreme-court-judgment-on.html>, (last visited Jan 3, 2024).

1. Based on uniqueness
2. Each individual has individual set of teeth which be traced back to establish dental records,
3. Teeth are a source of DNA, dental pulp or crushed tooth can provide nuclear or mitochondrial DNA to help identify the person.

3.1 When is dental identification used?

1. To identify human remains that cannot be identified using face recognition, fingerprint or other means.
2. Identify bodies in mass fatalities. In mass disasters, such as plane crashes, tsunami, flood, earthquake or natural disasters, forensic odontologists play a crucial role in identifying victims.
3. Determine the source of bite mark injuries the case of assault or suspected abuse, personal defence situations. Forensic odontologists examine and analyse bite marks left on victims or objects. They compare the dental impressions of suspects to determine if they match the bite mark pattern, which can help establish the identity of the perpetrator in cases of assault, sexual assault, or child abuse.
4. Estimate age and sex of skeletal remain- Teeth can provide valuable information about a person's age, particularly in cases involving child victims or unknown skeletal remains. By examining tooth development and eruption patterns, dental professionals can estimate the age range of an individual.
5. Ethnic race determination.
6. Other method used for identifications
Cheiloscopy is lip print analysis, Rugoscopy is palate rugae patterns identification, sialochemistry is detection of chemicals in saliva.

4. METHODS USED IN FORENSIC ANALYSIS

Forensic odontology plays a prominent role in death investigations as well as in the case of victim identification of sexual assault and child abuse. The dentist aid in keeping the records of all necessary information in identifying the individuals. Human dental anatomy composed of incisor, canine, premolar, and molar that has a various exogenous and endogenous factor such as in shape, size, restoration, rotation, missing tooth, broken teeth, pathologies, colour which derives unique identity to every individual.

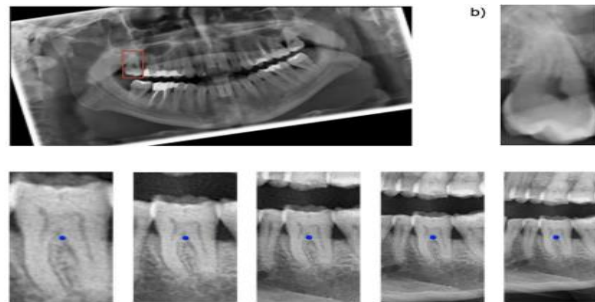
4.1 SPECIES IDENTIFICATION

Tooth identified from the crime scene can be identified by comparing and matching accurate antemortem and postmortem data. By recovering material from the scene, preparation and reconstruction, examination and documentation of postmortem material at the mortuary, collection and transcription of antemortem dental records and communication with dentist and sorting and comparing antemortem and postmortem data. Mass disaster victim identification is identified by Radiographs are better than charting for comparison as distinctive configuration of bony structures of jaw, roots of teeth and nearby sinuses often exist and are unique to each individual. In decomposed and charred bodies, jaws may be split down the midline in order to obtain better lateral films for comparisons to antemortem radiograph⁵.

⁵ Journal of Indian Academy of Forensic Medicine, (2016), JIAFM, 28 (2) ISSN: 0971-0973.



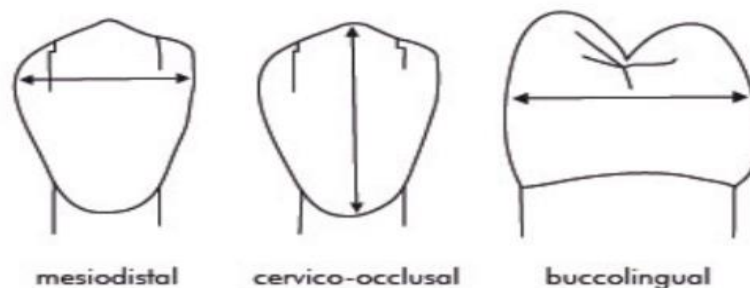
“Figure 1” Unique dentition



“Figure 2” Radiograph

4.2 GENDER DETERMINATION

Sex determination plays a major role in the recognizable proof of unknown person. Sex can be determined by features of the skull and mandible craniofacial morphology which is 96% success in identification of individual. Gender can also determine by the size of the tooth by mesiodistal and buccolingual dimensions in most studies. These dimensions are typically measured using dental radiographs or 3D imaging techniques. Additionally, the presence of certain dental features, such as the shape of the incisors or canines, can also provide clues about an individual's gender. Gender can be determined by the sex chromatin or bar bodies in the dentin due to the presence of the sex-linked gene amelogenin enamel protein. DNA Profiling to oral tissues with a minuscule amount of DNA upon microscopic examination of dental pulp reveals the sex of the individual. The fact that males have (XY) non-identical amel genes with 106 and 112 base pairs, whereas females have (XX) two identical amel genes with a single 106 base pair sequence, allows for differentiation between male and female identification.



“Figure 3” length of mesiodistal and buccolingual

4.2.1 Polymerase Chain Reaction

This technique is used in ultrasound to amplify relatively short, low-quality target DNA sequences in order to detect an individual's sex. With this technique, target DNA sequences are amplified by means of a number of temperature cycles and particular primers that bind to those sequences. Gel electrophoresis is

then used to see the amplified DNA fragments, making it possible to determine a person's sex based on the presence or absence of particular DNA bands.

4.2.2 Cryogenic Grinding

This is one of the techniques to collect the sample, coding the whole tooth extremely low temperature using liquid nitrogen and grinding to fine powder in a less destructive method is drilling the root canals and scrapping pulp area. This method helps preserve the integrity of the tooth structure and prevents any degradation or alteration of the sample. Additionally, cryogenic grinding ensures minimal damage to the surrounding tissues and maintains the quality of the extracted material for further analysis.

4.3 RACE DETERMINATION

The human species has been characterised based on Caucasoid (narrow 'v' shaped arch giving rise to crowding of teeth), Mongoloid and American Indians (posterior concave upper incisors grooves on rear surface of upper incisors), European (flat lingual surface on the incisor teeth), Japanese (ridges on lingual surface on the incisor teeth) and Negroid (molars are small and square). Shovelling, taurodontism, carebellies cusp hypocone, protostylid, peg form incisor, and other dental traits are used to determine ancestry. Dental restoration also aids in determining an individual's ethnicity. The sort of dental treatment a person receives indicates their financial situation. Teeth provide vital evidence about an individual's habits and occupation.

4.4 AGE ESTIMATION

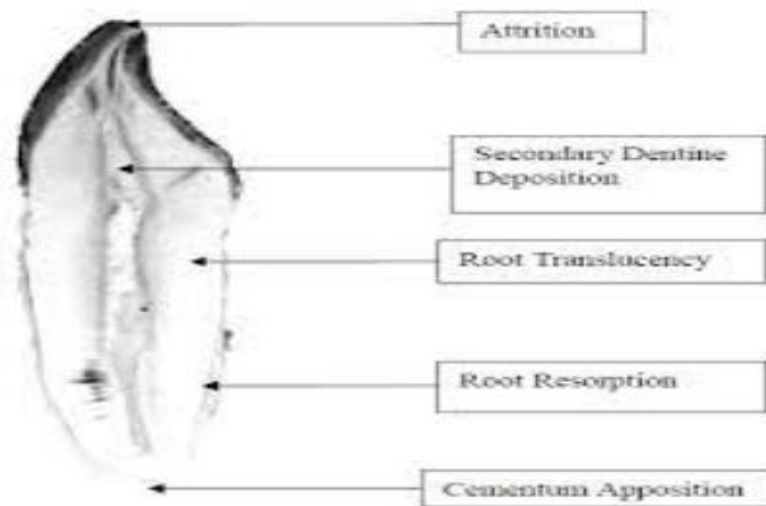
When the information related to the deceased is unavailable age is estimated by examining the development and tooth eruption patterns are the key factors in estimating an individual age accurately from the beginning of four month of a born baby to continuing to the third decade of human life shows the complete development of permanent teeth.

4.4.1 Children age estimation

Age estimation in Children challenging task due to their rapid growth and development. One the prominent method used is Demirjian method wherein based on the development of mandibular left teeth was divided into ten stages. Zero denotes tooth calcification, 5 indicates crown completion and 9 represents completion of tooth calcification. Depending on the stages scores assigned, total score s substituted to derive the chronological age the child.

4.4.2 Adult age estimation

Estimation of age in adult is complex task that observing the completion of growth, changes in the dentition, numerous exogenous and endogenous factors influencing the age of the of individual. Gustafson discovered a method for estimating age based on morphological and histological changes of the dentition in 1950. Attrition (A), secondary dentine deposition (S), loss of periodontal attachment (P), cementum apposition at the root apex (C), root resorption at the apex (R), and dentin translucency (T) were evaluated. For each of these regressive modifications or variables, scores ranging from 0 to 3 were assigned. This applies that attribution could have any of four scores (AO, A1, A2, or A3), and similarly one of four scores. A total score (X) was derived by adding the scores for each variable (e.g., A3 + S2 + P2 + C1 + R2 + T1 = X). It was discovered that a rise in the total score (X) corresponds to a rise in age.



“Figure 4” Root Dentin Translucency

Age estimation is based on dental cast and arrangements of individual chronological development of teeth. Similarly, there are numerous methods for age estimation and each method have different procedure for the examination. Furthermore, tooth development in the individual is important of histological changes in human specificity. Prediction of the age generally compared with modification of deceased or living being.

4.5 BITE MARK ANALYSIS

According to Mac Donald is defined as ‘mark caused by the teeth either alone or in combination with other mouth parts’ Bite marks in humans are typically associated with sex crimes due to their potential as forensic evidence. The unique patterns and characteristics of bite marks can often help identify the perpetrator and provide crucial information for criminal investigations. However, it is important to note that bite marks can also occur in other contexts, such as self -defence situations or accidents, and should be carefully analysed by forensic experts to determine their significance in each specific case. Bruises, scrapes, wounds, and lacerations are a few of the injuries that can be caused by teeth. A representative human bite is described as an elliptical or circular wound that captures the unique characteristics of the dentition. The injury may take the form of a doughnut, with characteristics documented around the perimeter of the mark. Alternately, it may be composed of two U-shaped arches that are separated by a gap at their bases. It is possible to identify distinct varieties of teeth based on their class characteristics and unique features.

4.5.1 Photographic Method

Two scales at a right angle to one another in the horizontal plane make up the bite mark as it is fully captured in the photograph. Teeth photos are taken with specialized mirrors that capture all of the teeth in either the upper or lower jaw in a single image. Photographs or tracings of the teeth are compared with the teeth photos. By inking the cutting edges of the front teeth, tracings of bite impressions can be created using positive casts. These are placed on clear sheets and overlapped with the pictures, or a negative picture of the teeth is placed on top of a positive picture of the bite. It is simpler to exclude than to match positively⁶. Photograph are widely taken from the scene of crime or from the victim or from the suspected

⁶ Jaypee Digital, Richik Tripathi. (2016). Handbook of Forensic Odontology and medical Jurisprudence, 1/e, 4.

persons for correct identification. Even bite marks photograph of the repeated offenders can be stored in the dental data base for future reference.

4.5.2 Computer odontology

Computers and its advancement in forensic odontology plays a crucial role for identification and analysis of dental evidence. The computer application and database management enable to enhances the accuracy, speed and efficiency in identification process in with emerging techniques in forensic odontology.



“Figure 5” Bite Mark Impression

1. Automatic dental code matching - bites runs through search to find a match.
2. Odontosearch - compare on bases of missing peoples.
3. Automatic dental identification system – list of people who have the same dental code number.
4. 3D bite mark analysis – used to generate overlays with various pressure and deviations compared with bite marks. This 3D technique facilitates accurate comparison between antemortem and post mortem dental records.
5. Dental Radiography- computerized CT scans provide high resolution image which aids in the identification process.

In Bite marks immediate response by forensic dentist is quite important, marks fade rapidly both in the living and dead, changing appearance in a matter of hour, delay in analysis may reduce the integrity of evidence and forensic dentist is responsible for the examination of the dentition of these suspected of bite mark perpetration.

5. EVIDENCE COLLECTION AND ANALYSIS

Evidence can be collected from the affected person or from the crime committed person or the from the scene of crime for proof of physical evidence before court. It can be in the form of various ways such as follows

5.1 Bite victim

When the evidence is first offered and witnessed, it may be the best or only opportunity to collect it. If a bite mark is thought to be criminal in character, it should be reported to the police. (1) Case Demographics, i.e., general information about the case; (2) Visual Examination of the bite mark; (3) Photography, i.e., extensive orientation and close-up photographs; (4) Saliva Swabs collection, i.e., saliva deposited on the skin during biting or sucking should be collected and analysed; and (5) Impression taking, i.e., an accurate impression of the bitten surface by vinyl polysiloxane or polyether may be done.

5.2 Bite suspect

Evidence gathered from a victim with a bite mark should be supplemented with evidence gathered from a suspect of the bite. It consists of (1) Clinical Examination, (2) Photographs of the suspect's teeth in occlusion and in open bite positions, (3) Rubber impressions of maxillary and mandibular teeth, (4) Saliva swab preferably from the buccal vestibule should be obtained for comparing with the swab collected from the bite mark, and (5) Bite sample, i.e., suspect's bite is recorded in centric occlusion using either a wafer of This should be photographed as soon as it has been recorded.

The only aspect of forensic odontology requiring an immediate response from the forensic dentist is the examination of bite marks. The marks fade swiftly in both the living and the deceased, altering their appearance in a matter of hours; delaying an examination may result in the loss of valuable evidence. The forensic dentist is also responsible for examining the dentition of individuals suspected of biting someone.

6. ADMISSIBILITY OF EXPERT OPINION

6.1 Section 45 of the Indian Evidence Act, 1872⁷

In India, under this section it is stated that the court may express an opinion on the admissibility of foreign law, handwriting analysis, science, art, and other expert evidence. The experts serve as consultants who offer advice on many facets of a situation that calls for scientific intervention. When determining if an expert opinion is reliable and whether it can be accepted or not at all, the judges must be cautious and responsible. A forensic expert's opinion or piece of evidence can have a significant impact on how a case turns out. An innocent person may be wrongfully imprisoned as a result of the improper inclusion or deletion of evidence. Therefore, it is crucial to choose admissible forensic evidence wisely based on a set of relevant standards.

In the case of *Fyre v united states* it is observed that "The rule is that the opinions of experts or skilled witnesses are admissible in evidence in those cases in the subject of the inquiry is such that unskilled persons will able to derive the accurate decision on it involves subject aspects of science, art or trade that knowledge of it requires prior study or experience. When a question falls on the purview of general knowledge or experience and specialized knowledge or expertise in that particular science, art, or trade to which the question relates are admissible in evidence."⁸ Although in the case of *Daubert v Merrell Dow Pharmaceuticals, Inc.*⁹ the Court held that the twin standards of Rule 702, relevance and reliability, are incompatible with the stricter "general acceptance" test. The Court highlighted the significance of a trial judge's "gatekeeping responsibility" when allowing testimony from experts and provided a list of non-exhaustive considerations, which included the following:

1. Whether the method or theory of the expert be verified and tested for accuracy?
2. Test involves the method or theory undergone peer review and publication?
3. The technique or theory's known or potential rate of error;
4. The existence and maintenance of standards and controls, and
5. The degree to which the technique or theory has gained widespread acceptance in the scientific community.

To be noted, admissibility of forensic evidence relies on the research conducted by scientific experts for legal purposes, which was an accepted principle. similarly, in the case of *K. Krishna Chettiar v Ambal &*

⁷ Section 45 in The Indian Evidence Act, 1872.

⁸ 293 F. 1013 (D.C. Cir. 1923).

⁹ 509 U.S. 579 (1993).

Co,¹⁰ expert refers as opinion of a person skilled in foreign law, science or art, or in questions related to identification of handwriting or finger imprints, which are considered important facts when the court is asked to make a decision on related issues. Further, in accordance to this section an expert is a person who has acquired special knowledge, skill or experience in any science, art, trade or profession acquired by practice, observation or careful as observed. In addition to this an expert is defined as the person who by his training and experience has acquired the ability to express an opinion but an ordinary witness does not possess this quality as the evidence of an expert is such evidence which is based on expertise and experience.

6.2 Section 293 of Code of Criminal Procedure

In the case of *Magan Bihari Lal v State of Punjab*, highlighting the credibility of expert opinion the Supreme Court stated that an expert opinion must be received with caution and a conviction solely on the basis of expert opinion without substantial corroboration is unsafe. The rule that was established has been followed by everyone and is on the verge of becoming the law. The admissibility of expert opinions is emphasized in Section 293 of the Code of Criminal Procedure, 1973, which states that any document in the control of a Government scientific expert based upon the matter or anything submitted to him for examination or analysis and report relating to any proceeding under this Code could be used as evidence in an inquiry. This provision also empowers the Court to summon or examine the expert in regards to his area of expertise and if the official to come personally unless expressly asked could send an official on his behalf who is well versed with the facts. In addition to this the section is applied to Government scientific experts which include Chemical Examiner or Assistant Chemical Examiner to Government, Chief Inspector of explosives, the Director of Finger Print Bureau, Haffkine Institute Bombay Director, Central Forensic Science Laboratory Director, State Forensic Science Laboratory Director, Deputy Director, or Assistant Director, and Serologist to the Government¹¹. Before the court of law, evidence is most vital, it can be any form but when comes to forensic testimony can be provided by skilled personnels who well versed in the particular subject matter as it is explicitly mentioned in the section 293 of the code of Criminal procedure. Competency of expert opinion considered in the court room only when the facts of the case and circumstance is dependable on expert testimony.

Dental evidence is recognised by the court which is established in the case *State v Sapsford*, a rape victim's body was discovered with bite marks. First suspect was held and freed after his dental did not match. Second suspect named Sapsford, was arrested and court ordered to collect the dental evidence and wax impression of the suspect. But the suspect rejected the order as it violates his rights and he argued it was unconstitutional. Hence, court established that dental cast, wax impression, photographs are legitimate tangible physical proof as evidence which cannot be sheltered under the privilege against self-incrimination. Extracting the dental evidence for identification purpose which does not violate right of unjustified act of search and seizure¹². This was a first case in Ohio considered dental evidence and later several cases been reported.

¹⁰ AIR 1970 SC 146.

¹¹ 1977 2 SCC 210.

¹² 22 Ohio App. 3d 1 (Ohio Ct. App. 1983).

6.3 SEXUAL ABUSIVE CASES

Forensic odontology involves applying the dental knowledge to resolve the legal issues. However, society changes and develops, crime also been evolving, in the case of murder and rape evidence is prominent, identification of evidence is essential. Forensic odontology typically focuses on through dental records, bite marks analysis, and related matters.

6.3.1 Ted Bundy case

Theodore Robert Bundy was a serial killer, necrophiliac and rapist. In this case killer raped and murdered the victim. The bite mark recovered from the victim (levy) which was photographed. Bite mark collected from the victim is the most prominent evidence in the court to sentence him. This case was solved with the help of forensic dentistry by dental expert Dr. Souviron¹³¹⁴. After this notorious and leading case, bite mark evidence in the court became rapidly increased and acceptable one¹⁵. Ted Bundy is a sensational case in which accused was identified correctly with expert knowledge.

6.3.2 Linda Peacock Case

On August 6, 1967, fifteen-year-old Linda Peacock disappeared from her home in Bigger, Lanarkshire, Scotland. On that same her body was found close to St. Mary's church graveyard. The deceased had distinct tooth mark on her body noticeably tooth marks on breast and in head. There were no incidents of rape. Bite marks has been captured as photograph and forwarded to Forensic dentistry Dr. John Furness. But Linda had been killed by beating and strangulation. Gordon Hay, a seventeen-year-old, was suspected as a murder. Suspect denied that he was not a murderer. Bite mark from the photograph had been matched with the suspect occlusion¹⁶. This was a first case accused was convicted by forensic dental evidence.

6.4 Forensic Role in India

In India, forensic dentistry played a significant role for the accused identification which is remarkable case for comparing the bite impression with the teeth of the accused, which is demonstrated as follows

6.4.1 Odontology Report in Delhi Gang Rape Case

In the Nirbhaya case, conviction of the accused is done wherein the prosecution has relied upon the odontology report, bite mark analysis found on the victim was compared with the dental models of the suspects. The bite marks on Photograph No. 4 are caused by the teeth on the dental models of the accused, Ram Singh, with reasonable medical certainty. Additionally, the bite marks on Photograph Nos. 1 and 2 exhibit some specificity to the teeth of this accused person due to a sufficient number of concordant points, including some corresponding unconventional/ individual characteristics. Therefore, analysis showed that at least three bite marks caused by the accused person with the name Ram Singh. The bite mark evident on Photograph No. 5 in connection to the rotated left first incisor, whose mesial surface oriented towards the tongue, and the biting surfaces of the teeth on the lower jaw of the accused individual with the name Akshay were found to be concordant. In general, the bite mark exhibits a certain level of specificity

¹³ Bundy v. Florida, 479 U.S. 894 (1986).

¹⁴ Garima Rastogi, "Bite marks encountered in violent crimes: punishes guilty and safeguards innocent", IP International Journal of Forensic Medicine and Toxicological sciences, 2017, 2(2), 27-31.

¹⁵ Cardoza A, "Forensic odontology and Bite Mark Analysis: Understanding the Debate", Journal of the California Dental Association, 51(1).

¹⁶ Maheswari TNU, Chaudhary M. (2021). Forensic Odontology-renowned cases solved, 2023, 6(1), 1-2.

regarding the accused's teeth due to several congruent features, one of which is a corresponding unique or unorthodox attribute. The bite mark and the biting surfaces of the accused person's teeth do not exhibit any inexplicable differences. Therefore, the bite marks seen in Photograph No. 5 were most likely inflicted by the teeth on the dental models of the accused individual with the name Akshay.

Report which links accused Ram Singh and accused Akshay in the case strengthens the prosecution case as to their involvement. Bite mark evidence, which connects a particular person to the crime or victim, offers additional benefits in the criminal justice system. A bite mark study needs to be comprehensive and include a lot of information on the tooth that left the mark. A thorough dental combination is administered after dental examination of the suspect.

Bite marks are less reliable and specific than fingerprints or DNA because human teeth can alter over time. Bite mark evidence, which connects a particular person to the crime or victim, offers additional benefits in the criminal justice system. Bite marks are less reliable and specific than fingerprints or DNA because human teeth can alter over time. Forensic Odontology has established itself as an important and indispensable science in medico-legal matters and expert evidence through various reports which have been utilized by courts in the administration of justice. Due to the bite marks in this case matching the accused individuals' tooth structures, the report is completely credible and prominent in dental findings¹⁷. With the help of the Forensic Odontology report capital sentence took place. However, in the case of sexual harassment and sexual assault cases, expert opinion is necessarily relevant and reliable one.

7. CHALLENGES IN FORENSIC ODONTOLOGY

Dental evidence in criminal justice system is a challenging task and difficult in using dental evidence in legal process. Although, the field of forensic odontology lacks uniform standards and protocols across different jurisdictions. Particularly there is no uniformity in identification techniques and procedure, that is to say many methods available in forensic dentistry. This creates major problem in examination methodologies, identification, comparison and acceptance of forensic odontology as evidence in court.

Fragmented or damaged remains: In many forensic cases, the dental evidence available to forensic odontologists is often fragmented, damaged, or degraded. Additionally, there are incomplete dental records which even creates too much burden to draw proper evidence. This results in inaccuracy to obtain dental records or makes it challenging to perform dental comparisons for identification purposes.

Limited dental records: One of the primary challenges in forensic odontology is the lack of comprehensive dental records for comparison. Not all individuals have detailed dental records, especially in cases involving victims of mass disasters, unidentified remains, or individuals with poor access to dental care.

Age estimation: Estimating the age of an individual based on dental evidence can be challenging. There are lot of methods aids in individual identification, which includes Schour and Massler, Demirjan¹⁸ and Gustafon¹⁹. Each method is different and time taken for results may vary. When working on legal cases one should opt for easy and simple method. In deed the probability of findings and accuracy of age estimation methods varies because these methods demographic specific. In some cases, accuracy

¹⁷ Mukesh & Anr v State for Nct of Delhi & Ors on 5 May, 2017.

¹⁸ Ajmal M, Assiri KI, Al-Ameer KY, Assiri AM, Luqman M, "Age estimation using third molar teeth: A study on southern Saudi population", J Forensic Dent Sci, 2012, 4, 63-65.

¹⁹ Bommannavar S, Kulkarni M, "Comparative study of age estimation using dentinal translucency by digital and conventional methods", J Forensic Dent Sci, 2015, 7(1), 71-75.

decreases significantly after adolescence, making it hard to determine the age of the individual²⁰. Age estimation in adults is quite challenging. Thus, evaluating age is extremely hard for identification.

Limited research and funding: Compared to other branches of forensic science, forensic odontology has received relatively less research attention and funding. The lack of robust research studies and resources hinders the development and validation of new techniques and technologies in the field.

Bite mark analysis: Bite mark analysis, a significant application of forensic odontology, has faced considerable scrutiny in recent years due to concerns regarding reliability and subjectivity. Bite mark identification is affected by surrounding factors, destructed, environment, defiled, unusual interference, time may influence the analysis of bite mark for accuracy²¹. In the case of sex crimes is different from the case of bite mark of self-defence. Hence, the interpretation of bite marks is highly subjective and dependent on the expertise of the forensic odontologist, which can lead to potential inaccuracies and wrongful convictions.

Alteration of Evidence: Defendant tried to change his teeth after knowing that his bite mark used as evidence as altered evidence. Intention of changing teeth giving reason for the same²². It is highly challenging to admissible the evidence which is demonstrated by expert testimony.

Admissibility in court: Like other forensic sciences, the admissibility of forensic odontology evidence in court can be challenged by defence counsel. The field must demonstrate a strong scientific basis, standardized methodologies, and rigorous quality assurance to enhance the acceptance and credibility of dental evidence in legal proceedings. To overcome these challenges, it is essential for the forensic odontology community to collaborate with other forensic disciplines, invest in research and development, establish standardized protocols, and ensure ongoing professional training and education to maintain high standards of practice.

8. CONCLUSION

Forensic odontology is a specialized field which is significant in criminal investigation and victim identification in crime cases. Forensic dentistry provides solid evidence and expert testimony which aids in the identification of individual, age determination, bite mark analysis and morphology of skull development identification. In medico legal cases, forensic dentistry has marked a prominent role by the scientific experts. The courts have utilised dental evidence findings in administration of justice by various reports and decisions. However, forensic odontology has proven to be an effective tool in the field of forensic science. It is crucial to recognize the field of forensic odontology as it has limitation and difficulties and that the expertise in forensic field determines the accuracy and reliability. Still there is no standard methods and procedures are addressing issues in the legal cases, in the advancement of technology in all field recognizing forensic odontology with appropriate techniques is much needed. In

²⁰ Namene J, Doggalli N, "Challenges in forensic odontology age estimation methods", Int J forensic, 2018, 3, 46-9.

²¹ Nandan M, Sankhla MS, Kumari M, Sharma K, Kumar R, "Investigation of Sexual Assault Cases through Bite Marks Identification – A Review Study", Int J of Social Relevance & Concern, 2016, 4(9).

²² Giannelli PC, "Bite Mark Evidence", Public Defender Reporter, 1986, 9.

order to acquire durable result experts should always be refer to latest authorities in the area and seek guidance appropriately for the admissibility of evidence.

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