Review Article

BITE MARK ANALYSIS AN INDIAN PERSPECTIVE - SCIENCE OF FAILURE OR FAILURE OF SCIENCE?

Vartika Chaddha[1], Aman Chowdhry[2], Deepika Bablani Popli[3*]

[1]Student
Faculty of Dentist,

[2]Associate Prof, [3]Asst Prof,
Department of Oral Pathology, Faculty of Dentistry,
Jamia Millia Islamia, New Delhi

** Corresponding author: deepikabablani@gmail.com*

ABSTRACT

A bite mark has been defined as a pattern produced by human or animal dentitions and associated structures in any substance capable of being marked by these means.[1]

Key Words: Bitemarks, Forensic Odontology

INTRODUCTION:

A bite mark has been defined as a pattern produced by human or animal dentitions and associated structures in any substance capable of being marked by these means.[1]

The first case which used bite marks as evidence in the court of law was in 1954, Doyle vs. State in Texas. Here a dentist and a firearms expert were called upon to match the bite marks of the suspect which were left behind at the scene of crime on a piece of cheese. Either of them did not have any previous exposure to bite mark analysis yet the evidence was admitted.[2] Following this case, bite mark analysis have been used as positive evidence by the judiciary all over the globe including in India.[3-6] The reliability and value of bite mark as forensic evidence still remains disputed due to lack of trained forensic odontologistsô and a paucity of research facilities.

Dentists often have to seek training abroad to hone their forensic skills. The

Dental Council of India (DCI) has addressed this concern and has recommended inclusion of forensic odontology in the BDS (Bachelor of Dental Surgery) curriculum,[7] ensuring that dentists gain basic knowledge of forensics and medico legal procedures during their bachelorûs degree program.

The American Board of Forensic Odontostomatology (ABFO) gave certain guidelines in 1986 for standardization of bite mark analysis. The guidelines objectified the procedure of taking history, photographs, extra oral and intra oral photography, taking bite mark impression and preparing study casts.[8] As per these guidelines, the first step prior to collection of any bite mark evidence is taking Orientation photographs. (FIG 1)

Fig 1: Example of a human bite mark orientation photograph.

This should then be followed by saliva swabs of bite site preferably by the double swab technique.[9] The bite site should then be digitally photographed by or under the guidance of a forensic odontologist. Photographs should be taken with and without an ABFO #2 photometric scale in place. (FIG 2, 3). Impressions using ADA approved impression materials should be made of the bite mark when three-dimensional properties are seen. If permitted by authorities the bite site tissue can be excised and preserved in post mortem cases.

Fig 2: Example of digital clos-eup photograph of a bite mark with an ABFO #2 photometric scale in place.

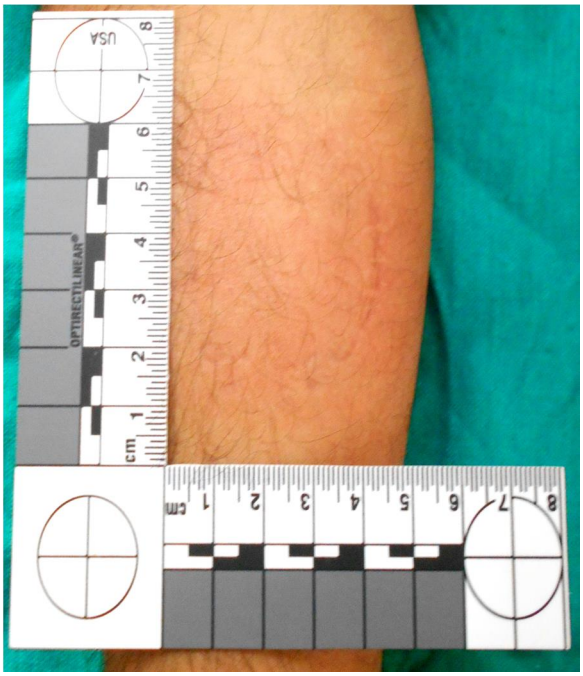

Fig 3: Example of digital close-up photograph of a bite mark.

Following this evidence collection of suspected human dentition is carried out which includes dental treatment records, examination, impressions, sample Bites and saliva collection. After careful appraisal of bite mark evidence, a comparison of suspect records with bite mark evidence is done by any one of the various available methods such as overlays, test bites, comparison techniques, transillumination, and stereomicroscopy.

Here we would also like to highlight the fact that in our country most of the forensic related work is done at the Central and State Forensic Science Laboratories, which use primarily the bite mark superimposition technique for identification.[14] The routine medico legal cases/forensic autopsy cases where examination of teeth/bite marks is required, are handled mostly by Forensic Physician, Forensic Pathologist and rarely by Dentists making use of routine methods including clinical examination of teeth and simple dental radiographs.

After careful appraisal of literature, we have prepared a compilation of the strengths and weaknesses of bite mark evidence [Table 1].

There is a need for translation of the forensic science research into specialized methods for dental identification and bite mark analysis. In India, bite mark evidence has been used in cases like: The Nirbhaya Gang Rape case, Sheena murder case, Papermill Colony case and numerous others.[4,17,18] However, there is lack of standardization of techniques and need for translational research in the subject. It is the need of the hour, that the dental fraternity of India realizes their role in the criminal investigation system and undertake the mammoth task of ensuring that forensic odontology becomes a more reliable and useful tool for investigation. Furthermore, the courts should not hesitate to base their verdict on the undisputed dental evidence tendered by Forensic dentist in the Court of law.[19]

TABLE 1: Illustrates the strengths and weaknesses of bite mark evidence

Strengths	Weaknesses
Unique and distinctive like fingerprints. Commonly found at crime scenes on skin and food items.[10] Source of assailant DNA. Objective and reliable scoring system for ruling out suspects.	Lack of standardized procedures leading to overdependence on the expertise of the forensic odontologist.[11] Viscoelastic property of skin causes distortion.[12] Innocents put behind bars, later proved ñnot guiltyòusing DNA.[13] Possibility of change in the shape and size of the mark due to alteration in the body position.[14,15] Arch configuration of any individual can change over time, which can alter the bite marks produced.[16]

Road ahead: Bite mark analysis should not be shunned by calling it ñinaccurateò and ñunscientificò rather one should explore newer avenues for improving its accuracy. Before jumping into the bandwagon of numerous organizations, like The Texas Forensic Science Commission, which recommend, in 2016, that bite mark evidence should not be used in criminal prosecutions.[20] One should introduce standardization in bite mark analysis. More research, resources and scientific commitment are required to enhance this invaluable tool of forensic odontology.

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Review Article

APPLICATION OF PERIODONTAL KNOWLEDGE TO FORENSIC DENTISTRY

Kirti Chawla

Assistant Professor,
Department of Periodontology, Faculty of Dentistry,
Jamia Millia Islamia, New Delhi

** Corresponding author: dr.kirtichawla@gmail.com, kchawla@jmi.ac.in*

ABSTRACT

Forensic odontology has been designated as a crucial part of forensic medicine. The first ever evidence of the use of forensic odontology to identify adead subject was done in the late 60ŝ AD when King Nero recognized the lady through her peculiar teethsetting.[1] Periodontics is a clinical science which deals with diseases of periodontium.[2] The study of the periodontal structures post mortem can help in identification, determination of time of death, sex determination and age estimation of the deceased. This article aims to summarize the application of the knowledge of the periodontium in the field of forensic odontology.

Key Words: Odontology, Forensic Medicine, Identification, Time since death

INTRODUCTION:

Forensic odontology has been designated as a crucial part of forensic medicine. The first ever evidence of the use of forensic odontology to identify adead subject was done in the late 60ŝ AD when King Nero recognized the lady through her peculiar teethsetting.[1] Periodontics is a clinical science which deals with diseases of periodontium.[2] This specialty is utilized for identification of individuals through morphology and pathology of periodontium and is also utilized for age estimation studies which include (periodontal ligament attachment level) periodontosis, root transparency and root length.[3]

The study of the periodontal structures post mortem can help in identification, determination of time of death, sex determination and age estimation of the deceased. This article aims to summarize

the application of the knowledge of the periodontium in the field of forensic odontology. IDENTIFICATION

The clinical parameters of the gingiva can help in identification of the individual. Contour, recession, enlargements, interproximal craters, color (inflammatory changes, physiological [racial] or pathological pigmentations) can be matched with ante mortem records to establish the identification of an individual.[4] The clinical parameters of the periodontal ligament such as thickness of periodontal ligament, widening of periodontal ligament and pathologies of the periodontal ligament such as lateral periodontal cysts and periodontal abscess have been taken into consideration for establishing identity of the individuals. Comparison of the ante and postmortem radiographical records forthe alveolar bone height, contour and density of crestal bone, thickness of interradicular bone, pattern of lamina dura, bone loss (horizontal or vertical), trabecular bone pattern and bone islands has helped in establishing the identity of the individuals. Records of the periodontal esthetic procedures have been used in identifying a person.[4]

DETERMINATION OF THE TIME OF DEATH

Estimation of time elapsed since death (PMI) is an important requisite in many forensic cases.[5] The various approaches to assess the PMI include physical (algor mortis, livor mortis), physicochemical (rigor mortis), biochemical (electrolyte concentration, enzyme activity), microbiological (decomposition), entomological and botanical processes.[6] The histological changes in the postmortem gingival tissues can be studied to studies to determine the changes after death. The initiation of decomposition occurs in 15 min and it progresses with time. The autolytic changes appear only in the superficial layers but the basal layer did not show any autolytic change and as the time increases the changes involves the basal layer which is evident in the sections studied at 4 h of time interval. Basal cell layer has an increased nuclear content compared with the other superficial layers of the epithelium. It has high mitotic potential and is considered to be composed of stem cells and progenitor cells.[7] The histological changes that are observed in the gingival tissues at different time intervals are chromatin clumping (he chromatin is fragmented forming visible clumps within the nucleus), nuclear vacuolation, karyopyknosis (shrinkage of the nucleus and increased basophilia), prominent and widened intercellular junction, eosinophilia

(bright pink staining of the cytoplasm), homogenization (merging of cellular outlines leading to a glossy, homogenous appearance) and loss of epithelial architecture.[7]

SEX DETERMINATION

The use of oral epithelium cells harvested by pressure application of a toothbrush has been used to assess the minute qualities of DNA of individuals followed by gender identification by sex determining region-Y (SRY) gene amplification using realtime polymerase chain reaction. This is a valuable and sensitive tool and functional amounts of DNA could suffice from SRY gene amplification for human gender identification.[8] Quantitative cytomorphometric analysis of exfoliated healthy gingival cells which were obtained by scraping attached gingiva to assess the age- and gender-related alterations in the nuclear area, cytoplasmic area, and nuclear: Cytoplasmic ratio values of pathologic smears of oral premalignant and malignant lesions has revealed that attached gingiva can be studied for human identification.[9]

AGE ESTIMATION

Cementum apposes continuously; if contributing conditions could be avoided for a reasonable period of time, this property of cementum apposition aids as an adjunct to biological age estimation, which may serve to be significant tool in forensic investigations. Tooth cementum annulations can be used for age estimation of the deceased. These are counted on a pictomicrograph under light microscopy, polarized microscopy, or phase-contrast microscopy.[10]

Number of incremental lines (n) = X/Y where,

X = Total width of cementum from dentino-cementum junction to cementum surface.

Y = Width of cementum between two adjacent incremental lines.

Addition of the eruption age of the tooth with the number of lines can give us the age of the individual.[11]

The measurements of alveolar bone level according to Lamendin indicated the process of alveolar resorption on the labial aspect of anterior monoradicular teeth to increase with aging.

Regression analysis showed labial alveolar resorption to increase toward older age groups. Labial alveolar resorption expressed as factor of alveolar resorption on the anterior monoradicular mandibular teeth increased in older age groups, showing a regular time dependent pattern; the respective maxillary teeth also showed

an increase in labial alveolar resorption toward older age groups, however, with a greater variability than the former.[12]

CONCLUSION

Teeth with the jaws are the most stable and most resistant parts of the human body postmortem, therefore being used for research in the fields of anthropology, archeology, anatomy, pathology, and forensic medicine. Hence, the teeth and jaws can be an important tool in the postmortem investigations in forensic odontology.

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