

Bite marks – A review

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Abstract- Teeth have used as tools and weapons since the advent of time. Bite marks inflicted by them during violent interactions form the basis for one of the most broad and sometimes controversial encounters in forensic dentistry. Forensic dentists play a pivotal role in various areas of crime scene investigations. Teeth appear to be vital pieces of evidence in several such investigations. Teeth are preserved in the closed cavities of the mouth and are generally resistant to the threatening environmental conditions that may be associated with the death of an individual. Thus, teeth prove to be an important adjunct in forensics. Its scope is ever-increasing with time, and a great amount of research is being carried out to implement the same.

Keywords: *bite mark, forensic dentistry, teeth*

Introduction:

Forensic odontology is a branch of dentistry, which in the interest of justice, deals with the proper handling and examination of dental evidence, and also with evaluation and presentation of dental findings. The term 'forensic' is derived from the Latin word forensis, which means 'pertaining to the forum' and 'odontology' refers to the study of teeth. [1]

Each dentition, including the number of teeth, their position, occlusion and the restorations are unique for each individual. This makes forensic odontology play a key role in identifying the deceased.

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.[2]

Females are usually bitten on the breasts, abdomen, thighs, buttocks, and pubis, while men are usually bitten on the back, arms, shoulders, chest. Bite marks have also been observed on various edible leftovers at the crime scenes, and these bite marks have also been used as evidence for identifying the criminals. Bite marks on inedible objects have also been reported including on soap and bullets.[3]

According to Pretty and Turnbull, the central dogma of bite mark analysis is based on two assumptions [4], the first is that human teeth are unique and the second is that sufficient detail of the uniqueness is rendered during the biting process to enable identification.

Classification of Bite Marks:

[A]MacDonald's Classification:

[I] Tooth pressure marks

Marks produced on tissue as a result of direct application of pressure by teeth. These are generally produced by the incisal or occlusal surfaces of teeth.

[II] Tongue pressure marks

When sufficient amount of tissue is taken in the mouth, the tongue presses it against rigid areas such as the lingual surface of teeth and palatal rugae.

[III] Tooth scrape marks

These are marks caused due to scraping of teeth across the bitten material. They are usually caused by anterior teeth and present as scratches or superficial abrasions.

[B] Webster's classification:

Type I: The food item fractures readily with limited depth of tooth penetration (e.g., hard chocolate)

Type II: Fracture of fragment of food item with considerable penetration of teeth (e.g., bite marks on apple and other firm fruits)

Type III: Complete or near complete penetration of the food item with slide marks (e.g., cheese, banana)

Appearance:

A classical human bite mark is circular or oval patterned injury consisting of two opposing symmetrical, U-shaped arches separated at their bases by open spaces.[8] The periphery of the arches can have abrasions, contusions, lacerations, etc., indicative of distinctiveness of the occlusal surfaces of the biting dentition. [9]

Depending of the skin colour they appear as reddish or purplish or dark brown discoloration on the skin surface and are due to the blood escaping into subcutaneous tissue from ruptured minute vessels.

Sweet has suggested that a human bite mark may be identified by the following characteristics:

Gross characteristics: A circular or elliptical mark found on the skin with a central area of ecchymosis. The circular mark is caused by the upper and the lower arches with the central area of ecchymosis could be due to tongue pressure.

Class characteristics: The marks produced by different classes of teeth are usually distinct, allowing one to differentiate the type of tooth within a bite mark. Incisors produce rectangular marks; canines are triangular or rectangular; premolars and molars are spherical or point- shape

Individual characteristics: Class characteristics may in turn, have features such as fractures, rotations, spacing, etc. Such attributes are referred to as individual features and make the bite mark distinct.

Collection of Evidence in Bite Mark Analysis:

[1] Collection of Evidence from the Victim:

DNA present in salivary trace evidence can be obtained by swabbing the bite site. The double swab technique involves moistening the site with a swab, moistened with sterile saline, and then removing of the moisture with a second dry swab and both swabs can be sent for analysis. Then, DNA fingerprinting can be done from salivary trace evidence of biter's exfoliated epithelial cells.

[2] Collection of Evidence from the Suspect:

Extraoral examination includes the examination of hard and soft tissue, TMJ status and facial asymmetry muscle zone. Maximum inter incisal opening, deviations in opening/ closing the jaws, occlusal disharmonies, facial scars, evidence of surgery and presence of surgery should also be well photographed.

Intraorally, salivary evidence, examination of tongue for size and function, periodontal examination and condition of teeth are examined.

Two impressions of each arch with ADA specified material is followed by obtaining dental casts with type II stone. Sample bites are made into appropriate material simulating the type of bite under examination.

Bite Analysis:

The first stage of bite mark is to confirm if the injury is a bite mark and then provide a statement on its forensic significance. The steps in bite mark analysis are:

Demographics:

Includes name of the victim, case number, date of examination, referring agency, person to contact, age, race, sex of the victim and name of the examiner.[11]

Location of Bite Marks:

Bite marks may be located on various parts of the body. It can be broadly classified as non- sexual and sexual bite marks. The sites where non-sexual bite marks are often seen on arms, legs, fingers, hands, chest, ears. Whereas, sexual bite marks may be seen on breast, neck, thigh, genitalia, axilla, upper back, arm, cheek, etc. [14]

Shape, Size and Arrangement of Teeth:

Bite marks may be crescent, ovoid, round, or irregular in shape. The cross-section of human incisors produces rectangular marks whereas canine yields triangular marks. Tooth numbers, missing teeth and placement of tooth marks should be noted.

Size of Dental Arch:

The size relationship of bite marks, as defined by the dental arches, could relate to a child or adult bite. It consists of U-shaped arches separated by an open space in between where bruising is usually seen.[15]

Colour of the Wound:

The colour should be noted e.g., red, purple or dark brown.

Evaluation of the Bite Mark Photographs:

This is a significant step during examination. Images should be of sufficient resolution to permit amplification to life- sized dimension without pixilation.[15]

Factors Affecting Bite Marks in Skin: Some marks are made through clothing. Hence clothing is considered a potential source of bite mark impressions and biological evidence from transferred saliva.[5]

1. Loose skin/subcutaneous fat lead to poor bite mark. Whereas areas of fibrous tissue or high muscle content bruise less easily and demonstrate good bite mark.[6]
2. The size and shape of bite mark is affected by its location on the body, because certain areas of the body bend distorting the surface area of the skin due to high viscoelasticity. [6]

Recent Advances – Digital Methods:

Image Perception Software Procedure:

An area of interest is chosen in the image perception software using the photograph of a bite mark. Different levels of grey values are assigned a particular colour which enables the forensic odontologist to select regions with similar grey values. It is feasible to isolate the region of the image which shows the bite mark, by excluding certain areas of pixel intensity.[25]

Automated Dental Identification System (ADIS):

This is a computerized program for the postmortem examination of victims based on the oral features of the subjects. It is precise and time efficient compared to the conventional approaches.[26]

3D Reconstruction of Bite Marks:

The benefit of utilizing 3D-CBCT over the conventional technique is the minimal handling of the sample, leading to lesser changes in the original bite mark found at the crime location. Additionally, it is simpler to store and recover the information.[28]

Odontosearch:

It provides an objective means of assessing the frequency of occurrence for dental code. The strength of match between a postmortem and ante mortem dental code is based on the clinical experience of the dentist.[29]

Conclusion:

Bite marks are a valuable and also a controversial aspect in forensic odontology as they can not only prove the suspects as guilty of the crime but also help in vindication of the acquitted.

Bite marks carry a high forensic value based on the characteristics of the bite marks that are similar to the defendant's. Such evidence is as conclusive as DNA and fingerprint evidence in rape cases. The human bite mark is capable of withstanding the extreme conditions of the environment and is a ready source of information that can be identified even in the deceased individual.

The importance of bite marks and their analysis in forensics is well asserted. The source of bite marks from which they are produced, the substrate onto which they are generated and the technique of lifting the bite imprints serve as important tools in analysis and identification.

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