



Bite Marks – An Aid In Autopsy

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Abstract:

Teeth are often used as weapons when one person attacks another or when a victim tries to ward off an assailant. It is relatively simple to record the evidence from the injury and the teeth for comparison of the shapes, sizes and pattern that are present. However, this comparative analysis is often very difficult, especially since human skin is curved, elastic, distortable and undergoing edema. In many cases, though, conclusions can be reached about any role a suspect may have played in a crime. Additionally, traces of saliva deposited during biting can be recovered to acquire DNA evidence and this can be analyzed to determine who contributed this biological evidence. If dentists are aware of the various methods to collect and preserve bitemark evidence from victims and suspects, it may be possible for them to assist the justice system to identify and prosecute violent offenders. This paper reviews the recognition and recovery of this evidence and provides insight into modern methods used to investigate bitemark evidence from heinous crimes.

Keywords: Bite marks, saliva, forensic identification, human skin

Introduction:

Forensic Odontology is the application of dentistry in legal proceedings deriving from any evidence that pertains to teeth. OR Area of dentistry concerned with the correct management, examination, evaluation & presentation of dental evidence in civil/criminal legal proceedings in the interest of justice (Neville)[1]. 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”. [2]

A bite mark is a form of patterned injury, which is the physical result of a biting action applied to skin or other material such as food or other inanimate substrates. Biting is used by human being as both offence and defense. A forensic odontologist collects, documents, evaluates, and compares the bite mark

evidence. Bite marks are considered as valuable alternative to fingerprinting and DNA identification in forensic examination. Bite marks may be found virtually on any part of the human body, common sites being the face, neck, arm, hand, finger, shoulder, nose, ear, breast, legs, buttocks, waist, and female genitals. In sexual assaults, the face, lips, breasts, shoulder, neck, thigh, genitals, and testicles are most involved. To identify the offender, the dental casts of suspected persons are prepared using dental materials and matched. Bite marks if analyzed properly can prove the involvement of a particular person or persons in a particular crime.[3]

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Historical Background;

66 AD: Well-documented evidence to the use of teeth for identification began AD with Agrippina and Lollia Pauline case. It was the first use of dental identification where there is a record. As the story goes, Nero's mother Agrippina had her soldiers kill Lollia Paulina, with instructions to bring back her head as proof that she was dead. Agrippina, unable to positively identify the head, examined the front teeth and on finding the discolored front tooth confirmed the identity of the victim.[4,5]

1193: The first forensic identification in India started in were Jai Chand, a great Indian monarchy was destroyed by Muhammad's army and Jai Chand, Raja of Kanauji was murdered and he was identified by his false teeth.[2]

1758: Peter Halket was killed in during French and Indian wars in a battle near Fort Duquesne. Halket son identified his father's skeleton by an artificial tooth.[2]

1776: At the battle for Breed's Hill in Boston, Dr. Joseph Warren was killed in the year 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.[2]

Classification of Bite Marks:

Bite marks can be broadly classified as:

- 1) Non-human (animal bite marks)
- 2) Human bite marks.

Based on manner of causation, the bite marks can be classified as:

- 1) Non-criminal (such as love bites)
- 2) Criminal

Which can be further be classified into

- 1) Offensive (upon victim by assailant)
- 2) Defensive (upon assailant by victim).[6,7]

There are seven types of bite marks; 'Haemorrhage' (a small bleeding spot), 'Abrasion' (undamaging mark on skin), 'Contusion' (ruptured blood vessels, bruise), 'Laceration' (near puncture of skin), 'Incision' (neat punctured or torn skin), 'Avulsion' (removal of skin), and 'Artefact' (bitten-off piece of body)[8]. These further can be classified into four degrees of impressions; 'Clearly defined' that results from the application of significant pressure, 'Obviously defined' which is the effect of first degree pressure, 'Quite noticeable' due to violent pressure and 'Lacerated' when the skin is violently torn from the body[9].

The following classes that are of proven significance in practical application regarding bite marks are as follows:

Class I: It includes diffused bite marks, which is having limited class characteristics and lacks individual characteristics, for example, bruise, diffused bite mark, a smoking ring, or a faint bite mark.

Class II: This pattern of injury referred to as a single arch bite or the partial bite mark as it has some individual and some class characteristics.

Class III: This classification incorporates both individual and additionally class characteristics. This bite has extraordinary evidentiary value and utilized generally for the comparison purposes. The main sites for this type of bite on the body are buttocks, shoulders, an upper arm, or the chest. The pressure and deep penetration of tissue are held to record the lingual surface of anterior teeth.

Class IV: Mainly, avulsion or laceration of the tissues is caused by the bite. In this class, class characteristics and individual characteristics are not present. This type of bite is commonly found where there is avulsion of an ear or finger.¹⁰

Cameron and Sims' Classification[11]

A simple classification based on the type of agent producing the bite marks and material exhibiting it.

Agent: Human and Animal.

Materials: Skin, body surface, food stuff, other materials.

McDonald's Classification[12]

- 1) Tooth pressure marks: By incisal edges of anterior teeth – stable with minimal distortion
- 2) Tongue pressure marks: Tongue pressure on palatal surfaces of the teeth, cingulae or palatal rugae causes distortion of marks
- 3) Tooth scrape marks: Caused due to irregularities in teeth due to fractures, restorations, etc.
- 4) Complex marks: Combination of above marks.

Websters Classification[7]

- 1) **Type I:** Bites in chocolate which fracture easily with limited depth of penetration. Most prominent are incisal edges of upper and lower anterior teeth
- 2) **Type II:** Good grip of material obtained by teeth and the bitten piece is fractured from main material. For example, Apple; The outline of labial aspect of upper and lower incisors are recorded

3) Type III: Bite mark produced by biting through cheese. Here, an advantage is that it indicates relative position of upper and lower incisors in centric occlusion.

Mechanism of Bite Marks :

Three predominant mechanisms associated with production of bite marks are; tooth pressure, tongue pressure and tooth scrape. Tooth pressure marks are caused by direct pressure application by incisal edges of anterior teeth/occlusal edges of posterior teeth¹³. Severity of bite mark depends upon duration, degree of force applied and degree of movement between tooth and tissue. Clinical presentation of tooth pressure indicates pale areas representing incisal edges and bruising that represent incisal margins. Tongue pressure is caused when the material taken into mouth is pressed by tongue against teeth/ palatal rugae and distinctive marks are present due to tongue sucking/ thrusting. Tooth scrape is caused by teeth scraping against tooth surface commonly involving the anterior teeth. Clinical presentation can be in the form of scratches and abrasions. Scratches and abrasions that indicate irregularity and peculiarity of incisal edges are useful in identification^[14].

Uniqueness of Bite Marks:

The scientific foundation of bite mark analysis is entrenched in the idea of the distinctiveness of the human dentition, the conviction that no two humans have identical dentition. The unique characteristic of a suspected individual's dentition is compared with the pattern observed over the bitten skin, and two simultaneous and opposite paths develop^[15].

The inclusive path where the suspected biter's dentition can be positively identified due to strong and consistent tooth and arch comparison with the pattern recorded. The exclusion path where the suspected biter's dentition does not match with the patterns recorded in the bite mark injury and the suspect can be excluded as being the cause for the bite mark. Exclusion is usually accomplished more frequently than the inclusion.^[15]

Characteristics of Bite Marks:

A human bite will often be elliptical or circular in formation and will display the specific characteristics of the teeth that have been used to make the mark. Likewise, a bite mark can be U-molded in appearance with a space in between to indicate where the biter has opened their mouth to a width necessary to get their teeth around a wrist or an arm. The mistreatment of teeth also has a large part to play in the identification of bite marks. Missing teeth, fractures, or malformed teeth all bear their own special characteristics and these show when a bite mark is examined^[16].

Class Characteristics:

According to the Manual of American Board of Forensic Odontology (ABFO)[17], a class characteristic is a feature, characteristic, or pattern that distinguishes a bite mark from other patterned injuries. It helps to identify the group from which the bite mark originates. While evaluating the bite marks, the first step is to confirm the presence of class characteristics. The 'tooth class characteristics' and the 'bite mark characteristics' are the two types of class characteristics[18].

In a bite mark, the front teeth which include the central incisors, lateral incisors and the cuspids are the primary biting teeth according to tooth class characteristics[19]. Each type of tooth in the human dentition has class characteristics (tooth class characteristics) that differentiate one tooth type from the others. Thus, the two mandibular central incisors and the two mandibular lateral incisors are almost uniform in width, while the mandibular cuspids are cone shaped[14].

The bite mark characteristics help in determining if the marks were from maxillary teeth or the mandibular teeth. According to the bite mark characteristics, the maxillary central incisors and lateral incisors make rectangular marks of which the centrals are wider than the laterals and the maxillary cuspids produce round or oval marks. The mandibular central incisors and lateral incisors also produce rectangular marks but these are almost equal in width, whereas the mandibular cuspids produce round or oval marks[20].

Individual characteristics:

Individual characteristics are deviations from the standard class characteristics. They are the specific features found within the class characteristics which can be a feature, a trait or a pattern that represents an individual variation rather than an expected finding¹⁰. Dental patterns, features, or traits may be seen in some individuals and not in others such as rotation, buccal or lingual version, and mesial or distal drifting of teeth etc. Dental characteristic is specific to an individual tooth and makes one tooth different from the other[21]. The teeth of different individuals differ from one another with respect to their size, their position in the dental arches and in their shape. Individual differences may be formed by various physical and chemical injuries affecting the teeth over the years like attrition, abrasion, erosion, the teeth may be affected by caries due to poor oral hygiene, and there may be restorations of the carious teeth[22]. The teeth are subjected to various insults such as sports injuries, chemical injuries, biologic attacks, motor vehicle accidents, workplace accidents, and caries. After such damages have taken place, the teeth often need a restoration. These restorations or the injury itself produces

distinctive and unique features within a tooth. Individual characteristics of bite marks may be affected by the type, number and peculiarities of the teeth, occlusion, muscle function, individual tooth movement and TMJ (Temporomandibular joint) dysfunction in the perpetrator[23].

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[24]. The periphery of the arches can have abrasions, contusions, lacerations, etc., indicative of distinctiveness of the occlusal surfaces of the biting dentition[25]. Usually, mandibular anterior teeth are detected more obviously than the maxillary teeth in bite marks, which is owed to mandibular jaw movement during bite infliction[24]. The bite mark is produced due to teeth pressure and starts with mandibular closure, followed by suction on the skin (as a negative pressure). Tongue thrusts can accompany the opposite action of mandible which are seen as tongue projections on teeth incisor and lingual surfaces[26]. About 11 kg pressure is exerted from the incisors and along with the tongue, it may reach up to 8 lb/square inch. Suction may produce a negative pressure of 20 mmHg[27].

Variables and Variations In Bite Marks Variations In Bitemarks:

Variables Affecting Bitemarks	
Structure and vascularity of tissue injured	Bruising in loose and highly vascular tissues is more pronounced
Children and elderly	Bruise more easily due to loose, delicate skin in former, and loss of subcutaneous tissue in latter
Victims health status	□ Hypertension, coagulation disorders, liver dysfunction, may affect extent of bruising
Medications	Aspirin: Increases bleeding
Mass and velocity of impact	Steroids: Alters dispersion rate of bruising Influences depth and surface of injury and rate of healing

Variations In Bitemarks:

- 1) A central ecchymotic area or “suck mark” surrounded by radiating linear abrasions resembling a “sunburst” found usually after sexually oriented crime[25]. The central ecchymosis is due to the negative pressure during biting, leading to leakage or rupture of the small vessels and capillaries and linear abrasions caused by the movement of the teeth. Imprint of the inner surface of teeth against the skin is called lingual marking or drag marking[15].
- 2) The second type closely resembles a “tooth mark” pattern. This is an “attack” or “defense” bite mark seen most often in “battered” child homicide[25].

Furthermore, double bite can be seen when two bites are done quickly in the same location on the skin whereas partial bite marks can be seen in situations when the victim moved during the bite[15].

Evidence Collection[28]

Demographics:

Name, age, sex, race, case number, date of examination, and name of the examiners should be recorded.

Location of the Bite Mark:

Describe the anatomic location, indicate the contour of the surface (flat, curved, or irregular), and state of the tissue characters, underlying tissue-bone, cartilage, muscle, or fat.

Shape of the Bite Marks:

Whether it is round, ovoid, crescent, or irregular in shape.

Color and Size of the Mark:

Both vertical and horizontal dimensions should be recorded in the metric system.

Type of Injury:

Due to bite, different types of injuries may occur such as petechial haemorrhages, contusion, abrasion, laceration, incision, avulsion, artifact, etc. The type of injury should be recorded.

Evidence Collection from Victim Documentation

A record of the bite mark, including the descriptive and narrative notes, is recorded. The documents contain the physical appearance, color, size, and characteristics of the bite mark.

Photograph:

The photograph is taken from different angles. Photographs are taken from a distance to show the relationship of the bite mark with the rest of the body and close-up photograph is also taken for bite mark measurement. All images are taken in both black-and- white and color.

Various photography techniques include:

- 1) **Visible light photography**
 - a. Digital photography
- 2) **Non-visible photography**
 - a. UV photography
 - b. Infrared photography.

Swabs:

Saliva which has been left behind after biting should be collected. A double swab technique can be used. First, cotton dampened with distilled water is wiped over the mark. Next, use a dry swab to collect the rest moisture present on the mark. Both the swabs are dried for 4–5 min before comparing.

Impressions:

A proper impression should be taken with impression materials or polyether which is used in dental clinics. A plaster model can be made and used as a rigid support for impression materials.

Evidence Collection from Bite Suspect:

Clinical examination:

An overall examination of the oral cavity is done and documented. Specific findings such as fracture, pocketing, and missing tooth are noted.

Impressions

An accurate impression of the entire tooth is recorded with all features. It is recommended to make two molds using dental die stone and hard stone.

Bite sample

A sample of the suspect's bite is recorded with either baseplate wax or putty impression. The sample is preserved and a photograph of the sample is documented.

Analysis of Bite Mark:

The exact identification of a living person using individual traits and characteristics of the teeth and jaws is the basis of forensic science. The bite marks left on a person may be used

to identify the perpetrator. Bite mark identification is based on the individuality of a dentition, which is used to match a bite mark to a suspected person.[29] One can exactly match the bite marks to the accused biter's dentition. The most important step in bite mark analysis is to recognize a patterned injury as a human bite mark followed by pattern analysis of the bite mark which provides the individual information about the suspect or an offender and relates the person who is involved in the crime.[30]

Bite marks with high evidence value that can be used in comparisons with the suspects' teeth will include marks from specific teeth that record different characters. The surface abrasion or subsurface hemorrhage caused by human bites appears as an arch. They are caused by the incisors, canines, and premolars. Contusions are the most common type of bite mark. It can be determined from the type of bleeding under the skin whether the victim was alive or dead at the time the bite mark was delivered.[31,32]

It is important to have individual characteristics in the bite mark to identify the perpetrator. Use, misuse, and abuse of the teeth result in features that are referred to as accidental or individual traits. If individual traits are not present in the teeth in the bite marks, the forensic significance of the bite mark is reduced.[31]

Bite marks are never viewed accidental, although some injuries caused by teeth (e.g., a child accidentally strikes his/her parent in the mouth leaving tooth marks on the hand) may be.[32]

The American Board of Forensic Odontology[33] provides a range of conclusions to describe whether or not an injury is a bite mark. These are as follows:

- 1) **Exclusion** - the injury is not a bite mark.
- 2) **Possible bite mark** - an injury showing a pattern that may or may not be caused by teeth could be caused by other factors, but biting cannot be ruled out.
- 3) **Probable bite mark** - the pattern strongly suggests or supports origin from teeth but could conceivably be caused by something else.
- 4) **Definite bite mark** - there is no reasonable doubt that teeth created the pattern.[33]

Bite Mark Analysis and Identification:

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It is important to have individual characteristics in the bite mark to identify the perpetrator. Use, misuse, and abuse of the teeth result in features that are referred to as accidental or individual traits. If individual traits are not present in the teeth in the bite marks, the forensic significance of the bite mark is reduced.³² Sometimes, palatal rugae impressions obtained along with the impressions of teeth can also help in the identification of the individual involved in crime. These are present in the form of a crest and are usually three to seven in number.[34]

One of the most remarkable, difficult and sometimes troublesome challenges in forensic dentistry is the identification, recovery and analysis of the bite marks with the suspected biters. In a study by Page et al.[35] on retrospective analysis of bite mark casework of 119 cases, it has been observed that the practice of bite mark analysis does not much strengthen odontology evidence as well as position of forensic practitioner in the courts of law. They further suggested that the forensic practitioners should be quite careful while giving opinion regarding the origin of the bite mark and the identification of the criminal on the basis of bite mark evidence. The conviction whether the accused is the biter or not is based on the expert testimony of the forensic odontologist after matching a bite mark with that of the dentition of the accused. In a recent communication, Pretty and Sweet[36] described the current status and a paradigm shift in the analysis of bite marks following some recent

research and case studies of wrongful convictions on the basis of bite marks. They further stressed that though the bite marks analysis has the ability to defend the innocent, protect children from harmful care givers, and convict the guilty, this at the same time, may also be the enemy of natural justice.

Conclusion:

Human bite mark analysis one of the most challenging and intricate part of forensic dentistry. Bite marks can be distorted by the elastic properties of the skin or by the anatomic location. The greatest challenge in Forensic Dentistry is analyzing bite marks found in human skin, because of the distortion presented and the time elapsed between the production and the analysis. Furthermore, though the individuality of human dentition is observed commonly in practice, there is no database to express quantitatively the uniqueness of the human dentition. There is a demand on the field of bite mark analysis for research to adhere to more stringent scientific regulations in order for it to be more resilient to scientific scrutiny. Hence, bite mark analysis by itself should not be permitted to lead to a guilty decree, but it will proffer the opening to eliminate a suspect from crime when the data do not correspond.³⁷

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