

## Bite Mark, a Pivotal Tool in Crime Investigation: A Review

Anandita Kale<sup>1</sup>, Namratha Patil<sup>2</sup>

<sup>1</sup>BDS Student, K.I.E. Vishwanath Katti Institute Of Dental Sciences, Kaher Belgaum, Karnataka, MDS- Lecturer, Department Of Oral Medicine And Radiology Vishwanath Katti Institute Of Dental Sciences

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### Abstract

*Objectives:* Forensic odontology believes that no two oral cavities are similar in characteristics. Bite marks are imprint of the dentition of a human or an animal on a pliable medium. Analysis of these help in narrowing down the list of suspects. *Sources from which data was obtained:* Various news reports and criminal journals (both containing cases from within the country as well as worldwide) *Study Selection:* There are many factors and grades that are used to evaluate the authenticity of a bite mark. Various methods of documentation and evaluation are used to produce a scientific testimony in the criminal investigations. *Conclusion:* Some experts believe that bite marks are only beneficial to eliminate suspects and cannot be relied as concrete evidence due to distortion caused by human skin and the subjective judgement with which it is evaluated.

**Keywords:** Bite marks, Criminal Investigation, Forensic Odontology, American Board of Forensic Odontology (ABFO)

### Introduction

*"Science gave us forensics. Law gave us crime"-  
Mokokoma Mokhonoana<sup>1</sup>*

A crime scene is a location where a crime took place and forensic evidence can be collected. Evidence collected can include fingerprints, footprints, blood and other fluids, any other DNA material such as hair so that they can be analysed in a lab and be

used in court proceedings of the investigation. One such evidence is Bite Marks.

According to American Board of Forensic Odontology (ABFO), "Bite marks may be outlined as a physical alteration or representative pattern recorded in a medium caused by the contact of the teeth of a human or animal".<sup>2</sup> It is basically a representative of the morphology of teeth of a human/animal on an impression bearing surface such as the human body neck, thighs, breasts, (gluteus region, genitals, face, lips) as seen in sexual assault cases, child abduction, child abuse and homicide cases<sup>3</sup> or can be found on chewing gums, impression materials, stationary items such as pencils, cigarettes and food items such as fruits, cheeses etc.<sup>4</sup> Though there are some limitations, Bite marks are still used as a forensic tool to slim down the inventory of suspects by comparing them to dental casts made of the suspects/offenders teeth impression so that it can be proved that a particular individual or a set of individuals have caused the crime or at least are involved in some part of it.

The review paper describes the classification, characteristics, mechanism, appearance, and collection of bite marks as well as their role in major crimes committed across the globe, along with recent advancement and whether they are universally accepted as clues during criminal trials.

### Classification of Bite Marks

They can also be categorised on the premise of appearance (general classification):<sup>5</sup>

1. Artefact-piece of flesh completely bitten off or removed from body.

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**Corresponding Author:** Anandita Kale, BDS Student, K.I.E. V.K. Institute Of Dental Sciences, Kaher Belgaum, Karnataka,

**E-mail:** kaleanandita96@gmail.com

2. Abrasion-undamaging mark on skin /bruise with no damage to skin
3. Avulsion-removal of skin
4. Contusion-broken blood vessels
5. Hemorrhage-a small bleeding spot
6. Incision-neat puncture of skin
7. Laceration-torn portion of skin

They are also categorised according to pressure (Mc Donald's classification):<sup>6</sup>

- Tooth Pressure Marks- made by incisal edge of anterior teeth; stable and are minimally distorted
- Tongue Pressure Marks- impressions of palatal surfaces or cingulae of teeth and palatal rugae; can cause maximum distortion
- Tooth Scrape Marks-irregularities of teeth caused due to fracture, restorations
- Complex marks- combination of above

They are sorted according to practical application as given by ABFO:<sup>7</sup>

- *Class I*- diffused bite marks; lacks individual characteristics e.g.:-bruise, faint bite mark
- *Class II*- single arch bite or partial bite mark; has some individual and class characteristics
- *Class III*- has both individual and class characteristics; used in evidence and for comparison in criminal cases
- *Class IV*- avulsion or laceration of tissues caused by bite

### **Characteristics of Bite Marks**

They can be characterized in two forms:

*Class Characteristics*- According to ABFO<sup>7</sup>, a class characteristic is an outline that differentiates a bite mark from other wounds or injuries. They determine what group the bite mark belongs and if it is caused by maxillary teeth or mandibular teeth. A few characteristics are:<sup>8</sup>

- Distance from one cuspid to another
- Shape and thickness of the oral arch
- Proof of a tooth out of position
- Curves of biting surface and the structure of incisal and occlusal edges
- Unique dentistry such as restorations, missing, fractured or malformed teeth

- Wear outlines such as erosion or grinding
- Labiolingual and rotational position
- Rotational position

They help in narrowing down the age, gender and other information of the suspect.

*Individual Characteristics*- These are distinct identifications present in the class characteristics which can be a trait or a pattern that represents an individual deviation instead of an anticipated finding such as<sup>7</sup>:

- Rotation of teeth
- Mesial or distal shifting of teeth
- Number, size and placement of teeth
- Occlusion
- TMJ abnormalities

### **Mechanism affecting Bite Marks:**

Three mechanisms related with fabrication of bite marks are<sup>9</sup>;

#### *Tooth pressure marks*

Direct pressure of incisal edges of anterior teeth/ occlusal edges of posterior teeth. Severity of bite mark is related to duration, degree of force applied and degree of movement between tooth and tissue.

#### *Tongue pressure*

Material taken into mouth is pressed by tongue against teeth/ palatal rugae and unique marks are there due to tongue sucking/ thrusting.

#### *Tooth Scrape:*

Teeth scraping against tooth surface involving the anterior teeth.

### **Appearance of Bite Marks:**

Human bite marks are semicircular caused by the front teeth (incisors and canines), with a gap at either side due to the separation of upper or lower jaw.<sup>10</sup> The teeth make comprehensible, separate marks or make a continuous or irregularly broken line.

The skin conditions, anatomical spot of the bite, age of the victim and weight are responsible for the distortion made by bite marks. Increased bruising is seen in children, females and geriatric people.<sup>10</sup>

### **Collection of Evidence**

From the victim:

- The photographs which are clicked in high resolution and color balance (to minimize the chances of distortion) and imaged should be of sufficient resolution so that they can be enlarged without distortion.<sup>16</sup>
- Images are presented in front of criminal court justices and investigators as they show the characteristics of the bite marks and the position of the body on which it was recorded.
- Impressions should be taken of the surface which contain 3D imprint of the bite mark. These can be scanned and digitalized by newer computer software<sup>10</sup>.
- Trace evidence in the form of DNA is obtained from saliva. Tooth particles can also be used to collect DNA and identify the blood group of the suspect.

From the Suspect:

After obtaining consent from the suspect, their test bites are photographed for legal purposes.

- Photograph should include extroral features (full face, right and left full profiles), intraoral features (taken with mirrors and retractors-anterior, posterior and occlusal view along with shape and size of tongue).<sup>16</sup>
- Examination is done of the hard and soft tissues, TMJ, facial symmetry, occlusal harmony, maximum opening of jaw, jaw deviations while opening and closing of mouth, visible scars, salivary evidence intraoral, number and shape of teeth present, size and shape of tongue, condition of peridontium and any other features that stand out in the oral cavity.<sup>7</sup>
- Impressions of both arches are made using ADA specified material. Duplicate casts are made from original/master cast.

### **Analysis of Bite Marks**

Odontologists should have a comprehensive knowledge of dental and facial structure, interpretation of bite mark patterns and understanding different treatment modalities.<sup>7</sup>

*Interpretation of Pattern-*

This includes summarizing and comparing class and individual characteristics manually or through computer assisted software to identify any abnormalities or unique dentition that can help identify the culprit.

### **New advances to help in Bite Mark comparison:**

- Overlays (hollow volume, solid volume, semi transparent and/or computer generated-2D/3D scans) and images should be used.<sup>15</sup>
- Test bites of the suspect made on ADA approved dental material, human skin or other mediums using dental casts are used to make overlays.
- Stereomicroscopy and manual or computer generated analysis using software is used.<sup>15</sup>
- Xeroradiography and enhanced contrast radiography is used to understand the depth of the injury.<sup>15</sup>
- Electron microscope investigation is used to analyze surface details of the mark.<sup>15</sup>

### **Limitations of Bite Marks:**

Using Bite marks as forensic evidence is slowly getting abolished as some argue that the precision of a bite mark cannot be maintained due to change in time and temperature and irregularities of the skin. Dentition can change due to diseases, restoration, fractures or any prosthodontic or orthodontic surgical/nonsurgical intervention. The uniqueness of an individual bite mark is assumed but is not recognized.<sup>18</sup>

Specialists claim that out of 32 teeth, only the anterior teeth are recorded in a bite mark and are heavily dependant in the following factors:

*Factors that affect bite marks:*

- Time at which the bite was inflicted
- Part of the body where the bite was inflicted
- Position of the part of the body that was bitten during the time of the assault
- If the bite was inflicted through clothing. If yes then the clothing is sent for examination for DNA traces through saliva
- If the bite mark and/or injury has been treated with water and medicaments
- If the victim has any pre existing conditions (such as blood disorders) that can alter the morphology of the bite mark
- Factors of location of bite mark such as- adipose deposit. Underlying tissue, area and thickness of skin, any rupture of blood vessels
- Pressure with which the bite was inflicted
- Type of bite inflicted

-The assaulter's oral hygiene and state of occlusion  
 - Whether the victim was alive when the bite was inflicted. In living beings, healing changes the form of a bite mark over time. Postmortem bites do not show erythema and contusions present in ante mortem marks.

- The temperature at which the bite was inflicted and the change in temperature between its infliction and its record.

-The time delayed after the infliction of the bite mark

The method of bite analysis uses the superimposition of the accuser's dentition to the bite mark so that sufficient comparisons can be taken between the two (taking in considerations of distortion). But this is highly subjective judgment which is dependent on the experience of the examiner and the different methods they choose to evaluate the clues using ABFO guidelines present.

A positive identification of the suspect is usually controversial as it is made without a standard set of conformity and the chance of high distortion at all stages of collection and analysis and falls within the region of opinion evidence.<sup>17</sup>

Bite marks have been used as a forensic tool to solve criminal cases since ages. Some of the cases published in literature have been discussed below;

**Case 1-Public prosecutor (Norway) v Torgersen (1958)<sup>11</sup>**

Rigmor Johnsen was found dead bearing signs of sexual assault and was considered a murdered. Professor Ferdinand Strom documented a bite mark on her breast and preserved the tissue sample and testified that Torgersen caused it. In 2001, Dr. David Senn re-examined the preserved breast tissue and he saved it with digital and micro photography and after independent and blindsided second opinions, he concluded that Torgersen should be barred as the biter.

**Case 2- Crown (Scotland) v Hay(1967)<sup>11</sup>**

Linda Peacock (15 years) was found strangled with a bite mark blueprint on her breast. Dr. Warren Harvey questioned 29 suspects out of which five boys were elected for further investigations. Gordon Hay was convicted as the bite mark features matched with the pits present at the tips of his canines.

**Case 3-California v Marx (1975)<sup>11</sup>**

Lovey Benovsky, found sexually assaulted and strangled with a bite mark on her nose. Three odontologists exhumed her body and took pictures and made a three dimensional model of the bite mark which was used to convict Walter Marx.

**Case 4- Florida v Bundy (1979)<sup>11</sup>**

One of Ted Bundy's victims had a double bite mark pattern on her gluteus region. Dr. Richard Souviron evaluated the bite marks and testified that Bundy's occlusion aligns perfectly with the picture of the bite mark present on the victim. They pointed out the individual characteristics of bite which were chipped and misaligned teeth and four distinct rows teeth.

**Case 5- Florida v Stewart (1979)<sup>11</sup>**

Margaret Hazlip was murdered and sexually assaulted with a bite mark pattern on her hip. The bite mark featured a gap between the two upper incisors. The profile of the assaulter was made using a partially eaten bologna found at the crime scene. These were later used to convict Roy Allen Stewart who was executed for his crime.

**Case 6 - Wisconsin v Robert Lee Stinson (1986)<sup>11</sup>**

Ione Cychosz (63 years) was found dead with bite mark evidence which odontologists evaluated and found several individual patterned injuries which was used to convict Robert Lee Stinson. In 2005, the Innocence Project asked four odontologists to review the case who evaluated DNA evidence which later concluded that it matched another man.

**Case 7- New York v Roy Brown (1992)<sup>11</sup>**

A social worker was found beaten, stabbed and strangled with 7 bite marks. Roy Brown was accused of the crime but the defense argued that six out of seven were deficient and the seventh barred Brown. DNA results at that time were open to doubt. Additional saliva samples were taken from victim's clothing that exonerated him and was matched to another suspect.

**Case 8-Mississippi v Brewer (1992)<sup>11</sup>**

Kennedy Brewer was found guilty with the murder of his girlfriend's three year old child. Medical examiner who performed the autopsy that several marks were present on the body which he believed were bite marks and concluded that they were caused by Brewer's top incisors and that the

mandibular teeth made no impression. Dr. Richard Souviron, testified that the marks were not human bitemarks at all but were insect made.

**Case 9-Mukesh and another v State (NCT of Delhi) and other/Nirbhaya case (2012)<sup>12</sup>**

The Delhi rape case concerned fatal sexual assault. There were six accused arrested with respect to the crime. The forensic odontology dept of SDM Dental College, Dharwad had bite marks taken from the victim and compared with the dental models of the suspect to tie them to the crime.

**Case 10- Ayesha Miran Case (2007)<sup>12</sup>**

19 year old, Ayesha Miran, was found murdered in Vijaywada. Autopsy revealed sexual assault with stab wounds, scratches and bite marks. DNA samples were pulled from semen traces found in the body.

**Case 11-Perumbavoor case (2016)<sup>13</sup>**

Rape and murder of a dalit woman had the evidence of two bite marks present on the left shoulder of the victim. The individual trait of the bite mark was a gap of three millimeters present between two teeth in the front rows, which the forensic expert claimed is indigenous to populations in Kerala.

**Case 12- Powai Rape Case (2014)<sup>14</sup>**

A female forensic odontologist (Dr. Hemalata Pandey) from KEM Hospital helped solve a rape case by matching bite marks present on the survivor's body after she was unable to recollect the details of her rape. Within 24 hours after the case was reported, impression and analysis of the bite marks was done.

**Conclusion**

Evaluation of a bite mark helps the judiciary to understand the relations between the suspect(s) and the victim(s). Shape, size and the individuality of the mark helps in making a profile of the bite and helps narrowing down the list of suspects by the process of elimination. Although it plays an important role in crime investigations, there is no standard set of rules and conformity to follow and is ambiguous as it is based on subjective judgment and opinion evidence. Slowly but surely, using latest technological advancements and by using DNA traces, this study is becoming less art and more scientific and precise as it expands further in the developing world of forensic odontology.

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