



## BITE MARKS - A PROSPECTIVE AID TO FORENSIC SCIENCE: A THROUGH AND THROUGH REVIEW

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### ABSTRACT

In lethal encounter conditions such as the assaults associated with life and death struggles amid assaulter and victims, the dentition are often used as an armament. Indeed, using the teeth to impose severe damage on an assailant may be the barely feasible defensive method for a victim. Alternately, it is well established that assaulters in sexual abuse, including sexual murder, sexual assault and child abuse, often bite their victims as a remark of power, fury and animalistic attitude. The teeth are an important constituent of our natural depository. Bite marks have evolved into one of the copious different ways in which an assaulter can be found after an assault on another person. The investigation of human bite marks is by far the most confronting and specific part of forensic dentistry.

**Keywords:** Assaults, Assailant, Abuse, Victims, Forensic dentistry.

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### INTRODUCTION

Our contemporary world shows advancements in social, economic, educational, and developmental fields. As there are newer advances, man is getting more and more inconsiderate in his demands. The rise of new thinking has involved all fields, and the field of abuse is of no exception. As the quoted by **Winston Churchill**,

“The victim shapes and molds the criminal” newer advances in medicine and dentistry is essential in unfolding the enigma of death due to crime. Each dentition, including the total number of teeth, their arrangement, spatial relation, and the dental restorations are distinctive for each individual. This build forensic odontology play a key role in recognizing 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.[1] Bite marks can be found in victim of sexual abuse in usual areas of the human body- genitals and breasts.

As no two fingers are alike, neither two mouths nor two teeth are exactly same. In 1972 defined bite marks as “A mark made by the teeth either alone or in combination with **Mc Donald** other mouth parts”. **Beckstead** in 1979 defined it as “The registration of tooth cutting edges on a substance caused by jaw closure”[2]. **Bernstein ML** in 2004 defined bite marks as “Patterns made by teeth in skin, food, or firm but compressible substrates”[3]. **Aboshi et al.** in 1994 reported the

identification of a suspect arsonist by means of bite marks in cakes which were found at the crime scene [4].

### History

Although the domain of forensic odontology seems to be a new one, it is likely as old as Human kind itself as defended by the Bible which says, Eve convinced Adam to put a “bite mark” in an apple. The first incident of bite mark identification occurred in 1692 which is termed Salem Witch Trials. A piece of cheese in the scene of robbery registered with a bite mark played a role in revealing the thief’s identity and thereby solving the case in America.<sup>1</sup> The most highly publicized bite mark case which paved the path for bite mark evidence to be used in courts was the case involving serial killer Theodore (Ted) Bundy, who was convicted based on bite-mark analysis by the US judicial system [4-12].

### Classification of Bite Marks

#### Camerons classification<sup>14</sup>

1. The agents that produced the mark
2. The materials and substances that have exhibited the marks.

#### McDonald's classification

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

#### Websters classification

Type I: Bites in chocolate which fracture easily with limited depth of penetration. Most prominent are incisal edges of upper and lower anterior teeth

Type II: Good grip of material obtained by teeth and then bitten piece is fractured from main material. For example, Apple; The outline of labial aspect of upper and lower incisors are recorded

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.

### Terms Used To Describe Bitemarks

1. **Unique:** Here, the bite mark is distinctive and unusual in such a way that no other individual could have made an identical pattern with their dentition.
2. **Distinctive:** Highly specific and individualized, varies from normal, i.e., unusual or infrequent.
3. **A definite (positive) bite mark:** is termed when there is no doubt that the mark was caused by teeth, and other conditions have been considered and eliminated.

4. **Highly probable** suggests with virtual certainty of the mark being a bite mark, but there is room for possibility of another cause, although this is highly unlikely.

5. **Possible/similar to/consistent with / conceivable /maybe/ cannot be ruled out/cannot be excluded:** These terms imply that the bite mark could be produced by teeth or could be created by something similar which produces marking that looks like a bite mark.

6. **Unlikely/inconsistent:** used when it is unlikely that the injury pattern is bite mark

7. **Incompatible/excluded/impossible:** implies that it is not a bite mark but something else

8. **Indeterminable/should not be used / insufficient:** The pattern is such that it could be related to teeth or a tooth as a cause of injury

### Terms Describing the Injury

- ✓ **Point** (match point or a consistent point): Used for comparison or evaluation. This term does not imply any degree of specificity but represents a focus in comparison.
- ✓ **A concordant point** (also called as matching point/unit of uncertainty): is a point of comparison seen in both the bite mark and the suspect’s exemplariness. It could also represent on an area that can be linked to a particular tooth and an area of injury which could have caused the bite mark.

### Individual Bite Marks

The marks left by the teeth in a person may be used to identify an individual. The differences in size and shape of teeth can sometimes be easily noticed, especially when teeth are missing and prominent. The most common type of bite marks are contusions [9,11].

Marks from the several of the upper front teeth and lower front teeth are usually found in the bite mark, but variations can and do occur: premolars and molars may be involved, the lower arch creates the most noticeable injury, perhaps explainable because the smaller lower teeth in comparison to the upper, have a reduced surface area and stress (force exerted by unit area ) is inversely related to surface area [9,11].

### PRESENTATION OF HUMAN BITE

Human bite is described as an elliptical or circular injury that records the specific characteristics of the teeth. Bite –mark consisted of an elliptical pattern of marks from individual teeth around a perimeter of abrasions and contusions.

The injury may be shaped like a doughnut with characteristics recorded around the perimeter of the mark. Alternatively, it may be composed of two U –shaped arches that are separated at their bases by an open space .The diameter of the injury typically ranges from 25 - 40 mm. Often a central area of bruising can be seen within marks from the teeth [10].



**Figure 1. Bite – mark with elliptical pattern**

## Evidence Collection Protocols

### 1) Bitten person

Evidence collected from the victim does not usually involve informed consent, but it is prudent to explain your intentions and record consent, just in case. It is extremely important that the bite mark is photographed correctly to avoid photographic distortions, and this is best undertaken by a skilled photographer.

### History, Examination/Description of injury

The physical appearance, color, size, and orientation of the injury.

- ❖ What is the location on the body? What is the relative contour and elasticity of the site?
- ❖ Can the difference between marks from the upper and lower teeth be determined?
- ❖ What types of injuries are present? Cuts? Bruises? Scrapes?

### Swabbing of area for saliva

Saliva will have been deposited on the skin during biting or sucking and this should be collected and analyzed. Use the double swab technique [4].

### Impressions

- ❖ Fabricate an accurate impression of the bitten surface to record any irregularities produced by the teeth, such as cuts, abrasions etc ;
- ❖ Use vinyl polysiloxane, polyether impression materials. Dental acrylic or plaster can be used as a rigid support for the impression material. This will

allow the impression to accurately record the curvature of the skin [10].

### First aid

- ❖ Prompt medical attention should be provided for the living victim since human bites have a higher potential for infection than animal bites
- ❖ Injuries that disrupt the integrity of the skin's surface should be treated as soon as possible [4]

### 2) Potential biter

Explain the accused what is to be done and why and obtain an informed consent. Check for any dental treatment done recently after the alleged incident.

### Photography

- ❖ Full face and profile, anterior and lateral views of teeth, occlusal views of upper and lower arches
- ❖ Scale should be placed in the same plane as the mark and close to, but not obscuring detail. ABFO No. 2 scale (with two short limbs at right angles) has both linear and circular components – useful for detection of distortion.
- ❖ The film plane of the camera should be kept parallel to the skin to minimize perspective distortion. On curved surfaces mandibular and maxillary tooth marks may have to be photographed separately
- ❖ Repeat photography at intervals to get best results as swelling, color, bruising, may change over several days [5].

### Impression

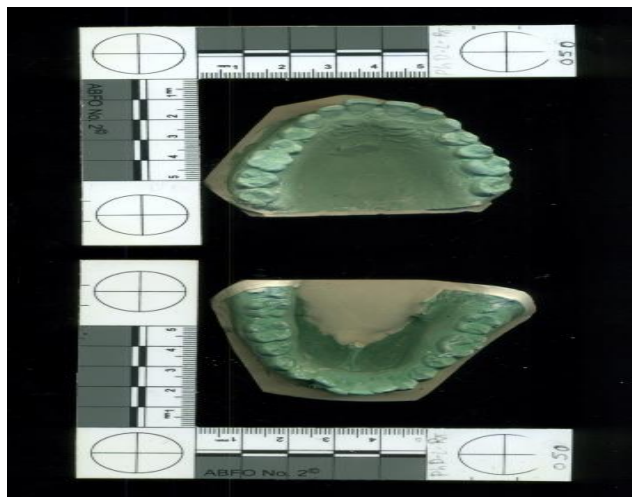
Whenever feasible at least two impressions should be taken of each arch using accepted dental impression techniques. The interocclusal relationship should be recorded.

### Sample bites

Whenever feasible, sample bites should be made into an appropriate material, simulating the type of bite under study.

### Study casts

Master casts should be prepared using American Dental Association approved Type 2 stone prepared according to manufacturer's specifications, using accepted dental techniques. Additional casts may be fabricated in appropriate materials for special studies. When additional models are required, they should be duplicated from master casts using accepted duplication procedures. Labeling should make it clear which master cast was utilized to produce a duplicate. The teeth and adjacent soft tissue areas of the master casts should not be altered by carving, trimming, marking or other alterations.



**Figure 2. Cast procured bite marks**

### **Bite sample**

A sample of the suspect's bite is recorded in centric occlusion using either a wafer of base plate wax or a sample of silicone putty.

### **3) Bite mark analysis**

- ❖ Examination of the bite mark.
- ❖ Ideally, the features of the bite mark should be studied (to include features of size, shape, and alignment of the teeth and arches, measurements and angles) before making comparisons with the potential biter's dentition in an attempt to reduce bias.
- ❖ Photographs of the bite mark are scanned and sent to photoshop.
- ❖ Photographic distortions are detected and corrected, where possible. It is not possible to correct major distortions that are due to poor photographic technique: the bite must be re-photographed.
- ❖ Life size (1:1) photographs / images are produced.
- ❖ Photographs can be printed, or images stored on the computer.
- ❖ Scan (three- dimensional) models of the potential biter and import to photoshop.
- ❖ Produce hollow volume computer generated acetate overlays of the biting edges of
- ❖ Compare the bite marks from photographs (life – size) or computer images with biter dentition, using superimposition. Some features can be digitally measured, for example tooth rotation, labiolingual position, arch and individual tooth dimensions, spacing between teeth.
- ❖ Prepare report.

### **4) Principles of report writing: Description of bite mark**

- ❖ Both in the case of a living victim or deceased individual , the odontologist should determine and record certain vital information

- ❖ The demographic detail including name of the examiners should be recorded
- ❖ The anatomical location, surface contour (flat, curved or irregular) and tissue characteristics (bone, cartilage, muscle and fat) and the skin (mobile or fixed) should be noted.

### **Methods of Bite Mark Analysis**

It is solely the differentiation of bite mark evidence to accused evidence to establish, if a correlation exists. Examination involves visualization and correlation, conformation of the verdict and often, court testimony [6].

#### **Direct method**

In this method, the model of suspects teeth is compared to a life size photograph of the actual bite mark .Here direct comparison is made between dental models , photographs (or) finger print powder lift models .The “ finger print powder lift “ technique involves dusting the bitten skin with fingerprint powder and using fingerprint tape to transfer the bite marks onto a sheet of acetate.

#### **Indirect method**

This method involves the use of transparent overlays to record a suspect's biting edges . Transparent overlays are made by free –hand tracing the occlusal surfaces of a dental model onto a acetate sheet. When comparing the “fingerprint powder print lift “ technique against the photographs, the use of photographs resulted in higher scores determined by a modified version of the American Board of Forensic Odontology (ABFO) Scoring guidelines 13.The use of transparent overlays is considered subjective because the tracing can be easily manipulated. On the other hand, Photocopier – generated overlays where no tracing is used is considered to be the best method in matching the correct bite mark to the correct set of models without the use of computer imaging.

### **New Methods in Bite Mark Analysis:**

1. 3D scanners in tooth mark analysis
2. Geometric morphometric analysis.

### **Distortion in Human Bite Marks**

Distortion in bite mark may alter the outward impression of a bite or the photographs of the bite, such that it is never an exact counter part of the features of the mouth of the biter. Distortion can occur at many stages in the causation and the probabation of the bite marks. When it develops at the moment of biting it is called primary distortion. Distortion when occurs delayed to the bite being made or imported at the stage when the mark is being investigated, it is called secondary distortion [6-15].



### Primary distortion

1. Dynamic distortion
2. Tissue distortion
3. Photographic distortion

### Secondary distortion

1. Tissue related distortion
2. Posture distortion

### Medicolegal Aspects

Sex-related abuse, domestic crimes, and child abuse are most constant cases for bite mark formation. It is essential to understand that all members of the dental squad have an exclusive possibility and a legal commitment to leg up the victims. These injuries may be seen during the procedure of dental treatment. Determination of the documentary value of the bite mark

involves an associated events starting with the assemblage of bite mark evidence from the person who was abused, following investigation of the bite mark and the conclusive comparison with dental evidence collected from any potential biter [15].

### CONCLUSION

The domain of bite mark science is glorifying, and the need for individuals qualified and skillful in the awareness, compilation and investigation of this type of evidence is rising. Outcome from bite mark analysis can help to explain some very necessary questions about the circumstances at the crime picture thus helping the judicial system. Readiness by dentists to help in this domain is priceless in the resolution of disgusting interpersonal crimes.

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