



BITE MARKS: A SPEAKING FORENSIC TOOL

Prosthodontics

**Dr. Anubha
Agarwal***

Deputy Medical Superintendent All India Institute of Medical Sciences
Rishikesh*Corresponding Author

Dr. Jyotsna Seth

Reader, Department of Prosthodontics Seema Dental College & Hospital,
Rishikesh, Uttarakhand, India

**Dr.
HimanshuAeran**

Director Principal, Professor and Head Department of Prosthodontics
Seema Dental College & Hospital, Rishikesh, Uttarakhand, India

ABSTRACT

Forensic dentistry is an essential part of Forensic science, mainly involves the identification of an assailant by comparing a record of their dentition with a record of a bite mark left on a victim. Other uses in law for dentists include the medico-legal assessment of trauma to oral tissues, testimony about dental malpractices and identification of human remains. Teeth has been also used as a forensic tool and bite marks are used during violent interactions such as sexual offences, homicides, child abuse and during sports events form the basis of forensic dentistry. Bite mark identification is based on the individuality of a dentition, which is used to match a bite mark to a suspect. Bite marks are often considered as valuable alternative to fingerprinting and DNA identification in forensic examinations. This article will describes the classification, characteristics, mechanism of production, and appearance of bite marks injuries, collection of evidence, comparison techniques and technical aids in the analysis of the bite marks.

KEYWORDS

evidence, forensic, bite marks

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 means¹. They have been routinely used as evidence in criminal and civil court cases for more than half a century². The principle is similar as in case of e.g fingerprint, ballistic and tool mark studies: the visually observable signs or marks at the scene are compared by an expert with the signs or marks left by the suspect object or person under comparable circumstances. The incisal or biting surfaces of the upper and lower anterior teeth can be arranged in 1.36 X 1026 different ways. Hence, a bite mark may reflect the presumed 'unique' characteristics of the biter's teeth. This may be crucial to identify a suspect in a crime or in excluding an innocent person, both of which are equally important.

Review of Literature:

Humble (1933) used the transparencies for bite marks comparison³. Webster (1982) stated that bite marks have been reported in flesh, foodstuffs and inanimate objects. This used to describe food bite marks is very varied and thus gave classification of food bites in an effort to bring a degree of uniformity to analysis of such marks.

Bernstein stated about the application of photography in forensic dentistry⁴.

Gleen M. Wagner (1986) stated that using tool-mark technology, comparisons are possible even in limited material. Computer enhancement of bite mark photographs increases a favourable comparison by further delineating unique characteristics of the arch and individual teeth.

Whittaker and McDonald emphasized that bite mark analysis starts with the examination of the wound⁵.

Aboshi et al(1994) reported the identification of suspect arsonist by means of bite marks in cakes which were found at the scene of the crime. A missing upper right central incisor was proved to be in patterned injury.

Sweet(1995)is of view that no two humans bite marks can be identical⁶.

Berlitz et al (2000) reported a case of murder with a bite mark in piece of cheese which was recorded. The pattern associated with comparison between the impression and a study model of the suspect was able to identify the perpetrator.

Franklin and Curtis have described in detail the method of bite mark OVERLAY Technique⁷.

Sheasby and MacDonald (2001) have described in detail about the primary and secondary' distortions in the bite marks⁸.

Richard (2001) has written that unique characteristics of biter's teeth are compared with that of the bite mark on the skin and which will help in identification⁹.

Earlier, in old English law, bite marks were recognized on paper "member proper for defense; included arms, legs and anterior teeth". In 1692 in the United States during the Salem Witch Trials, I Rev. Burroughs used to bite his victims. His bite marks and of other people were compared to the victim's marks. The judges readily accepted the bite marks as evidence and this was the first time in the US that bite marks were used as evidence to solve a murder. He was later convicted and hanged. In 1870 A.I Robinson was suspected of murdering his mistress. Five bite marks were found on her arm. Charged of murdering his mistress, Ansil Robinson was acquitted despite the fact that evidence matching his teeth to a bite mark on the victim's arm was presented¹⁰. The bite mark evidence did not hold but by 1890 bite mark evidence started to be recognized in the science field¹¹. The contemporary history of bite marks is thought to have started with Sorup. In 1924, Sorup used transparent paper upon which biting edges of a suspect's dentition were rendered to compare with life size photographs of a bite mark¹². In 1930 in Quebec, Canada had an infant murdered. This was the first case that had bite mark evidence on the skin.

Bite mark appearance:

Bite marks appear as any one of the following types of injury:

- Bruise
- Abrasion
- Laceration
- Avulsion

Most commonly, bite marks appear as bruising/contusion, which is the result of pressure exerted by teeth during biting, causing tissue compression, rupture of minute blood capillaries and consequent subcutaneous bleeding which appears as a discolouration on the skin surface. Apart from the aforementioned four types of injuries, bite marks may present as indentations, on occasion (note: an indentation is not an injury per se).

A human bite mark may be identified by its gross characteristics, class

characteristics and individual characteristics, which are described below.

Gross characteristics – A circular or elliptical mark found on the skin with a central area of ecchymosis. The circular/elliptical mark is caused by the upper and lower dental arches; the central area of ecchymosis may be due to the pressure exerted by the tongue.

Class characteristics – The pattern present in the bite mark may vary in size and shape. This enables one to differentiate between adults and children, and between different types of teeth—incisors usually produce rectangular marks, canines triangular, and premolars spherical or point-shaped marks.

Individual characteristics – Class characteristics may in turn have features such as rotations, spacing, attrition, fractures, etc. Such features are known as individual characteristics and they make the bite mark distinct and useful in comparing with a suspect's teeth and establishing biter's identity.

Bite mark-mimicking bruises may be caused by certain objects such as:

- Defibrillator pad
- Hair curling iron
- The ends of a pipe
- Jewellery
- Shoe heel

These, however, are usually differentiated by the absence of class characteristics.

Classification of Bite Marks:

In general, bite mark consists of superficial abrasions, or subsurface hemorrhage, or bruising of the skin because of bite¹³. The pattern of the injury is affected by the force and length in time of the bite, in combination with other mechanical and physiologic factors. Human bites may be classified in different ways, for example, defensive or offensive¹⁴.

Cameron & Sims classification This is based on the type of agent producing the bite mark and the material exhibiting it.

- a. Agent
 - Human
 - Animal
- b. Material
 - Skin, body tissue
 - Foodstuff
 - Others (e.g., pencil, bottle top)

MacDonald's classification is most cited. MacDonald suggested an etiologic classification.

It is pertinent to human bite marks but equally applicable to marks on other materials.

1. **Tooth pressure marks:** These are caused by incisal edges of the anterior teeth. They are stable and subjected to minimal distortion
2. **Tongue pressure marks:** Because of tongue pressure, impressions of the palatal surfaces of the teeth, cingulum, or palatal rugae may be produced. This causes distortion of marks
3. **Tooth scrape marks:** These are produced because of irregularities in the teeth due to fractures, restorations, etc.
4. **Complex marks:** These are a combination of the above types of marks. The shape depends on amount of tissue taken into a mouth.

Webster's classification (bite marks on foodstuff)

Type I – Foodstuff fractures readily with limited depth of tooth penetration (e.g., hard chocolate)

Type II – Fracture of foodstuff with considerable penetration of teeth (e.g., apple and other firm fruits)

Type III – Complete or almost complete penetration of foodstuff with 'slide' marks (e.g., cheese)

Bite mark investigation:

Preliminary questions:

Any attempt at bite mark investigation should begin with the following

questions:

- Is the injury a bite mark?
- If a bite, was it caused by human teeth?
- If human, was it caused by an adult or a child?
- Are there any individual characteristics in the bite mark that can be compared to the suspect's teeth?

Evidence collection from the victim:

Dentists must be aware of evidence collection from a victim of bite mark. This is especially significant in a population with a high incidence of violence and sex crimes, wherein bites may be routinely discovered. The best and only opportunity to collect evidence may be when the victim/bite mark is first presented and observed. A conscious victim should be questioned regarding the date and location of bite(s). An unconscious victim should be examined thoroughly, as any part of the body may have been bitten (although the aforementioned areas may be more prone to it). The following procedures should then be undertaken:

When a bite mark case presents, the primary concern is patient care. Therefore, at no time should bite mark evidence collection affect timely patient treatment.

1. **First aid** Prompt medical attention has to be provided since human bites have a higher risk for infection than animal bites (especially when there are abrasions and lacerations).
2. **Visual examination** Visual examination of bite marks is desirable. Preferably, it should be done soon after the mark has been reported. If death has occurred, visual examination must be done prior to autopsy.
3. **Documentation**

Record the following:

- The appearance, colour, shape, size, orientation, location of the bite mark and type of injury
 - Contour and elasticity of the bite site
 - Differentiate between the upper and lower teeth
4. **Photography** Photography is non-invasive and does not interfere with prompt patient treatment. Colour and black and white photographs from different angles should be taken. It is desirable to have photographs from two views:

- a. Orientation photography
- b. Close-up photography

5. **Saliva swab** Care should be taken not to wash the bite area before saliva swabbing. The amount of saliva deposited in a bite mark is about 0.3 ml, distributed over an area of 20 sq. cm. Saliva is taken from within the bitten area. A cotton swab moistened with distilled water is used to collect saliva. The swab is held vertical (along its long axis) making circular motion under light pressure over the bitten surface. A second dry swab is used to collect remaining moisture that is left on the skin by the first swab. Both swabs are then air-dried at room temperature for at least 40 minutes. The swabs are placed in sterile paper envelopes or plastic containers. These are stored under refrigeration or freezing to prevent degradation of salivary DNA and bacterial growth. A third control swab is taken from outside the bitten area but from an anatomically similar location. If the bite has occurred through clothing, the clothes must also be sent for saliva swab tests. The use of high intensity alternative light source (such as UV light) to locate stains from body fluids enable saliva trace recovery even in the absence of visible bite marks.

6. **Impressions:**

Impressions of the bite area may be made when tooth indentations exist on the bite mark. The material of choice is light body elastomeric impression material. The impressions may be stabilised using dowels and reinforced with orthopaedic mesh, dental plaster or impression compound.

Evidence collection from the suspect:

Collecting dental evidence from a suspect is considered as an 'invasive' procedure. Therefore, any evidence that requires dental impression and bite registration may be governed by certain legal regulations. The following evidences are to be recovered:

1. Clinical examination

- a. Extra-oral: Observe and record any significant soft/hard tissue findings (TMJ status, facial asymmetry, muscle tone, etc.) that may influence the suspect's ability to open the mouth or move the mandible— maximum opening, deviations, and occlusal disharmonies should all be recorded.
 - b. Intra-oral: Periodontal health, tooth mobility, missing and fractured teeth, tongue size and function, areas of inflammation or hypertrophy, supra- and infra-erupted teeth (if any) must be noted.
2. Photography Full facial and profile photographs are taken. Intra-oral pictures of upper and lower arches, frontal and lateral views of teeth in occlusion and in open bite should be taken.
 3. Impressions It is very important to produce accurate dental casts which record all the traits of the dentition. For this purpose, impression making using elastomeric impression material is recommended. However, the setting of such material is about 8 minutes, and this may pose problems in uncooperative individuals. In such cases, a material that sets faster—for instance, alginate—may be used. Impressions obtained should be poured preferably in dental stone. Ideally, at least two sets of dental casts should be poured—one as an untouched record of the suspect's dentition and a second for use in the bite mark analysis. Once used, the impressions and casts may be photographed and sealed as exhibits for future court reference.
 4. Saliva swab: If saliva swab was obtained from the bite mark, one must ensure that saliva sample is obtained from the suspect. A sterile cotton swab is used, which is rolled in the vestibule of the mouth and along the buccal mucosa with enough pressure to pick both saliva and loose epithelial cells. If done properly, this can prove invaluable in establishing a link between the bite mark and the biter.

Bite mark analysis and comparison:

The protocol for bite mark comparison is made up of two broad categories:

1. The measurement of specific features of the bite mark and suspect's dentition, called metric analysis.
2. Matching the pattern of bite mark to the configuration of teeth on the suspect's dental cast, called pattern association.

Methods Of Analysis Of Bite Marks 15:

- a) Odontometric triangle method: This is done for both upper and lower jaw teeth model and compared with that of bite marks of wax, apple, and skin. Statistical analysis is carried out, and results are obtained.
- b) Comparison technique: It has two types (1) direct and (2) indirect.
- c) Image perception software procedure: This is a new method of comparing and analyzing photographs of bite mark with overlays of suspected biter's dentition using image perception software.

Other special methods in bite mark analysis are:

Vectron: This is used to measure distance between fixed points and angles.

Stereometric graphic analysis: This is used to produce counter map of the suspect's dentition.

Scanning electron microscopic analysis of bite mark wounds: Scanning electron microscope can readily demonstrate individual characteristics when they are present, it can be an extremely useful tool for the forensic odontologist.

The ABFO provides a range of conclusions to describe results of bite mark comparison:

1. Excluded: Discrepancies in bite marks and suspect's dentition
2. Inconclusive: Insufficient forensic detail to draw any conclusion
3. Possible biter: Teeth like the suspects could be expected to create a mark like the one examined but so could other dentition
4. Probable biter: Suspect most likely made the bite; most people in population would not leave such bite
5. Reasonable medical certainty: Suspect is identified for all practical and reasonable purposes by the bite mark.

Difficulties in bite mark analysis:

1. Subjective element in fabrication
2. Subjective element in comparison
3. Distortion through skin elasticity, anatomical location, and body

positioning is recurring problem

4. Loss of data, contamination.

Conclusion:

The field of bite mark science is expanding, and need for individuals trained and experienced in the recognition, collection, and analysis of this type of evidence is increasing. The conclusion from bite mark analysis can assist crime judicial system; thus, it is an important tool in crime investigation. The serious nature of crimes in which bites are found often dictates that "Forensic Standards" should be established for gathering and interpretation of evidence. Errors in recording, comparison, analysis, and interpretations of bite marks may lead to serious consequences. With recent advances in research, more objective methods of bite mark analysis such as salivary DNA recovery and bacterial genotyping have become mainstay of investigation in such crimes. Further efforts to reduce subjectivity in standard physical techniques are required.

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