

## Bite Marks: Fingerprints of the Mouth

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### Abstract

Bite marks may be caused by humans or animals, they may be on tissue, food items or on objects. Biting is considered to be a primitive type of assault and results when teeth are employed as a weapon in an act of dominance or desperation. As a result bite marks are usually associated with sex crimes, violent fights, child abuse and even in scenes of theft. Hence, matching the bite mark to a suspect's dentition may enable investigating officers to implicate the suspect in a crime.

**Keywords:** Bite marks; Weapon; Crime.

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### Introduction

Bite marks have been defined by Mac Donald as "a mark caused by the teeth either alone or in combination with other mouth parts". Bite marks may be caused by humans or animals, they may be on tissue, food items or on objects. All the places that can be kissed are also the places that can be bitten, except upper lip, the interior of mouth and the eyes.[1,2]

Human bite marks vary in location, appearance and severity. They are usually identified by their clinical appearance, a circular or oval injury consisting of one arch or two arches.[4] Even though bite marks can be seen on any site of the body, women are

most often bitten on the breasts, buttocks and legs during sexual attacks, whereas bites on men are commonly seen on the arms and shoulders.[3,4,5]

Sweet and Pretty consider the size, shape and pattern of the incisal/ biting edges of upper and lower anterior teeth to be specific to an individual. Rawson and associates have mathematically calculated that biting edges of twelve anterior teeth can be arranged in  $1.36 \times 10^{26}$  different combinations. Therefore, a bite mark may accurately depict the 'unique' pattern of a biter's teeth. This may be crucial to identify a suspect or to exclude an innocent person, both of which are equally significant. Hence, the scientific examination of bite mark evidence is fascinating and challenging in forensic dentistry.[1,5]

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### History

Several notable early bite mark cases include the 1870 Ohio vs Robinson case; a 1906 case

in Paris, in which the bite was in cheese and use of overlays by Stroup in 1924. Since the 1950s, bite mark evidence and dentists have played a role in the judicial system. In 1996, at the American Academy of Forensic Sciences meeting in Nashville, Pitluck published a list of more than 260 judicial cases involving bite mark evidence dating from 1954.[6,7,8]

#### *Classification of bite marks*

Mac Donald has stated that as any field of specialization gets established, 'it requires the development of specific nomenclature and systems of classification'. Unsurprisingly, as the study of bite marks developed over the past five decades, numerous authors have tried to classify the injury.

#### *Cameron and Sims classification*

A relatively simple, wide-encompassing classification, this is based on the type of agent producing the bite mark and the material exhibiting it.

- a. Agents
  1. Human
  2. Animal
- b. Materials
  1. Skin, body tissue
  2. Foodstuff
  3. Other materials

#### *MacDonald's classification*

MacDonald suggested an etiologic classification. This is pertinent for human bite marks, but he adds, 'it is equally applicable to marks on other materials'.

- a. 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.
- b. Tongue Pressure Marks: When sufficient amount of tissue is taken into the mouth, the tongue presses against rigid areas such

as the lingual surface of teeth and palatal rugae. The marks thus left on the skin are referred to as 'suckling,' since there is a combination of sucking and tongue thrusting involved.

- c. 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.[1]
- d. Complex Marks: These marks are combination of all the above, occasionally complicated by multiple bites.[2]

#### *Webster's classification*

It is common to note bite marks on foodstuff. This is especially so in cases of theft or robbery at home or shopping centres, where the perpetrator may bite on food items during the course of crime.

Type I: The food item fractures readily with limited depth of tooth penetration.

Eg: Hard chocolate

Type II: Fracture of fragment of food item with considerable penetration of teeth.

Eg: Bite marks in apple and other firm fruits

Type III: Complete or near complete penetration of the food item with slide marks.

Eg: Cheese[1]

#### *Gustafson's clinical classification*

- a) Sadistic or sexual bite is usually made slowly and is therefore well defined.
- b) Aggressive bite is made quickly with force and is caused by scribbling across the tissue.
- c) Most aggressive bite results in tissue being bitten off usually and involves ears, nose and nipples.[2]

#### *Prevalence of bites*

The biting of one human by another is the third most common bite injury following dogs and cats and was first reported in the literature by Hultzen in 1910 who described an infective

sequel to a human bite. About one half of the people in America will be bitten by an animal or human during their life time and these injuries will account for 1% of all emergency room admissions and cost over 25 million dollars in health care expenses per year.[9]

In addition to these statistics not all cases are reported to a public health agency. One study reported the incidence of human bite injuries in New York City to be 11.8/100,000 people per year. Other studies found that the incidence in children is close to one human bite per 600 pediatric emergency room visits.[10] Bites have been described to occur in a number of situations, including overtly aggressive behavior (violent and sexual attacks), accidental bites (e. g. those associated with sports and medical treatment) and sexual activity. The site of a bite is an important variable in the risk of infection. Male victims of bites are most frequently bitten on the hand, arm and shoulder; female victims are most frequently bitten on the breast, genitalia, leg or arm.[11]

The distribution of bites are - for hand and upper extremities 60-75%, for head or neck 15-20%, for trunk 10-20%, for lower extremities 5% and for other sites 5-10%. When analyzing these figures on bite frequency and site, it is important to remember that there is a bias introduced by the fact that the figures relate only to those individuals who sought treatment. Failure to attend could be motivated by the severity of the injury, inadequate self-treatment or if the individual was attacked as part of a violent crime. Many individuals do not seek treatment for human bites due to embarrassment and legal repercussions.[9,10,11]

#### *Location of bite mark*

In a non-sexually based assault, bite marks may be found on the fingers, ears, nose, chest and thorax. In cases of sexual assault where the victim is female, wounds tend to cluster around parts of the body associated with sexuality. Bite marks might be found on the neck, front of the shoulder, arm, breast, pubic

area, buttocks and thigh.[10] In a male victim bite marks might be found on the arm, chest and abdomen (Lane, 1992). In cases of homosexual assault there is only data for male victims. In male victims bite marks might be found on the back of the shoulder, back, arm or armpit, chest, penis or scrotum.[11,12,13]

According to Beckstead and associates, bite marks in infants may be the result of punishment. In older children, it may occur due to sexual abuse. Kenney and Clark have attributed marks with an intercanine width greater than 3 cm to adults.[1] A smaller dimension may be the result of self-inflicted bites, as can occur when the child's arm is forced into the mouth to prevent it from screaming. In addition to the location of the bite mark, the type of severity of the injury may give investigators clues as to the mental state of the offender.[11]

#### *Characteristics of the bite mark*

A characteristic, as applied to a human bite mark, is a distinguishing feature, trait, or pattern within the bite mark and is delineated as a class or an individual characteristic.

#### *Gross features*

- Circular / elliptical mark on the skin with central areas of ecchymosis – suckling action

#### *Class features*

- Differentiate the tooth type within a bite mark
- Incisors – rectangular marks
- Canines – triangular or rectangular depending on amount of attrition
- Premolars and molars – spherical or pin point

#### *Individual features*

- Characteristics like fractures, rotations,

spacing. They make bite mark distinct.[1,14,15,16]

### *Bite mark analysis*

Of the many aspects of bite mark analysis, the recognition of a patterned injury on the skin as a possible bite mark by medical personnel or investigating authorities is paramount. Many bite mark injuries go undiscovered by medical, dental, and other health care providers as well as criminal investigators each year in the United States. Such situations can occur with abused children, elders and spouse who although alive, fear the repercussions that reporting such occurrences to the proper authorities may bring.[6,17]

- Often the difference in size and shape of teeth are very obvious to even a layman, for instance when someone has teeth missing or very prominent teeth.
- A representative human bite mark is described as an elliptical or circular injury that records the specific characteristics of the teeth.
- According to an article in the British Dental Journal by Dr. David Sweet and Dr. Iain Pretty, the size, shape and pattern of the biting edges of the anterior teeth that are arranged in the upper and lower dental arcades are thought to be specific to that individual. This is mainly caused by the sequence of eruption of anterior and posterior teeth.
- Bite marks with high evidentiary value that can be used in comparison with the suspect's teeth will include marks from specific teeth that accurately record distinct traits. It is possible to identify specific type of teeth by their class characteristics. [18,19,20]

Experience has shown that not all death investigators and medical examiners recognize bite mark pattern injuries for what they are. The availability of a forensic dentist for consultation and the training of other investigators and authorities are limited in

many geographic areas. Without proper training, this lack of recognition of bite mark pattern injuries by otherwise competent professionals will continue.[6,17]

*Terms indicating degree of confidence that an injury is a bite mark*

*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.

*Criteria:* General shape and size are present but distinctive features such as tooth marks are missing, incomplete or distorted or a few marks resembling tooth marks are present but the arch configuration is missing.

*Probable Bite mark:* The pattern strongly suggests or supports origin from teeth but could conceivably be caused by something else.

*Criteria:* Pattern shows some basic general characteristics of teeth arranged around arches.

*Definite Bite mark:* There is no reasonable doubt that teeth created the pattern, other possibilities were considered and excluded.

*Criteria:* Pattern conclusively illustrates typical class characteristics of dental arches and human teeth in proper arrangement so that it is recognizable as an impression of the human dentition.[19]

### *Complications of human bite marks*

Injuries resulting from animal or human bites may become septic or may progress to systemic infections. Secondary bacterial infections are more commonly associated with human bites than with animal bites. Infectious complications include tetanus, tuberculosis, syphilis, actinomycosis and those infectious complications related to streptococcal and staphylococcal organisms.[5]

Viral complications including hepatitis B virus, herpes simplex and cytomegalovirus have resulted from transmission through human bites. The human immunodeficiency virus can also potentially be transmitted

through the exchange of blood and saliva in a bite injury.[9]

The transmission of the human immunodeficiency virus via human bite is important to a number of distinct groups. The first group are those who are likely to be bitten as an occupational risk, such as police officers, correctional officers, medical personnel and others working in an institutional setting.[6,7] Another group are represented by the victims and perpetrators of crimes involving biting – both in attack and defense situations. The possibility of these bites transmitting a potentially fatal disease is of interest to the physicians who treat such patients and the legal system who may have to deal with the repercussions of such a transmission. A bite injury which transmitted HIV to the recipient could be classed as assault with a deadly weapon.[5,11]

The severity of the bite injury is one factor that is likely to increase the chance of HIV transmission. HIV is a predominately blood transmitted virus so, in order to access the victims blood, a bite must at least break the skin - hence an abrasion or more severe injury. Consideration must also be given to skin that is already broken. For example, skin with a previous injury or pathological lesion that suffers a superficial bite may allow saliva or oral blood to contact the bite recipient's blood.[6,13]

The reported infection rate of human bites varies. The infection rate for a bite to the hand was 28%, in one study, compared to only 4% for bites to the facial area. Mann and co-workers examined fifty human bites and found a 50% incidence of infection. In another study an infection rate of 17.7% of 434 bites was reported. Despite these variations it should be noted that human bites have a higher incidence of infection than any other bite type such as dog or cat, but the potential for bias as previously discussed must also be considered.[9]

The hand, of all potential bite sites, is the most likely to have an infective sequel, especially if the injury involves the metacarpophalangeal (MCP) joint. This kind

of injury is most likely to occur in a "clenched fist" situation. This typically occurs when the attacker strikes and hits the victim in the mouth and causes a laceration from the teeth. In the clenched fist injury, a laceration of roughly 5 mm occurs, typically in the third MCP joint (normally the most prominent), which looks superficial and benign.[7] Typically the patient will extend their hand to examine the injury and in the process create a deep inoculum of oral bacteria that enter the wound. Some authors believe that a clenched fist injury is a separate entity to a bite mark and that the two should be separated in bite classifications.[9]

#### *Human bite marks on skin*

##### Do

- Collect saliva from the bite marks for DNA.
- Remember the possibility of a bite through clothing.
- Photograph the bite mark with the ABFO ruler.
- Photograph the bite mark or patterned injury from a distance for orientation purposes.
- Photograph the pattern or bite mark with ultraviolet, infrared, and ALS.
- Dust the bite mark and lift the bite print.
- Take photographs of the dusted bite mark.
- Take an impression of the bite mark with the dusting powder in place using PVS.
- Remove the tissue and preserve in 10 percent formalin.

##### Don't

- Wash the bite mark or medically treat before swabbing for DNA.
- Dissect the tissue before photographing.
- Forget to use the ABFO #2 ruler or other standard when taking photographs.
- Forget to dust and lift the bite print.
- Forget to photograph the dusted bite print.
- Forget to take impressions before dissecting.

- Forget to use the retaining ring to secure the tissue before removing the bite mark tissue from the body.[9]

## Conclusion

A criminal may lie through his teeth, his teeth marks will never.

Bite mark is as unique as a fingerprint and is characteristic and specific for an individual. It has been estimated that the odds against two persons with all the teeth, producing identical bite marks are 2.5 billion to 1. This means that in India, with a population of 1 billion, no two persons will have identical bite marks and in the whole world with a population of about 6 billion, only 2 or 3 people will have identical bite marks. This is a very reasonable conclusion and courts will not hesitate to prosecute a criminal on bite mark evidence. It's recording, therefore, is an important aspect of dental evidence in forensic odontology.

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