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Bite Marks as Physical Evidence from the Crime Scene-An Overview

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Abstract

Bites have been found in cases of homicide, attempted suicide, sexual assault, and child abuse Bite marks with high evidentiary value that can be used in comparisons with the suspects' teeth will include marks from specific teeth that accurately record distinct traits. This article explores the scientific basis of bite mark evidence. Each person has a unique dental arrangement and that these unique features are sufficiently replicated in a bite mark to identify an individual to the exclusion of all others. Before examination, it is pertinent to separate the dental uniqueness used in dental identifications from the uniqueness of human bite marks. Such characteristics include fractures, rotations, attritional wear, malformations, etc. When these are recorded in the injury it may be possible to compare them to identify the specific teeth that caused the injury. This article aims to address the forensic aspects of bite marks evidence from the crime scene.

Keywords: Bites; Bite marks; Teeth; Dental uniqueness; Fractures; Attritional wear; Injury; Forensic; Crime scene

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 mean's [1]. Forensic dentistry is the application of dental knowledge to those criminal and civil laws that are enforced by police agencies in a criminal justice system [2]. Forensic dentists are involved in assisting investigative agencies to identify recovered human remains in addition to the identification of whole or fragmented bodies; forensic dentists may also be asked to assist in determining age, race, occupation, previous dental history and socioeconomic status of unidentified human beings. Identification is done by the comparison of ante mortem and post mortem dental records and using the unique features visible on dental radiographs, including both those resulting from dental treatment and those occurring naturally [3]. Human bite marks is one among the most violent crimes tried in the criminal courts. Bites have been found in cases of homicide, attempted suicide, sexual assault, and child abuse [4]. Bites can occur on both the victim and the suspect; teeth are used as weapon by the aggressor and in self defense by the victim [5]. Although they are only a small portion of most forensic dentist's case load, bite marks represent the most challenging aspect of the discipline. 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 [6].

Bite marks may be found on the flesh of victims of a violent attack, particularly on the stomach or buttocks. Alternatively they may be found on the suspect, left by the victim during self defense. The quality and accuracy of a bite mark are dependent on numerous factors, including time-dependent changes, where the bite mark was found, damage on soft tissue, dental similarity among individuals [7], and poor photography [8-11], impressions or measurements. If a bite mark is only represented as a bruise it is often extremely difficult to detect any individual characteristics. Bite marks in food [12] tend to be more useful than those in flesh.

However the reliability of forensic Odon tology has been called into question on numerous occasions. The skin itself is not a good medium for dental impressions, often having a number of irregularities that will cause distortion [13]. Bite marks can be altered through stretching, movement, or change in environment after the bite. There is also no set standard by which to analyse and compare bite marks. Aside from criminal cases, forensic odontologists and dentists are greatly involved in the identification of victims of mass disasters. Dental records in particular are beneficial in identifying such victims.

History

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 presented [14].

The bite mark evidence did not hold but by 1890 bite mark evidence started to be recognized in the science field [15]. 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 mark [16]. In 1930 in Quebec, Canada had an infant murdered. This was the first case that had bite mark evidence on the skin.

Examination of Bite Marks

A common method of comparing bite marks is to use transparent overlays [17] to record the biting edges of a suspect's teeth and compare them with the crime scene sample. These are often drawn on sheets of acetate, which can then be placed over one another for comparison. If it is possible, a dental cast will be made of the bite mark for later comparison to a suspect sample.

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The clinical history:

Most bite marks are found in the following type of homicides;

(1) The homicide victim involved in sexual activity around the time of death.

(2) The battered-child homicide victim.

Areas of the body most likely to bitten during assaults: Breasts (e. g. sexually motivated assault), arms, legs, face, head, abdomen, back, shoulder, buttocks, female genitalia, hands/fingers, chest, ears/nose, neck, male genitalia [18]. When faced with a person who has allegedly been bitten, a history of the bite/assault should be ascertained:-

- When was the bite inflicted?
- Which part (s) of the body was bitten?
- Which position (s) were the bitten parts in at the time?
- Did the bite take place through clothing? Has this clothing been submitted for examination already?
- Has the skin been washed since the assault?
- Does the person suffer from any condition liable to have influenced the appearance of a bite mark/bruise? (e.g. Bleeding diatheses or clotting disorder etc.). Table 1 shows the types of damage to skin.

Injuries observed with bite marks include abrasions, lacerations, contusions/bruises, petechiae, indentations, erythema and punctures [19-23] (Table 1).

All of these categories indicate a level of violence. From this investigators can infer the mental state of the offender.

The appearance of a bite mark is dependent upon a number of different variables, such as:

Artefact	Where a piece of flesh or body part is completely removed or bitten off piece of body
Abrasion	Undamaging mark on the skin or bruise without damage to the skin
Avulsion	Removal of the skin
Contusion	Ruptured or broken blood vessels
Hemorrhage	A small bleeding spot
Incision	Neat puncture of the skin
Laceration	Torn or Punctured skin

Table 1: Bite marks have been divided into seven classifications.

Figure 1: In sexual assault cases evidence 'ruptured or broken blood vessels' and its investigations analysis.

- Anatomical location (fat deposition, underlying hard tissue, Skin thickness Elasticity and vascularity)
- Number of teeth contacting the skin
- Amount of force
- Direction and type of biting action
- The biter's occlusion and oral health
- Whether the victim was alive when the bite was inflicted.

In living victims, the effect of healing will alter the appearance of a bite mark over time (Figure 1). Postmortem bites lack the classical erythema and contusions found with ante mortem bites. Bites can also be found on foodstuffs and less frequently on a variety of other materials such as chewing gum and paper towels [24-26].

These are then further divided into four degrees of impression, which when analyzed can help to note what kind of violence was exerted and may be used as aggravating circumstances.

- Significant pressure
- First degree pressure
- Violent pressure
- Skin violently torn from body

Bite mark injuries (Figure 2) and suspect (s) teeth possess pertinent physical characteristics which are amenable to digital measurement. The most obvious are:

- The distance from cuspid to cuspid
- The shape of the mouth arch
- The evidence of a tooth out of alignment
- The width and thickness, spacing between teeth
- Missing teeth
- The curves of biting edges
- The unique dentistry
- The Wear patterns such as chips or grinding.
- The Arch width
- The Labiolingual position
- The Rotational position

All of these are examined in detail and then compared (Table 2), preferably in a blind test in which the odontologists are not aware of which teeth impressions belong to the suspect. At the very least, the injury pattern itself should be completely analyzed first before looking at the data from the suspect.

Individual Bite Marks

Each person has a unique dental arrangement and that these unique features are sufficiently replicated in a bite mark to identify an individual to the exclusion of all others [27]. Before this examination, it is pertinent to separate the dental uniqueness used in dental identifications from the uniqueness of human bite marks. Dental identifications use dental records and radiographs in a systematic and well-validated method that has little to do with the features examined during a bite mark analysis (Figure 3).

The marks left by the teeth in a person may be used to identify an individual. A human bite mark is usually described as an elliptical or circular injury [28]. The differences in size and shape of teeth can sometimes be easily noticed especially when teeth are missing or prominent [29]. A bite mark is not always an accurate representation of the teeth; it depends on the jaw movement and use of the tongue. The

Figure 2: Images shows the types of degrees applied to skin in different crimes.

Bite mark	Suspect
Upper Jaw Distance	Upper Jaw Distance
Cuspid to cuspid	Cuspid to cuspid
Distance from tooth 6 to tooth 10	Distance from tooth 6 to tooth 10

Table 2: Compare data among the suspects and the type of bite mark.

lower jaw is moveable and gives the most biting force. The upper jaw is usually stationery and holds and stretches the skin. The most common type of bite marks are contusions. In most cases, bites have been identified with molar teeth represented on the injury. A double- arched pattern is a common presentation of human bites [30]. Despite the described presentations in terms of location, appearance and severity there are some basic features of bites that can be used to identify them. The initial identification of an injury as a bite mark is a prerequisite to the proper handling of the evidence.

Human Bite Marks as Forensic Evidence

Human bite marks are most often found on the skin of victims, but they may be found on almost all parts of the human body. Females are most often bitten on the breasts and legs during sexual attacks, whereas bites on males are commonly seen on the arms and shoulders [4]. In defensive circumstances, as when the arms are held up to ward off an attacker the arms and hands are often bitten.

Bites can occur singly, but are often present at multiple sites or multiple bites at a single location. Bite marks are therefore complex injuries and their recognition and interpretation of forensic significance relies upon a thorough understanding of the mechanisms involved [4]. Bite injuries can establish that a suspect was in violent contact with the victim. Bites can also provide evidence that a suspect was present at a particular crime. A bite on an abused child can indicate that other injuries may not be accidental. In order to ensure that this type of evidence is retained, it is important for odontologists to inform investigators about the proper recognition and preservation of bite mark evidence. It is the role of forensic odontologists to confirm that a particular injury is indeed a bite mark, to collect the required evidence from both the victim and the suspect, and to analyze the bite in light of the collected evidence. Good practice encourages odontologists to present their results in a written report, adhering to strict guidelines relating to wording and levels of conclusion (Figure 4).

But as such the question about bite mark uniqueness remains unanswered till date. Many forensic dentists and lawyers have questioned this fact and demanded to know from testifying experts the relative frequency of dental features identified in bite marks. By examining the ability of forensic dentists to identify correctly biters from the bite marks, the issue of bite mark uniqueness can be answered. If it is quite clear that odontologists have a great deal of difficulty in correctly identifying bite marks, the question of uniqueness will become irrelevant.

Accuracy of bite marks on human skin has been the most debated area in discussions of forensic significance. Skin is a poor registration material because it is highly variable in terms of anatomical location, underlying musculature, or fat, curvature, and looseness or adherence to underlying tissues. Skin is highly visco-elastic, which allows stretching to occur during either the biting process or when evidence is collected. They concluded that the changes in bite mark appearance are likely to be greater as the injury grows older.

Human Bite Marks as Physical Evidence

Physical evidence can yield significant information about the nature and circumstances of a crime. The analysis regimen for bite marks is broadly split into two main components. First is the metric analysis that involves the measurement of specific traits and features, secondly, the comparison of the configuration and pattern of the bite injury to that of the suspect's teeth. This comparison is often referred to as pattern association [31]. Three main classifications of characteristics exist: gross, class and individual [32]. Gross characteristics are those that identify the general origin of the object.

A semicircular injury with central area of ecchymosis and small areas of incision or bruising demonstrates the gross characteristics of bite marks. Class characteristics can be defined as the properties of evidence that can only be associated with a group and never with a single source [2]. Sweet describes dental class characteristics as the number and shape of individual teeth and the familial arched arrangement of teeth in upper and lower jaws. Using measurements, a bite mark can be described as having been created by a child or an adult. Individualizing characteristics on teeth can be divided into two main categories: developmental and acquired. Developmental features that can be considered unique include prominent marginal ridges, additional cusps, talon cusps, macro-or-microdontia and genetic abnormalities of tooth form. Acquired characteristics include restorations, fractures,

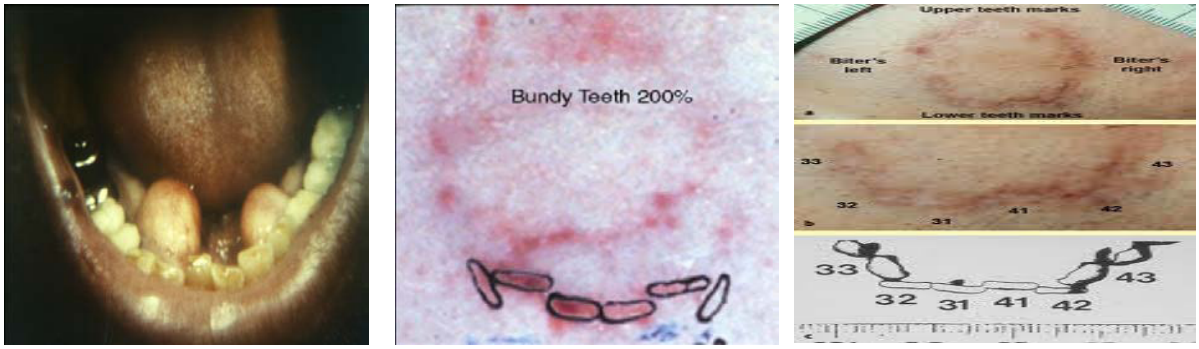

Figure 3: Images shows the different individualistic characteristics in different crimes.

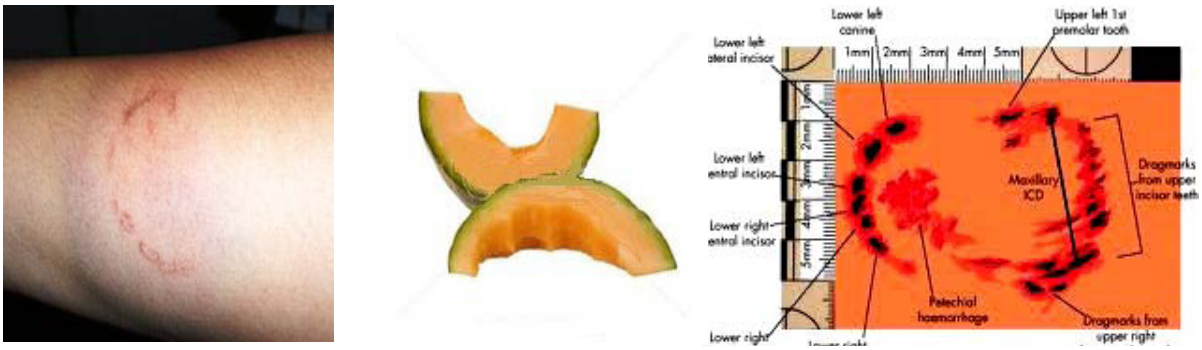

Figure 4: Images shows different bite marks on human skins and fruits in different crimes as forensic evidence.

occlusal adjustments, and occlusal wear [33-35]. These characteristics provide the odontologists with the necessary detail to enable a single person to be identified as the biter.

Human Bite Marks as Biological Evidence

Regarding the uniqueness and reproducibility, researchers turned to biological evidence. Initially this evidence was limited to the blood typing of saliva stains using ABO antigen groups [36] (Figure 5).

Some scientist found that saliva deposited by a biter could be collected, using a double swab technique [37], and would yield DNA for forensic analysis. Now, it is possible to retrieve and analyze DNA from bites on victims [38]. By using PCR (Polymerase Chain Reaction) technique [30], DNA analysis will play an increasingly crucial role in the investigation of bite injuries. Degradation, expense, and environmental assaults may restrict the use of DNA analysis. However, DNA analysis represents the most scientific, and defensible method of bite mark analysis. Physical evidence is likely to remain a crucial part of bite mark evidence.

Human Bite Marks as Psychological evidence

Some scientists elaborated the psychological aspects of bite marks and in doing so, elucidated three motivational dimensions [39]:

Anger-impulsive biting

The anger-impulsive bite is said to often result from frustration and incompetence in dealing effectively with conflict situations on the part of the perpetrator and is governed by type of anger.

Sadistic biting

The sadistic bite is said to satisfy the need for power, domination, control, and omniscience.

Ego-cannibalistic biting

The ego-cannibalistic biter bites in an attempt to satisfy ego demands by annihilating, consuming, and absorbing life essences from the victim [39] (Figure 6).

All of these categories indicate a level of violence. From this investigators can infer the mental state of the offender. Current theories suggest that psychological techniques, such as personal construct theory, may also be applied to bite marks [22,40].

Conclusion

Analysis of bite mark evidence has been assisting the judiciary to answer crucial questions about interactions between people at the scene of a crime. The shape of the bitemark can give useful clues about the person who caused it and may lead to the implication or exclusion of an individual under investigation. Physical bite mark evidence will always play an important part in criminal investigations. But currently, there is no agreement among forensic odontologists about the individuality (uniqueness) of the dentition and on the behavior of human skin during and after biting. With the slow but rational enhancement of techniques along scientific lines like the DNA analysis, bite mark evidence can reinforce and expand its sound and logical basis.

'*Bite-mark evidence has been used as an aid in the identification of criminals in many instances. It is shown how perpetrators of violent injuries were detected from bite marks on the victim or the perpetrator, or on foodstuffs found at the scene of the crime, when the marks were compared to dental impressions taken subsequently*'.

Some scientist recommends that thorough analysis of the size, position and other features of bite marks be completed before any comparison with a suspect's dentition is made. It is possible to identify specific types of teeth by their class characteristics. But it is necessary to

Figure 5: Images shows the types of biological evidence source in different crimes and teeth patterns.

Figure 6: Images shows the different types of bite's psychological behavior in different crimes and teeth vs. age.

have individual characteristics recorded in the bite mark to be able to identify positively the perpetrator. Use, misuse and abuse of the teeth result in unique features that are referred to as accidental or individual traits. Such characteristics include fractures, rotations, attritional wear, congenital malformations, etc.

When these are recorded in the injury it may be possible to compare them to identify the specific teeth (person) that caused the injury. This article aims to address the forensic aspects of bite marks as physical evidence from the crime scene.

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