# Acquaintance of bite mark identification procedures in forensic odontology

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ABSTRACT

Introduction: Bite mark analysis casework strives to connect a biter to the teeth pattern present on the object linked in some way to crime or event. This analysis requiring an immediate response by the forensic odontologist since the marks fade rapidly in the living and the dead in a matter of hours. The aim of this article is to help the dentist to know and understand the procedures of bite mark identification in forensic odontology field. Literature review: Bite marks may be present the following situations, a fight between adults or children, a part of sexual or physical assault by adult on children, a rape, and homosexual activities. The marks can be single or multiple, varying degrees of severity from mild marking of the tissue to deep perforation, varying location may be found on breast, face/ head, abdomen, shoulder, upper extremity, buttocks, female genitalia, male genitalia, legs, ear, nose and neck. Discussion: Dentist should master the bite mark analysis procedures. When the suspect has been recognized, the first thing to do is swabbing the oral mucosa, and then taking photographs. The next steps are preparing to take impression, and always taking notes about the procedure and the result. A soon as all the documents are completed, do the matching procedures. Delay examination will cause the lost of valuable evidence. Conclution: Dentist should carefully determine the conclusion among these possibilities , the mark is "possible biter", "probable biter", or "with a high level of confidence, is the biter".

Keywords: Bite mark analysis, Bite mark procedures, Forensic odontology.

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**ABSTRAK**

*pendahuluan: Analisis kasus bite mark akan menghubungkan penggigit dengan pola gigitan yang terdapat pada suatu objek dalam kasus kejahatan atau kasus lainnya. Analisis ini memerlukan respon yang cepat oleh seorang forensik odontologi karena tanda ini akan menghilang dengan cepat dalam hitungan jam. Tujuan artikel ini adalah untuk membantu para dokter gigi untuk mengetahui dan memahami prosedur identifikasi bite mark dalam ruang lingkup forensik odontologi. Tinjauan Pustaka: Bite mark dapat muncul pada beberapa situasi seperti saat perkelahian antara orang dewasa dan anak, kejadian kekerasan seksual dan fisik pada anak, pemerkosaan dan aktivitas homoseksual. Tanda tersebut dapat berupa tanda tunggal atau multipel, derajat yang bervariasi dari tanda ringan hingga perforasi pada jaringan lunak, dengan lokasi yang bervariasi dapat ditemukan di payudara, wajah/ kepala, perut, pundak, ekstrimitas atas, bokong, alat kelamin wanita dan pria, kaki, telinga, hidung dan leher. Diskusi: Seorang dokter gigi harus menguasai prosedur analisis bite mark. Saat seorang tersangka diketahui, hal pertama yang perlu dilakukan adalah swab mukosa oral dan mengambil fotographi. Tahap berikutnya adalah persiapan pencetakan dan mencatat setiap tahap dan hasilnya. Setelah seluruh dokumen telah lengkap, lakukan prosedur pencocokan. Keterlambatan pemeriksaan akan menyebabkan kehilangantanda bukti yang berharga. Simpulan: Seorang dokter gigi harus dapat menentukan simpulan dari segala kemungkinan berikut yaitu tanda tersebut kemungkinan adalah sang penggigit, mungkin sang penggigit, atau sangat yakin sang penggigit.*

***Kata kunci**: analisis bite mark, prosedu bite mark, Forensic odontology.*

## INTRODUCTION

Bite mark defined as a pattern produced by human or animal dentitions and associated structures in any substance capable of being marked by those means.[1] It is more commmonly associated with marks in the skin, but it is also related in foods and other inanimate objects.[1] The ability of skin to register sufficient detail of a biter's teeth is highly variable. Bite mark casework indicates that many bite marks are no well defined in detail and possess distortion due to the physical nature of skin it self.[2] Individual have been biten may be either alive or dead. The evidence considered by bite mark analysis is subject to changes by the healing process and or decomposition.

Bite marks may be present in condition such as a fight between adults or children, as part of a sexual or physical assault by an adult on a child, in rape or attempted rape where bites are likely to be noted on the breast, and between homosexuals. Harvey in Clark state that the marks, single or multiple in nature, may be of varying degrees of severity, ranging from a mild marking of the tissue to deep perforation of the epidermis and dermis, and may be found (in order of frequency) on breast, face/ head, abdomen, shoulder, upper extremity, buttocks, female genitalia, male genitalia, legs, ear, nose and neck.[1]

Bite mark comparison represents a vital contribution of dentistry to the forensic science. The comparison involves the bite mark pattern at the scene of the crime with the dental alignment and characteristics of the dentition of a suspect. Depending upon the circumstances, bite mark patterns may be deposited within food utensils and other objects or upon the victim of an assault or homicide.[3]

Bite mark examination is the one aspect of forensic odontology requiring an immediate response by the forensic odontologist.[1] The marks fade rapidly, both in the living and the dead, changing appearance in a matter of hours; delay in examination may result in loss of valuable evidence.[1] Bite mark discussion is that the forensic pathologist is not qualified to handle bite mark analysis since the techniques and data interpretation requirre the knowledge of the dentist.[3] Therefore, the aim of this article is to help the dentist to know and understand the procedures of bite mark identification.

## LITERATURE REVIEW

Many bite mark associated with the violent crime go unnoticed. The responsibility of recognizing a possible bite mark usualy faills on either law personnel or medical staff in hospital or morgue facilities.[2] Investigator should be suspicious of any marks or bruises which have characteristic resembling injuries by teeth. Recognition of a human bite mark is an important things. The physical parameters of the injury can be measured. The law personnel or medical staff who may have a suspicion about an ovoid skin wound, have to call in the local dentist for confirmation.

The logic tree for the on screen investigator or autopsy dental examiner involves the following[2]: 1. Is the pattern a bite mark; 2. Could human teeth be the cause of; 3. Does the area allow swabbing for salivary DNA; 4. Do the teeth marks present in the evidence possess information sufficient to identify one person; 5. If 4 is no: what the features present in the bite mark are sufficient to eliminate specific people from the investigation? If 4 is yes: What is the probability of an unassociated person being matches with the bite mark evidence?

Figure 1. Bite mark in children.[4]

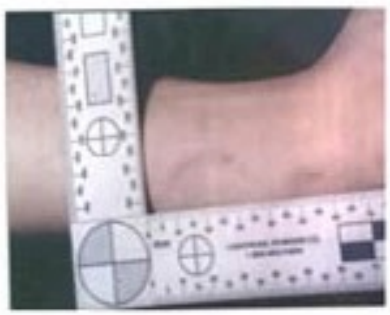

Figure 2. Bite mark made by a child.[4]

The difference between adult or child bite mark, the adult teeth are bigger and the jaw is bigger than child, but a young teenager have some adult teeth and developing towards an adult jaw size. An adolesence bite mark if it is just bruishing can mimic as adult bite when in between age 12 to 17 years old.[2]

The difference between human or animal bite mark are, the large carnivore (dog bite) bite wound can be remarkable in their depth and amount of damage to skin and underlying muscle. These animal have a long canine, and six incisors plus two canines.[2]

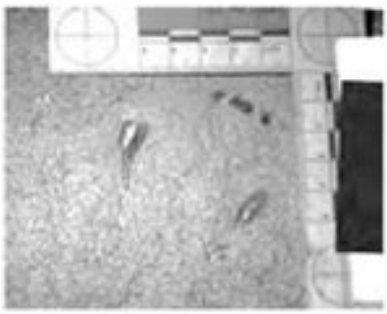

Figure 3. The dog's Bite mark.[5]

### Procedural aspect of bite mark analysis/ examination of the bite mark on the victim

Upon recognition of a bite mark injury, the forensic investigation should commence as soon as possible.[3] Since just a few hours delay may mean the loss of potentially valuable points of indentation or areas of superficial skin contusion.[3]

### Swab salivary secretory substance retrieval

The first step in the bite mark examination is the swabbing of the involved skin surface to detect the possible presence of secretory antigens conveyed by the saliva of the bitter.[3] The present of a bite mark means that the mouth of the biter has made contact with the object. Such contact will almost leave some trace of saliva. This can be an important source of DNA that can be used for identification. Saliva containing skin cell from the lining of the oral mucosa, which contain a nucleus that possess nuclear DNA. The concentration of these cell is quite high in human saliva. So its potential to identifying information on who or what (animal) made the mark.[2] Clift and Lamont in Clark state that the amount of saliva deposited with a bite mark is liable to be small, about 0.3

ml, and distributed over a relatively wide area of about 20 cm$^2$.[1] The aim is to collect as concentrated a sample as possible avoiding contamination with blood which may be present in the bite mark area.[1] The basic A, B, and O group protein antigenic complexes, quite concentrated in saliva relative to blood, are represent in the various body fluids of such persons.[3]

The presence of a Y chromosome in the resulting profile, indicates a biter is a male. The lack of a Y chromosome and presence of XX means a biter is a female.[2] The test for seretory substance should be implemented as soon as possible, for such antigens in saliva may break down rapidly due to the presence of proteolytic enzymes.[3] The bite mark saliva sample is acquired by swabbing the involved area, utilizing a sterile cotton swab moistened with isotonic saline solution.[3] Important to use a sterile glove while swabbing. The swab is then placed in a clean dry vial, write the detail on the label for transmission to the laboratory.[3]

In addition to swab of the bitten surface, a control swab, used in similar fashion, should be applied to an unbitten skin surface of the victim. The intraoral saliva and a blood sample of the victim must also be procured for examination purposes.[3] The bite mark and control swab should be used at the very outset on the examination prior to the removal of clothing and prior to wiping the body surface for cleansing purpose.[3]

If the bite mark swab reveal an absence of detechable secretory substance, the two possibilities are the secretory substance is not detachable postmortem, and the biter is a nonsecretor[3]. If the bite mark swab reveal a secretory type different than that of the deceased, the implication is that the biter was a secretor of the type discovered[3]. If the bite mark and control swabs disclose similar A, B, and O secretory typing for booth the victim and the area of bite mark, no conclusions can be drawn.[3]

## Photographic method to registration the bite mark

The bite mark analysis involves a comparisons of the bite mark with the dentition of the suspect. One of registration of the bite mark is accomplished by a photographic method. The photographic method use a photograph of the bite mark as a means of the bite mark registration.[3] The characteristic of morphology and measurement of the recorded bite mark from the photograph are then compared with the corresponding features of the suspects dentition.[3] Bruises in the skin of a live person change color as healing takes place. These color changes are different from person to person. Age estimation of the bite mark is neither a scientific nor accurate process.[2]

The bite mark must be photographed in situ, and a rigid milimeter rule (ABFO #2) must be incorporated within the photograph positioned next to and adjacent to the plane of the bite mark. The rule is an essential element because the eventual comparison of the mark with the suspects dentition will be made using life-size models of his dentition. The incorporation of the ruler allows a life-size one-to-one enlargement or duplication of the bite mark negative to be made.[3]

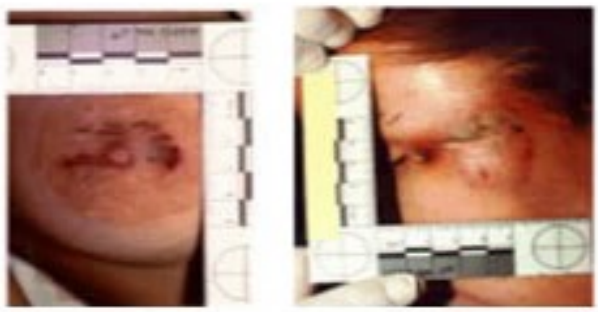

Figure 4. Bite mark photography using ABFO #2.[4]

Black and white photographs should be available for introduction as court evidence if an objection arises regarding inflammatory color photographs.[3] If the bite mark has been inflicted upon a convex surface, such as the dome of the breast or convexity of the arm, it may be helpful to take a separate photograph of each arch pattern since a single overhead photograph may distort the more distant anterior rim of each arch and the depth of field focus and subject curvature may alter the photographic reproduction.[3]

Bite mark in live adult, arrangements should be made for repeat photography to be undertaken 24 hours and 36 hours later, preferably by the same photographer.[1] Note should be made of the camera used, lens, filters, flash, film and fil speed, distance, shutter speed and aperture.[1] An experienced photographer throughly knowledgeable with his camera equipment should perform the photographic techniques because a photographic failure may ruin the analysis.[3]

**Impression method to registration the bite mark**

If the bite mark has perforated the skin, consider taking an impresssion of the area.[1] Other registration of the bite mark method is an impression method which using a rubber-base or silicone impression which is then converted to a model of the bite mark preferably made from plaster of paris.[3] The impression method is needed if only the bite indentations are present within the skin surface. The value of the impression method rest upon the fact that bite mark indentations of the skin are exactly reproduced in the three-dimensional model.[3] The dimension of depth is provided for comparison with the denntition of the suspect.

Particular tooth mark indentations will always be present on bite mark injury. The passage of time, however, results in a smooting out of the tooth depressions. The latter phenomenon occurs as a result of edema due to injury, post mortem change and the inherent ability of the plastic skin, dermis and subdermal tissue to reconstitute the original contour of the body surface. At a later point in time only the tooth contussions (bruises) or less common tooth laceration (tears in the skin) remain as hallmarks of the bite.[3]

Sebata in Sopher state that the bite mark which do not break the skin surface will persist for as short an interval as three minutes or as long as twenty-four hours, depending upon the bite pressure applied.[3] Harvey in Sopher state that face bite fade more quickly than bites upon other body areas. Further he said that bite mark upon the male subject fade more rapidly than bite inflicted upon female.[3]

Rubber base or silicone impression compound should be applied to the bitten area and reinforced by stone after setting but prior to removal from the body surface. The stone backing preserve the general contour of the skin surface. A subsequence plaster positive of the rubber base impression can also be poured to create a facsimile of the mark indentations.[3] It is also adviceable to take several rubber base or silicone impression, and several plaster model of each impression can be made.[3] After impression is taken, take a photograph of the impression from some view, with a rule scale. Make an superimposition from the bite mark's photo and impression's photo from the edge of these teeth to see the match.

**Preservation of the bitten tissue**

The pathologist should excise the bite mark exercising wide latitudes of tissue resection to minimize specimen distortion due to release of tissue tension and charge in tissue elasticity. Upon removal of the bite mark tissue, the specimen should be retained and preserved in 10% formalin or Keiserling's solution. A tissue shrinkage of 10 to 20 % is common with such preservatives since the mark is no longer a life-size specimen.[3]

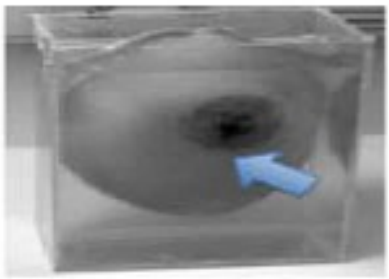

Figure 6. Breast preservation.[3]

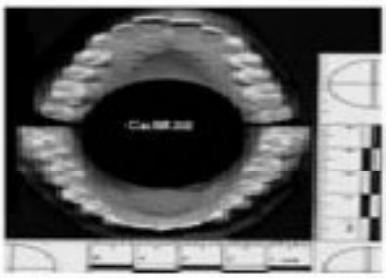

Figure 7. Digitally recorded dental study casts from bite mark suspect.[4]

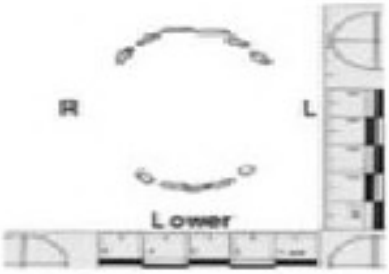


Figure 8. Bite mark comparison overlay produced using Adobe Photoshop.[4,5]



the edge of these teeth to see the match.

**Figure 9. Direct comparison of maxillary dental model to bite mark injury on breast.[5]**

## DISCUSSION

Once all the avalaible bite mark evidence has been documented, collected and inventoried, the forensic dentist is asked to render an opinion. Once a suspect are developed, then the dentist will initiate a physical dental profiling, and DNA profilling these suspect. These suspect information comparison with the bite mark information to get the match pair. Special note is taken of unusual characteristics such as chipped or worn teeth, the presence of developmental mammelons and space due to missing teeth, crowding and position in the jaws relative to cheek or tongue side. Each of these factor will have a bearing on the injury pattern caused by the biter.

Bite mark analysis see the tooth size, shape, chips and fractures, the jaw shape, tooth aligmnent, missing teeth and the length of the dentition to identify one person from another. The weight given to these features in establishing a positive match is the dentist's opinion. The equivalent features in tool mark analysis are called accidental characeristics. The dental equivalent means a change to a class characteristic due to events such as wear, accident or unussual dental restoration.

Typical protocol performed to the bite mark evidence and dental suspect are swabbing the region, taking photography, taking impression of the bite mark site, and writing documentation of the examination and procedures. The methods of documentation and preservation of the bite mark are very important. Skin as the media of the bite mark is an elastic organ which can be change easily during injury and healings. Therefore the procedures must be done as soon as possible. Material and technique should be sufficiently high in quality to minimize physical and photographic distortion in order to compare the bite mark evidence and dental suspect.

## CONCLUSION

Dentist should carefully determine the conclusion among these possibilities , the mark is "possible biter", "probable biter", or "with a high level of confidence, is the biter".

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## REFERENCES

1. Clark DH. Practical forensic odontology. oxford; 1992.
2. Bowers CM. Forensic dental evidence, an investigator's handbook. first edit. London: Elsevier; 2006.
3. Sopher IM. Forensic dentistry. Fisher RS, editor. Illinois: Charles C Thomas; 1976.
4. Sweet D. Computer assisted 2D and 3D comparison of bite mark evidence and tooth exemplars. 1998;(TR-07-98).
5. Senn DR, Stimson PG. Forensic Dentistry - Edition, Second. second edi. CRC Press; 2010. p. 472.