

Human Bite Marks In Skin: A Review

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Abstract

Human identification is the mainstay of civilization. Identification by teeth is not new. Bite marks may be found at a number of crime scenes. Human bite mark analysis is one of the most complicated and demanding part of forensic dentistry. The individuality of human dentition allows the forensic odontologists to reach to a strong opinion of association in cases of identification and bite mark analysis. In the cases of physical assault having skin injuries, the anatomy and physiology of skin and the position of the victim affect the detail and the shape of the bite mark and hence not all bite marks have the level of forensic value necessary to identify just one individual. Advanced techniques using digital overlays have been suggested. However the advent of DNA and its recovery from bite marks has offered an objective method of bite mark analysis. The issues within the bite mark analysis are discussed in this paper.

INTRODUCTION

Identification by teeth is not new. It goes back to 66 A.D. at the time of Nero when Nero's mother Agrippina had her soldiers kill Lollia Paulina, with instructions to bring back her head as proof that she was dead. Agrippina, unable to positively identify the head, examined the front teeth and on finding the discolored front tooth confirmed the identity of the victim¹. The fact that the humans bite each other is a subject of interest and study for a number of researchers. There are reports of the marks left by teeth of humans in the skin of other humans as well as in inanimate objects. Since the 1950s, the bite mark evidence and dentists have played a role in the judicial system². However their role has increased after 1975³. the scientific basis of bite mark analysis is rooted in the premise of individuality of the human dentition, the belief that no two humans have identical dentitions in regard to size, shape, and alignment of the teeth¹². This asserted uniqueness is transferred and recorded in the injury produced by the teeth during biting¹. The main aim of the analysis of bite mark cases is to connect the biter to the teeth pattern present in an object or the skin and to find out whether it is in any way related to the crime or the event. The human skin has the ability to register sufficient detail of the teeth of the biter, however it is quite variable. A number of studies have shown that the physical nature of the skin causes distortion of the bite marks. Moreover the process of healing and decomposition produces changes in the bite marks which are left in the skin of dead or living individuals. The investigators dealing with analysis of bite marks should also

have the knowledge of any marks or bruises which have characteristics which closely resemble the injuries produced by teeth as the determination of an injury being produced by human teeth requires substantial information⁴. Tooth markings may also be found in inanimate objects that might be associated with the crime such as foods like chocolates, vegetables, chewing gums, Styrofoam cups, cigarette butts and even on the steering wheel of a car^{2,5}. Aboshi et al reported the identification of a suspect when the police called to investigate a fire in a snackbar in Mount Gambier, South Australia, discovered four cakes with characteristics marks apparently produced by human teeth. These marks were examined and compared with the teeth of a suspect arsonist. The comparison was made by computer imaging analysis and a remarkable similarity in arch shape was observed⁶. Bernitz et al even reported a case of a murder in which the bite marks in a piece of cheese was recorded⁹. Bite marks left in substances which are malleable like the cheese have a more potential for accurate identification⁴.

The manual of American Board of Forensic Odontologists (ABFO) defines the bite mark as a physical pattern left in an object or tissue by dental structures of human or an animal. The manual also describes the bite mark as a circular or oval patterned injury consisting of two opposing symmetrical, U shaped arches separated at their bases by open spaces. Along the periphery of the arches are series of individual contusions, abrasions, and/or lacerations reflecting the size, shape, arrangement, and distribution of the class

characteristics of the contacting surfaces of the human dentition³.

Teeth marks and bite marks: The teeth can also leave marks without the act of biting as is seen when the skin or the objects contact the teeth instead of the biter intentionally closing his jaws. Hence the teeth marks are passive, as there is no intentional, active or reflexive jaw movement. These teeth marks are different from the bite marks where the muscles of the jaws are active, causing the teeth to move into the bitten substrate which can be skin or any other object³.

A characteristic, in a human bite mark, is a distinguishing feature, trait, or pattern within the bite mark and is delineated as a class or an individual characteristic².

CLASS CHARACTERISTICS

These are referred to as the measurable features and shapes that allow us to ascertain an adult versus a child biter and to determine which teeth are present in the bite pattern. For example the arch sizes of an adult are different from that of a child. It also helps us to differentiate between the upper and the lower arch forms in a bite mark. According to the manual of ABFO a class characteristic is a feature, trait, or pattern that distinguishes a bite mark from other patterned injuries. It helps us to identify the group from which the bite mark originates, which can be human, animals, fish, or other species. While evaluating the bite marks, the first step is to confirm the presence of class characteristics. The tooth class characteristics and bite mark characteristics are the two types of class characteristics. In a bite mark the front teeth which include the central incisors, lateral incisors and the cuspids are the primary biting teeth according to tooth class characteristics. There are twelve teeth markings in a bite mark which has both the maxillary and the mandibular front teeth. Each type of tooth in the human dentition has class characteristics that differentiate one tooth type from the others. The two mandibular central incisors and the two mandibular lateral incisors are almost uniform in width, while the mandibular cuspids are cone shaped. When compared to the maxillary central incisors the maxillary lateral incisors are narrower and the maxillary cuspids are cone shaped. The upper jaw is wider than the lower jaw. The bite mark characteristics help us in determining of which marks were made from maxillary teeth and from the mandibular teeth. According to bite mark characteristics the maxillary central incisors and lateral incisors make rectangular marks of which the centrals are wider than the laterals and the maxillary cuspids produce round or oval

marks. The mandibular central incisors and lateral incisors also produce rectangular marks but these are almost equal in width, whereas the mandibular cuspids produce round or oval marks. Sometimes the suspect may have a missing tooth/teeth, or due to breakage the tooth is shorter in size or there may be some clothing which prevented the tooth/teeth from contacting the skin. All these factors may lead to gaps which can be seen between the marks.

INDIVIDUAL CHARACTERISTICS

Individual characteristics are deviations from standard class characteristics. They are the specific features found within the class characteristics which can be a feature, trait or a pattern that represents an individual variation rather than an expected finding. Arch characteristics and dental characteristics are the two types of individual characteristics. The arch characteristics help to differentiate between individuals by distinguishing one person's arch from another. It is based on the fact that some patterns, features, or traits may be seen in some individuals and not in others, for example teeth in rotation, buccal or lingual version, mesial or distal drifting of teeth. Dental characteristic is specific to an individual tooth and makes one tooth different from the other tooth. Eruption is continuous process and the teeth are subjected to various insults like sports injuries, chemical injuries, biologic attacks, motor vehicle accidents, workplace accidents, caries etc. After such damages have taken place, the teeth are need of a restoration. These restorations or the injury itself produces distinctive and unique features within a tooth.

Each human dentition is unique⁷. The teeth of different individuals differ from one another with respect to their size, their position in the dental arches and in their shape. These differences may be produced by various physical and chemical injuries affecting the teeth over the years like attrition, abrasion, erosion, the teeth may be affected by caries due to poor oral hygiene, and there may be restorations of the carious teeth⁴. The eruption sequence of the maxillary and mandibular anterior and posterior dentition also provides uniqueness to the human dentition. The erupting canine forces its way into the dental arch which causes displacement, rotation and may even cause bodily movement of the surrounding teeth. This uniqueness of the human dentition produces a pattern which can be compared the patterns which are found on the skin or other objects which have been bitten⁷.

An ideal human bite mark is doughnut shaped which

consists of two U shaped arches representing the mandibular and the maxillary arches separated from one another at their base. The individual arches are produced by the anterior six teeth². When teeth in only one of the two arches contact the skin during biting, then instead of the two U shaped marks, we get only one C shaped mark in the injury produced by biting. Such types of bite mark patterns provide very less information to the investigator. The diameter of the bite mark injury varies but is usually between 25-40 mm in diameter. The size of an injury must fall within the known parameters of the human dentition, from a pediatric dentition through mixed dentition to complete adult dentition². In the centre of the bite mark injury, due to the pressure created by the biting teeth and by the negative pressure created by tongue and suction, there is extra vascular bleeding which causes bruising. The color of these bruising changes over a period of time and the color also changes as the injury undergoes a healing process in the skin of a living individual⁴. There can be a lot of variations of an ideal human bite mark which are discussed below:

1.ADDITIONAL FEATURES

- a)Central ecchymosis: The negative pressure created by the tongue and suction and the positive pressure created by closing of the teeth causes extra vascular bleeding due to disruption of the small blood vessels produces central ecchymosis.
- b)Linear abrasions, contusions or striations: These are produced by slipping of the teeth slip against the skin or by imprinting of the lingual surfaces of the teeth on the skin.
- c)Double bite: It is also called bite within a bite and is produced when during initial contact with the teeth the skin slips and the teeth contact again for the second time with the skin.
- d)Weave patterns of interposed clothing.
- e)Peripheral ecchymosis: It is produced when there is excessive and confluent bruising.

2.PARTIAL BITE MARKS

- a)One arched: Also called half bites.
- b)One or a few teeth.
- c)Unilateral marks: It is produced when the dentition is incomplete or when there is uneven

pressure during biting.

3.FADED BITE MARKS

- a)Fused arches: In this there are no individual tooth marks.
- b)Solid: It is produced when the erythema or the contusion fills the entire central area of the bite mark. In this the bite mark does not show a ring pattern, but instead there is a discolored circular mark.
- c)Closed arches: in this the maxillary and the mandibular arches are joined at their edges.
- d)Latent: Seen with special imaging techniques.

4.SUPERIMPOSED BITES

5.AVULSIVE BITES:

These are the ones in which the tissue is bitten off the victim during biting.

When one person bites another person, then in such a situation there is movement of both the victim and the biter. The biting force may be so powerful that it may cause the surface of the bitten skin to be twisted. All these factors may produce marks which may vary from an ideal bite injury mark. These may include additions or subtractions. In the case of additions a single tooth may bite at or near the original bite a number of times. However when under the biting pressure the skin gets twisted, a few or multiple teeth may not contact the skin during biting, hence produce subtractions⁴. There are a number of situations where some injuries may resemble bite marks. The injury marks in the skin which are produced by the ECG pads are very similar to the bite marks. Also in the cases of deceased individuals the process of decomposition takes place. This decomposition process and the injuries produced by the insects produce marks in the skin which are very similar to the bite marks⁴.

Different terms can be used to indicate the degrees of confidence as to whether an injury is a bite mark or not. Possible bite mark is the term used to describe the injury pattern that may or may not be caused by teeth. Distinctive features are missing, incomplete or distorted⁸. When the pattern has some of the basic general characteristics of the teeth arranged around the arches but could possibly be caused by something else then the term probable bite mark is used⁸. If the injury pattern demonstrates all characteristics of

dental arches and human teeth and all other possibilities have been excluded then we use the term definitive bite mark⁸. Bite mark injuries are found in many crimes and sometime are the only physical evidence available to solve the crime. It is very important for the dentists, police officers and the various people involved in bite mark analysis to know the locations where the bite marks are most commonly found on the body. Depending upon the circumstances of the events, the location of the bite marks can be categorized. In the cases of sexual assault the bite marks are seen more in females as compared to the males. Bite marks in females in such cases are seen more frequently on breasts, nipples, abdomen, thighs and pubis⁴. The individuals who are attacked, in order to defend themselves usually receive defense wounds on hands and forearms⁴. During an event of animal attack on humans, the animal bite marks are seen more frequently on the legs⁴.

COLLECTION OF EVIDENCE FROM THE BITE VICTIM

The collection of evidence associated with the bite mark is very important and crucial to investigate the injury. Healing of the bite mark occurs in a living victim and degradation occurs in a deceased victim, hence it is important to review and document the injury pattern over time².

A)Saliva swabs of the bite site^{2,4,7}: About 0.3 mL of saliva is deposited while making a bite and saliva is one of the various body fluids from which DNA can be extracted. In bite injury cases when the offender's mouth comes in contact with the victim's skin, there is deposition of offender's saliva on to the skin of the victim. This can be used as a source of salivary DNA for investigational purposes to solve criminal cases. However due to the presence of nucleases within the saliva whose activity is accelerated due to the ambient temperature of the skin of a living victim, there is degradation of the salivary DNA. The oral cavity is lined by the oral mucous membrane. The cells of the oral mucous membrane are continuously being exfoliated into the oral cavity. These exfoliated cells of the oral mucous membrane can also be used as a very good source of DNA. From the analysis of the DNA so collected, the sex of the offender can be found out. If the DNA contains a Y chromosome then the offender is a male, and if there is the presence of XX chromosome then the offender is a female. Different methods and techniques have been described to collect the saliva from the bite site, but the most commonly used is the Sweet's double swab technique which uses two cotton swabs to collect the saliva. The first cotton swab is

moistened with distilled water and is used to clean the skin at the bite site of the victim which was contaminated by the tongue and the lips of the offender. The second cotton swab is completely dry and is used to collect the moisture that is left on the skin by the first swab. Both the first and the second cotton swabs are air dried for about 45 minutes before they are sent for DNA analysis. Both the swabs should be kept dry and cool in order to prevent degradation of the salivary DNA and to prevent the contamination of the saliva by the growth of other micro organisms. If there is a lot of time delay from collecting the salivary swabs till they are sent for analysis then the cotton swabs should be stored properly in a box that allows air to circulate between the swab tips.

B)Photographic documentation of the bite injury^{2,4,7,9}: It is the most common method which is used to document and preserve the bite mark evidence. Hence the care should be taken that the photographs which are taken should be of the highest standards. Both the color and black & white photographs should be taken of the bite mark. The color in the photographs blocks the eye from seeing the subtle and minute details associated with the injury. When the same injury is viewed in black and white photographs, those details are more readily noted. We should first start with the broader orientation photographs and then take the close up photographs. Digital camera may also be used to photograph the injury. The digital camera captures the image on a charge coupled device. This can be transferred to a computer and can be processed further. The computer can change the same image into a black and white image, hence eliminating the step of taking a separate black and white photograph. The photographs have to be taken both before and after the DNA protocol. Photographs taken before the DNA protocol record the original condition of the bite injury and the ones which are taken after the DNA protocol record the condition of the bite injury after the bite injury has been cleansed of all blood stains if present. The color of the bite mark changes over a period of time. This is because during biting damage occurs to the smaller blood vessels which causes bruising, and this causes a change in the color of the bite marks over a few days. These color changes which take place improve the detail of the bite mark. Hence photographic documentation of the injury should also be after an interval of a few days. Whenever the photographic documentation is carried out, a reference scale such as a ruler should be placed in the same plane as the bite injury. This reference scale should be visible in the photographs as this can be used for future measurements of the bite marks.

The ABFO no.2 scale is the most commonly used reference scale. Bite injury in the skin may also have depth or three dimensional features which can be recorded by the use of side lighting and by low level positioning of the flash. The human body has a few flat surfaces and the muscle activity of the human body makes the skin surfaces curved. Photographs of such curved surfaces creates shapes that are distorted from real life, however this inaccuracy can be overcome by using incremental positioning of the camera over the curved surfaces. This is known as splitting the bite. There are four types of photographic distortions. Type I distortion: it occurs when the scale and the bite mark are on the same plane, but the camera is not parallel to them. Type II distortion: it occurs when the scale is not on the same plane as the bite mark. Type III distortion: it occurs when one leg of the two dimensional scale has a perspective distortion, but the other leg does not. Type IV distortion: it occurs when scale is itself bent or skewed. Non visible light photography can also be used which includes ultraviolet (UV) photography and infrared photography. The UV light does not penetrate the skin surface and hence produces a detailed image of the surface of the skin, whereas the infrared light does penetrate the surface the skin and creates an image of the bite mark injury as it appears below the surface of skin. It also captures the bleeding pattern below the surface of the skin.

C) Impressions^{2,4,7}: Impressions should be taken only after taking the photographs and swabs of the injury site. Taking the impressions of the bite marks plays a very important role in solving the criminal cases. With the help of these impressions dental stone models can be fabricated which are then compared to the suspect. Various dental materials have been used for taking the impressions of the bite marks, but the most commonly used is the polyvinyl siloxane. The advantage of polyvinyl siloxane is that they can be poured numerous times if there is an error. Alginate can also be used for taking the impressions. However the main drawback in using alginate as an impression material is that they have to be poured with one to two hours to prevent contraction. Prepare the area for impression taking by removing all the hair and area should be washed and dried. The impression material is then applied to the area and allowed to set. Care must be taken to reinforce the impression material by a durable and a rigid material like acrylic, orthopedic mesh, dental stone or silicone putty before the impression material is removed from the skin. This reinforcement will prevent the inaccuracies being developed in the impressions due to physical distortion. These impressions are then used to

create dental stone models. We should make two stone casts. One is used for analysis purpose and the second cast is preserved for presentation in the court. This entire process of impression taking and dental stone model fabrication should be properly photographed.

D) Excision of the bite mark^{2,4}: Tissue removal is done in the case of deceased individuals. In this procedure the skin and the underlying fatty tissue is removed from the deceased victim. The bite mark and adjacent tissue are attached to plastic ring to maintain the orientation of the injured tissue and excised. Various fixatives can be used for the proper preservation of this tissue, but the most commonly used fixative is 10% formalin. The excised tissue is stored in a plastic bag. The excised skin is then visualized by transillumination method, in which a bright light is placed behind the excised skin. By transillumination method there is a better visualization of the bruise detail in the tissues below the skin surface.

EVIDENCE COLLECTION OF SUSPECT

A) History and dental records^{4,5,10}: Dental records play a very important role in establishing the identity of the suspect. These dental records can be obtained from the dentist of the suspect. These dental records are extremely helpful in those cases where the suspect has intentionally had the front teeth altered after leaving a bite mark.

B) Photographs^{4,5,7}: It is very important to take the photographs of the suspect. Both intraoral and extra oral photographs should be taken. The extra oral photographs should include the both profile and full face photographs. The intraoral photographs should include the frontal, lateral and the occlusal view of both the arches. Photographs of the maximum interincisal opening with scale in place should also be taken. A reference scale to enable measurements to be taken from the photographs should be included in the same plane of the teeth.

C) Extraoral examination^{5,10}: Biting is a dynamic process which is influenced by a number of factors which include both the soft tissue and the hard tissue factors like the functioning of temporomandibular joints, activity of the muscles of mastication, facial asymmetry. Disorders affecting the temporomandibular joints may cause deviation of the lower while biting. The maximum opening of the oral cavity should be measured and noted down, deviations of the jaw during opening and closing should also be noted. Injuries or surgical interventions sometimes leave scars on the face which should be noted during extra oral

examination.

D)Intraoral examination^{4,5}: The investigator should carry out a thorough intraoral examination of the suspect. The suspect may have a missing tooth due to trauma or due to caries which has to be noted down along with any malalignment of the teeth if present. Poor oral may lead to caries for which the suspect might have got his teeth restored by various restorative materials, the suspect might have a poor periodontal condition which may lead mobility of his teeth, and all these findings should be properly documented. The size of the tongue may vary; suspect may have an enlarged tongue (macroglossia) or may have a small tongue (microglossia), which may affect the functioning of the tongue. The size and function of the tongue should also be noted.

E)Impressions and study casts^{5,7,10}: Impression taking and fabrication of study casts of the dentition of the suspect is a very important part of the investigation of bite marks. This helps us to record the occlusal relationship of the biter's teeth. Care should be taken to include all the physical traits and the characteristics of the dentition. Various impression materials are available to take the impressions of the suspect's dentition, but the most commonly used is the vinyl polysiloxane or polyether due to their high degree of accuracy and dimensional stability. After the impressions have been taken they should be poured in dental die stone to fabricated two sets of study casts. Care should be taken that the soft tissue extensions of the impression in the master cats should be trimmed or altered.

F)Test bites and sample bites^{2,7}: These tell us about the position, shape, alignment of the incisal edges of the biter's teeth. Various materials can be used for this purpose, but the most commonly used are baseplate wax, aluwax, coprwx or silicone putty can be used to take the sample bites of the suspect in centric occlusion. These sample bites which are taken have to be photographed to future comparison.

G)DNA samples^{9,10}: As already mentioned saliva is one the sources from where DNA can be extracted. However we can also use whole blood of the suspect to extract his/her DNA. This is an invasive procedure, so we can saliva as a source of DNA which can be collected by non invasive procedures. Buccal swabs are also a valuable source of DNA. These samples collected from the suspect can then be used for comparison to any biological evidence at the crime scene that might be thought to originate from the suspect.

INVESTIGATION OF BITE MARKS

The first person to whom real credit must be given for having published an analysis of a bite-mark case is Sorup. The method used he called "odontoscopy," analogous to the fingerprint identification called "dactyloscopy." By this method, plaster casts of the teeth of the suspect are obtained, dried, and varnished, after which the incisal edges and occlusal surfaces are coated with printer's ink. Upon this inked surface a sheet of moistened paper is pressed, and a print is transferred from it to transparent paper. This print is placed over a life-size photograph of the bite-mark and compared¹¹. On the basis of the method created by him, other methods have been developed. One method, for instance, is to compare the photograph of the actual bite-mark with the diapositive of the suspect's bite-mark, which may be made in a slice of plastic material. It is an easier method, but, while photographing, care must be taken as to the distance from the camera, which must be identical for the two objects. Buhtz and Erhardt have advocated reconstructing in a phantom the area in which the bite-marks were left. Their method is indeed quite complicated. If one had to deal with a bite impression in the arm, he would construct a phantom resembling the arm with its structure. The phantom is made of a wooden stick surrounded by spongy rubber, with an outer layer of baked dough covering the whole. With the models of the dentition of the suspect placed in an occludator, bite-marks are made on the phantom and then photographed. The diapositive of this photograph is compared with the photograph of the actual bite mark. By using the baked dough, Buhtz and Erhardt intended to obtain nearly the same conditions, especially with regard to the skin. Berg and Schaidt have warned that no positive identification can be made unless there are at least four or five approximate teeth marks left in a profile-bite. However it is not primarily the number of teeth marks that is essential in making a positive identification. The important point is to find characteristic details that may establish that the bite-marks, as compared with the suspect's dentition, are of such a type that there can be no doubt about their identity, and this is to be given as a positive statement¹¹.

However biting is a dynamic process comprising of multiple component movements by the perpetrator and the victim. Therefore, every episode of contact is a unique event, and the same dentition can produce bite marks with variations in appearance. This is one of the reasons for the complexity of bite mark analysis, and emphasizes the need to apply objective techniques and incorporate movement in the analysis. These challenges can be met with a 3D approach to

bite mark analysis. Thali et al. have used 3D/CAD software, designed mainly to superimpose photographs of the bite mark obtained with a photogrammetry procedure onto dental casts digitized with a 3D scanner. Most common analysis methods are used to produce life-sized comparison overlays from suspect's teeth to detect similarities or differences with the bite mark. In most of them the perimeter of the biting edges of the suspect's teeth are hand-traced directly from dental study casts or from wax bite exemplars, or indirectly from xerographic images produced with office photocopiers that are calibrated to produce life-sized final images. Other methods use X-ray film overlays created from radiopaque material applied to the suspect's wax bite. Recently Heras et al have used computer based production of comparison overlays from 3D-scanned dental casts for bite mark analysis, in which the software selects the highest points from the data model of the dental casts and defines a contact plane that allows users to generate the biting edges of the dental casts without interference from the observer. Furthermore, the biting edges of the data model of the dental casts can be printed to a transparent acetate overlay or converted to a .bmp file. These files can also be imported to Adobe Photoshop software to compare them with digital photographs of the bite mark, as described by Johansen and Bowers¹². A recurring difficulty in bite mark analysis arises from distortions produced by the dynamics of the action of biting. When multiple bite marks are produced by a single dentition in a single victim, the bite marks vary in appearance because of the unique dynamics of each biting episode. Variability in the process of recording the biting edges make it necessary to obtain different comparison overlays from a single dentition in actual forensic practice. The software allows users to generate a variety of comparison overlays depending on the teeth involved in the bite mark, the distortion caused by victim-biter interaction and even the pressure of the biting episode^{8,12}.

Other methods of analyzing bite marks: the human mouth contains over 500 distinct species of bacteria, and every individual has a highly different combination, dependent upon, for example, oral hygiene status, dental status and the presence or absence of prosthesis. One research group has suggested that the genotypic identification of the oral streptococci may be of use in bite mark analysis. This technique is a valuable addition to the armamentarium of the forensic dentist⁹.

The American Board of Forensic Odontology provides a range of conclusions to describe whether or not an injury is a

bite mark. These are: Exclusion – The injury is not 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. Probable bite mark – The pattern strongly suggests or supports origin from teeth but could conceivably be caused by something else. Definite bite mark – There is no reasonable doubt that teeth created the pattern⁹.

CONCLUSION

all humans have an identity in life. The positive identification of a living person using unique traits and characteristics of the teeth and jaws is the cornerstone of forensic science¹⁴. One of the most intriguing, complex and sometimes controversial challenges in forensic dentistry is the recognition, recovery and analysis of the bite marks with the suspected biters². Bite mark distortion through skin elasticity, anatomical location and body positioning is a recurring problem¹³. The field of bite mark science is expanding, and the need for individuals trained and experienced in the recognition, collection and analysis of this type of evidence is increasing. Research into more objective methods of bite mark analysis has produced techniques such as bacterial genotyping, although further efforts to reduce subjectivity in standard physical techniques are required⁹.

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