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Role of Bitemark Analysis in Identification of a Person

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ABSTRACT

Background: Forensic dentistry is the examination and evaluation of dental evidence which will be then presented in the interest of justice. Today Forensic dentistry is a essential part of Forensic science. Like fingerprints and DNA, bite marks are unique to an individual. There characteristics in the dental structure such as distance and angles between teeth, missing teeth, fillings and dental work. This type of impression evidence can be left in the skin of a victim and also can be in food, chewing gum and other miscellaneous items such as pens and pencils. The advent of DNA and its recovery from bite marks has offered an objective method of bite mark analysis.

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Introduction

Identification of age and sex from teeth is the major subject for study and research in the field of forensic odontology. Forensic odontology is one of the most unexplored and intriguing branch of forensic medicine. For many years its important was not recognised, as very few people were aware of the forensic aspect of odontology. Major dental clues, once upon a time neglected are now increasingly used to solve crimes.

Sorup¹ was the first to publish an analysis of bite marks. Bite marks can be found in food, flesh, cigars, pipes and musical instruments². Bite marks in themselves provide a kind of dental identification. It is now realized that bite marks have come to provide detail of a kind comparable with the infinitesimal detail that was previously thought likely to be provided only by finger prints.³

The process of comparing bite marks with a suspect's dentition includes analysis and measurement of size, shape and position of the individual teeth.⁴ Most comparison methods involve the fabrication of overlays.⁵ There are a number of different ways to

produce overlays from a suspect's dentition: hand tracing from dental study casts,⁶ hand-tracing from wax impressions,⁷ hand-tracing from xerographic images,⁸ the radio opaque wax impression method⁹ and the computer-based method.¹⁰ Sweet and Bowers⁶ studied the accuracy of these bite mark overlay production methods and concluded that the computer-generated overlays provided the most accurate and reproducible exemplars.

It has been estimated by use of computer that there were over two billion possibilities in the charting of adult dentition.^{11,12} This would therefore rule out the possibility of two adults having exactly the identical dentition.¹³ And hence the theory of uniqueness is a strong point used in the analysis of bite marks to convince the court of law that a dentition in one individual is different from other human dentition.¹⁴ This uniqueness is displaced vividly in a bite mark that is well executed¹. Forensic aspects of bite mark analysis can be applied in case of teeth marks left in food stuffs or in the criminal when the victim bites the assailant in self defence or on the victim found in cases of sexual offences like rape.

In all cases of bite marks left in food stuffs or in human tissue, taking photograph is to be recommended. Place a scale beside the bite mark and make a note of distance at which photograph was taken. UV light photographs can see the damage deeper into the tissue and can capture the spacing, size and shape of teeth. A blood group determination is possible in bite marks in human tissue as well as in food stuffs on account of saliva left in bite mark. The next step is to make casts of bite marks and it is important to make two casts not only one. The first of these two casts is meant to be untouched evidence to be shown later in court. A fingerprint can be lifted and compared to the fingerprint obtained from a suspect to determine a match. In this way a bite mark can be compared to a set of teeth to determine a match if they left the mark. Because of the uniqueness of teeth size and shape, marks left behind from a bite can be used for identification purposes.

Forensic aspect of bitemarks analysis can be applied in the following circumstances:-

1) Teethmarks left in the food stuffs.2) Teethmarks on the criminal: When the victim bites the assailant in self defence.3) Teethmarks on the victim: Found in cases of assault and murder and were usually caused during or after sexual act. It might be due to:

a) Self infliction by the victim. b) The criminal attacking the victim usually during sexual offences like rape, and are found mostly on the breast, neck or cheek.

Guidelines for the analysis of bite marks

Guidelines for the analysis of bite marks are important for the investigation and should be respected. To standardize the analysis of bite marks the American Board of Forensic Odontostomatology (ABFO)¹⁵ established the following guidelines in 1986:

- 1) History – Obtain a thorough history of any dental treatment carried out after the suspected date of the bite mark.
- 2) Photography – Extra-oral photo-graphs including full face and profile views, intra-orals should include frontal views, two lateral views and an occlusal view of each arch. Often it's useful to include a photograph of maximal mouth opening. If inanimate materials, such as foodstuffs, are used for test bites the results should be preserved photographically.
- 3) Extra-oral examination – Record and observe soft tissue and hard tissue factors that may influence biting dynamics.

Measurements of maximal opening and any deviations on opening or closing should be made.

- 4) Intra-oral examination – Salivary swabs should be taken. The tongue should be examined to assess size and function. The periodontal status should be noted with particular reference to mobility. Prepare a dental chart if possible.
- 5) Impressions – Take two impressions of each arch using material that meet the American Dental Association specifications. The occlusal relationship should be recorded.
- 6) Sample bites – Whenever possible, sample bites should be made into an appropriate material, simulating the type of bite under study.
- 7) Study casts – Casts should be prepared using Type II stone. Additional casts should be made by duplicating the master casts.

These guidelines should be obeyed in routine case work.

Methods

Subjects, made a bite on a sample of bite registration wax sheet (Size 10x6x0.5cms).Levine⁴ suggested the use of Aluwax. Bites are made with an incisive action to get impression of the incisal edges and a portion of the labial and lingual surfaces of upper and lower incisors and canines. Subjects are told to bite on apple and they were told to bite on their own flexor surface of forearm.

Impressions of upper and lower arch are taken and plaster cast made. Only central and canine are preserved and the rest were trimmed. Each model and bitemarks on bite registration wax, apple and skin is photographed with scale besides using SLR camera with extension tube for close up photography. Then each photograph is enlarged keeping the scale so as to get life size photography while printing. And 1:1 photography is done for bitemarks and teeth model.

Then by two methods- odontometric triangle (Objective) method and by superimposition (Subjective) method the comparison of bitemarks and teeth model is done.

Two senior persons gave the grading for superimposition (Subjective) method. The grades given are:-

Grade A---- Fully superimposition

Grade B---- Partially superimposition

Grade C---- No superimposition

In odontometric triangle method (Objective method) a triangle is made on the tracing of bitemarks and teeth models by making three points-A,B,C. Points A & B are plotted on the outermost convex point on the canine teeth. Center of upper two central incisors is selected as point C. And all the three points are joined to form a triangle ABC. Lines AB, BC, CA are measured and angles a, b, c were calculated. This was done for both upper and lower jaw. Of teeth model and compared with that of bitemarks of wax, apple and skin statistical analysis is carried out and results are obtained.

Image perception software procedure:

A photograph of a bite mark is opened with the image perception software, and a region of interest is then selected. After such selection, one can add color to different grey scale areas of the image. The assigning of selected colors to levels of grey values enables the forensic odontologist to select regions with similar grey values or to enhance subtle differences of grey values in the picture. The human eye can only distinguish about 40 shades of grey in a monochrome image, but can distinguish hundreds of different colours.¹⁶ This will make it easier to establish which regions of pixel intensity are part of the bite mark and which are not. By omitting certain areas of pixel intensity, it is possible to isolate the region of the image which shows the bite mark. A detailed image of the bite mark is produced. The colored image of the bite mark is now layered over the original bite mark photograph using Photoshop® of Adobe Systems.

Discussion

Since 1950, bite mark evidence and dentists have played a role in judicial system.¹³The scientific basis of bite mark analysis is rooted in the premise of individuality of human dentition, the belief that no two humans have identical dentitions in regard to size, shape and alignment of teeth.^{12,17}The investigators dealing with analysis of bite marks should also have the knowledge of any mark or bruise which have characteristics which closely resemble the injuries produced by teeth as determination of an injury being produced by human teeth requires substantial information.^{11,18} Tooth markings may also be found on foods like chocolates, vegetables, chewing gums, Styrofoam cups, cigarette but-and even on steering wheel of a car.^{13,19} Bermitz et al and pretty even reported a case of a murder in which the bite marks in a piece of cheese was recorded.¹⁴ Bite marks left in substances which are malleable like cheese have a more potential for accurate identification.^{11,20} A characteristics in a

human bite mark is a distinguish feature, trial or pattern within the bite mark and is delivered as a class or an individual characteristic.^{13, 21}

Although more research is needed to explore the possibilities of image perception technology, its possibilities to visualize more details in a bite mark photograph are promising. The availability of additional coloring of selected areas with similar intensity values as well as rendering 2-D photographs as pseudo 3-D images may enable the researcher to analyze the image more extensively and come to a more accurate conclusion regarding the source of the bite. However, bite mark analysis alone should not be allowed to lead to a guilty verdict, but it will offer the opportunity to exclude a suspect from a crime when the data do not correspond.

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