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## Bite Mark Evidence: Recognition, Perservation, Analysis and Courtroom Presentation

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# Bite Mark Evidence

## Recognition, Preservation, Analysis and Courtroom Presentation

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### Background

The study of human bite marks is an area of forensic dentistry that has attracted considerable attention in the past 10 years. However, the analysis of bite marks is by no means new. Bite mark analysis has been used as a means of identifying the culprit for over a century. The Scandinavian countries were using bite mark evidence many years before the authorities in the United States realized its value. More legal cases utilizing bite mark evidence have been documented in the past 10 years, than in the preceding ninety. Case law research reveals over 100 trials in which bite mark evidence has played a role.<sup>1</sup> In the United States, bite mark evidence has been admitted as evidence in at least 19 states and nowhere has its admissibility been denied.<sup>2</sup>

The basic principle of bite mark analysis is that teeth, like tools, can leave recognizable marks.<sup>3</sup> Unlike tool marks, which are more commonly left on materials such as wood or metal, human or animal bite marks are more often made on food or human skin. Because the pattern left on food or skin is subject to change due to dehydration or decomposition, prompt action is

necessary in order to preserve the best evidence. Once a possible source of the bite mark is found, the process of comparison can begin.

### Recognition

Bite marks appear most often as elliptical or round areas of contusion, skin abrasion, and, sometimes, indentations. Occasionally, human (and more often, animal bites) exhibit avulsion or a severing of tissue. Noses, nipples or ears are particularly vulnerable in human bites, while the extremities are more often lacerated in animal bites. In a well-defined bite mark, the arcs making up these ellipses may show individual rectangular patterns representing the incisal edges of the teeth and occasionally indentations or pressure marks. Most bites reveal marks from only a few of the six upper or lower anterior teeth; rarely would marks from all twelve be found.

One exception to this occurred a few years ago, in one of the authors cases. when one of the bites examined was found to contain the imprint of a maxillary first molar.<sup>4</sup> It is from the cases where specific and complete patterns of individual teeth are registered that it is possible to derive the most information (Figure I). A trained examiner, for example, can differentiate animal from human bites since the number, spacing, size and arrangement of teeth in each type of bite are distinctive. Depending upon the recognizable characteristics recorded in the bite, it may be pos-

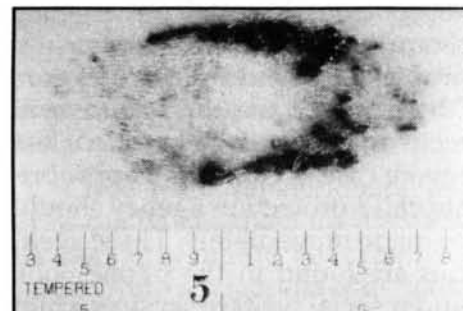


Figure 1 - A distinctly registered bite yields considerable information. Twenty-six points of comparison were found when examining the teeth of a suspect, including fractured incisal angles on two of the maxillary incisors, rotation of the lower incisors and a deviation of the lower midline.

sible not only to identify it as a human in origin, but to be able to ascertain the biter's jaw size, jaw shape and number of teeth present or missing. We have had cases in Wisconsin in which multiple unusual characteristics of the teeth were registered in the bite and enabled the examiners to relate the bite to a specific suspect with a reasonable degree of scientific probability.

Controlling law in Wisconsin for expert testimony is that the opinion be based upon a reasonable degree of scientific or medical probability, rather than a reasonable degree of scientific or medical certainty.<sup>5</sup> For example, the evidence in a precedent-setting case demonstrated eight bites, with from four to 11 teeth registered in each bite, for a total of 72 individually identifiable tooth marks. These bites were distributed over three different areas of the victim's anatomy.

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Several unique patterns of the suspect's teeth could be found repeating in each of these areas. This was a rare opportunity to study, under field conditions, the affect of various skin textures and surface curvatures which are thought to produce distortion problems.<sup>6</sup> Based upon an extensive study, we were able to reasonably conclude that this unique pattern was not artifactual or distorted and that it had to have been caused by the suspect's unique teeth. In fact, it has been our general experience that most distortion occurs in the process of photography, rather than in the act of biting. The eight bites proved to be the state's key evidence, at trial, resulting in the conviction of the accused of murder in the first degree. The conviction was appealed. In October 1986, the Wisconsin Court of Appeals affirmed the conviction and recommended publication of the decision.<sup>7</sup>

### Validity

Perhaps the greatest assist in the recognition of the credibility of bite mark evidence by the judiciary has come from the American Academy of Forensic Sciences and the American Board of Forensic Odontology. Established in 1976, under the auspices of the American Academy of Forensic Sciences, the ABFO is a voluntary examining and credentialing process which identifies qualified odontologists to the various agencies which may require their services. The ABFO is analogous to the other Forensic Science Boards in Pathology, Toxicology, Questioned Documents, and Anthropology, which are also sponsored by the American Academy of Forensic Sciences. Currently, there are approximately 90 ABFO Diplomates in the United States and Canada. In 1981, responding to requests for "standards" in bite mark analysis, the ABFO appointed a committee to study the possibility of developing and publishing a protocol for use by odontologists

doing bite mark analysis.<sup>8</sup> In February 1984, in Anaheim, California, for several days before the annual meeting of the American Academy of Forensic Sciences approximately 39 members of the ABFO held a workshop to discuss and evaluate some of the Bite Mark Committee's suggestions. Actually, the ideas proposed were many of the procedures which all of us had been using independently, but we now had a consensus. It was decided to call them guidelines, rather than rigid standards and to publish what we all had agreed upon, for the use of all who were interested in bite mark evidence.<sup>9</sup> The publication of these guidelines was a milestone in forensic dentistry in the United States.

### Preservation

Since 85 or more percent of the population are secretors, it is possible to determine blood type from their saliva. Because it is also almost impossible to inflict a bite without leaving traces of saliva on the skin of the victim, salivary swabbing of the area is an important consideration when examining a bite mark. It is the first procedure to be done and care must be taken to avoid areas which have become contaminated with the victim's own blood. Remember that a control, taken from the victim's skin in an area away from the bite, is also necessary. All salivary swabs should be identified with tags and be allowed to air dry before being packaged and sent to the serology laboratory.

As has been mentioned, prompt recognition and preservation of bite marks is crucial, since they are not static, but subject to change. Probably the most common means used to record or preserve bite mark evidence is photography. Although 35 mm cameras can and have been used successfully, we recommend the use of a large format (4"x5") camera.<sup>10</sup> The process of making scaled prints at 2X and court charts at 7X later is much

easier and detail in the enlargement better.

Both color film and black and white film is utilized. The use of color filtration is also helpful, especially in bites exhibiting diffuse, deep contusion. Color separation can assist in determining the outline of the pressure marks of the individual teeth and has been used by the authors successfully in several cases. Not only is it necessary that the pattern be accurately and clearly recorded, but also that a suitable scale be included in the photographs.<sup>11</sup> In fact, we recommend that photographs be taken from the same position both with and then without the scale, to demonstrate that the scale is not covering additional evidence. If it is necessary to wash the body, we recommend photographing the same area before and after washing.

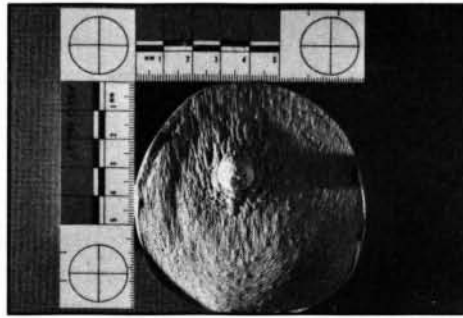
It is again, in the development of first the ABFO scale #1 and most recently the ABFO scale #2, that the American Board of Forensic Odontology has worked to encourage accuracy in recording bite mark evidence. As with the Guidelines for Bite Mark Analysis, the ABFO scales are not meant to be the only means. Rather, they are made available to assist the analyst in obtaining the best possible evidence. His choice of scale is flexible, however he should be aware that some scales photograph better than others. It is necessary to retain the scale used in a particular case so that it is available later to demonstrate the accuracy of scaled photographic prints.

Since the opportunity to rephotograph is seldom available, it is advisable to make multiple exposures, bracketing and recording the details of each exposure as you proceed. The use of a tripod is advisable in maintaining parallelism between the body surface and film plane, as well as to prevent camera movement. Lighting from

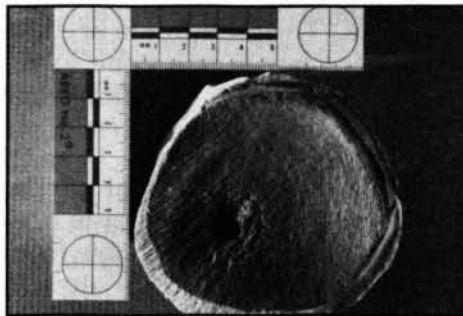
oblique angles can be valuable in depicting three dimensional qualities by casting shadows. It has been interesting to observe the variation in detail which can be observed in exposures taken of the same bite at different f stops, so bracketing is good practice.<sup>12</sup>

A common method of preserving the surface detail in those cases exhibiting three-dimensional characteristics, is to use dental impression materials to produce a static replica. We have found from experience that the vinyl polysiloxanes possess the most desirable qualities. They are accurate, stabile, clean to work with and set up rapidly (Figure II). Just as you would use an impression tray to support the finished dental impression and maintain its accuracy, it is necessary to utilize a suitable rigid backing to maintain the surface contours of the body when removing the impression and while fabricating the model (Figure III). When advisable, it is also possible to retain the actual bite. The tissue surrounding the bite is fixed to a rigid ring which has been adapted to the natural topography, by using cyanoacrylate adhesive and sutures. The entire specimen is then removed by *en bloc* dissection and preserved by immersion in a solution of 10 percent formalin.

Similar techniques are used in preserving evidence obtained during an examination of a suspect. The most common means are dental impressions in order to produce a study cast of the teeth and close-up photography to record details of the teeth and occlusion. We have found that although many cameras and lenses can be used, a large format camera gives the best results. One such camera that can be used in the photography of both the victim and the suspect is the Polaroid CU-5. With its accessories, such as ratio multipliers and intra-oral mirrors, it is possible to make life-size photographs of even the biting surfaces of the teeth. By using a sheet film back on the camera, it is



**Figure II - Dental impression materials are ideal for the preservation of the three-dimensional characteristics in bite marks. They accurately capture even minute details in the skin, as is evident in this photograph.**



**Figure III - Rigid backing material is necessary for the impression material to preserve accuracy and surface contours when the impression is removed. Recorded on the backing are details such as the anatomic orientation, location, case number, date, and the examiner's initials.**

possible to produce negatives, from which scaled enlargements can be made. It should be pointed out, to avoid legal complications later, the collection of any physical evidence must be done with proper authorization. Examination of the victim should be requested and authorized by the Medical Examiner or Coroner. Examination of a suspect should be done only after obtaining a valid, informed consent from the suspect or a court order specifically authorizing or appointing the odontologist to conduct the procedure. In that authorization, a dental examination, x-rays, impressions, photographs and exemplars (wax bites) should be enumerated. Without proper authorization, you may find that the evidence secured is inadmissible and you have been

charged with technical assault. Many agencies currently have a duly authorized forensic odontologist on staff and several serve as coroners or medical examiners.

### **Analysis**

There are many variations in the materials used in the analysis of bite mark evidence, but the principle and the goal are the same. If one follows the scoring sheet developed by the ABFO, the teeth and bite are first compared for gross characteristics. A suspect may at this point be eliminated if the overall class characteristics don't match. The examiner then proceeds to more specific tooth and intradental characteristics. Working with scale photographs, models of both the bite and suspect, photographic overlays<sup>13</sup> and sometimes the tissue we attempt to establish significant points of comparison. (Figure



**Figure IV - Overlays can be produced by tracing, radiography, and photography. The use of photographic, positive black and white, overlays compared to color transparencies of the bite, has become standard in our procedure.**

IV) Obviously, a tooth mark found in the bite which is missing from the mouth of the accused and could be established as missing at the time of the crime, would eliminate that individual. During this part of the analysis we are comparing individual tooth position, rotation, spacing, length and unique characteristics such as fractured or grossly misaligned teeth. Each of these concordant points is given a weighted score, depending upon how unusual it is. Although following the scoring sheet is not a necessity, it does give an examiner with limited

experience a check list to follow in conducting the analysis. By observing the total score given, the examiner has an indication of just how strong a comparison the bite reflected and what his conclusion should be. It is common procedure among the odontologists who do a considerable amount of bite mark analysis to then submit the physical evidence to an independent examiner for a second opinion. This is not because they are unsure of their conclusions. Rather, it is because of the weight given to bite mark evidence that we want to explore every opportunity to develop the best evidence.

### Courtroom Presentation

Remember, at trial, the court is not bound to accept the conclusions of the expert for either the prosecution or the defense. If, after examining the physical evidence in a bite mark case, you render an opinion implicating a suspect, the accused then has the right to the examination of the evidence by an expert of his own. After that defense examination, if you have done a thorough and accurate evaluation, the expert may have to agree. However, if your analysis was not well done or your conclusions erroneous, you will probably both appear at trial. The weight given to any bite mark evidence, particularly if there is disagreement among the experts, will depend upon its quality, the procedures used and the qualification of the expert. Almost as important as the qualifications of the expert, is his demeanor and ability to communicate with the court. Sincerity and eye contact with the jury make a credible witness.

Since bite mark evidence is relatively unknown to most jurors, after being qualified as an expert by the court, we begin our testimony with a brief introduction of what bite mark evidence is. We describe how it occurs, what it looks like, how we preserve it, analyze it, make comparisons with possible sources and why these comparisons are

valid when unique characteristics are found.<sup>14</sup> Studies have demonstrated that even monozygotic twins do not have identical definitions, but rather that subtle differences sometimes appeared as mirror images<sup>15</sup> This all comes about because of pretrial preparation of the expert conferring with the attorney who has called him. Few attorneys have had any experience with this type of evidence and you may have no or limited experience in the court room. Thus, it is a process of mutual education so that there will be no surprises.

It is also important to plan how you wish to demonstrate your analysis and findings to the court. By planning your court charts, you can reduce the volume of material. Through the use of enlarged photographs and transparencies, it is possible to clearly demonstrate the comparisons which were made. We like to use 16" x 20" enlargements which are the equivalent of 7X. It is also possible to prepare multiple 2X charts for the jurors to share. Models of the teeth and the three-dimensional qualities of the bite are also effective. Successful presentation of your conclusions depends not only upon your ability to explain what you did to reach your conclusions, but also your ability to prepare demonstrative evidence that will allow the jurors to see the comparisons for themselves. Above all, remember that you are an independent forensic scientist asked to examine a piece of a puzzle, interpret it, and reach a conclusion. You are not an advocate. You may be attacked in an effort to shake your opinion. This is nothing personal, merely a technique to test the strength of your opinion. If you are well prepared, you have done a thorough analysis, and are confident of your conclusions, you will be successful. □

*The opinions or assertions contained herein are the personal views of the authors and should not be construed as official or reflecting the views of the governmental agencies employing them.*

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