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Bite Mark Analysis

Paul C. Giannelli*

In criminal trials, forensic dentistry typically is used in two ways: (1) to establish the identity of a homicide victim through an examination of dentition and (2) to connect a defendant with a crime by means of bite mark analysis. These are very different procedures, and the failure to distinguish them has often proved problematic.¹

I. DENTAL IDENTIFICATION

Dental identification is based on the assumption that every person's dentition is unique.² The human adult dentition consists of thirty-two teeth, each with five anatomic surfaces. Thus, there are 160 dental surfaces that may contain identifying characteristics. Restorations alone, with varying shapes, sizes, and restorative materials, may offer numerous points of individuality. In addition to restorations, the number of teeth, prostheses, decay, malposition, malrotation, peculiar shapes, root canal therapy, bone patterns, bite relationship, and oral pathology may all provide identifying characteristics.

The courts have accepted dental identification as a means of establishing the identity of a homicide victim,³ with some cases going back to the

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¹ See PAUL C. GIANNELLI & EDWARD J. IMWINKELRIED, *SCIENTIFIC EVIDENCE* ch. 13 (4th ed. 2007).

² "The premise that human dentition is unique to each individual is widely accepted The randomness of filling locations and shapes are unique identifying features which can be compared to preexisting dental records and radiographs." David J. Sweet, *Human Bitemarks: Examination, Recovery, and Analysis*, in *MANUAL OF FORENSIC ODONTOLOGY* 148 (3d ed. 1997) (American Society of Forensic Odontology) [hereinafter *ASFO MANUAL*].

³ *E.g.*, *Wooley v. People*, 367 P.2d 903 (Colo.1961) (dentist compared his patient's record with dentition of a corpse); *State v. Johnston*, 113 P.2d 809 (Idaho 1941); *Martin v. State*, 636 N.E.2d 1268, 1272 (Ind. Ct. App. 1994) (dentist who had been out of dental school for approximately 3 months was qualified to compare X rays of one of his patients with skeletal remains of murder victim and make a positive identification); *Fields v. State*, 322 P.2d 431, 446 (Okla. Crim. App. 1958) (murder case in which victim was burned beyond recognition); *Williamson v. State*, 679 S.W.2d 523, 529-30 (Tex. Ct. App.), *rev'd on other grounds*, 672 S.W.2d 484 (Tex. Crim. App. 1984).

Nineteenth Century.⁴ According to one court, "it cannot be seriously disputed that a dental structure may constitute a means of identifying a deceased person . . . where there is some dental record of that person with which the structure may be compared."⁵

II. Bite Mark Analysis

The second procedure, bite mark analysis, has been used for more than fifty years to establish a connection between a defendant and a crime.⁶ Bite marks occur primarily in sex-related crimes, child abuse cases, and offenses involving physical altercations, such as homicide.⁷ Male victims are most often bitten on the arms and shoulders, while female victims are most commonly bitten on the breasts, arms, and legs.⁸ A survey of 101 cases observed:

More than one bitemark was present in 48% of all the bite cases studied. Bitemarks were found on adults in 81.3% of the cases and on children under 18 years-of-age in 16.7% of cases. Bitemarks were associated with the following types of crimes: murder, including attempted murder (53.9%), rape (20.8%), sexual assault (9.7%), child abuse (9.7%), burglary (3.3%), and kidnapping (12.6%).⁹

A. Theory of Uniqueness

Identification of a suspect by matching his dentition with a bite mark found on the victim of a crime rests on the theory that each person's dentition is unique. In this respect, bite mark comparisons are based on the same

⁴ See *Commonwealth v. Webster*, 59 Mass. (5 Cush.) 295 (1850) (remains of the incinerated victim, including charred teeth and parts of a denture, were identified by the victim's dentist); *Lindsay v. People*, 63 N.Y. 143 (1875).

⁵ *People v. Mattox*, 237 N.E.2d 845, 846 (Ill. App. Ct. 1968).

⁶ See E.H. Dinkel, *The Use of Bite Mark Evidence as an Investigative Aid*, 19 J. FORENSIC SCI. 535 (1973).

⁷ See David Sweet & Gary G. Shutler, *Analysis of Salivary DNA Evidence from a Bite Mark on a Body Submerged in Water*, 44 J. FORENSIC SCI. 1069, 1069 (1999) ("The teeth may be used as an offensive weapon during an attack, or they may be used in self-defense. Obviously, the scope of the bitemark injuries on human skin is broad depending upon the circumstances, such as the amount of force generated by the teeth, the time of interaction between the teeth and skin, and the type of tissue bitten, as well as the site on the body. Teeth may produce various types of traumatic injuries, including erythema, contusion, abrasion, laceration, or tissue avulsion.").

⁸ Adam J. Freeman et al., *Seven Hundred Seventy Eight Bite Marks: Analysis by Anatomic Location, Victim and Biter Demographics, Type of Crime and Legal Disposition*, 50 J. FORENSIC SCI. 1436 (2005).

⁹ Iain A. Pretty & David J. Sweet, *Anatomical Location of Bitemarks and Associated Findings in 101 Cases from the United States*, 45 J. FORENSIC SCI. 812, 812 (2000).

principle as the identification of a deceased person.¹⁰ Although the courts have accepted this theory,¹¹ there are significant differences in the application of these two uses of forensic dentistry. In 1976, when bite mark comparisons were first studied, one authority raised the following problems:

[Bite]marks can never be taken to reproduce accurately the dental features of the originator. This is due partially to the fact that bite marks generally include only a limited number of teeth. Furthermore, the material (whether food stuff or human skin) in which the mark has been left is usually found to be a very unsatisfactory impression material with shrinkage and distortion characteristics that are unknown. Finally, these marks represent only the remaining and fixed picture of an action, the mechanism of which may vary from case to case. For instance, there is as yet no precise knowledge of the possible differences between biting off a morsel of food and using one's teeth for purposes of attack or defense.¹²

None of these problems is involved with dental identifications.¹³ As noted, thirty-two teeth are not used in bite mark comparisons; often only four to eight teeth are biting teeth. Similarly, five anatomic surfaces are not used in

¹⁰ One study attempted to establish the individuality of the human dentition. Raymond D. Rawson et al., *Statistical Evidence for the Individuality of the Human Dentition*, 29 J. FORENSIC SCI. 245 (1984). This is not the same as establishing the individuality of bite marks. See Iain A. Pretty & David J. Sweet, *The Scientific Basis for Human Bitemark Analyses—A Critical Review*, 41 SCI. & JUST. 85, 89, 90 (2001) (“Should a study that determined morphological human dental uniqueness in wax or plaster be extrapolated to fulfill a legally sound statement that a bitemark on skin is unique?”); “This lack of independence renders Rawson’s certainties of individualization invalid. Rawson’s results also showed a possible sampling error, as evidenced by the data sets regarding possible tooth position for each unit.”) [hereinafter *Critical Review*]; David J. Sweet & C. Michael Bowers, *Accuracy of Bite Mark Overlays: A Comparison of Five Common Methods to Produce Exemplars from a Suspect’s Dentition*, 43 J. FORENSIC SCI. 362 (1998) (“Neither study examines the resultant transference of the hypothesized individual characteristics to skin or similar media.”).

¹¹ E.g., *People v. Milone*, 356 N.E.2d 1350, 1358 (Ill. App. Ct. 1976) (“The concept of identifying a suspect by matching his dentition to a bite mark found at the scene of a crime is a logical extension of the accepted principle that each person’s dentition is unique.”); *People v. Smith*, 443 N.Y.S.2d 551, 556-57 (Cty. Ct. 1981) (“The basic premise is the unique nature of individual dentition . . . and the virtually infinite number of individual bite configurations.”).

¹² S. Keiser-Nielson, *Forensic Odontology*, 1 U. TOLEDO L. REV. 633, 636 (1969). In an early experiment, a commentator concluded that expert witnesses “should be aware that at the present state of our knowledge there are problems not only in determining the incidence of identical or near identical occlusions but also in interpreting the bite marks made under standardized laboratory conditions.” D.K. Whittaker, *Some Laboratory Studies on the Accuracy of Bite Mark Comparison*, 25 INT’L DENTAL J. 166, 170 (1975). See also Pretty & Sweet, *Critical Review*, *supra* note 10, at 88 (“A distinction must be drawn from the ability of a forensic dentist to identify an individual from their dentition by using radiographs and dental records and the science of bitemark analysis.”).

¹³ In one of the first books in the field, published in 1976, Dr. Sopher noted:

biting; only the edges of the front teeth are used. In sum, bite mark identification depends not only on the uniqueness of each person's dentition but also on "whether there is a [sufficient] representation of that uniqueness in the mark found on the skin or other inanimate object."¹⁴ This remains the critical question.¹⁵

Nevertheless, some experts believe that bite marks in skin can capture the unique and individual characteristics of teeth with good fidelity, at least in some cases.¹⁶ Others disagree. Two commentators have written:

There is effectively no valid documented scientific data to support the hypothesis that bite marks are demonstrably unique. Additionally, there is no documented scientific data to support the hypothesis that a latent bite mark, like a latent fingerprint, is a true and accurate reflection of this uniqueness. To the contrary, what little scientific evidence that does exist clearly supports the conclusion that crime-related bite marks are grossly

The problem of specificity in the bite mark analysis results from the lack of a scientific core of basic data for comparison. The results of the bite mark comparison may indicate a perfect or reasonably perfect fit between the bite mark and a suspect's dentition; however, how can one be absolutely or even perhaps reasonably certain that no other individual could have produced a particular bite? Classified bite mark characteristics on large segments of the population are unavailable; therefore, an absolute scientific estimation of specificity regarding the particular bite mark/suspect comparison is not possible. The situation is comparable to the point in the distant past when the 100th set of fingerprints was classified. At that time, it was known that the set of prints did not match the ninety-nine others previously recorded, but it was not known if the set of prints were specific for only the one individual fingerprinted.

IRVIN M. SOPHER, *FORENSIC DENTISTRY* 140 (1976).

¹⁴ Rawson et al., *supra* note 10, at 252.

¹⁵ See C. MICHAEL BOWERS, *FORENSIC DENTAL EVIDENCE: AN INVESTIGATOR'S HANDBOOK* 197 (2004) ("The overall 'uniqueness' of dental characteristics is a common statement used in court and in literature. This conclusion is generally accepted but is subject to considerable criticism. The reason it is criticized is that it has never been proven."); Iain A. Pretty, *Unresolved Issues in Bitemark Analysis*, in *BITEMARK EVIDENCE* 547, 560 (Robert B.J. Dorion ed., 2005) ("Rawson has proven what his article claims, although perhaps not to the mathematical or statistical certainty expressed. The article determined that the dentition is unique; however, when this paper is cited, authors often extend this conclusion to incorporate the uniqueness of bite-marks.").

¹⁶ See Iain A. Pretty, *Reliability of Bitemark Evidence*, in *BITEMARK EVIDENCE* 531, 543 (Robert B.J. Dorion ed., 2005) ("The research suggests that bitemark evidence, at least that which is used to identify biters, is a potentially valid and reliable methodology. It is generally accepted within the scientific community, although the basis of this acceptance within the peer-reviewed literature is thin. Only three studies have examined the ability of odontologists to utilise bitemarks for the identification of biters, and only two studies have been performed in what could be considered a contemporary framework of attitudes and techniques.").

distorted, inaccurate, and therefore unreliable as a method of identification.¹⁷

Another commentary has noted that “[d]espite the continued acceptance of bitemark evidence in European, Oceanic and North American Courts the fundamental scientific basis for bitemark analysis have never been established.”¹⁸ These commentators highlighted the following areas of controversy: “a) accuracy of the bitemark itself, b) uniqueness of the human dentition, and c) analytical techniques.”¹⁹

B. Methods of Comparison

Several methods of bite mark analysis have been reported.²⁰ All methods involve three steps: (1) registration of both the bite mark and the suspect’s dentition, (2) comparison of the dentition and bite mark, and (3) evaluation of the points of similarity or dissimilarity.

Registration of the bite mark by photography is used in all cases; the photographs are then enlarged to life-size proportion for comparison.²¹ However, “a potential bite must be recognized early, as the clarity and shape of the mark may change in a relatively short time in both living and dead victims.”²² Where bite indentations (three-dimensional bite marks) are present in the skin tissue, impressions may be obtained; these are used to reproduce models of the bitemark, which can then be used for comparison.²³ In deceased persons, the bitemarks should be excised.²⁴ The suspect’s denti-

¹⁷ Allen P. Wilkinson & Ronald M. Gerugthy, *Bite Mark Evidence: Its Admissibility is Hard to Swallow*, 12 W. ST. U. L. REV. 519, 560 (1985). See also Iain A. Pretty, *A Web-Based Survey of Odontologist’s Opinions Concerning Bitemark Analyses*, 48 J. FORENSIC SCI. 1117, 1119 (2003) (“It would appear that many individuals would state that the human dentition is unique and yet they have little knowledge of the evidence to substantiate this claim, or some of the controversies surrounding works that have claimed to support their views.”) [hereinafter *Web-Based Survey*].

¹⁸ Pretty & Sweet, *Critical Review*, *supra* note 10, at 86.

¹⁹ Pretty & Sweet, *Critical Review*, *supra* note 10, at 87.

²⁰ See *State v. Sager*, 600 S.W.2d 541, 569-70 (Mo. Ct. App. 1980) (outlining different methods); SOPHER, *supra* note 13, at 125-26.

²¹ See Raymond D. Rawson et al., *Analysis of Photographic Distortion in Bite Marks: A Report of the Bite Mark Guidelines Committee*, 31 J. FORENSIC SCI. 1261 (1986) (presenting a method for analyzing photographically distorted bite marks).

²² Bruce R. Rothwell, *Bitemarks in Forensic Dentistry: A Review of Legal, Scientific Issues*, 126 J. AM. DENT. ASS’N 223, 226 (1995).

²³ See Byron W. Benson et al., *Bite Mark Impressions: A Review of Techniques and Materials*, 33 J. FORENSIC SCI. 1238 (1988) (describing techniques and material used to make impressions for comparison).

²⁴ See Robert B.J. Dorion, *Excision of Bitemarks*, in ASFO MANUAL, *supra* note 2, at 171; Robert B.J. Dorion, *Preserving, Storing and Transporting Excised Skin*, *id.* at 172.

tion is reproduced by means of models.²⁵ Errors can be introduced at any stage.²⁶ Typically, salivary trace evidence, if available, is collected at this time for DNA testing.²⁷

The reproductions of the bite mark and the suspect's dentition are then analyzed through a variety of methods.²⁸ The comparison may be either direct or indirect. The former involves the use of a model of the suspect's teeth, which is compared to life-size photographs of the bite mark, while the latter involves transparent overlays. Computer-based comparison techniques have also been used.²⁹

²⁵ See Sweet & Bowers, *supra* note 10, at 362 ("There are numerous methods available to the odontologist to reproduce two-or three-dimensional examples of the suspected dentition. These include styrofoam to record the shape and position of tooth surfaces, scanning electron microscopy, hand-traced outlines, wax impressions, xerographic images, videotapes, computer imaging, and computerized axial tomography. This reflects the current freedom allowed by the discipline to permit the expert to use a 'personal' preference for this phase of bite mark analysis.").

²⁶ See David J. Sweet et al., *Computer-Based Production of Bite Mark Comparison Overlays*, 43 J. FORENSIC SCI. 1050, 1050 (1998) ("Several methods which are widely utilized by odontologists exist to produce these overlays. However, each of these methods involves some degree of subjective input by the odontologist. This may lead to significant errors being incorporated into the overlays which may make it difficult to reach a valid conclusion.").

²⁷ See *State v. Lyons*, 924 P.2d 802, 804 (Or. 1993) ("Blake, a forensic evidence consultant, conducted PCR-based DNA tests on the hair and saliva samples."); see also Pretty, *Web-Based Survey*, *supra* note 17, at 1119 ("The use of DNA in the assessment of bitemarks has been established for some time, although previous studies have suggested that the uptake of this technique has been slow. It is encouraging to note that nearly half of the respondents in this case have employed biological evidence in a bitemark case.").

²⁸ David J. Sweet, *Human Bitemarks: Examination, Recovery, and Analysis*, in ASFO MANUAL, *supra* note 2, at 162 ("The analytical protocol for bitemark comparison is made up of two broad categories. Firstly, the measurement of specific traits and features called a *metric analysis*, and secondly, the physical matching or comparison of the configuration and pattern of the injury called a *pattern association*."). See also Sweet & Bowers, *supra* note 10, at 362 ("A review of the forensic odontology literature reveals multiple techniques for overlay production. There is an absence of reliability testing or comparison of these methods to known or reference standards.").

²⁹ Roland F. Kouble & Geoffrey T. Craig, *A Comparison Between Direct and Indirect Methods Available for Human Bite Mark Analysis*, 49 J. FORENSIC SCI. 111 (2004). See also Anne H. McNamee et al., *A Comparative Reliability Analysis of Computer-Generated Bitemark Overlays*, 50 J. FORENSIC SCI. 400 (2005); Iain A. Pretty & David J. Sweet, *Digital Bitemark Overlays—An Analysis of Effectiveness*, 46 J. FORENSIC SCI. 1385, 1390 (2001) ("The continued use of computer-generated overlays in bite mark analysis appears to be justified . . ."); Pretty, *A Web-Based Survey*, *supra* note 17, at 1119 ("Interestingly a study published in 1998 determined that the digital techniques were superior to other methods; however, many odontologists were still employing hand-drawn or radiographic overlays.").

C. Findings

It is easier to conclude that a person's dentition and a bite mark do not match than it is to find a match.³⁰ This is due to the fact that any unexplained inconsistency between the bite mark and the dentition means that the suspect could not have made the bite mark.³¹ Yet, a positive identification may be made by forensic dentists even though some inconsistencies are present, provided the inconsistencies can be explained. One commentator has written:

There may, of course, be slight variations that are consistent—i.e., all of the bite marks are on a larger (or smaller) arch than the teeth themselves. In other words, depending on the location of the bite marks, whether the person (victim or suspect) was passive, unconscious, or struggling, the degree of sucking that occurred during the biting and manual manipulation, the forensic odontologist may be able to explain “consistent variations” in the comparison.³²

The conclusions that an expert can draw from the evaluation depend on the number and quality of the points of comparison. In the reported cases, experts have expressed their opinions in a variety of ways, some testifying that the suspect's dentition was “consistent with” the bite mark, others that the dentition probably made the bite mark, and still others that the match was a positive identification (to the exclusion of all other persons).³³

D. Subjectivity

Although the expert's conclusions are based on objective data, the opinion is essentially a subjective one.³⁴ There is no accepted minimum

³⁰ See Keiser-Nielson, *supra* note 12, at 637-38. See also Iain A. Pretty, *Unresolved Issues in Bitemark Analysis*, in BITEMARK EVIDENCE 547, 560 (Robert B.J. Dorion ed., 2005) (“To address some of the inherent complications concerning bitemark physical comparisons, a number of authors have suggested that bitemark evidence should only be employed in the exclusion of a suspect.”).

³¹ See Norman D. Sperber, *Forensic Odontology*, in PRACTISING LAW INSTITUTE, SCIENTIFIC AND EXPERT EVIDENCE 721, 747 (Edward J. Imwinkelried ed. 1981). See also *Litaker v. State*, 784 S.W.2d 739, 743 (Tex. App. 1990) (board certified forensic odontologist “affirmed that if there were just one inconsistency in the bite mark pattern, that would exclude the individual as being the biter”).

³² Sperber, *supra* note 31, at 747-48.

³³ See *infra* text accompanying notes 103-05.

³⁴ See Kouble & Craig, *supra* note 29, at 111 (“It is important to remember that computer-generated overlays still retain an element of subjectivity, as the selection of the biting edge profiles is reliant on the operator placing the ‘magic wand’ onto the areas to be highlighted within the digitized image.”); Pretty, *Web-Based Survey*, *supra* note 17, at 1120 (“It has been proposed by odontologists who are concerned about the level of subjectivity in traditional bitemark analyses, that bitemark evidence should only be used to exclude a suspect. This is supported by research which shows that the exclusion of non-biters within a population of suspects is extremely accurate; far more so than the positive identification of biters.”).

number of points of identity required for a positive identification.³⁵ The experts who have testified in reported bite mark cases have used a low of eight points of comparison to a high of fifty-two points.³⁶ Like fingerprint and firearms identifications (which are also subjective), the conclusions are based on the examiner's experience and expertise. Not surprisingly, this aspect opens the door to skepticism: "Recently, criticism of bite mark evidence as a reliable scientific tool has been expressed due to the subjective nature of the comparative analysis."³⁷

Moreover, disagreements between experts in court appear commonplace. "Although bite mark evidence has demonstrated a high degree of acceptance, it continues to be hotly contested in 'battles of the experts.' Review of trial transcripts reveals that distortion and the interpretation of distortion is a factor in most cases."³⁸ One commentator observed:

Forensic odontologists note that it is easier to observe dissimilarity between bitemarks and suspect dentition, and harder to identify uniqueness. It is this difficulty that often results in disagreements among bitemark experts. Disagreements are common for at least four basic reasons: 1) bites are not accurate reproductions of dentition; 2) bites include a limited number [of] teeth; 3) skin is not suitable impression material; and 4) similar results may have different mechanisms.³⁹

E. ABFO Guidelines

The development of an objective and reliable scoring system would overcome, to a significant degree, the subjectivity problem. In 1984, the American Board of Forensic Odontology (ABFO) adopted guidelines for

³⁵ See Keiser-Nielson, *supra* note 12, at 637-38. See also *Stubbs v. State*, 845 So. 2d 656, 669 (Miss. 2003) ("There is little consensus in the scientific community on the number of points which must match before any positive identification can be announced.").

³⁶ *E.g.*, *State v. Garrison*, 585 P.2d 563, 566 (Ariz. 1978) (10 points); *People v. Slone*, 143 Cal. Rptr. 61, 62 (Cal. Ct. App. 1978) (10 points); *People v. Milone*, 356 N.E.2d 1350, 1356 (Ill. App. Ct. 1976) (29 points); *State v. Sager*, 600 S.W.2d 541, 564 (Mo. Ct. App. 1980) (52 points); *State v. Green*, 290 S.E.2d 625, 630 (N.C. 1982) (14 points); *State v. Temple*, 273 S.E.2d 273, 279 (N.C. 1981) (8 points); *Kennedy v. State*, 640 P.2d 971, 976 (Okla. Crim. App. 1982) (40 points); *State v. Jones*, 259 S.E.2d 120, 124 (S.C. 1979) (37 points).

³⁷ Sweet et al., *supra* note 26, at 1050.

³⁸ Rawson et al., *Analysis of Photographic Distortion in Bite Marks: A Report of the Bite Mark Guidelines Committee*, 31 J. FORENSIC SCI. 1261, 1261-62 (1986). The Committee noted: "[P]hotographic distortion can be very difficult to understand and interpret when viewing prints of bite marks that have been photographed from unknown angles." *Id.* at 1267.

³⁹ Jon J. Nordby, *Can We Believe What We See, If We See What We Believe?—Expert Disagreement*, 37 J. FORENSIC SCI. 1115, 1118 (1992).

bite mark analysis, including a uniform scoring system.⁴⁰ According to the drafting committee, "The scoring system . . . has demonstrated a method of evaluation that produced a high degree of reliability among observers."⁴¹ Moreover, "[t]he scoring guide . . . is the beginning of a truly scientific approach to bite mark analysis."⁴² In a subsequent letter, however, the drafting committee wrote:

While the Board's published guidelines suggest use of the scoring system, the authors' present recommendation is that all odontologists await the results of further research before relying on precise point counts in evidentiary proceedings . . . [T]he authors believe that further research is needed regarding the quantification of bite mark evidence before precise point counts can be relied upon in court proceedings.⁴³

One commentator has observed that the ABFO's "attempt in the 1980s to achieve certain scaled minima of evidentiary value failed, not surprisingly, due to inter examiner discord and unreliable quantitative interpretation of bitemark autopsy and human dentition data."⁴⁴

F. Research

There have been only a few empirical studies of bite mark comparisons,⁴⁵

⁴⁰ A.B.F.O., *Guidelines For Bite Mark Analysis*, 112 J. AM. DENTAL ASS'N 383 (1986). For a discussion of the ABFO guidelines, see Michelle McClure, Comment, *Odontology: Bite Marks as Evidence in Criminal Trials*, 11 SANTA CLARA COMPUTER & HIGH TECH. L. J. 269, 275-77 (1995); Pretty, *Web-Based Survey*, *supra* note 17, at 1120 (finding adherence to guidelines but "the guidelines were last updated in 1986").

⁴¹ Raymond D. Rawson et al., *Reliability of the Scoring System of the American Board of Forensic Odontology for Human Bite Marks*, 31 J. FORENSIC SCI. 1235, 1259 (1986).

⁴² Rawson et al., *supra* note 41, at 1259.

⁴³ Letter, *Discussion of "Reliability of the Scoring System of the American Board of Forensic Odontology for Human Bite Marks,"* 33 J. FORENSIC SCI. 20 (1988). See also Anne H. McNamee & David J. Sweet, *Adherence of Forensic Odontologists to the ABFO Bite Mark Guidelines for Victim Evidence Collection*, 48 J. FORENSIC SCI. 382 (2003); Iain A. Pretty & David J. Sweet, *Adherence of Forensic Odontologists to the ABFO Bite Mark Guidelines for Suspect Evidence Collection*, 46 J. FORENSIC SCI. 1152 (2001).

⁴⁴ C. Michael Bowers, *Problem-Based Analysis of Bitemark Misidentifications: The Role of DNA*, 159S FORENSIC SCI. INT'L S104, S106 (2006) [hereinafter *Problem-Based Analysis*].

⁴⁵ See C. MICHAEL BOWERS, *FORENSIC DENTAL EVIDENCE: AN INVESTIGATOR'S HANDBOOK* 189 (2004) ("As a number of legal commentators have observed, bite mark analysis has never passed through the rigorous scientific examination that is common to most sciences. The literature does not go far in disputing that claim."); Iain A. Pretty, *Unresolved Issues in Bitemark Analysis*, in BITEMARK EVIDENCE 547, 547 (Robert B.J. Dorion ed., 2005) ("As a general rule, case reports add little to the scientific knowledge base, and therefore, if these, along with noncritical reviews, are discarded, very little new empirical evidence has been developed in the

and these vary widely in approach and result.⁴⁶ One part of a 1975 study involved identification of bites made on pigskin: "Incorrect identification of the bites made on pigskin ranged from 24% incorrect identifications under ideal laboratory conditions to as high as 91% incorrect identifications when the bites were photographed 24 [hours] after the bites were made."⁴⁷ A 1999 ABFO Workshop, "where ABFO diplomats attempted to match four bite-marks to seven dental models, resulted in 63.5% false positives."⁴⁸ A 2001 study of bites on pigskin "found false positive identifications of 11.9-22.0% for various groups of forensic odontologists (15.9% false positives for ABFO diplomats), with some ABFO diplomats faring far worse."⁴⁹ Other commentators take a more favorable view of these studies.⁵⁰

G. DNA Exonerations

The availability of DNA analysis has altered the debate on the reliability of bite mark evidence. In *State v. Krone*,⁵¹ two experienced experts concluded that the defendant had made the bite mark found on a murder

past five years.'"); *id.* at 561 ("[T]he final question in the recent survey asked, 'Should an appropriately trained individual positively identify a suspect from a bite-mark on skin'—70% of the respondents stated yes. However, it is the judicial system that must assess validity, reliability, and a sound scientific base for expert forensic testimony. A great deal of further research is required if odontology hopes to continue to be a generally accepted science.'").

⁴⁶ See Bowers, *Problem-Based Analysis*, *supra* note 44, at S106 (discussing the studies); Iain A. Pretty, *Reliability of Bitemark Evidence*, in BITEMARK EVIDENCE 531, 543 (Robert B.J. Dorion ed., 2005) ("Only three studies have examined the ability of odontologists to utilise bitemarks for the identification of biters, and only two studies have been performed in what could be considered a contemporary framework of attitudes and techniques.'").

⁴⁷ Bowers, *Problem-Based Analysis*, *supra* note 44, at S106 (citing D.K. Whitaker, *Some Laboratory Studies on the Accuracy of Bite Mark Comparison*, 25 INT'L DENTAL. J. 166 (1975)).

⁴⁸ Bowers, *Problem-Based Analysis*, *supra* note 44, at S106. *But see* Kristopher L. Arheart & Iain A. Pretty, *Results of the 4th ABFO Bitemark Workshop 1999*, 124 FORENSIC SCI. INT'L 104 (2001).

⁴⁹ Bowers, *Problem-Based Analysis*, *supra* note 44, at S106 (citing Iain A. Pretty & David J. Sweet, *Digital Bitemark Overlays—An Analysis of Effectiveness*, 46 J. FORENSIC SCI. 1385, 1390 (2001) ("While the overall effectiveness of overlays has been established, the variation in individual performance of odontologists is of concern.'")).

⁵⁰ See Iain A. Pretty, *Reliability of Bitemark Evidence*, in BITEMARK EVIDENCE 531, 538-42 (Robert B.J. Dorion ed., 2005).

⁵¹ 897 P.2d 621, 622, 623 (Ariz. 1995) ("The bite marks were crucial to the State's case because there was very little other evidence to suggest Krone's guilt"; "Another State dental expert, Dr. John Piakis, also said that Krone made the bite marks . . . Dr. Rawson himself said that Krone made the bite marks . . .").

victim. The defendant, however, was later exonerated through DNA testing.⁵² In *Ege v. Yukins*,⁵³ the court reviewed an expert's testimony in other cases, noting that the expert had opined in one case that "the chances of someone else having made the mark would be 4.1 billion to one. Mr. Otero [the defendant in that case] was subsequently exonerated when DNA from semen found in the victim's body was shown to be from someone other than Mr. Otero and the prosecution dismissed its case against him." In *Burke v. Town of Walpole*,⁵⁴ the expert said that "Burke's teeth matched the bite mark on the victim's left breast to a 'reasonable degree of scientific certainty.' That same morning . . . DNA analysis showed that Burke was excluded as the source of male DNA found in the bite mark on the victim's left breast."⁵⁵

III. ADMISSIBILITY & WEIGHT OF BITE MARK EVIDENCE

Courts have admitted bite mark comparison evidence in homicide,⁵⁶ rape,⁵⁷ and child abuse cases.⁵⁸ In virtually all the cases, the evidence was first offered by the prosecution.⁵⁹ The typical bite mark case has involved the identification of the defendant by matching his dentition with a mark left on the victim. In several cases, however, the victim's teeth have been compared

⁵² See Mark Hansen, *The Uncertain Science of Evidence*, A.B.A. J. 49 (July 2005) (discussing *Krone*).

⁵³ 380 F. Supp. 2d 852, 871 (E.D. Mich. 2005). See also *Otero v. Warnick*, 614 N.W.2d 177, 178 (Mich. Ct. App. 2000) (Forensic dentist "testified regarding his findings, suggesting that plaintiff was the only person in the world who could have inflicted the bite marks on [the murder victim's] body. On January 30, 1995, the Detroit Police Crime Laboratory released a supplemental report that concluded that plaintiff was excluded as a possible source of DNA obtained from vaginal and rectal swabs taken from [the victim's] body.").

⁵⁴ 405 F.3d 66, 73 (1st Cir. 2005).

⁵⁵ See also Bowers, *Problem-Based Analysis*, *supra* note 44, at S104 (citing several cases involving bitemarks and DNA exonerations: *Gates*, *Bourne*, *Morris*, *Krone*, *Otero*, *Young*, and *Brewer*); Mark Hansen, *Out of the Blue*, A.B.A. J. 50, 51 (Feb. 1996) (DNA analysis of skin taken from fingernail scrapings of the victim conclusively excluded Bourne).

⁵⁶ *E.g.*, *State v. Garrison*, 585 P.2d 563 (Ariz. 1978); *People v. Marx*, 26 Cal. Rptr. 350 (Cal. Ct. App. 1975); *People v. Malone*, 356 N.E.2d 1350 (Ill. App. Ct. 1976); *State v. Temple*, 273 S.E.2d 273 (N.C. 1981); *State v. Howe*, 386 A.2d 1125 (Vt. 1978).

⁵⁷ *E.g.*, *People v. Johnson*, 289 N.E.2d 722 (Ill. App. Ct. 1972); *State v. Routh*, 568 P.2d 704 (Or. Ct. App. 1977); *People v. Bethune*, 484 N.Y.S.2d 577 (A.D. 1984); *State v. Green*, 290 S.E.2d 625 (N.C. 1982); *State v. Jones*, 259 S.E.2d 120 (S.C. 1979).

⁵⁸ *E.g.*, *People v. Staniel*, 606 N.E.2d 1201, 1205 (Ill. 1992) ("According to Dr. Kenney, these [26 bite] marks showed that the victim had been abused over a long period of time."); *Bludsworth v. State*, 646 P.2d 558, 559 n.1 (Nev. 1982).

⁵⁹ *But see State v. Stokes*, 433 So. 2d 96, 103 (La. 1983) (expert report on bite mark evidence offered by the defense was excluded as inadmissible hearsay).

with marks on the defendant's body.⁶⁰ One bite mark case involved dentures,⁶¹ another braces.⁶² A few cases have involved bite impressions on foodstuff found at a crime scene: apple,⁶³ piece of cheese,⁶⁴ and sandwich.⁶⁵ Other cases involved dog bites.⁶⁶

In addition to establishing identity, bite mark evidence has been

⁶⁰ See *Rogers v. State*, 344 S.E.2d 644, 647 (Ga. 1986) ("Bite marks on one of Rogers' arms were consistent with the dentures worn by the elderly victim."); *Bradford v. State*, 460 So. 2d 926, 929-30 (Fla. Ct. App. 1984); *Davis v. State*, 611 So. 2d 906, 910 (Miss. 1992); *State v. Schaefer*, 855 S.W.2d 504, 506 (Mo. Ct. App. 1993); *State v. Timmendequas*, 737 A.2d 55, 113 (N.J. 1999) ("Askin testified that his examination established, to a reasonable degree of medical certainty, that: (1) the injury on defendant's hand was inflicted by a human bite; (2) given the positioning of the teeth, the bite was not self-inflicted; and (3) given the open, red, inflamed nature of the wound, the bite-mark appeared to have been inflicted recently. Based on the positioning and the angulation of the teeth, Askin further concluded that the bite-mark was inflicted by the victim."); *State v. Warness*, 893 P.2d 665, 669 (Wash. Ct. App. 1995) ("[T]he expert testified that his opinion was not conclusive, but the evidence was consistent with the alleged victim's assertion that she had bitten Warness . . . Its probative value was therefore limited, but its relevance was not extinguished.").

⁶¹ See *Rogers v. State*, 344 S.E.2d 644, 647 (Ga. 1986) ("Bite marks on one of Rogers' arms were consistent with the dentures worn by the elderly victim.").

⁶² See *People v. Shaw*, 664 N.E.2d 97, 101, 103 (Ill. App. Ct. 1996) (In a murder and aggravated sexual assault prosecution, the forensic odontologist opined that the mark on the defendant was caused by the orthodontic braces on the victim's teeth; "Dr. Kenney admitted that he was not a certified toolmark examiner."; no abuse of discretion to admit evidence).

⁶³ See *State v. Ortiz*, 502 A.2d 400 (Conn. 1985).

⁶⁴ See *Doyle v. State*, 263 S.W.2d 779 (Tex. Crim. 1954); *Seivewright v. State*, 7 P.3d 24, 26 (Wyo. 2000) ("On the basis of his comparison of the impressions from the cheese with Seivewright's dentition, Dr. Huber concluded that Seivewright was the person who bit the cheese.").

⁶⁵ See *Banks v. State*, 725 So. 2d 711 (Miss. 1997) (finding a due process violation when prosecution expert threw away sandwich after finding the accused's teeth consistent with the sandwich bite).

⁶⁶ See *Davasher v. State*, 823 S.W.2d 863, 870 (Ark. 1992) (expert testified that victim's dog could be eliminated as the source of mark found on defendant); *State v. Powell*, 446 S.E.2d 26, 27-28 (N.C. 1994) ("A forensic odontologist testified that dental impressions taken from Bruno and Woody [accused's dogs] were compatible with some of the lacerations in the wounds pictured in scale photographs of Prevette's body.").

introduced to show unfitness to be a parent,⁶⁷ aggravating circumstances ("torture") in a capital case,⁶⁸ and as uncharged misconduct evidence.⁶⁹

A. Early Bite Mark Cases

The first bite mark case reported in an American judicial opinion appears to be *Doyle v. State*,⁷⁰ decided in 1954 by the Texas Court of Criminal Appeals. The court devoted only twelve lines of its opinion to this issue. Moreover, the bite mark in *Doyle* was left on a piece of cheese by a burglar, unlike the later cases where the mark was left on human tissue, a substance far more subject to distortion. Further, the two experts were a dentist and a firearms identification ("ballistics") expert. There is no indication that either had any experience in bitemark analysis.⁷¹

Two decades later, *Patterson v. State*,⁷² another Texas case, was decided. In this trial, prosecution experts matched the defendant's teeth with a mark found on the murder victim. These experts conceded that the dentition of others might also match the mark. The defense expert testified that he could

⁶⁷ *Rimer v. Rimer*, 395 N.W.2d 390, 391, 393 (Minn. 1986) (child custody case) ("In the one substantiated incident, in which Robbie reported a bite mark on the child's arm, Regina admitted biting the child as a disciplinary measure to teach him not to bite others."; "However inappropriate, that alone will not support a finding of unfitness.").

⁶⁸ *Commonwealth v. Edwards*, 555 A.2d 818, 822, 833 (Pa. 1989) ("The rest of her body was marked by at least thirty-five human bite wounds. The victim had been bitten on her chest, breasts, stomach, thighs, pelvis, arms and hands. The bite marks were vicious, deep and penetrating The bites . . . were not random bites. Except for the defensive wounds, the bites were systematically inflicted in sexual areas of the victim's body.").

⁶⁹ *United States v. Dia*, 826 F. Supp. 1237, 1241 (D. Ariz. 1993) (applying Fed. R. Evid. 404(b)); "both [victims] sustained bites on their breasts during the assault"; *State v. Fortin*, 724 A.2d 818, 824 (N.J. Super. 1999) ("The bite marks on both women of the left breast, outer aspect, chin, and nipple exhibit segments which have similarities when compared to each other. . . . Based upon the comparison revealing similarities among the bite marks, it is my opinion that the bite marks on both women could have been caused by Steven Fortin."), *rev'd on other grounds*, *State v. Fortin*, 745 A.2d 509 (N.J. 2000).

⁷⁰ 263 S.W.2d 779 (Tex. Crim. 1954).

⁷¹ Pamela Zarkowski, *Bite Mark Evidence: Its Worth in the Eyes of the Expert*, 1 J. LAW & ETHICS IN DENT. 47, 52 (1988) ("The acceptance of bite mark analysis as a scientific procedure evolved from a weak beginning Experiments were not conducted, nor were techniques tested, to apply the theory of bite mark analysis and evaluate the concept The acceptance of bite mark evidence seemed to be premised on the assumption than anatomical configurations, like fingerprints, are unique to each individual, although support for this belief was not apparent."); Michael J. Saks, *Merlin And Solomon: Lessons From The Law's Formative Encounters With Forensic Identification Science*, 49 HASTINGS L.J. 1069 (1998).

⁷² 509 S.W.2d 857, 862 (Tex. Crim. App. 1974). One dentist testified that bite marks were as unique as fingerprints.

not see a "match." However, he was able to match the cast of one of his patient's teeth to the mark. The appellate court rejected the accused's attack on the reliability of the bite mark evidence by noting merely that it had previously admitted "similar evidence" in *Doyle*.

The next case, *People v. Marx* (1975),⁷³ is the leading bite mark case. The court in *Marx* avoided applying the *Frye* test, which requires acceptance of a novel technique by the scientific community as a prerequisite to admissibility.⁷⁴ According to the court, the *Frye* test "finds its rational basis in the degree to which the trier of fact must accept, on faith, scientific hypotheses not capable of proof or disproof in court and not even generally accepted outside the courtroom."⁷⁵ The court went on to hold that bite mark evidence did not involve blind acceptance by the jury. The bases on which the expert reached his conclusions—models, photographs, and X-rays—were shown to the trier of fact, and the expert's conclusions were verifiable by the court. Thus, the "court did not have to sacrifice its independence and common sense in evaluating" the evidence.⁷⁶ Whether the *Frye* test should be so easily avoided is less than clear.

Moreover, the precedential value of *Marx* is undercut, at least to a certain degree, because the case involved an exceptional three-dimensional bite mark. Indeed, the court noted that the experts used a "virtually unprecedented three dimensional approach."⁷⁷ An article about the case in the *Journal of Forensic Sciences* used the term "unusual" in the title.⁷⁸

B. Judicial Acceptance

Despite this rather modest judicial pedigree,⁷⁹ bite mark evidence soon became accepted as evidence.⁸⁰ By 1992, it had been introduced or noted in

⁷³ 126 Cal. Rptr. 350 (Cal. Ct. App. 1975). This case is discussed in Note, *The Admissibility of Bite Mark Evidence*, 51 S. CAL. L. REV. 309 (1978).

⁷⁴ For a discussion of the *Frye* test, see GIANNELLI & IMWINKELRIED, *supra* note 1, ch. 1.

⁷⁵ 126 Cal. Rptr. at 355-56.

⁷⁶ 126 Cal. Rptr. at 356.

⁷⁷ 126 Cal. Rptr. at 353.

⁷⁸ G.L. Vale et al., *Unusual Three-Dimensional Bite Mark Evidence in a Homicide Case*, 21 J. FORENSIC SCI. 642 (1976). In addition, the victim had been embalmed and buried for three months.

⁷⁹ Two Australian cases, however, excluded bite mark evidence. See Lewis (1987), 29 A. Crim. R. 267 (odontological evidence was improperly relied on, in that this method has not been scientifically accepted); Carroll (1985), 19 A. Crim. R. 410 ("[T]he evidence given by the three odontologist is such that it would be unsafe or dangerous to allow a verdict based upon it to stand.").

⁸⁰ See *Seivewright v. State*, 7 P.3d 24, 30 (Wyo. 2000) ("Given the wide acceptance of bite mark identification testimony and Seivewright's failure to present evidence challenging the methodology, we find no abuse of discretion in the district court's refusal to hold an evidentiary hearing to analyze Dr. Huber's testimony.").

193 reported cases and accepted as admissible in thirty-five states.⁸¹ Some courts followed *Marx* and admitted such evidence without applying the *Frye* test.⁸² Courts applying the *Frye* general acceptance standard reached the same result.⁸³

Moreover, some courts spoke of bite mark comparison as a "science."⁸⁴ Indeed, its acceptance became so well-established that the New York Court of Appeals held that its validity need not be proved in every case:

The reliability of bite mark evidence as a means of identification is sufficiently established in the scientific community to make such evidence admissible in a criminal case, without separately establishing scientific reliability in each case, but subject, of course, to the establishment by foundation evidence of the authenticity of the materials used and propriety of the procedure followed in the particular case and to cross-examination intended to test the reliability of the conclusion reached in that case.⁸⁵

In short, courts may judicially notice the general validity of bite mark evi-

⁸¹ Steven Weigler, *Bite Mark Evidence: Forensic Odontology and the Law*, 2 HEALTH MATRIX: J.L.-MED. 303 (1992).

⁸² See *Handley v. State*, 515 So. 2d 121, 130-31 (Ala. Crim. App. 1987); *State v. Garrison*, 585 P.2d 563 (Ariz. 1978); *Verdict v. State*, 868 S.W.2d 443 (Ark. 1993) (bite mark evidence "widely accepted by the courts"); *People v. Watson*, 142 Cal. Rptr. 134 (Cal. Ct. App. 1977); *Bundy v. State*, 455 So. 2d 330, 348-49 (Fla. 1984); *People v. Holmes*, 601 N.E.2d 985, 991-93 (Ill. App. Ct. 1992); *People v. Milone*, 356 N.E.2d 1350 (Ill. App. Ct. 1976); *People v. Johnson*, 289 N.E.2d 722 (Ill. App. Ct. 1972); *Niehaus v. State*, 359 N.E.2d 513 (Ind. 1977); *State v. Peoples*, 605 P.2d 135 (Kan. 1980); *Commonwealth v. Cifizzari*, 492 N.E.2d 357, 362-64 (Mass. 1986); *People v. Marsh*, 441 N.W.2d 33, 35-36 (Mich. Ct. App. 1989); *Bludsworth v. State*, 646 P.2d 558 (Nev. 1982); *State v. Green*, 290 S.E.2d 625 (N.C. 1982); *State v. Temple*, 273 S.E.2d 273 (N.C. 1981); *Kennedy v. State*, 640 P.2d 971 (Okla. Crim. App. 1982); *State v. Routh*, 568 P.2d 704 (Or. Ct. App. 1977); *State v. Jones*, 259 S.E.2d 120 (S.C. 1979); *State v. Cazes*, 875 S.W.2d 253 (Tenn. 1994); *Spence v. State*, 795 S.W.2d 743, 750-52 (Tex. Crim. App. 1990); *Patterson v. State*, 509 S.W.2d 857 (Tex. Crim. App. 1974); *State v. Howe*, 386 A.2d 1125 (Vt. 1978).

⁸³ See *United States v. Martin*, 13 M.J. 66, 67-68 (C.M.A. 1982); *People v. Slone*, 143 Cal. Rptr. 61, 68-69 (Cal. Ct. App. 1978); *State v. Hodgson*, 512 N.W.2d 95, 98 (Minn. 1994) (bite mark analysis routinely used); *State v. Kleypas*, 602 S.W.2d 863, 868-70 (Mo. Ct. App. 1980); *State v. Sager*, 600 S.W.2d 541, 573 (Mo. Ct. App. 1980); *People v. Middleton*, 429 N.E.2d 100, 103-04 (N.Y. 1981); *People v. Bethune*, 484 N.Y.S.2d 577, 581 (A.D. 1984); *People v. Smith*, 443 N.Y.S.2d 551, 556-57 (Cty. Ct. 1981).

⁸⁴ See *People v. Marsh*, 441 N.W.2d 33, 35 (Mich. Ct. App. 1989) ("the science of bite mark analysis has been extensively reviewed in other jurisdictions"); *State v. Sager*, 600 S.W.2d 541, 569 (Mo. Ct. App. 1980) ("an exact science").

⁸⁵ *People v. Middleton*, 429 N.E.2d 100, 101 (N.Y. 1981). See also *State v. Richards*, 804 P.2d 109, 112 (Ariz. Ct. App. 1990) ("[B]ite mark evidence is admissible without a preliminary determination of reliability . . ."); *People v. Smith*, 468 N.E.2d 879, 889 (N.Y. 1984); *State v. Armstrong*, 369 S.E.2d 870, 877 (W. Va. 1988) (judicially noticing the reliability of bite mark evidence).

dence,⁸⁶ although judicial notice does not extend to the validity of an identification in a particular case.

C. Post-Daubert Cases

The impact of *Daubert v. Merrell Dow Pharmaceuticals, Inc.*⁸⁷ on the admissibility of bite mark evidence has yet to be determined. One commentator has stated that "the *Daubert* decision is likely to have little effect on bite mark admissibility."⁸⁸ In light of later developments in other fields, however, this statement seems highly debatable. *Daubert* has evolved into a far more stringent standard than many courts and commentators thought at the time it was decided,⁸⁹ and the DNA exonerations discussed above have undercut the reliability claims of practitioners. In addition, the lack of empirical studies on the subject leaves a substantial void.

D. Mississippi Bite Mark Cases

A series of cases in Mississippi has made Dr. Michael West a controversial figure. In *Banks v. State*,⁹⁰ a 1997 capital murder case, West testified as a prosecution witness, matching the accused's teeth with the bite marks in the remaining portion of a bologna sandwich found at the crime scene. A defense expert was compelled to use photographs of the sandwich because the sandwich had been destroyed. Consequently, he was unable to reach any definite conclusions. Reversing the conviction, the Mississippi Supreme Court wrote that "the prejudicial impact of the State's destruction of the sandwich on the persuasive value of Banks' case is plainly apparent, and Dr. West's destruction of the sandwich was unnecessary and inexcusable."

In *Brooks v. State*,⁹¹ a subsequent case decided in 1999, the Court upheld the use of Dr. West bite mark testimony, acknowledging, however, the need for defense experts in bite mark cases. A blistering dissent pointed out that there were only two linear marks on the victim and the defense expert could not say that they were even bite marks. Moreover, the dissent commented on Dr. West's proclivity "to boldly go where no expert has gone before,"⁹² to

⁸⁶ For a discussion of judicial notice, see GIANNELLI & IMWINKELRIED, *supra* note 1, ch. 1.

⁸⁷ 509 U.S. 579 (1993).

⁸⁸ McClure, *supra* note 40, at 281. *But see* Pretty & Sweet, *Critical Review*, *supra* note 10, at 85 ("The review revealed a lack of valid evidence to support many of the assumptions made by forensic dentists during bitemark comparisons. The new level of judicial scrutiny of such scientific evidence is likely to emphasise this lack of knowledge upon which bitemark analysis relies.").

⁸⁹ See Paul C. Giannelli, *Daubert Revisited*, 41 CRIM. L. BULL. 302 (2005).

⁹⁰ 725 So. 2d 711, 716 (Miss. 1997).

⁹¹ 748 So. 2d 736 (Miss. 1999).

⁹² 748 So. 2d at 748 ("In *Harrison v. State*, 635 So. 2d 894, 897 (Miss. 1994), West testified that the victim's body was covered in teeth marks inflicted by the defendant. On appeal, Dr. Mincer gave an affidavit to the effect that the marks ap-

lose evidence,⁹³ and to create new fields of expertise.⁹⁴ The dissent concluded: "This Court's apparent willingness to allow West to testify to anything and everything so long as the defense is permitted to cross-examine him may be expedient for prosecutors but it is harmful to the criminal justice system."⁹⁵

In 2001, an enterprising attorney, who had represented a defendant convicted on bitemark evidence but later exonerated with DNA evidence, decided to give Dr. West a blind proficiency test.⁹⁶ Using a ruse, he hired West to compare the bitemark in a prior murder case (photographed at the time of autopsy) with dental models supplied by a foil. In Dr. West's videotaped report, he concluded: "Finding this many patterns on this injury, I believe, can only lead an odontologist to an opinion that these teeth did create that mark."⁹⁷ He was wrong: DNA had already identified the biter.

In *State v. Howard*,⁹⁸ 2003, the Court again upheld the admissibility of Dr. West's bite mark comparison. Once again, a dissenting opinion vigorously disagreed, calling his testimony "junk science" and noting that of the 100 board certified forensic odontologists in the United States, "about 90% of them have testified for the opposite side when Dr. West is called as an expert witness."⁹⁹ By this time, even the majority of the Court was having qualms. In *Stubbs v. State*,¹⁰⁰ the majority wrote: "[W]e in no way implied that Dr. Michael West was given carte blanche to testify to anything and

peared to be ant bites. In *Davis v. State*, 611 So. 2d 906, 910 (Miss. 1992), West concluded that 'the wound was a bite mark consistent with having been inflicted approximately three weeks previously.' But Dr. Richard Souviron, a forensic odontologist from Miami, Florida, 'testified that the wound on Davis' arm was not a bite mark, but even if it were, it was inconsistent with Mrs. Davis' teeth.'").

⁹³ 748 So. 2d at 750 ("West seems to have difficulty in keeping up with evidence. In the instant case, he lost not only the mold to Brooks's lower teeth but also the mold of another suspect's teeth. In [*Banks*] this Court was forced to reverse where West testified that the defendant's teeth correlated to marks in a sandwich left at the crime scene but failed to preserve the sandwich so that the defense could make its own comparisons.'").

⁹⁴ 748 So. 2d at 750 n.4 ("A Westlaw search reveals that Michael West is apparently the only person testifying about the 'science' of 'wound pattern analysis.'").

⁹⁵ 748 So. 2d at 750.

⁹⁶ The attorney, Christopher J. Plourd, had represented Ray Krone, who had been convicted of capital murder and sentenced to death based on the testimony of forensic dentists. In *State v. Krone*, 897 P.2d 621, 622, 623 (Ariz. 1995), two experienced experts concluded that the defendant had made the bite mark found on a murder victim: "The bite marks were crucial to the State's case because there was very little other evidence to suggest Krone's guilt." The defendant, however, was later exonerated through DNA testing. See Mark Hansen, *The Uncertain Science of Evidence*, A.B.A. J. 49 (July 2005) (discussing *Krone*).

⁹⁷ Video (on file with author). He also stated: "I feel very confident that there are enough points of unique individual characteristics in this study model to say that these teeth inflicted this bite mark."

⁹⁸ 853 So. 2d 781 (Miss. 2003).

⁹⁹ 853 So. 2d at 799- 800.

¹⁰⁰ 845 So. 2d 656, 670 (Miss. 2003).

everything he so desired . . . We caution prosecutors and defense attorneys, as well as our learned trial judges, to take care that Dr. West's testimony as an expert is confined to the area of his expertise . . ."

DNA evidence has contradicted Dr. West's conclusions on two occasions.¹⁰¹

E. Other Cases

In *State v. Timmendequas*,¹⁰² the New Jersey Supreme Court admitted bitemark evidence, commenting that "[j]udicial opinion from other jurisdictions establish that bite-mark analysis has gained general acceptance and therefore is reliable. Over thirty states considering such evidence have found it admissible and no state has rejected bite-mark evidence as unreliable."

F. Specificity of Opinion

In some cases experts have testified only that a bite mark is "consistent with" the defendant's teeth.¹⁰³ In other cases experts have testified that it is "highly probable" or "very highly probable" that the defendant made the

¹⁰¹ See Mark Hansen, *Out of the Blue*, A.B.A.J. 50, 51 (Feb. 1996) (DNA analysis of skin taken from fingernail scrapings of the victim conclusively excluded Bourne); Shalia Dewan, *Despite DNA Test, Prosecutor Is Retrying Rape-Murder Case*, N.Y. TIMES, Sept. 6, 2007, at A1 (noting DNA exclusion in Kennedy Brewer case).

¹⁰² 737 A.2d 55, 114 (N.J. 1999).

¹⁰³ E.g., *Handley v. State*, 515 So. 2d 121, 129 (Ala. Crim. App. 1987); *People v. Watson*, 142 Cal. Rptr. 134, 143 (Cal. Ct. App. 1977); *Rogers v. State*, 344 S.E.2d 644, 647 (Ga. 1986) ("Bite marks on one of Rogers' arms were consistent with the dentures worn by the elderly victim."); *People v. Williams*, 470 N.E.2d 1140, 1150 (Ill. App. Ct. 1984) ("could have"); *People v. Marsh*, 441 N.W.2d 33, 35 (Mich. Ct. App. 1989); *State v. Hodgson*, 512 N.W.2d 95, 98 (Minn. 1994) (en banc) (Board-certified forensic odontologist testified that "there were several similarities between the bite mark and the pattern of [the victim's] teeth, as revealed by known molds of his mouth."); *Bludsworth v. State*, 646 P.2d 558, 559 n.1 (Nev. 1982); *People v. Bethune*, 484 N.Y.S.2d 577, 580-81 (A.D. 1984); *State v. Routh*, 568 P.2d 704, 705 (Or. Ct. App. 1977) ("similarity"); *Litaker v. State*, 784 S.W.2d 739, 743 (Tex. App. 1990); *Williams v. State*, 838 S.W.2d 952, 954 (Tex. App. 1992) ("One expert, a forensic odontologist, testified that Williams's dentition was consistent with the injury (bite mark) on the deceased. On cross-examination, the expert said, 'I did not say that to a reasonable certainty or a positive certainty that [Williams] did it.'"); *State v. Warness*, 893 P.2d 665, 669 (Wash. Ct. App. 1995) ("[T]he expert testified that his opinion was not conclusive, but the evidence was consistent with the alleged victim's assertion that she had bitten Warness . . . Its probative value was therefore limited, but its relevance was not extinguished.").

mark.¹⁰⁴ In still other cases experts have made positive identifications (to the exclusion of all other persons).¹⁰⁵

G. Disagreements Among Experts

Given the subjective character of bite mark comparisons, it is not surprising to find experts disagreeing in individual cases - often about whether a wound is even a bite mark.¹⁰⁶ In some cases the experts have arrived at dia-

¹⁰⁴ *E.g.*, *People v. Slone*, 143 Cal. Rptr. 61, 67 (Cal. Ct. App. 1978); *People v. Johnson*, 289 N.E.2d 722, 726 (Ill. App. Ct. 1972).

¹⁰⁵ *E.g.*, *Dubois v. State*, 520 So. 2d 260, 261 (Fla. 1988) (Expert "testified at trial that within a reasonable degree of dental certainty Dubois had bitten the victim."); *Morgan v. State*, 639 So. 2d 6, 9 (Fla. 1994) ("[T]he testimony of a dental expert at trial positively matched the bite marks on the victim with Morgan's teeth."); *People v. Gallo*, 632 N.E.2d 99, 103 (Ill. App. Ct. 1994) (forensic dentist testified that the injury to the murder victim's "breast was caused by human teeth and that it was the defendant's teeth that made the teeth mark"); *People v. Milone*, 356 N.E.2d 1350, 1355-56 (Ill. App. Ct. 1976); *Commonwealth v. Cifizzari*, 492 N.E.2d 357, 360 (Mass. 1986); *Brewer v. State*, 725 So. 2d 106, 116 (Miss. 1998) ("Dr. West opined that Brewer's teeth inflicted the five bite mark patterns found on the body of Christine Jackson."); *Davis v. State*, 611 So. 2d 906, 910 (Miss. 1992) (prosecution expert had "no doubt"); *State v. Schaefer*, 855 S.W.2d 504, 506 (Mo. Ct. App. 1993) ("[A] forensic dentist testified that the bite marks on Schaefer's shoulder matched victim's dental impression, and concluded that victim caused the marks."); *State v. Sager*, 600 S.W.2d 541, 564 (Mo. Ct. App. 1980); *State v. Temple*, 273 S.E.2d 273, 279 (N.C. 1981); *State v. Lyons*, 924 P.2d 802, 804 (Or. 1993) (forensic odontologist "had no doubt that the wax models were made from the same person whose teeth marks appeared on the victim's body"); *State v. Cazes*, 875 S.W.2d 253, 258 (Tenn. 1994) (A forensic odontologist "concluded to a reasonable degree of dental certainty that Cazes' teeth had made the bite marks on the victim's body at or about the time of her death.").

¹⁰⁶ *E.g.*, *Ege v. Yukins*, 380 F. Supp. 2d 852, 878 (E.D. Mich. 2005) ("[T]he defense attempted to rebut Dr. Warnick's testimony with the testimony of other experts who opined that the mark on the victim's cheek was the result of *livor mortis* and was not a bite mark at all."); *Czapleski v. Woodward*, 1991 WL 639360 (N.D. Cal. Aug. 30, 1991) (dentist's initial report concluded that "bite" marks found on child were consistent with dental impressions of mother; several experts later established that the marks on child's body were postmortem abrasion marks and not bite marks); *Kinney v. State*, 868 S.W.2d 463 (Ark. 1994) (disagreement that marks were human bite marks); *Harris v. State*, 1992 Ark. App. LEXIS 728, at *5 (Nov. 18, 1992) ("Appellant also points to the testimony of Dr. Thomas Krauss, a forensic odontologist, who disputed the opinion of Dr. West that the bite mark was made by the appellant."); *People v. Noguera*, 842 P.2d 1160, 1165 n.1 (Cal. 1992) ("At trial, extensive testimony by forensic odontologists was presented by both sides, pro and con, as to whether the wounds were human bite marks and, if so, when they were inflicted."); *State v. Duncan*, 802 So. 2d 533, 553 (La. 2001) ("As part of its case-in-chief, the state called Dr. Reisner, a forensic odontologist, who testified that several marks on the victim's body were bite marks that with varying degrees of certainty matched defendant's dentition . . . Both defense experts testified that

metrically opposed conclusions, while in others they disagree only on whether the data is sufficient to support a positive identification.

*People v. Milone*¹⁰⁷ is an example. In that case three experts testified for the prosecution and four experts testified for the defense. The prosecution experts all positively identified the defendant's teeth as the source of the bite mark found on the victim. The defense experts testified either that a positive identification could not be made or that the defendant's teeth did not make the mark. Despite this disagreement, the defendant was convicted. Interestingly, one of the experts in that case subsequently wrote that "[r]ecently discovered evidence proves that Milone . . . is innocent."¹⁰⁸ Milone subsequently filed a federal habeas petition, once again challenging the admissibility of the bite mark evidence and offering the testimony of a new expert. The federal court, however, ruled this testimony cumulative and therefore not a basis for habeas relief: "The bite mark testimony of Milone's new expert, Dr. Campbell, would merely be one more expert opinion added to the numerous opinions before the court."¹⁰⁹ The Seventh Circuit upheld the district court's ruling that Milone's constitutional rights had not been violated. Nevertheless, the court also added that "Milone has made a credible claim that newly discovered evidence would not only cast a doubt upon his guilt but in fact would exonerate him."¹¹⁰

Similarly, in *People v. Smith*,¹¹¹ seven experts testified, four for the prosecution and three for the defense. While the prosecution experts found that the bitemark on a murder victim had been made by the accused, the defense experts testified that not only was the mark not made by the defendant but that it "was not a bite mark at all." In addition, the experts disagreed about the proper methods that may be used for the comparison. The prosecution experts used two methods of comparison. First, they compared a stone model

these marks on the victim's body were not bite marks."); *Stubbs v. State*, 845 So. 2d 656, 668 (Miss. 2003) ("Dr. Galvez denied the impressions found on Williams were the results of bite marks."). See also JOHN GRISHAM, *THE INNOCENT MAN* 263 (2006) ("During his first trial, the most damaging evidence was the testimony of the state's two bite-mark experts . . . [The defense lawyer] then sent the bite mark to 11 nationally renowned experts, many of whom usually testified on behalf of the prosecution. They included the FBI's top bite-mark consultant and the expert who testified against Ted Bundy. The verdict was unanimous—all 12 bite-mark experts concluded that Greg Wilhoit had to be excluded. The comparisons were not even close.").

¹⁰⁷ 356 N.E.2d 1350, 1356 (Ill. App. Ct. 1976).

¹⁰⁸ Lowell J. Levine, *Forensic Dentistry: Our Most Controversial Case*, in *LEGAL MED. ANN.* 73 (Cyril H. Wecht ed., 1978).

¹⁰⁹ U.S. ex rel. *Milone v. Camp*, 1992 WL 253147 (N.D. Ill. Sep 29, 1992) (also noting that the "trial judge reviewed over 1300 pages of bite mark evidence"). See also U.S. ex rel. *Milone v. Camp*, 643 F. Supp 679 (N.D. Ill. Jun 20, 1986) (also noting that the "trial judge reviewed over 1300 pages of bite mark evidence"). See also *Malone v. Camp*, 643 F. Supp. 679 (N.D. Ill. 1986).

¹¹⁰ *Malone v. Camp*, 22 F.3d 693, 705 (7th Cir. 1994).

¹¹¹ 468 N.E.2d 879, 886 (N.Y. 1984).

of the defendant's dentition and impressions made in aluwax from the model with life-size photographs of the mark on the victim. Second, they made photo-to-photo comparisons of the victim's mark and a bite mark known to have been made by the defendant on human tissue four years earlier. In contrast, the defense experts compared transparencies made from a model of the defendant's teeth with a photograph of the mark on the victim. The transparencies were then laid over the photograph. The defense experts, however, conceded that there was no completely objective method for identifying bitemarks and that each method ultimately relied on the judgment of the individual expert.

In still another case, two odontologists made a positive identification of bitemarks in a murder trial. Defense experts, however, showed that the mark had been misinterpreted—that it was not a bite mark. The jury acquitted the accused.¹¹²

These types of disagreements continued in later cases. In *State v. Holmes*,¹¹³ two prosecution experts testified that the defendant inflicted the bite marks found on the victim. Then, two defense experts testified that the marks were not bitemarks and thus were not made by the defendant. In *Davis v. State*,¹¹⁴ the prosecution expert had "no doubt" that the victim's teeth made the bite mark on the defendant's arm, whereas the defense expert testified that the mark "was not a bite mark, but even if it were, it was inconsistent with [the victim's] teeth." In *Brewer v. State*,¹¹⁵ Dr. West opined that Brewer's teeth inflicted the five bite mark patterns found on the victim's body. "The doctor further concluded that it was 'highly consistent and probable' that the other fourteen bite mark patterns were also inflicted by Brewer." In contrast, Dr. Souviron, a founding member of the ABFO, testified that "none of the wounds on the child's body were bite marks . . . because there were no corresponding lower teeth prints found on the child's body. Dr. West explained that, for some unknown reason, Brewer's lower teeth were not very sharp."

¹¹² Kris Sperry & Homer R. Campbell, *An Elliptical Incised Wound of the Breast Misinterpreted as a Bite Injury*, 35 J. FORENSIC SCI. 1226 (1990). See also Norman D. Sperber, *Lingual Markings of Anterior Teeth As Seen in Human Bite Marks*, 35 J. FORENSIC SCI. 838, 838 (1990) ("In a recent California case, it was necessary to perform a histologic examination in order to demonstrate conclusively that the lesion identified by a forensic dentist as a bite mark was, in fact, a postmortem artifact."); C.P. Karazulas, *The Presentation of Bite Mark Evidence Resulting in the Acquittal of a Man After Serving Seven Years in Prison for Murder*, 29 J. FORENSIC SCI. 355 (1984) (After three trials, defendant finally acquitted where bite mark evidence was the main issue in the third trial); Nordby, *supra* note 39, at 1122 n.16 ("The trial . . . involved disagreements among reputable forensic odontologists ranging from those unwilling to identify the injury as a bite mark to the exclusion of other mechanisms, to those willing to identify the injury as a bite inflicted by a specific individual to the exclusion of all other individuals."); citing *State v. Kendrick*, 736 P.2d 1079 (Wash. Ct. App. 1987)).

¹¹³ 601 N.E.2d 985, 991-93 (Ill. App. Ct. 1992).

¹¹⁴ 611 So. 2d 906, 910 (Miss. 1992).

¹¹⁵ 725 So. 2d 106, 116 (Miss. 1998).

In *State v. Prade*,¹¹⁶ the prosecution expert conclusively determined that the victim did not bite herself. He went on to exclude four other persons as the source of the bite mark left on the victim. Finally, he opined that “my conclusion [is] that the bite found on Margo Prade was made by [Defendant].”¹¹⁷ In contrast, the defense expert indicated that Prade had a diminished ability to bite down. However, he acknowledged that a person’s ability to bite as illustrated through bite mark exemplars depends upon the person’s cooperation in the process and that adrenaline can affect an individual’s ability to bite down and the amount of force that person can exert.

H. Expert Qualifications

Although the qualifications of experts who have testified in bite mark cases have been challenged in some prosecutions, these challenges typically have failed.¹¹⁸ ABFO certification is not required.¹¹⁹ Most of the experts have been experienced forensic odontologists. In one case, however, a court ruled that a pathologist’s testimony that a bruise discovered during an autopsy was consistent with a bite mark was improper because he was not qualified in fo-

¹¹⁶ 745 N.E.2d 475, 493 (Ohio Ct. App. 2000).

¹¹⁷ See also *State v. Fortin*, 843 A.2d 974, 987 (N.J. 2004) (“Dr. Lowell Levine, the State’s forensic expert in odontology, compared photographs of the marks on Padilla’s chin and breast to molds of Fortin’s teeth. Levine concluded to a ‘high degree of probability’ that Fortin made the bite marks found on Padilla’s chest. Levine, however, conjectured that Fortin ‘could have’ been responsible for the bite mark on Padilla’s chin. Dr. Norman Sperber . . . opined that the injuries to Padilla’s breast and chin probably were not bite marks and, if they were, they could not be attributed to Fortin.”).

¹¹⁸ See *People v. Williams*, 470 N.E.2d 1140, 1149-50 (Ill. App. Ct. 1984); *State v. Peoples*, 605 P.2d 135, 139-40 (Kan. 1980); *State v. Wommack*, 770 So. 2d 365, 373 (La. Ct. App. 2000) (“Dr. Downs, an oral-maxillofacial surgeon, and Dr. Welke, a forensic pathologist and jail physician, both identified the wound on Wommack’s arm as a human bitemark.”); *State v. Hodgson*, 512 N.W.2d 95, 98 (Minn. 1994) (“a board-certified forensic odontologist”); *State v. Timmendequas*, 737 A.2d 55, 113 (N.J. 1999) (“Dr. Askin is board certified by the American Board of Forensic Odontology. At the time of trial, he had performed dozens of bite-mark comparisons and had qualified as an expert witness in four previous trials.”); *State v. Temple*, 273 S.E.2d 273, 280 (N.C. 1981).

¹¹⁹ See *Seivewright v. State*, 7 P.3d 24, 30 (Wyo. 2000) (“Seivewright’s chief complaint is that Dr. Huber was not qualified to offer expert testimony because he is not certified by the American Board of Forensic Odontologists (ABFO), which has established standards for qualification to testify as an expert in the field of forensic odontology. However, Seivewright directs us to no authority establishing that ABFO certification is a prerequisite to testifying as an expert in the field of forensic odontology.”).

rensic dentistry.¹²⁰ In another case, a dentist was considered qualified even though the bite mark comparison in issue was the first he had made.¹²¹

In *Brewer v. State*,¹²² the defense challenged the qualifications of Dr. West because he had been suspended by the American Board of Forensic Odontology, and had resigned from the International Association of Identification and the American Academy of Forensic Sciences. The court rejected the challenge, pointing out that West's "fiasco" in a prior case involved his "bluelight" technique, through which he claimed that he could perfectly match a bruise on the accused's palm with the murder weapon.¹²³ Moreover, West had testified in seven cases after his suspension. Finally, the defense expert conceded that West was qualified and that West's direct comparison technique was an acceptable method.¹²⁴

In *State v. Swinton*,¹²⁵ the Connecticut Supreme Court held admissible computer enhanced photographs of bite marks on a murder victim but not superimposed images created by Adobe Photoshop. The decision did not turn on the Connecticut version of *Daubert* but rather on the authentication requirement and the right of confrontation. In the court's view, "Karazulas, a highly qualified odontologist, recognized his own limitations as a witness with respect to the Adobe Photoshop evidence. He admitted that he had 'no skill or experience' with Adobe Photoshop."

I. Statistical Evidence

In *State v. Garrison*,¹²⁶ the expert was permitted to state his conclusion in terms of probability theory, testifying that "there is an eight in one million probability that the teeth marks found on the deceased's breast were not made by appellant."¹²⁷ Such a statement appears to be without scientific

¹²⁰ *State v. Adams*, 481 A.2d 718, 727-28 (R.I. 1984).

¹²¹ *Niehaus v. State*, 359 N.E.2d 513 (Ind. 1977).

¹²² 725 So. 2d 106 (Miss. 1998).

¹²³ See Paul C. Giannelli, *The Abuse of Scientific Evidence: The Need for Independent Crime Laboratories*, 4 VA. J. L. & SOC. POL'Y 439, 454-55 (1997) (discussing the blue-light technique).

¹²⁴ 725 So. 2d at 125-26.

¹²⁵ 847 A.2d 921, 951 (Conn. 2004). "A witness must be able to testify, adequately and truthfully, as to exactly what the jury is looking at, and the defendant has a right to cross-examine the witness concerning the evidence. Without a witness who satisfactorily can explain or analyze the data and the program, the effectiveness of cross-examination can be seriously undermined, particularly in light of the extent to which the evidence in the present case has been 'created.' Karazulas lacked the computer expertise to provide the defendant with this opportunity." *Id.* at 951-52.

¹²⁶ 585 P.2d 563 (Ariz. 1978).

¹²⁷ "As indicated in the majority opinion, Dr. Campbell was unsure as to precisely where he obtained the figure 'eight in one million.' My independent research reveals that of the two treatises which he could name as containing statistical information, only . . . [one] lists any figures on the uniqueness of a bite-mark. Rather than the eight in one million figure vouched for by Dr. Campbell, though, that treatise . . .

foundation. The expert did not perform any of his own mathematical calculations, was unaware of the formula used to arrive at that figure other than that it was "computerized," and was ignorant of the statistical weight assigned to each variable used in the equation. The dissent commented: "[W]hile Dr. Campbell may have a great deal of expertise in the actual comparison techniques of bitemark identification, he is totally out of his field when the discussion turns to probability theory."¹²⁸ A commentary on *Garrison* and the article it cites notes:

The authors concluded that they had not confirmed the individuality of the human anterior teeth, nor had they considered the impact or representation of any of the features examined on a bitemark in human skin. The highly subjective examination of the casts by multiple examiners and lack of tabulated results make this study weak . . .¹²⁹

In *Ege v. Yukins*,¹³⁰ a habeas case, the expert "characterized the 'match' of a mark on the victim's cheek with the petitioner's dentition in terms of overwhelming mathematical probability."¹³¹ The court stated that the "flaw in Dr. Warnick's statistical opinion should have been obvious and its admissibility readily assailable." The court went on to find the defense counsel's representation ineffective.

CONCLUSION

Daubert and its progeny have revolutionized the way courts handle scientific evidence. Over the last decade, *Daubert* has developed into an "exact-ing" standard.¹³² Many well-accepted forensic techniques have been challenged, including handwriting,¹³³ fingerprints,¹³⁴ and firearms identification.¹³⁵ Although many of these assaults on well-accepted techniques have not been

contains the figure eight in one hundred thousand." 585 P.2d at 568-69. "Moreover, the applicability of even an eight in one hundred thousand figure to the defendant is dubious." *Id.* at 569 n.1.

¹²⁸ 585 P.2d at 568. See also David McCord, *A Primer For the Nonmathematically Inclined on Mathematical Evidence in Criminal Cases: People v. Collins and Beyond*, 47 WASH. & LEE L. REV. 741, 801 (1990) ("A blistering and convincing dissent [in *Garrison*] showed the probability to be without foundation and thus unfairly prejudicial.").

¹²⁹ Pretty & Sweet, *Critical Review*, *supra* note 10, at 88.

¹³⁰ 380 F. Supp. 2d 852, 857 (E.D. Mich. 2005). The expert "said that out of the 3.5 million people residing in the Detroit metropolitan area, the defendant was the only one whose dentition could match the individual who left the possible bite mark on the victim's cheek." *Id.* at 869.

¹³¹ 380 F. Supp. 2d at 876 ("There is no question that the evidence in the case was unreliable and not worthy of consideration by a jury.").

¹³² *Weisgram v. Marley Co.*, 528 U.S. 440, 455 (2000).

¹³³ See Paul C. Giannelli & Carin Cozza, *Daubert Challenges to Handwriting Comparisons*, 42 CRIM. L. BULL. 347 (2006).

¹³⁴ See Paul C. Giannelli, *Daubert Challenges to Fingerprints*, 42 CRIM. L. BULL. 624 (2006).

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successful, they demonstrate that expert testimony is no longer given a free pass. Given this background, the number of unresolved issues associated with the technique, and the DNA exonerations in bite mark cases, vigorous attacks on bite mark evidence should be expected.

¹³⁵ See Paul C. Giannelli, *Daubert Challenges to Firearms ("Ballistics") Identifications*, 43 CRIM. L. BULL. 548 (2007).