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January 26, 2014

To: National Commission on Forensic Science

RE: Personal comment submission

Hello:

Please accept the attached documents as background information for the Commission's deliberations. The first document is a recent chapter contribution I wrote for Elsevier/Academic Press regarding "bite mark identifications" and the criminal justice system's response to issues regarding expert reliability and wrongful convictions. Bite mark identification was covered in chapter five of the National Academy of Sciences report, *Strengthening Forensic Science in the United States: A Path Forward*, and serious concerns were raised regarding its validity and reliability. The second document is a peer reviewed article, *Problem-based analysis of bitemark misidentifications: The role of DNA*, which was referenced and cited by the NAS in their Report.

Although my chapter focuses on a specific forensic field, it also describes the status of forensic accreditation administered by organized forensic groups. I present systemic problems associated with self-administered validity testing by practitioners of weak forensic science. I believe these issues are applicable to the Commission's scope of activities.

Regards,



C. Michael Bowers DDS JD

## Bite Mark Evidence and Miscarriages of Justice

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“When science advances beyond a previously accepted forensic discipline”

### INTRODUCTION

This chapter in “Miscarriages of Justice” provides the reader with an overview of the adversarial process in the US criminal justice system regarding a specific type of scientific evidence used to convict defendants. The forensic subject is bite mark identification. This is a subset of forensic odontology (dentistry) which principally identifies humans from dental records and post mortem dental autopsies.<sup>1</sup> Dentists call this subset “shape analysis” but the broader forensic community considers it within the broader subject of “pattern analysis.”<sup>2</sup> For decades, the criminal justice application of this small “scientific” community’s (following the Frye Rule definition) bite mark tenets (now being expressed by its certifying board as a “non-scientific” process<sup>3 4</sup> when combined with the US courts’ slow response to scientific advances and legal case law is problematic. A meta-data analysis of their cases and accompanying unconvincing “validation” literature points to its core failure of preventing false positive expert opinions in criminal proceedings. Despite the truth of these matters, which reflect poorly on the public’s beliefs of criminal justice (i.e. “CSI effects”), it still exists in every US state as a long admissible method of forensic opinion. Bite mark proponents currently are battling for survival against both new science (DNA and other research) and their record of

assisting in wrongful convictions and arrests. Simply put, for decades, they have mis-identified innocent criminal defendants. Unfortunately, the battle regarding exclusion of bite mark opinions is being fought in a piecemeal manner (case by case; state by state) due to the multi-structured and independent US state court system and lax judicial forensic quality control. The 1993 Daubert framework for “gatekeeping” bad science, conjoined with no control from federal governmental oversight (the 2009 NAS Report recording similar criticisms, but is repeatedly denounced as a mandate by prosecutors and their reviewing judiciary)<sup>5</sup> continue to allow the unfettered use of this “impression evidence.”<sup>6</sup> All this legal inaction prevents a global decommissioning for bite mark identification. Coupled with a lack of rigorous organized forensic review of the case data is the fact that prosecutors are also immune <sup>7</sup> from legal scrutiny and sanctions when they continue to use bitemark evidence as proof of guilt. Additionally, most prosecutors do not admit mistakes when their bite mark cases have been quashed on appeal, the convictions vacated, and the defendant exonerated.<sup>8</sup> The appellate system in some cases has responded to the availability of post-conviction DNA science to quash prosecutorial bite mark evidence used at trial and to overturn convictions.<sup>9</sup> As mentioned above, this is reflected in the exoneration cases. However, this new evidence is commonly opposed by prosecutors in post-conviction appeals. They present arbitrary excuses and ill-founded theories of continued guilt which continue the legal debate for years in many cases (See Section D in this chapter). To date, no US court has been capable of undertaking a legitimate scientifically relevant inquiry and determining this type of evidence as invalid <sup>10</sup> despite published scientific and legal criticisms based on erroneous convictions. <sup>11</sup>

*Factors indicating the fraud of bite mark identification's judicial admissibility as a forensic "science."*

1. Its meager scientific literature has become the "poster child" for non-forensic science.

It is a method that has no university-based applied scientific precursors (unlike DNA) that support its continued use as a reliable forensic practice for use in criminal courts.<sup>12</sup>

The scientific underpinnings of bitemark identification are merely a collection of beliefs and attitudes rather than hypotheses driven by validation and research experimentation (also unlike DNA).

2. Its continued acceptance by the US courts since 1954, despite 2009 findings by the US National Academy of Sciences, the methods and guidelines of bitemark experts has not been scientifically validated.<sup>13</sup>

3. Empirical evidence from legal research of cases by the Innocence Project and other legal authorities that bitemark opinions have contributed to dozens of wrongful convictions and arrests in the US.

4. DNA has replaced bitemark "matching" as the premier method of biter identification regardless of the platitudes of practitioners of this impression comparison method. If proper crime scene protocols are followed, many cases allow recovery and biological analysis of saliva left from bitten skin and clothing covering the injury area.<sup>14</sup> This modality of DNA capture from saliva has been in existence since the late 1990's and

has continued to be refined via improvements in the ability to produce a complete biological profile from increasingly smaller samples. These advances have also impacted the long accepted use of fingerprint identification and other impression evidence methods, such as firearm and tool mark identification.<sup>15</sup>

A. Overview of bitemark comparisons' professional status of its practitioners.

### *Training*

Unlike forensic pathology in medicine, forensic dentistry is not a recognized as a specialty of dental practice (i.e. the American Dental Association has no standards for this aspect of dental activity) or included in the Federal Bureau of Investigation's, or other law enforcement crime labs. Also unlike medicine, there are no forensic residency programs for dentists in the United States. Existing forensic training exists only as online and short course programs with mentorship available in some circumstances.

### *Employment*

The typical forensic dental expert is an independent contractor who is not an employee of a governmental laboratory or law enforcement agency. This is important in the respect that the analytical protocols, work product and opinions of a bitemark expert are not supervised. A popular trend of a few bitemark examiners is to use a second independent dental examiner to peer review the bitemark and suspect evidence for "quality control." This is an unsophisticated substitute for methods widely used within professional crime labs to prevent contact between examiners working on the same

cases. Despite this purported safeguard, the methods bitemark examiners adopt amongst themselves are not validated by independent scientific study and cannot be solved by a second review using methods that are not validated.

## B. Bitemark Analysis: The Evidence, Methods and Assumptions

### *The Bite Evidence*

Human and animal bitemarks commonly are seen in criminal and civil cases involving assaults, child and elder abuse and homicides. This evidence mostly occurs as marks on human skin, although occasionally tooth marks are seen in foodstuffs and other inanimate objects. The presentation of this evidence is generally reflected by bruising in the skin injuries and by indentations of front teeth on substrates such as Styrofoam cups. The skin injuries are extremely variable in pattern shape and detail definition due to the physical properties of human skin. The bulk of skin injuries of this type are of little pattern analysis value (i.e., the ability to reliably “match” to a known human being’s teeth). They seldom show an undistorted pattern necessary to even identify individual teeth. Bitemarks from homicides and violent attacks appear to possess more detail than in child abuse cases, although no research is available on the subject. Any guidelines for determining the minimum detail necessary to comparisons of these varying patterns are non-existent (i.e., a threshold minimum for use in court). The skin evidence is generally ambiguous and the standards for interpretation are not available. These are major reasons that bite mark interpretations for biter identification purposes are speculative and unreliable. The best available crime scene protocol in circumstances

involving a purported bite mark is the transfer of saliva with its accompanying genomic DNA. The necessity of timely collection is paramount. The crime scene or victim investigator must be trained in the recognition of suspected bite mark evidence and DNA collection from skin, clothing overlying a bitemark and objects associated as possibly having been bitten. The proper preservation of this evidence is a paramount responsibility of law enforcement

### *The Suspect's Dental Evidence*

Law enforcement investigations generally start with a list of “suspects” or “persons of interest.” Starting in the US in the 1950’s, the presence of bite mark injuries in a case raised the question regarding the biter’s dental characteristics seen in the injury. The dental examination of any suspect involves the production of plaster casts taken from standard dental impression materials. This information may be legally obtained from a series of suspects in a single case.

### *The Methods*

A bitemark expert compares latent (meaning the pattern in the bruise is incomplete) bruises on the skin present on a crime victim with the front teeth a criminal suspect (sometimes multiple suspects) suspected of being the biter. Cases exist where a victim’s teeth created a bite mark on the assailant. In either case, the comparison of teeth to bitemark is a matter of choice for dental examiners. No list of comparison methods (varying from diverse digital comparison of injury photographs to no method other than the examiner’s visual comparison of the evidences’ “shape”) are published by

any US forensic dental organization, including the American Board of Forensic Odontology. None of these methods have been tested for reliability of measurement techniques, accuracy, reproducibility of different methods by different examiners, physical distortion limitations or dental similarities amongst a realistic population of human subjects (DNA has this data). Additionally, there are no recommendations for which method is best in the varying physical circumstances seen in crime scenes, victim type or locations of injuries seen on victim's body (i.e., child, adult, senior citizen; breast, arm, leg neck, torso or extremities).

**Bitemark Evidence:** Images of the evidence used by police and the courts.

Generally, photographic images are presented to demonstrate evidence considered by the bitemark expert. The variations of patterns in shape and resolution seen in these skin injury patterns and some inanimate objects (i.e. clothing) considered to be made by human teeth are significant. Actual cases brought into investigations and the criminal courts by prosecutors and their bitemark experts show significant levels of expert disagreement.<sup>16</sup>

*The Dentists' Bitemark Opinions* Currently, bitemark "identifications" have devolved to the state where dentists may avoid saying a specific person is the "biter" with "medical-dental certainty" or a "positive match." The increasing number of erroneous bite mark opinions aiding erroneous conviction cases has had a major chilling effect on the contents of their recent opinions. These cases of erroneous convictions have left prosecution dentists with massive liability in civil litigation after the defendant is freed.



Despite this, the few remaining adherents in the bite mark community speak loudly of their value to the US justice system and profess they can still identify “the biter.”<sup>17</sup> They substitute statements such as the suspect “cannot be ruled out,” “is a possible biter” or something similar and just as ambiguous. These semantics are confusing, untestable for accuracy and commonly misinterpreted by juries.

### The Assumptions Present in the Opinions

Bite mark adherents presuppose numerous other unvalidated assumptions. The recent research uncovering these myths has been noticed by the American Dental Association.

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1. These experts have no control of the physical properties of skin (aka “anisotropy, i.e. stretching, tearing, etc.) and lack studies focusing on the match rate of tooth arrangements in the human population. Most admit skin distortion exists but disclaim or ignore it in actual casework. This is a personal assumption. Some even use Adobe Photoshop to “arbitrarily correct” for it.<sup>19</sup>
2. The human dentition is unique. Adherents consider this the equivalent of a fingerprint. It is a weak substitute for doing legitimate research on the subject that human skin can accurately reflect and maintain the teeth pattern’s uniqueness. Research contradictions to this tenet are similar to item 1.
3. Probabilities of matches between a suspect and evidence can be determined by the expert without any scientific foundation or proofs.

### C. A Brief Legal Discussion

Like all forensic identification “sciences”, the claims of the field of forensic odontology clearly are measurable to a certain extent and therefore able for review under the judicial rules and “tests” for evaluating experts’ scientific claims. To date there have been no exclusions of bitemark evidence in US, whether a court uses either the Daubert (1993) or Frye (1923) tests for scientific validity in forensic science subjects. Most researcher and legal experts admit that any court system and its rule makers are poorly equipped to have personal experience in vetting expert witnesses on scientific merits. The court system appears to be unmoved with this method’s lack of validity testing and generally prefers the tried and very unscientific attitude that “stare decisis” (precedence setting cases from the past) as a substitute for foundational scientific scrutiny. Against those criteria, bitemark identification encounters several interesting problems. Clearly, the nature of dentition and the asserted skills of forensic dentists are testable, and the NAS 2009 report said as much, but the practitioners are not equipped, nor inclined to pursue research in any modern context. A relatively recent investigation by the US Congress bypassed bite mark matching as deserving of added funding.<sup>20</sup> The practitioners are much more content to just criticize relevant research that does not support their assumptions.<sup>21</sup>

What is evident from the literature which can be used to predict a semblance of accuracy for bitemark methods suggests an unacceptably high rate of error. Both with the exoneration case results and the few empirical studies, the unerring conclusion is that the multiple variables and challenges inherent to this type of pattern evidence

overwhelms the “art and science” of its practitioners. The bitemark adherents say the wrongful convictions are due to “rogue” practitioners.<sup>22</sup>

Legal arguments currently being used to exclude bitemark experts from testifying in court submit that bitemark injuries are relevant evidence in criminal cases, but only for the instances where DNA has been collected from the bitten area. In cases where DNA is not available, any theory on the biter’s identification from a pattern is argued as a detriment to the defendant’s constitutional right to a fair trial. Further arguments against admissibility focus on its non-science status, case research of erroneous opinions and unacceptable expert conjecture.

D. The William Richards Story: A case study on inexpert investigation and forensic analysis leading to an ongoing “miscarriage of justice.”

A late evening emergency call to law enforcement in a rural desert area of California resulted in the first responder arriving on private property and contacting the male caller. The resident said his wife had been attacked by an unknown person(s) and showed the officer where she lay outside their small trailer. The woman had massive head injuries and was deceased.

The scene was processed by police the following morning when the county coroner removed the remains and detectives arrived once the sun came up. The victim was left unprotected on the property as the security officer was stationed at the entrance to the property along a highway. Three or four dogs entered the scene and partially buried the body.

### *Police omissions and misdirection of investigatory interest*

The officer who first responded considered the husband the prime suspect as he had blood on his clothes, was not significantly despondent at the scene (i.e., not behaving as would be expected considering the circumstances), and in an act of forensic magic, determined on the scene that the woman had been recently murdered, thus eliminating the husband's time alibi (he came home from work and found her body). Detectives and the District Attorney concurred and the husband was eventually convicted (after four trial attempts).<sup>23</sup>

Admission of the officer's statements regarding the following should have been considered suspect at trial:

1. His "expertise" on time of death (TOD) was later admitted at trial as being based on attending a first aid class in the military. This conveniently avoided the improper security of the scene and failure of the Sheriff-Coroner to establish TOD estimates near the time of first contact at the scene.
2. Tests regularly conducted in death investigation SOPs to establish TOD (like core body and liver temperature) were not conducted, leaving the first responding officer's opinion that the victim was not dead very long the only opinion available.
3. His observations of inappropriate behavior of the husband at the scene were clearly an attempt to discredit the husband without any basis of

reliability. The DA did proffer him as an expert trained to psychologically profile persons considered as suspects in a crime.

Other forensic misdirection occurred at the last and final trial before conviction was attained.

### *Bitemark analysts*

At the fourth trial, the DA admitted new evidence proposed by a bitemark expert who confidently stated the victim had a human bitemark on the top of her hand between her right thumb and forefinger. The expert detailed how one particular human upper eyetooth did not leave a mark and that tooth must have been misaligned (i.e., shorter than two adjacent teeth). He then indicated the husband had a tooth that fit the bill regarding this feature found on the hand. He made an added assurance that only a very small percentage (one or two or less out of every hundred people) of people possessed this type of dental anomaly. This virtually identified the husband as the murderer. The defense bitemark analyst agreed this minimal and ambiguous injury was a human bitemark (no marks were seen on the palm of the hand indicating any lower teeth had also bitten). He could not observe any common features between the victim's hand and the husband once again on trial. The fourth trial ended in a conviction.

### Appellate efforts to achieve exoneration of the husband

The post-conviction appeals process was started a few years after the conviction in 1997. Numerous requests for DNA testing of various objects and of biological material and hair taken from the victim years after her murder, once granted, revealed male profiles on the murder weapon (a stepping stone used to bludgeon the victim) excluding

the husband as the biological contributor. Subsequent questioning of the bitemark analysts elicited a new response from each (2008). They both recanted their trial opinions regarding the injury being a human bitemark and the DA expert admitted that no statistical data exists to have supported his opinion presented at the final trial. This new evidence and expert reassessment were added to later appeals which continue to face significant legal opposition from the prosecution on legal procedural and interpretive grounds. The DA argued on appeal that no “new” evidence regarding the bitemark should be considered. The California Supreme Court recently held that the expert recantations and subsequent DNA profiling was still suspect (according to the DA position on appeal the objects and tissue were not properly maintained or documented by their own crime lab). They also authored a new threshold regarding “new evidence” of innocence (i.e., the DNA, and changed bitemark opinions) requiring it to be scientifically “undeniable.” This essentially removes the judicial standard of “beyond reasonable doubt” to prove a conviction and imposes a much more demanding new appellate legal standard. Their new opinion creates an artificial standard of post-conviction proof of innocence that is unattainable in the general scientific community, unheard of in the legal community and further increases a defendant’s burden of proof to legally unattainable levels. The final step for this appeal is a petition to the Supreme Court of California asking for clarification and new review on these aspects.

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## REFERENCES

<sup>1</sup> Amodeo, Oscar, "L'arte dentaire en médecine légale," 1898.

In mass disasters, dentists are able to identify 20-25% of the victims when dental records and passenger lists or missing person reports are available for investigators.

<sup>2</sup> The two categories of physical evidence are impression evidence and pattern evidence. They may be combined as evidence can possess a combination of both types. Human bite marks on victims rarely have compelling indentations (i.e. dents in the skin). Impression and pattern evidence may "link" a suspect or tool to a particular crime scene. This "linkage" is mostly personal opinion rather than scientifically derived proof of the impression or patterns' forensic value or scientific proofs of "uniqueness." This term is a philosophical myth that has been the foundation of certain police "sciences" including bite mark evidence. Traditionally, fingerprints have been considered the strongest proofs of certainty of human identification. Much newer DNA testing indicates that fingerprinting can be involved in erroneous arrests and convictions. Bite mark patterns are seen as bruising injuries on human skin and cannot be used to identify a particular suspect.

<http://www.nij.gov/topics/evidence/impression/welcome.htm>

<sup>3</sup> American Board of Forensic Odontology, See current "President Greg Golden's Fourth Quarter Message." [www.abfo.org](http://www.abfo.org)

<sup>4</sup> <http://csidds.wordpress.com/wp-admin/post.php?post=228&action=edit> . Past ABFO president Lowell Levine discusses how his bitemark efforts are compelling but not scientifically proven.

<sup>5</sup> *"Every now and again, we get a look, usually no more than a glimpse, at how the justice system really works. What we see before the sanitizing curtain is drawn abruptly... is a process full of human fallibility and error, sometimes noble, more often unfair, rarely evil but frequently unequal, and...inevitably influenced by issues of race and class and economic status."* Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council, (2009) *Strengthening Forensic Science in the United States: A Path Forward*, p. 43, 108 available at: <http://www.nap.edu/catalog/12589.html>

<sup>6</sup> This may change due to the 2014 inauguration of the National Forensic Science Commission co-sponsored by the US Department of Justice and the US Commerce Department's Standard's department. See: <http://www.whitehouse.gov/blog/2014/01/10/strengthening-intersection-science-and-justice> . It remains to be seen if there will be any enforcement power to this Commission's output on forensic changes necessary for improvements and solutions.

<sup>7</sup> US courts have provided prosecutorial protections from civil liability law suits after litigating criminal cases where the defendant later has been exonerated. Rarely does prosecutorial misconduct result in court sanction against a District Attorney. Harry F. CONNICK, District Attorney, et al., Petitioners, v. John THOMPSON, 131 S.Ct. 1350 (2011), [No. 09-571](#). See: [http://www.huffingtonpost.com/2013/08/01/prosecutorial-misconduct-new-orleans-louisiana\\_n\\_3529891.html?utm\\_source=Alert-blogger&utm\\_medium=email&utm\\_campaign=Email%2BNotifications](http://www.huffingtonpost.com/2013/08/01/prosecutorial-misconduct-new-orleans-louisiana_n_3529891.html?utm_source=Alert-blogger&utm_medium=email&utm_campaign=Email%2BNotifications).

A recent (2013) criminal court proceedings in Texas has reversed Connick in a case involving similar circumstances. An ex-District Attorney, Ken Anderson, was convicted of contempt of court and sentenced to 10 days in jail for multiple *Brady* ( cite article: [http://www.law.cornell.edu/wex/brady\\_rule](http://www.law.cornell.edu/wex/brady_rule)) violations during a murder prosecution and conviction which resulted in 25 years of false imprisonment for Michael Morton.

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See <http://www.statesman.com/news/news/local/ken-anderson-begins-serving-jail-sentence-in-micha/nbrck/>

<sup>8</sup> See: [http://blogs.phoenixnewtimes.com/bastard/2013/08/bill\\_montgomery\\_opposes\\_propos.php](http://blogs.phoenixnewtimes.com/bastard/2013/08/bill_montgomery_opposes_propos.php) (last accessed August 1, 2013).

This Arizona prosecutor is just the latest example of the distorted view held by some as to what truth, honesty and integrity means in the criminal justice system. After his local office gets a black eye for another exoneration on the books, he riles at the thought that there are no ethical requirements for defendants to be given a fair trial. The US Constitutional right for the 6<sup>th</sup> Amendment is just words to the “win-at-all costs” lawyers. His statement in this news piece that releasing information of evidence favoring a criminal defendant as “burdensome.” What he really wants is a longer list of convictions by any means.

<sup>9</sup> As an example, the prosecution dentists in these three cases continue to deny culpability in contributing to a wrongful convictions.  
[http://www.innocenceproject.org/Content/Bennie\\_Starks\\_Exonerated\\_After\\_25\\_Year\\_Struggle\\_to\\_Clear\\_His\\_Name.php](http://www.innocenceproject.org/Content/Bennie_Starks_Exonerated_After_25_Year_Struggle_to_Clear_His_Name.php) ; <http://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3666> ; <http://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3365>

<sup>10</sup> The most recent case of pre-trial review on the reliability of bite mark identifications had the judge determining State of New York rules of evidence were sufficient to admit bite mark testimony at trial. He based the opinion on the Frye Rule established in 1923.  
<http://www.foxnews.com/us/2013/09/05/new-york-judge-allows-bite-mark-analysis-in-murder-trial/>

<sup>11</sup> .“Bite-mark verdict faces new scrutiny”, 2004 Chicago Tribune, WATCHDOG.  
([http://www.chicagotribune.com/news/watchdog/chi-0411290148nov29\\_0,1894615.story](http://www.chicagotribune.com/news/watchdog/chi-0411290148nov29_0,1894615.story)).

This article describes the questionable convictions in multiple criminal cases where a prosecution bitemark expert identified the biter with “no margin of error.” One case was overturned and exoneration occurred due to conclusive DNA testing. The second case, having the same expert, had the prosecution requesting post-conviction DNA testing to confirm or deny the credibility of the same expert who helped identify the defendant as the perpetrator.

“AP IMPACT: Bite marks, long accepted as criminal evidence, face doubts about reliability,” 2013.  
<http://www.foxnews.com/us/2013/06/16/ap-impact-bite-marks-long-accepted-as-criminal-evidence-face-doubts-about/>

Excerpt: [“...DNA has outstripped the usefulness of bite mark analysis in many cases: The FBI doesn't use it and the American Dental Association does not recognize it.” ]

<sup>12</sup> Applied science is a discipline of science that applies existing scientific knowledge to develop more practical applications, such as technology or inventions. DNA stands as the “gold standard” forensic identification disciplines that meets this criterion of “science

<sup>13</sup> The 2009 NAS Report was the culmination of nearly four years of work by a select committee of members of the forensic, scientific and legal communities, who were directed by Congress to assess the current state of forensic science in this country and make recommendations to strengthen it. The committee heard extensive testimony from a vast array of scientists, law enforcement officials, medical examiners, crime laboratory officials, investigators, attorneys and leaders of professional and standard-setting organizations.

See: Strengthening Forensic Science in the United States: A Path Forward



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Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council. ISBN: 0-309-13131-6, 352 pages, 6 x 9, (2009) <https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf>;

One group studied was bitemark experts and their underlying proofs for validity and judicial acceptance. The Academy 2009 Report detailed their findings on pages 173 – 176.

The report finds "there is continuing dispute over the value and scientific validity of comparing and identifying bite marks." [p. 173](#). The report lists the following concerns:

- "Bite marks on the skin will change over time";
- Bite marks "can be distorted by the elasticity of the skin, the unevenness of the surface bite, and swelling and healing";
- "Distortions in photographs and changes over time in the dentition of suspects, may limit the accuracy of the results";
- "Different experts provide widely differing results and a high percentage of false positive matches of bite marks using controlled comparison studies";
- and concerns about a lack of supporting research, a lack of a central repository of bite marks and patterns, and the potential for examiner bias.

[p. 174](#).

Lack of proficiency testing: None exist

Other forensic organizations such as the American Society of Crime Laboratory Directors (ASCLD) do post examiner proficiency results. It should be noted that some certified crime labs have not avoided having serious problems in quality assurance and examiner credibility.

<sup>14</sup> Hildebrand, Dean, "DNA for first responders: recognizing, collecting and analyzing biological evidence related to forensic dentistry," Chapter 8, ppg.159-181. In "Forensic Dental Evidence: An Investigator's Handbook, 2d edition, Bowers, C.M. editor, Elsevier/Academic Press, 2010.

<sup>15</sup> An excellent article describing this interface of ultra-sensitive DNA profiling and other identification methods is available at: <http://www.promega.com/~media/files/resources/conference%20proceedings/ishi%2002/oral%20presentations/26.pdf?la=en>

<sup>16</sup> Bowers CM, Pretty IA. Expert disagreement in bitemark casework. J Forensic Sci. 2009 Jul;54(4):915-8. doi: 10.1111/j.1556-4029.2009.01073.x. Epub 2009 May 26. <http://www.ncbi.nlm.nih.gov/pubmed/19486248>

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<sup>17</sup> <http://csidids.com/2013/07/01/bite-mark-expert-defends-his-methods-as-good-for-the-court-system-without-scientific-validation/>

<sup>18</sup> “JADA Leads article on bitemarks”. <http://www.forensicdentalservices.co.uk/wp/?p=426>

<sup>19</sup> Bush, MA, et al. Inquiry into the Scientific Basis for Bitemark Profiling and Arbitrary Distortion Compensation. J Forensic Sci, July 2010, Vol. 55, No. 4  
doi: 10.1111/j.1556-4029.2010.01394.x

<sup>20</sup> Proceedings of Senate Judiciary Committee, “Criminal Justice And Forensic Science Reform Act Of 2011”

<sup>21</sup> The ABFO failed to convince the Journal of Forensic Sciences, in two attempts, to publish, their rambling criticisms against University of Buffalo research papers about bitemarks and the similarity of human dentition. The researchers also debunked incorrect and outdated papers relied upon by the ABFO. All 13 papers from the U of Buffalo had been previously peer reviewed and published by the JFS over the last five years. The unprofessionally and personal attack letters to the JFS were refused publication by the JFS editor, Michael Peat.

A 2014 news release by Marquette University cites a four year long project that claims to have solved all (all in one swoop) the questions dogging bite mark advocates for decades. Considering the time gap from bite marks’ first introduction in US Courts (1954) to 2014, this paper’s grandiose claims, merely on its face, reinforces the fact that the bite mark community has been flying blind for about 60 years.

<sup>22</sup> Supra, cite 7. AP IMPACT

Short communication

## Problem-based analysis of bitemark misidentifications: The role of DNA

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### Abstract

The dental literature concerning bitemark methodology is surprisingly thin and sorely lacking in rigorous scientific testing. Contra to this fact, the bitemark legal caselaw is surprisingly strong and is used as a substitute for reliability testing of bite mark identification. In short, the Judiciary and the Prosecutors have loved forensic odontologists.

This paper will focus on the author's participation as a Defense expert over the last seven years in over 50 bitemark prosecutions and judicial appeals. This sampling will act as an anecdotal survey of actual bitemark evidence. Certain trends regarding methods and reliability issues of odontologists will be discussed.

Several of these cases have been later judicially overturned due to DNA analyses after the defendants were originally convicted. These diagnostic misadventures are being vocally discussed in the US media by news and legal investigators who are asking hard questions. The forensic dentistry community, however, is curiously silent. What actions are necessary by the profession to improve this assault on the 52-year tradition of bite mark identifications in the United States?

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*Keywords:* Bitemark misidentification; DNA; Erroneous criminal conviction; Validity; Forensic science

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### 1. Review of contemporary bitemark comparison techniques

A 1998 article reviewed five bitemark techniques used to create suspect dental exemplars [1] which are then superimposed [2] onto rectified and life-sized autopsy photographs [3]. The 1998 study ignored "direct comparison" methods. This technique of placing plaster models of teeth directly onto or adjacent to postmortem supposed bitemark injuries on human skin was rejected due to the dentist's inability to adequately visualize neither the injury pattern nor the dental minutiae of the dental array. This method had also been previously experimentally studied and considered unreliable [4]. The four most common methods were compared to a "digital image gold standard" which produced resulting recommendations to (1) eliminate hand drawn overlay exemplars of suspects' teeth and to (2) use digital images of

suspects' teeth acquired through scanning of dental study casts due to greater accuracy.

No contradiction of these suggestions has been noted in the dental literature since their publication. A recent survey of 30 volunteer dentists of varying experience assessed their performance in digital overlay production and found favorable results [5].

As seen in mainstream dentistry, additional tools and therapeutics can be developed for improvement of health care expectations. These new forensic imaging tools have the same purpose. Since being introduced to the profession [6] these new tools have had little use in certain Prosecution bitemark cases seen by this author while acting as a Defense Counsel expert. This disregard of almost 10-year-old scientific literature possibly indicates the established dental experts (trained in the previous Millenium) do not consider common digital procedures will change their opinions or improve their accuracy.

This author's experience is that bitemark misidentifications have resulted from dentists not using high image resolution superimposition or even dental exemplars of any kind. The

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“direct comparison” method appears frequently in a high number of bitemark mis-identifications where convictions have been later overturned by DNA (see Appendix A, LR1). Attitudes have also played a significant role as these same dentists assume every suspect’s dental array (including gaps, spaces and accidental enamel chipping) is unique in the human population (LR2).

DNA evidence has been used to clear 172 people wrongly convicted of crimes in 31 states since 1989 (LR3). DNA profiling in the US is having a serious impact on expert bitemark opinions regardless of the traditional bitemark methods or techniques utilized. The following section discusses the legal history of bitemarks in the US court system and will shed some light on the judicial attitudes surrounding established bitemark methods encounter with new scientific scrutiny and the biology of DNA.

## 2. History of bitemarks in court

Bite mark analysis has been used in the United States courts since 1954 (LR4). In this first legally published case from Texas, a certain Doyle was charged with burglary. At the crime scene, a piece of cheese was discovered that possessed tooth marks. A suspect was captured by the police and asked to bite a piece of cheese to which he voluntarily complied. A firearms examiner compared the two pieces of cheese to investigate similarities or dissimilarities of the tooth marks. This non-dentist concluded the marks were made by the same person. At trial, a testifying dentist made the same conclusion from plaster models of the original crime scene cheese and the defendant’s cheese exemplar. Appellate court review accepted this method. In later years, this acceptance was judicially stretched to include tooth marks in skin and occasionally other objects. Still lacking up to today is accompanying scientific validation of the chances for mis-identification in the processes used by court recognized bitemark experts (LR5). This void in scientific support for bitemark identifications reliability was ignored 20 years after Doyle by the Patterson (LR6) court, also in Texas. Both courts ignored the unanswered scientific questions and are mentioned here as a reflection of the persistent U.S. judiciary’s avoidance of scientific validation in certain forensic disciplines, with bitemarks being among them. This paper discusses the current legal climate where DNA exonerations of previous bitemark convictions have become the primary fuel to support earlier odontological and legal opinions doubting the reliability of the method.

## 3. Forensic mistakes in court

A recent article about forensic errors [7] targeted the judicial history of legal miscues, false confessions, witness, police, and scientific testimony in relation to the same cases later becoming DNA exonerations. Fig. 1 shows the distribution of trial court opinion and scientific evidence in 86 convictions that have been overturned in the United States. The original judicial decisions were waived in favor of better investigatory, forensic and biological methods.

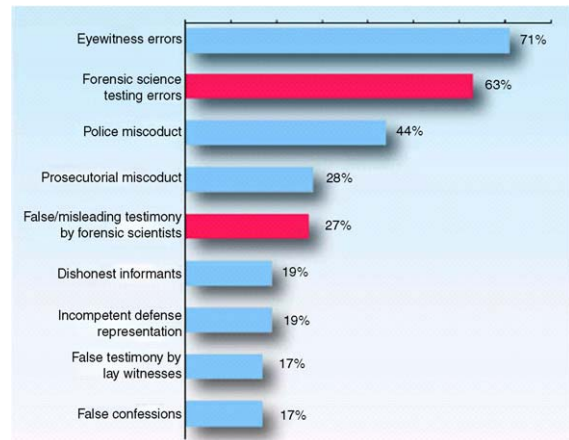


Fig. 1. Saks and Koehler [7] reported that of the 86 DNA exoneration cases they studied, 63% had erroneous forensic science testimony that contributed to the original conviction. They stated published results of bitemark proficiency workshops had false-positive opinions ranging as high as 64% (courtesy to Saks and Koehler [7]).

## 4. The judicial responses to bitemark evidence in criminal court

Scientific admissibility for bitemark evidence could be changing at some legal levels in States that have changed to the Federal Rules for scientific admissibility established in *Daubert v. Merrell Dow Pharmaceuticals* (LR7) in 1993. The most recent *Daubert* reviews in seven U.S. States (LR8), however, indicate no appellate court inclination to tackle ad hoc the underpinnings of bitemark assumptions and methodology. They appear content to expect either the trial court to allow opposing expert testimony or simply wait for DNA results to occasionally appear after conviction to finally settle the questions of guilt.

Proponents of positive biter identification methodology have always and still are (except in the state of Oklahoma) (LR9) allowed to render expert opinions that carry the same evidentiary weight as DNA results (LR10). This fact has fueled many pre-DNA bite mark opinions over the last 52 years that have helped criminal prosecutors influence juries regarding guilt of criminal defendants. The broad-based judicial admissibility of DNA evidence in the US has entered its second decade of use. The judicial problem or task in bitemark identification has always been whether the credentials of the testifying experts meet a modicum of respectability. The questions of science are presented to a jury who weighs the veracity and credibility of the expert. The scientific aspects of reliability are either assumed to be established or the instant case has the expert satisfying the court’s threshold of certainty. Little scientific progress can be accomplished by opposing bitemark experts debating their arguments in front of either a judge or jury as the general judicial rationale is the truth will come out during the judicial proceedings. This is an exceedingly poor venue for scientific review as the viewing participants are being asked to consider concepts beyond their knowledge. The ad hominem (adversarial) style of US court proceedings asks the layman jury to accept/reject dental

experts' conclusions based on mere opinion evidence of (1) dental uniqueness in the human population being confirmed in bitemark injuries, and (2) the appearance and replication of dental features by court accepted dental experts on bruised and injured skin being reliable.

Opinions of positive linkage between injuries and a specific person are not arrived at via scientific rigor (LR11). Entering this 52-year tradition is the new (in its forensic context) independent source of bitemark identification via DNA analysis. This advent of independent scientific analysis is having a direct effect on the credibility of dental bitemark experts. The problems with bitemark opinion evidence have been well documented in the legal literature and are discussed below.

### 5. The history of divergence of opinions by bitemark experts

The legal history of bitemark experts shows dental experts seldom agree with one another at trial [8]. This is not only regarding the identification of a biter, as the record also indicates disagreement as to whether a bitemark exists at all. These disagreements are admitted by the judge, as a matter of course, and are then tasked to the jury to ponder and weigh during the deliberations. The subsequent jury decision is a layman's decision, as the professional experts are merely asked to render their varying opinions without reliability data as convincingly as their abilities allow. This author's opinion on the basis for such expert discord is the failure of the profession to set a minimum threshold for bitemark identification. The American Board of Forensic Odontology's (ABFO) attempt in the 1980s to achieve certain scaled minima of evidentiary value [9] failed, not surprisingly, due to inter examiner discord and unreliable quantitative interpretation of bitemark autopsy and human dentition data [10].

### 6. Data concerning reliability of bitemark opinions

The back and forth argument regarding the reliability of bitemark expert testimony has been going on for decades. Beyond the personal opinion arena, the science of this forensic specialty has the following foundation of data to support its adherents and, conversely, to support its detractors. The weight of these studies is a paucity compared to DNA basic and applied science.

- A 1975 study found that while bites made in wax could accurately be compared to dental models, matching bites made on pigskin, a medium akin to human skin, was vastly more difficult. 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 h after the bites were made [11]. The study concluded that "the inability of examiners to correctly identify bitemarks in skin in 25% of cases under ideal laboratory conditions and when examined immediately after biting suggests that under sometimes

adverse conditions found in an actual forensic investigation it is unlikely that a greater degree of accuracy will be achieved". Due to the problems the study revealed, it concluded, "further studies to substantiate the reliability of the technique are clearly required".

- A 1999 American Board of Forensic Odontology ("ABFO") Bitemark Workshop where ABFO diplomats attempted to match four bitemarks to seven dental models found 63.5% false positives [12]. The ABFO supported publication of a contra response (with accompanying statistical analysis) to this finding by stating, in part, the 4th Workshop was never formally titled a "proficiency test", the samples were unusable for statistical determinations and the findings of this study generalize only to cases having moderate to high forensic value [13].
- A 2001 study of bites made in pig skin, "widely accepted as an accurate analogue of human skin", with dental casts 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 fairing far worse [14]. The study cautioned that the "poor performance" is a cause of concern because of its "very serious implications for the accused, the discipline, and society."

### 7. The availability of DNA and other forensic analysis information that contradicts bitemark evidence

The later 1990s showed the initial influence DNA profiling had on criminal judicial proceedings containing bitemark testimony. In Gates (1998) (LR12), DNA eliminated the suspect from investigation after a forensic dentist stated his teeth matched bitemarks on the victim. The multi-disciplines of DNA, hair and fingerprints excluded a suspect in Bourne (1993) (LR13) where the dentist stated the defendant's teeth matched bitemarks on the victim even though hair, and fingerprint excluded the defendant. Morris (1997) (LR14) was dismissed after the court had opposing dentists disagreeing on bitemark evidence and later DNA profiling arrived which excluded the defendant.

The new millennium has Krone (2002) (LR15). It is the most publicized case of this decade, as the defendant was sentenced to death (later overturned), reconvicted a second time and given a life sentence, and 10 years later exonerated and released. In a stroke of law enforcement luck, the real killer was identified from crime scene DNA and easily found as he was already incarcerated in the same prison as Krone. The primary evidence against Krone in both trials was bitemark testimony from a senior member of the United States odontology community. He successfully swayed the jury in both instances but lost out to a better identification science (Fig. 2).

It seems that manner and outer trappings of the State's dental expert lacked the scientific wherewithal to be sustainable. It is fascinating to read recounts from the jury regarding their certainty that the teeth marks were a "perfect match". Mr. Krone has recently received a considerable settlement from the State of Arizona and various other individuals.



Fig. 2. The Krone case had a senior forensic dentist testifying twice to the positive correlation between these plaster models of the defendant and the injury pattern depicted underneath. DNA proved the defendant was not involved in the murder and rape of the victim.

A forensic odontologist testified at a “preliminary examination” that Otero (2000) (LR16) was “the only person in the world” who could have inflicted the bitemarks at issue. After spending 5 months in jail awaiting trial, the State dismissed the charges after a newly available DNA test excluded Otero as the source of DNA on the victim.

A suspect arrested based on bite mark identification sued for false arrest after DNA tests excluded him (2005) (LR17). Twelve years after being convicted based on testimony from a forensic odontologist purportedly linking Young to a bite mark on the victim, prosecutors agreed to a new trial and dropped all charges after DNA testing excluded Young (2005) (LR18). A codefendant Hill was also released in separate proceedings.

2004–2006 has ongoing appellate proceedings in Brewer (LR19) that after conviction uncovered DNA obtained from the decomposed victim indicating two male sexual assault perpetrators. The man convicted for the crime in the early 1990s and sentenced to death was not a contributor to either DNA profile. The only remaining forensic evidence against the defendant is bitemark testimony that the trial county’s District Attorney has indicated is sufficient to try and convict Brewer a second time. An example of the methods and evidence used in this trial is illustrated in Fig. 3.



Fig. 3. The State’s use of hard plaster models placed onto decomposed skin of the murder victim. The correlation of the models is zero since there are no discernible teeth marks on the body. Note the similar method of “direct superimposition” that was used in Krone.

## 8. Conclusion

Since the above narrates the obvious diagnostic problems involving bitemark identification, my final statement is rather brief. When reputable practitioners strongly disagree with each other, there needs to be a reliable scientific method to prevent past and future errors. In a medical sense, if treatment is considered therapeutically faulty, new diagnostics and modalities must be found. It is up to the dental forensic community to accept this challenge. The legal profession and in particular the judiciary must realize that the proponent of bitemark evidence has the burden of proving its validity using the current available data. This data, however, shows a disturbingly high false-positive error rate.

## Appendix A. Legal references (LR)

### LR1.

Howard v. State of Mississippi, 701 So. 2d 274 (Miss. 1997); Howard v. State of Mississippi, 853 So.2d 781 (Miss. 2003) direct comparison was used by the State expert; Brooks v. State of Mississippi, 748 So. 2d 736, 747 (Miss. 1999) direct comparison used by the State; Mississippi v. Gates, No. 5060 (Humphrey Cty. Cir. Ct. 1998) direct comparison used by the State; Mississippi v. Bourne, No. 93-10,214 (3) (Cir. Ct. Jackson County Mississippi) direct comparison used by the State; Kennedy Brewer v. State of Mississippi. 725So.2d 106 (Miss. 1998) and 819 So.2d 1169 (Miss. 2002) direct comparison used by the State; State of California v. William Richards, Case #FV100826, visual comparison with no exemplars used by the State; State v. Krone, 182 Ariz. 319, 897 P.2d 621 (1995) Low resolution video superimposition used by the State; State of Illinois v Harold Hill, State of Illinois v Dan Young, 12 Years Behind Bars, Now Justice at Last (Chicago Tribune, February 1, 2005).

### LR2.

Id. All cases had the State dental experts arguing either dental uniqueness existed in the bitemark evidence or that individualizing single tooth characteristics of the defendant were present in skin injuries. All defendants were convicted by the jury.

### LR3.

DNA has help exonerate 172, Associated Press, January 13, 2006.

### LR4.

Doyle v. State, 159 Tex. Crim. 310, 263 S.W. 2d 779 (1954). This was the first U.S. bitemark case that underwent appellate court review. The court rationalized that the individual steps involved in looking at impression evidence had been in use for decades, and therefore fell under the Frye scientific rules of admissibility of the time. The threshold rule of Frye held that general acceptance of the relevant scientific community made the analysis acceptable. This was not based on scientific rigor of the dental testimony, as at that time, the dental literature on bitemark scientific reliability was non-existent.

### LR5.

Bowers C.M.: A statement why court opinions on bitemark analysis should be limited. *American Board of Forensic Odontology Newsletter* 1996; 4(2): 5. The author's opinion was that (1) dentists were testifying as to identifications from assumed bitemarks on the basis of general dental characteristics which are ambiguous for human identification, (2) DNA profiling would soon act as a higher standard of identification due to its scientific basis and population studies, and (3) the bitemark cases with conflicting DNA results would have dentists being questioned about their methods and attitudes on the reliability of their opinions.

LR6.

*Patterson v. State*, 509 S.W. 2d 857 (Tex. Crim. App. 1974).

LR7.

*Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 569 (1993). This case and the subsequent *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 119 S. Ct. 1167, 143 L. Ed. 2d 238 (1999). The federal threshold for admissibility of scientific evidence was raised to include published error-rates, and other protections against unsubstantiated opinion evidence. The majority of the U.S. States has adopted this opinion, but has struggled with the science of analyzing science.

LR8.

*Garrison v. State*, 2004 CR 35, 103 P. 2d 590 (Okla. Crim. App. 2004). A dentist was not permitted to testify whether the victim was the source of an alleged bitemark on the defendant. This was based on the holding of Crider listed below.

*State v. Hodgson*, 512 N.W.2d 95 (Minn. 1994). An appeal of admitted bitemark evidence was considered permissible under Daubert rules since the methods were not novel (new).

*People v. Quaderer*, 2003 WL 22801204 (Mich. Ct. App. 2003), appeal denied, 470 Mich. 867, 680 N.W.2d 899 (2004). This holding stated only novel science needs to be scrutinized by Daubert standards. These two cases raise the question regarding why the courts should think lack of "novelty" acts as a guard against scientific proof as Daubert itself stated the applicability of review to established and unconventional (new) evidence (*Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 593 n. 11).

*Seivewright v. State*, 7 P 3d 24 (Wyo. 2000). This court said Daubert did not require an evidentiary hearing prior to being admitted and relied on previous cases where it had been admitted under Frye rules. This hardly rises to a new standard of scientific review of the assumptions, empirical data, and proofs of a forensic science.

*Howard v. State of Mississippi*, 701 So. 2d 274 (Miss. 1997) and *Howard v. State of Mississippi*, 853 So. 2d 781 (Miss. 2003). These are two appellate reviews of bitemark evidence used in a Mississippi death penalty case. The first ruling reluctantly accepted the bitemark evidence and reversed the conviction. The second holding, denied Supreme Court review in 2004, failed to use the Daubert litmus testing of the testifying DA's dental witness use of extreme confidence regardless of DNA refutation, and his untested abilities to identify one human being from artificial partial removable denture teeth he compared to equivocal skin injuries.

In *Brooks v. State of Mississippi*, 748 So. 2d 736, 747 (Miss. 1999), the Court said bitemark expert testimony was admissible because the defense could bring their own opinions at trial and satisfy all the scientific issues. A dissenting opinion expressed considerable skepticism that these scientific issues were settled.

LR9.

*Crider v. State*, F-1999-1422 (October 11, 2001). The lower court only allowed the expert to express that the wound was a "probable bitemark", and the appellate court upheld the judge's ruling. The upper court did not state how this opinion was allowable under the state's newly adopted Daubert standard as no empirical data was presented at trial.

LR10.

*Howard v. State of Mississippi*, 697 So. 2d 415 (Miss. 1997), republished as corrected at 701 So. 2d 274 (holding bitemark expert testimony admissible). *Brooks v. State* 748 So. 2d 736 (Miss. 1999) (holding bitemark expert evidence admissible).

LR11.

D.L. Faigman, D.H. Kaye, M.J. Saks and J. Sanders, *Modern Scientific Evidence: The Law and Science of Expert Testimony*, Chapter 30, Thompson-West, California, 2005–2006. This chapter outlines, in detail, the case law and range of scientific areas of bitemark analysis that are both settled and contentious.

LR12.

*Mississippi v. Gates*, No. 5060 (Humphrey Cty. Cir. Ct. 1998).

LR13.

*Mississippi v. Bourne*, No. 93-10,214 (3) (Cir. Ct. Jackson County Mississippi).

LR14.

*Florida v. Dale Morris* (Pasco County, 97–3251 CFAES, 1997). Two Forensic Dentists Added to Wrongful Arrest Lawsuit (*St. Petersburg Times*, December 24, 1999).

LR15.

*State v. Krone*, 182 Ariz, 319, 897 P.2d 621 (1995).

LR16.

*Otero v. Warnick*, 241 Mich. App. 143 (Mich. Ct. App. 2000).

LR17.

*Burke v. Town of Walpole*, 405 F.3d 66, 73 (1st Cir. 2005).

LR18.

12 Years Behind Bars, Now Justice at Last (*Chicago Tribune*, February 1, 2005).

LR19.

*Kennedy Brewer v. State of Mississippi*. 725So.2d 106 (Miss. 1998) and 819 So.2d 1169 (Miss. 2002).

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