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**INNOCENCE PROJECT PUBLIC COMMENT ON**

**NIST IR 8352-DRAFT Bitemark Analysis: *A NIST Scientific Foundation Review***

**December 9, 2022**

The Innocence Project is pleased to respond to the National Institute of Standards and Technology's (NIST) call for public comments regarding the Bitemark Analysis: *A NIST Scientific Foundation Review* (SFR). For 30 years, the Innocence Project has worked to exonerate the innocent and prevent wrongful convictions through systemic reform. As of 2021, in the United States alone, there have been a total of 29 exonerations and 7 wrongful indictments, where bite mark evidence was used in the original prosecution.[1] Those wrongful convictions have resulted in innocent people serving as long as 35 years in prison and a total of approximately 424 years of wrongful imprisonment.[2] Wrongful convictions not only corrupt the well-being and livelihood of the innocent but also weaken the public's trust in the criminal legal system and diminish the reliability and importance of forensic science.

In 2015, members of the Innocence Project and Dallas Public Defender's Office filed a complaint with the Texas Forensic Science Commission (TFSC) on behalf of their client, Steven Chaney.[3] Chaney was imprisoned for nearly 30 years because of erroneous bitemark analysis. After reviewing the complaint and investigating the issue, TFSC concluded that the validity of bitemark analysis had not been established and recommended a moratorium on the use of bitemark comparison in Texas's criminal courts.[4] As a sign of their concern with the use of bitemark evidence, TFSC encouraged other jurisdictions to conduct statewide reviews of bitemark comparison cases.[5] The integrity of our legal system requires that all forensic methods possess a firm scientific foundation.[6] Bitemark analysis has led to many wrongful convictions because it stands on a weak scientific foundation.[7] The bitemark analysis SFR report explored

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[1] Innocence Project, *Description of Bite Mark Exonerations*, https://innocenceproject.org/wp-content/uploads/2021/07/Description-of-bite-mark-exonerations-and-statistical-analysis_UPDATED-7.6.2021_DRAFT-1.pdf (last visited Nov 14, 2022).

[2] *Id.*

[3] Michael C. Bowers, *Bite Mark Evidence*, *in* Forensic Science Reform 137 (2017), https://linkinghub.elsevier.com/retrieve/pii/B9780128027196000054 (last visited Nov 14, 2022).

[4] Bite Mark Case Review Report, (2017), https://www.txcourts.gov/media/1445768/bite-mark-review-report.pdf; In a Landmark Decision, Texas Forensic Science Commission Issues Moratorium on the Use of Bite Mark Evidence, Innocence Project (2016), https://innocenceproject.org/in-a-landmark-decision-texas-forensic-science-commission-issues-moratorium-on-the-use-of-bite-mark-evidence/ (last visited Nov 14, 2022).

[5] Bite Mark Case Review Report, *supra* note 4.

[6] J.G. Clement & S.A. Blackwell, *Is current bite mark analysis a misnomer?*, 201 Forensic Sci. Int. 33 (2010).

[7] Michael J. Saks et al., *Forensic bitemark identification: weak foundations, exaggerated claims*, 3 J. Law Biosci. 538 (2016).

whether the weakness of bitemark evidence is due to the nature of the evidence or whether inadequacies in current analysis and comparison methods are barriers to its scientific rigor.

## Importance of this Report

The bitemark analysis SFR is an important tool for centralizing the mounting scientific concerns regarding this forensic field. The report accomplishes this by evaluating articles that critique and support bitemark analysis and investigates their scientific principles and methodological limitations. The report is limited to three primary postulates (i.e., uniqueness, transference, and interpretation) of the discipline. Nonetheless, it is an important start to investigating the validity of bitemark analysis. The Innocence Project respectfully offers comments that are intended to strengthen the report. In our comments, we focus on bitemark recognition and identification, the classification of bitemarks and influencing factors, literature clarification, the need for statistical methods, biting devices, and the need for human factors and bias research. However, it is important to acknowledge that proponents of bitemark analysis have not proven that the field can reliably recognize a skin lesion as a bitemark, determine if the supposed bite is from a human, or determine if the suspected biter is a child or an adult. Until those claims can be scientifically proven, the suggestion of a uniform classification system and statistical method are futile.

## Comments

### Bitemark Recognition and Identification

The scope of the bitemark report is clear. The report is solely investigating the uniqueness, transference, and interpretation postulates of bitemark analysis.[8] However, those are not the only important propositions of the field. Bitemark analysts must first determine whether an injury is a bitemark and whether that bitemark is human.[9] A former president of the American Board of Forensic Odontology insisted that bitemark analysis is useful for suspect elimination and determining if the mark originated from a human.[10] There is limited research assessing the validity of this claim. Identifying an injury as a bitemark is complex and can be highly subjective, depending on the severity and location of the skin lesion.[11] The Freeman and Pretty study, referenced in the report draft, demonstrates that there is a lack of consensus among bitemark experts when determining if a pattern injury is a human bitemark.[12]

Additionally, bitemark analysts assert that they can differentiate between a bitemark from a child and an adult.[13] However, research has shown that there is a difference of opinion between

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[8] Kelly Sauerwein et al., *Bitemark Analysis: A NIST Scientific Foundation Review*, NIST IR 8352 (2022), https://nvlpubs.nist.gov/nistpubs/ir/2022/NIST.IR.8352-draft.pdf (last visited Nov 14, 2022).

[9] Richard Souviron & Leslie Haller, *Bite mark evidence: bite mark analysis is not the same as bite mark comparison or matching or identification*, 4 J. Law Biosci. 617 (2017); I.A. Pretty & D. Sweet, *The scientific basis for human bitemark analyses – a critical review*, 41 Sci. Justice 85 (2001).

[10] Sara Reardon, *Faulty forensic science under fire: US panels aim to set standards for crime labs*, 505 Nature 13 (2014).

[11] Anoop K. Verma, Sachil Kumar & Sandeep Bhattacharya, *Identification of a person with the help of bite mark analysis*, 3 J. Oral Biol. Craniofacial Res. 88 (2013).

[12] Adam J. Freeman, *Construct validity of Bitemark assessments using the ABFO decision tree*, https://www.wsj.com/public/resources/documents/ConstructValidBMdecisiontreePRETTYFREEMAN.pdf (last visited Nov 10, 2022).

[13] Iain A. Pretty & David Sweet, *A paradigm shift in the analysis of bitemarks*, 201 Forensic Sci. Int. 38 (2010).

experts when determining whether an assumed biter is an adult or a child. Reesu and Brown conducted a study to assess if the opinions of forensic odontologists and individual odontologists were consistent.[14] The participants were provided four bitemark case photographs and asked to determine if the skin injury was a bite, if the suspected bite was from a human, and if the potential human biter was a child or adult. Eight weeks later, they were provided the same photographs and asked to repeat the questionnaire. The researchers found that there was inconsistency in opinions between odontologists, and there were changes of opinions for individuals over time, regardless of experience level.

Recommendation:

1) Bitemark experts claim that they can accurately recognize and identify a bitemark, determine if the bitemark is from a human, and distinguish between bitemarks caused by a child and adult. The bitemark analysis report should examine this claim when investigating the validity of bitemark analysis.

**The Classification of Bitemarks and Influencing Factors**

If the above postulates of the field can be substantiated using accurate and reliable science, a classification system is needed for skin lesions that have been identified as bitemarks. Currently, there is no singular way to classify different types of bitemarks and this has led to confusion in the field. The use of a singular classification system or scale is important because it allows professionals to communicate the nature of the injury between themselves and allows injuries to be categorized using a common system for research and legal purposes.[15] There are many published classification systems. Sheasby and MacDonald attempted to classify bitemarks based on degrees of distortion.[16] They concluded that the degree of distortion affects arch shape and size. The authors recommend that size-matching techniques should only be used on bitemarks with minimal distortion. In 2007, Pretty offered a human bitemark severity and significance scale.[17] According to this classification method, bitemarks with very obvious bruising and small lacerations or multiple areas of laceration but little bruising have high forensic significance and moderate severity. Whereas marks with complete tissue avulsion, have high severity and low forensic significance. This severity and significance scale was created to enable professionals to assess the forensic quality of bitemark.[18] This scale was utilized to assess the degree of expert agreement in bitemark casework.[19] There are a lot of inconsistencies in bitemark analysis, especially when it comes to expert witness testimony. The use of a verified classification system could aid in revealing inconsistencies and unifying the field. The current bitemark analysis SFR draft should include a discussion on bitemark classification and provide a key takeaway emphasizing the need for consistent terminology and categorization of bitemarks.

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[14] Gowri Vijay Reesu & Nathan Lee Brown, *Inconsistency in opinions of forensic odontologists when considering bite mark evidence*, 266 FORENSIC SCI. INT. 263 (2016).

[15] Pretty and Sweet, *supra* note 13.

[16] D.R. Sheasby & D.G. MacDonald, *A forensic classification of distortion in human bite marks*, 122 FORENSIC SCI. INT. 75 (2001).

[17] Iain A. Pretty, *Development and Validation of a Human Bitemark Severity and Significance Scale*, 52 J. FORENSIC SCI. 687 (2007).

[18] C. Michael Bowers & Iain A. Pretty, *Expert Disagreement in Bitemark Casework*, 54 J. FORENSIC SCI. 915 (2009).

[19] *Id.*

Bitemarks are difficult to classify because of various influencing factors. The current draft of the bitemark analysis SFR report briefly mentions some of the factors that influence bitemark analysis. Influencing factors, such as skin elasticity, location of the bite, tissue damage, body composition, bite force, movement of victim, etc., affect the severity, shape, and size of the mark.[20] The report should explain, in addition to listing, how these influencing factors can affect the transference of an individual's dentition. A lack of bitemark analysis publications focusing on influencing factors reveals that there are major gaps in the literature.

> Recommendation:

2) Include a discussion on bitemark classification.
3) Explain the effects of influencing factors and research studies that investigate or discuss these factors.

**Literature Clarification**

This report succeeds in providing useful studies that properly support the key takeaways and final conclusions. However, a more expansive discussion of the literature would strengthen its conclusions. Lines 718-723 highlights a meta-study with a sample size of over 1,200 articles.[21] This report does not explain the criteria or parameters used to assess the articles and narrow the focus to only 13 articles or cite the methodology if it is explained elsewhere. There were also no in-text citations to help identify these sources.

> Recommendations:

4) Briefly explain the criteria used to narrow the number of articles down to 13.
5) Provide in-text citations for the four articles claiming uniqueness and the 9 articles that found positive matches between dentitions.

Moreover, lines 829-832 provides an example of two highly controlled–and therefore meaningful–studies that resulted in high levels of inaccurate identifications.[22] This report did not provide in-text citations for the study that found a 38% chance of a false positive.

> Recommendations:

6) Provide in-text citation for the above article.

**Need for Statistical Methods**

Lines 735 to 736 of the report states that understanding the frequency of class characteristics in a given population is needed to assess the value of a conclusion of excluded or not excluded.[23] That information will potentially be stored in a frequency database. In general, forensic frequency databases should not be limited to class characteristics. According to ABFO, class characteristics are best used to distinguish between species, whereas individual characteristics

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[20] J.C. Barbenel & J.H. Evans, *Bite Marks in Skin—Mechanical Factors*, 14 J. FORENSIC SCI. SOC. 235 (1974); Crime Museum, *Bite Marks*, https://www.crimemuseum.org/crime-library/forensic-investigation/bite-marks/.
[21] SAUERWEIN ET AL., *supra* note 8.
[22] *Id.*
[23] *Id.*

(i.e., arch and dental characteristics) are used to distinguish between individuals.[24] Bitemark analysis is not limited to species identification, ergo the development of a frequency database should include class and individual characteristics. Additionally, this section of the report should explicitly discuss the need for statistical methods. Once frequency databases are developed, a statistical method will be needed to evaluate the weight of the evidence. Without the goal of developing a statistical method to assess the value of bitemark evidence, understanding the frequency of class or individual characteristics and developing frequency databases lacks utility. However, prior to the development of a statistical method, the field must first prove that class and individual characteristics in dentitions can be reliably identified and transferred to skin.

> Recommendations:

7) Change line 735-736 to "Understanding the frequency of class and individual characteristics…"
8) Add a discussion about the need for and lack of statistical methods for evidence evaluation.

**Biting Devices**

Some bitemark studies involve the use of biting devices.[25] These devices are utilized in bitemark studies that use pig skin or cadavers as representative models. The biting devices are used to ensure that a controlled force is applied to the skin model. As stated in the draft report, bite force is a factor that affects the degree of bitemark distortion.[26] Studies that utilize unchanging skin models and use biting devices produce results that are highly conservative and may overestimate the accuracy of the method. However, these studies still find inconsistencies between bitemarks from the same teeth model and examiners with different experience levels.[27] This report points out that even in highly controlled settings, there are high levels of inconsistency and inaccuracy, even without the inherent distortion and other factors impacting bite mark analysis in case work.[28] A discussion of biting devices will strengthen this conclusion and add to Key Takeaway #4.4.

> Recommendations:

9) Add a paragraph, in 4.2, detailing the use of biting devices in bitemark research

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[24] The American Board of Forensic Odontology, *ABFO Bitemark Methodology Standards and Guidelines*, http://abfo.org/wp-content/uploads/2016/03/ABFO-Bitemark-Standards-03162016.pdf.

[25] S. L. Avon & R. E. Wood, *Porcine skin as an in-vivo model for ageing of human bite marks*, 23 J. FORENSIC ODONTOSTOMATOL. 30 (2005); S.L. Avon et al., *Error rates in bite mark analysis in an in vivo animal model*, 201 FORENSIC SCI. INT. 45 (2010); Mary A. Bush et al., *Biomechanical Factors in Human Dermal Bitemarks in a Cadaver Model\**, 54 J. FORENSIC SCI. 167 (2009).

[26] SAUERWEIN ET AL., *supra* note 8.

[27] Bush et al., *supra* note 25; Avon et al., *supra* note 25.

[28] SAUERWEIN ET AL., *supra* note 8.

**Need for Human Factors and Bias Research**

Bitemark comparison and interpretation methods involve a high degree of subjectivity that shrinks the credibility of the field.[29] The comparison procedures remain subjective, regardless of whether 2D or 3D technology is used to create comparison overlays.[30] The bitemark analysis SFR report should explore the subjective nature of bitemark comparison and interpretation and include a discussion on human factor and bias. There are many potential biasing factors in bitemark analysis.[31] Forensic odontologists usually assist with or perform bitemark evidence collection. During this process, they meet and/or interact with victims and suspects. That interaction may trigger a wave of emotional cognitive input.[32] Emotional influences can have drastic effects on decision making.[33] Some practitioners have a close relationship or communicate closely with law enforcement agencies, which can lead to cognitive bias.[34] This close communication renders a specific type of cognitive bias, i.e., confirmation bias. Confirmation bias intensifies when there is a desired outcome.[35] Additionally, the knowledge of contextual information, such as crime type, age of victim, gender of person of interest (POI) or victim, and race of POI, can influence interpretation and decision-making.[36] These potential biasing factors run the risk of erroneous matches and identifications. It is important to investigate if there is a *bias blind spot* in bitemark analysis. Bias blind spot is a psychological phenomenon that occurs when examiner's acknowledge bias in other fields but not their own and contextual effects go ignored.[37] Bias blind spot yields misguided interpretations, overconfidence, and erroneous results.[38]

Recommendations:

10) Discuss human factors and bias in bitemark analysis.

**Conclusion**

We are grateful for NIST's leadership in the scientific foundation review program and recognize the extensive work that was undertaken to produce the report including an extensive literature review and a Thinkshop to obtain feedback from a diverse set of stakeholders. Thank you for your consideration of this feedback and for providing us the opportunity to comment on NIST IR

[29] STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD, (2009).

[30] Stella Martin-de-las-Heras & Daniel Tafur, *Validity of a dichotomous expert response in bitemark analysis using 3-D technology*, 51 SCI. JUSTICE 24 (2011).

[31] Mark Page, Jane Taylor & Matt Blenkin, *Context Effects and Observer Bias-Implications for Forensic Odontology: CONTEXT EFFECTS AND OBSERVER BIAS*, 57 J. FORENSIC SCI. 108 (2012).

[32] Mark Page, Jane Taylor & Matt Blenkin, *Reality bites—A ten-year retrospective analysis of bitemark casework in Australia*, 216 FORENSIC SCI. INT. 82 (2012).

[33] Itiel E. Dror et al., *When emotions get the better of us: the effect of contextual top-down processing on matching fingerprints*, 19 APPL. COGN. PSYCHOL. 799 (2005).

[34] Page, Taylor, and Blenkin, *supra* note 31.

[35] DANIEL EDGCUMBE, *Confirmation bias in decision making for fingerprints, DNA and eyewitness evidence cannot be explained by cognitive style or thinking dispositions.*, (2019), https://osf.io/59tzd (last visited Nov 14, 2022).

[36] Glinda S. Cooper & Vanessa Meterko, *Cognitive bias research in forensic science: A systematic review*, 297 FORENSIC SCI. INT. 35 (2019).

[37] Jeff Kukucka et al., *Cognitive bias and blindness: A global survey of forensic science examiners.*, 6 J. APPL. RES. MEM. COGN. 452 (2017); Page, Taylor, and Blenkin, *supra* note 31.

[38] Page, Taylor, and Blenkin, *supra* note 31.

8352-DRAFT entitled Bitemark Analysis: *A NIST Scientific Foundation Review*. The Innocence Project appreciates your hard work and diligence. We look forward to the final report or future drafts.