AP® Research Academic Paper

Sample Student Responses and Scoring Commentary

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AP® Research — Academic Paper 2021 Scoring Guidelines

The Response…				
Score of 1 **Report on Existing Knowledge**	**Score of 2** **Report on Existing Knowledge with Simplistic Use of a Research Method**	**Score of 3** **Ineffectual Argument for a New Understanding**	**Score of 4** **Well-Supported, Articulate Argument Conveying a New Understanding**	**Score of 5** **Rich Analysis of a New Understanding Addressing a Gap in the Research Base**
Presents an overly broad topic of inquiry.	Presents a topic of inquiry with narrowing scope or focus, that is NOT carried through either in the method or in the overall line of reasoning.	Carries the focus or scope of a topic of inquiry through the method **AND** overall line of reasoning, even though the focus or scope might still be narrowing.	Focuses a topic of inquiry with clear and narrow parameters, which are addressed through the method and the conclusion.	Focuses a topic of inquiry with clear and narrow parameters, which are addressed through the method and the conclusion.
Situates a topic of inquiry within a single perspective derived from scholarly works **OR** through a variety of perspectives derived from mostly non-scholarly works.	Situates a topic of inquiry within a single perspective derived from scholarly works **OR** through a variety of perspectives derived from mostly non-scholarly works.	Situates a topic of inquiry within relevant scholarly works of varying perspectives, although connections to some works may be unclear.	Explicitly connects a topic of inquiry to relevant scholarly works of varying perspectives **AND** logically explains how the topic of inquiry addresses a gap.	Explicitly connects a topic of inquiry to relevant scholarly works of varying perspectives **AND** logically explains how the topic of inquiry addresses a gap.
Describes a search and report process.	Describes a nonreplicable research method **OR** provides an oversimplified description of a method, with questionable alignment to the purpose of the inquiry.	Describes a reasonably replicable research method, with questionable alignment to the purpose of the inquiry.	Logically defends the alignment of a detailed, replicable research method to the purpose of the inquiry.	Logically defends the alignment of a detailed, replicable research method to the purpose of the inquiry.
Summarizes or reports existing knowledge in the field of understanding pertaining to the topic of inquiry.	Summarizes or reports existing knowledge in the field of understanding pertaining to the topic of inquiry.	Conveys a new understanding or conclusion, with an underdeveloped line of reasoning **OR** insufficient evidence.	Supports a new understanding or conclusion through a logically organized line of reasoning **AND** sufficient evidence. The limitations and/or implications, if present, of the new understanding or conclusion are oversimplified.	Justifies a new understanding or conclusion through a logical progression of inquiry choices, sufficient evidence, explanation of the limitations of the conclusion, and an explanation of the implications to the community of practice.
Generally communicates the student's ideas, although errors in grammar, discipline-specific style, and organization distract or confuse the reader.	Generally communicates the student's ideas, although errors in grammar, discipline-specific style, and organization distract or confuse the reader.	Competently communicates the student's ideas, although there may be some errors in grammar, discipline-specific style, and organization.	Competently communicates the student's ideas, although there may be some errors in grammar, discipline-specific style, and organization.	Enhances the communication of the student's ideas through organization, use of design elements, conventions of grammar, style, mechanics, and word precision, with few to no errors.
Cites **AND/OR** attributes sources (in bibliography/ works cited and/or in-text), with multiple errors and/or an inconsistent use of a discipline-specific style.	Cites **AND/OR** attributes sources (in bibliography/ works cited and/or in-text), with multiple errors and/or an inconsistent use of a discipline-specific style.	Cites **AND** attributes sources, using a discipline-specific style (in both bibliography/works cited **AND** in-text), with few errors or inconsistencies.	Cites **AND** attributes sources, with a consistent use of an appropriate discipline-specific style (in both bibliography/works cited **AND** in-text), with few to no errors.	Cites **AND** attributes sources, with a consistent use of an appropriate discipline-specific style (in both bibliography/works cited **AND** in-text), with few to no errors.

Academic Paper

Overview

This performance task was intended to assess students' ability to conduct scholarly and responsible research and articulate an evidence-based argument that clearly communicates the conclusion, solution, or answer to their stated research question. More specifically, this performance task was intended to assess students' ability to:

- Generate a focused research question that is situated within or connected to a larger scholarly context or community;

- Explore relationships between and among multiple works representing multiple perspectives within the scholarly literature related to the topic of inquiry;
  Articulate what approach, method, or process they have chosen to use to address their research question, why they have chosen that approach to answering their question, and how they employed it;

- Develop and present their own argument, conclusion, or new understanding while acknowledging its limitations and discussing implications;

- Support their conclusion through the compilation, use, and synthesis of relevant and significant evidence generated by their research;

- Use organizational and design elements to effectively convey the paper's message;

- Consistently and accurately cite, attribute, and integrate the knowledge and work of others, while distinguishing between the student's voice and that of others;

- Generate a paper in which word choice and syntax enhance communication by adhering to established conventions of grammar, usage, and mechanics.

Bite Mark Evidence: Credible or Corrupt?

Word Count: 2,864

Abstract

Studies have been conducted into deducing the reliability of forensic evidence in addition to its usage in the criminal justice system. However, these studies fail to include the specific topic of bite mark evidence and its overall reliability. Bite mark evidence is assumed to be a sound science implemented into most murder and/or assault charge cases. Despite this assumption and surrounding doubt of its reliability, bite mark evidence has never been brought under analysis. Upon researching several case studies detailing the usage of bite mark evidence in the criminal justice system, it is obvious there are several inconsistencies within the science. Besides, there is little to no overarching standard used in bite mark analysis. Therefore, this research into the presence of periodontal disease and outlying factors that influence a shifting bite mark supports the inconsistencies found in explored case studies. Furthermore, this research conducted includes impressions made from an individual experiencing periodontal disease, All impressions were taken from the same individual with the same material, yet all produced varying results. This further urges a closer look into bite mark evidence and offers the conclusion that science as a whole is unsound and could be responsible for several wrongful convictions. This alone offers a reason for further research to ensure the reliability of our criminal justice system and its approved evidence.

Introduction

In the world of Forensics, a popular form of criminal evidence has undergone great controversy. This controversial field of evidence in question is that of bite mark analysis. This type of forensic analysis originally came about in the 1970s and specializes in the imprints left behind through bite marks. In reference to these bite marks, a majority of cases utilizing bite mark analysis fall under assault/murder charges. Since the 1970s, however, bite mark analysis has taken a hold of the criminal justice system. It slowly has been implemented into the system as a primary form of convicting evidence. Recently, nevertheless, the credibility of this analysis has come into question. Individuals no longer believe that impression analysis is the most absolute form of science. In relative terms, many factors could influence such an analysis of evidence proving the evidence invalid. Considering the overarching category of court cases that bite mark analysis specializes in, more concern should be allocated toward the credibility of this evidence. Murder/assault conviction isn't slightly achieved or involved with incredible and unanalyzed evidence. This being said, bite mark analysis should rather be analyzed to a severe degree considering its involvement in the criminal justice system. Despite this pressing influence, little action has been taken into the proper evaluation of bite mark analysis.

Considering this topic is largely untouched, there is little to no studies to build off from. Taking into consideration the true effect and depth of this topic allows for urgency to arise in conducting a study. Proper criminal conviction especially in the subjects of assault/murder should be an utmost priority for our country. Exploring the credibility of this forensic evidence will allow for concrete evidence to take place in the criminal justice system. Hopefully, this research will show the lack of credibility in bite mark analysis and result in proper action to be taken in ensuring proper convictions are made.

Literature Review

To gain a complete understanding of the questioned credibility of bite mark DNA, a scope into this evidences' history is essential. Bite mark DNA is classified under the field of Forensic Odontology. In short, according to the *International Journal of Dental Clinics*, a specialty journal in all topics of dentistry, Forensic Odontology is a science "concerned with dental evidence" (Satyawan et al. 1). While Forensic Odontology has been identified in a few incidents of the past, the science truly became predominant in the 1950s. It was gradually defined as the "application of dental knowledge" to both "criminal and civil laws" enforced in the United States justice system (Balachander 1). Odontologists deal with the "proper handling and examination of dental evidence and the proper evaluation and presentation of dental findings"(2). Bite mark analysis is essentially the evidence that fuels forensic dentistry. Teeth, as one can assume, make up the entirety of the evidence investigated. Through the years bite mark analysis has come to play an "important role" within our modern-day justice system (4). With the improvement of technology such as "laser scanning, scanning electron microscopy or cone-beam computed tomography" bite mark analysis has been deemed a successful and sound science (4). Many scientists that back the profession and criminal use of evidence claim that more detail is shown through bite marks especially that of "individual teeth" (5). Yet despite this support system, questions surrounding the credibility of bite mark analysis have come into play within the past decade.

A majority of uncertainty stems from a similar thought process, What if teeth change? Theoretically, such an assumption carries validity. Our mouths are constantly changing through the transformation from adolescents and into adulthood. This is supported through the *Centre for*

Forensic and Legal Medicine and Dentistry, a forensic research center through the University of

Dundee, conducting a study on the evidentiary value of teeth throughout an individual's lifespan.

The center found that the overall "assessment of tooth development is effective until ages 14-16

years" (Manica et al. 43). They further expanded commenting on the assessment of "third

molars" only being dependable "till the age of 21 to 23 years" (43). This evidentiary conclusion

alludes to the unreliable usage of bite mark analysis. If teeth continuously change and can only

be assessed through a certain length of time, then conclusions made off of bite mark analysis

could potentially be invalid. ThisSuch can be proven in the ideology behind bite mark analysis.

In broader terms, bite mark analysis relies on the theory "that no two humans have identical

dentition regarding the shape, size, position and the alignment of teeth " (43). A study conducted

by the *Journal of Forensic Dental Sciences*, an official publication of the Indian Association of

Forensic Odontology, compared the bite marks of canines to that of humans. They concluded that

both canine and human bite marks can create "Intercanine distance" (Kashyap et al. 5) This

essentially details that both canine and human bite marks result in many variations and depend

upon multiple factors. The study concluded that animal and human bite marks require "more

investigation" to properly be included within the justice system (1). Thus such a conclusion

brings in the discussion of the possibility of wrongful conviction. Due to bite mark analysis

becoming more prevalent in recent years, many cases have been convicted solely on this type of

evidence. If basing credibility off of this past touched research, this unsound evidence could have

easily led to the wrongful conviction.

Due to the lack of proof in bite mark analysis credibility, the possibility of wrongful

conviction comes into play. Brandon L. Garrett and Peter J. Neufeld, forensic law analysts, detail

in their article of the *Virginia Law Review* numerous wrongful conviction cases. They discuss

over one hundred percent cases that relied on or included bite mark DNA as their incriminating counterparts. After exhausting extensive research into each case, they concluded that "60%" of cases "provided invalid testimony at trial" based on misstated "empirical data or wholly unsure-ported...empirical data " (Garrett & Neufeld 12). They stated that this failure of credible evidence was an "insult" to "valid presentation of forensic science in criminal cases" (74). Moreover, this disconnect threatened the "integrity and fairness of the criminal process" (45). Such findings shed light on the rising issue of credibility within bite mark analysis. Growing evidence mounts against the solid ground bite make DNA is portrayed to lay upon. If findings like Garret ad Neufeld are completely accurate, the possibility of further wrongful convictions is endless.

This possibility of wrongful convictions and questions of credibility brings about many unanswered questions surrounding bite mark analysis. The validity of bite mark assessment, through research, has become increasingly unknown. In the studies above, researchers have failed to assess the possibility of false or out of date dental records. In many individual cases, the dental records being analyzed as criminal evidence were from years prior. Such a length of time allows for teeth to change. Whether this ranges from missing teeth to even dentures, false dental records have yet to be addressed in the field of bite mark analysis. Hence opening an opportunity to truly research and evaluate the credibility of bite mark DNA in the criminal justice system.

Method Participants

This experimental case study involved no viable pool of participants. A case study is useful "to employ when there is a need to obtain an in-depth appreciation of an issue, event or phenomenon of interest, in its natural real-life context" (Crowe et al. 7). I rather analyzed five past court cases pertaining to assaultassualt/murder charges in which conviction was primarily

based on bite mark evidence. To further analyze the extent of bite mark analysis, a 3D model was

created to offer a visual aid. This model represented a prevalent undocumented issue that is

undocumented called periodontal disease. Periodontal disease "destroys and 'detaches' your

gums and bone from your teeth, forming 'pockets' which allows bacteria to enter and travel

deeper and deeper under the gums, creating a periodontal infection" (Staff 22).

Materials and Procedure

The first step in this experimental case study was to select the five subjects embodying

my look into court cases. I searched through a variety of assaultassualt/murder cases utilizing

bite mark evidence in making a conviction. I focused on selecting cases that involved a variety of

subjects yet revolved around the central conviction of bite mark evidence. This was to

incorporate enough variability amongst the five cases to show more of a trend towards the usage

of bite mark evidence in criminal conviction. **Figure 1** below designates the analysis of

parameters implemented for each case in reference to bite mark analysis.

Figure A

Case A	R v Mohan
Case B	White Burgess Langille Inman v Abbott and Haliburton Co
Case C	R v Abbey
Case D	Ray Krone
Case E	People v Marx

The five court cases/studies were selected under the classification of assault/murder charges. All subjects were convicted solely or partly by bite mark DNA. The specific parameters revolving around this evidence were documented in specific for each listed subject.

The next step in this experimental case study was the creation of a visual model to aid in assessment of the proper parameters for bite mark evidence and its usage in the criminal justice system. Pertaining to the 3D Dental Model, the following materials are necessary, see **Figure 2**.

1	Alginate Impression Material (1lb.)
2	Dental Trays (For dental aligner placement)
3	Polymer Clay (12 oz.)
4	Food Coloring (Optional)
5	Water (16oz.)
6	Tin Cure Silicone (Setting)

All materials besides polymer clay are actively used in the creation of a 3D Dental model. The dental trays are required for both the creation and storage of the 3D model. The procedure surrounding the creation of the model goes as follows. Initially, mix 16oz. of water with 1lb of alginate impression material. Once mixed, add this substance to a single dental tray. Allow this mixture to sit for a total of two minutes and then apply to the dental tray. The substance is malleable for up to twenty four hours, meaning manipulation can easily occur. Following placing the mixture into the dental tray, begin shaping each section of the clay into the desired shape. This dental model created was to outline an individual inflicted with periodontal disease, so I shaped each tooth towards the bite of a hypothetically inflicted individual. Once the teeth have been properly shaped, allow the model to sit for several days. The mixture of polymer clay

requires an extended dry time. After allowing a proper time to cure, place a layer of tin cure

silicone onto your model. This allows for a sheen on your model and further secures the

durability of the model. Furthermore, allow this layer of silicone to dry for around two to three

more hours. Afterwards, the 3D model will be complete.

Once all of the monumental dry time has been completed, your 3D model is prepared to

make impressions. First off, gather the 12oz. of polymer clay and split into four sections of three

ounces. Proceed, to flatten each section of polymer clay. Adding food coloring to each section of

polymer clay is completely optional, however I added this step solely to easier differentiate

between impressions. Once all sections have been flattened, select one to place on the 3D model

for impressions. Hold the desired section to the 3D model for thirty seconds and then release.

This forms an impression of the desired dental alignment that can be used to create bite mark

indentations. Follow these same steps to produce further impressions. I ultimately produced four

bite mark indentations from the dental model. Once the model creation was completed and

transferred into the polymer clay impressions, the next step was to compare and analyze the

resulting information.

Results

Touching back to my central question within this study, "To what extent are the murder

and/or assault convictions in the U.S., made off of bite mark DNA, evidently sound?" This

question is pressing because individuals are becoming critical of impression analysis and

whether or not it is the most absolute form of science. In relative terms, many factors could

influence such an analysis of evidence proving the evidence invalid. Considering the overarching

category of court cases that bite mark analysis specializes in, more concern should be allocated

toward the credibility of this evidence. Murder/assault conviction isn't slightly achieved or

overlooked rather analyzed to a severe degree. This means that invalid evidence could result in a false conviction. This means innocent individuals could be sentenced for charges they didn't commit.

In my research, I collected five specific court cases and studies to be the components of my case study. These cases in specific can be referenced below in Figure A. From my research into these cases/studies, I concluded that the criminal justice system follows little to no parameters in the process of evidence analysis. These cases all evaluated different aspects of bite mark evidence ranging from mouth width to the instance of missing teeth. However, in retrospect to parameters placed upon the actual analysis, none of the cases/studies matched.
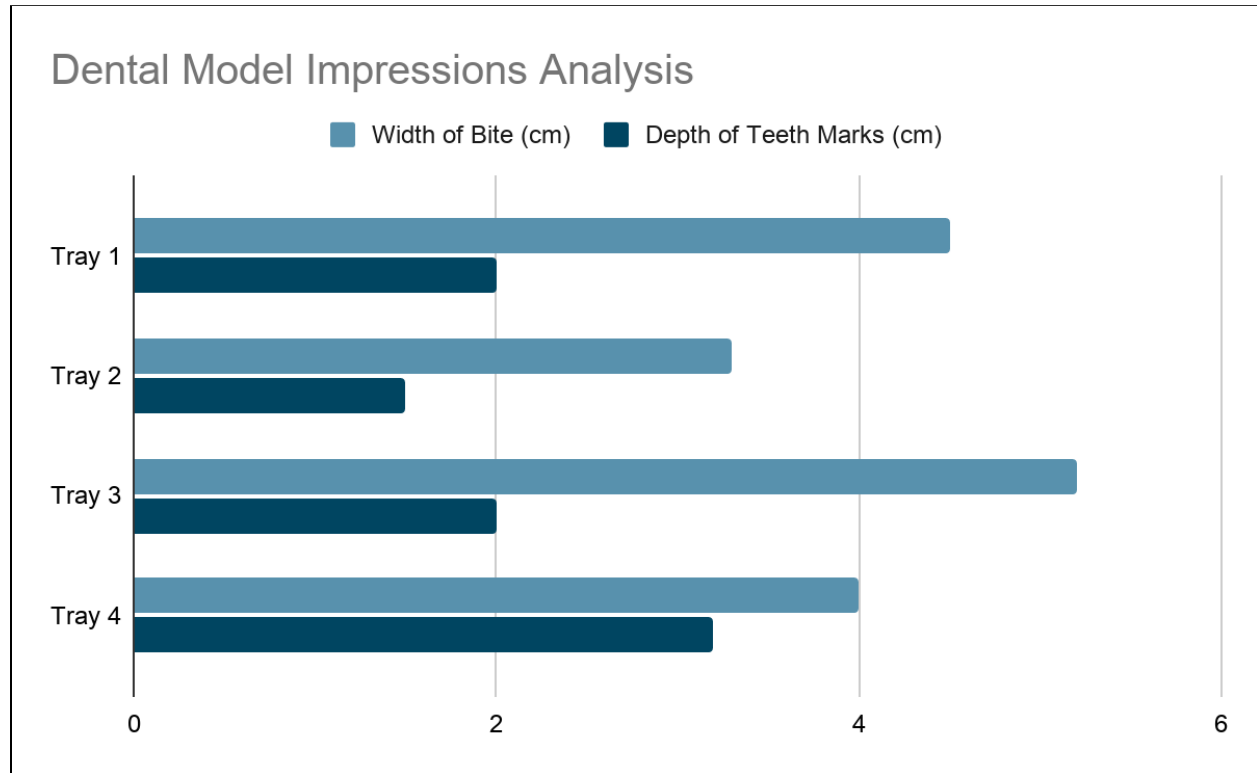
Figure A

Case A	R v Mohan
Case B	White Burgess Langille Inman v Abbott and Haliburton Co
Case C	R v Abbey
Case D	Ray Krone
Case E	People v Marx

Specific court cases and studies included within the case study.

My impressions were made by my 3D-Model depicting an individual with periodontal disease. These trays are attempting to show the unreliability of bite mark DNA in the criminal justice system. The graph below measures each individual tray in cm. Each tray held noticeable differences, making no two-bite impressions the same.

For a further look into these specific trays look into Appendix A

Figure B

Appendix A
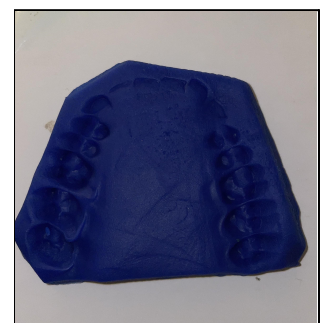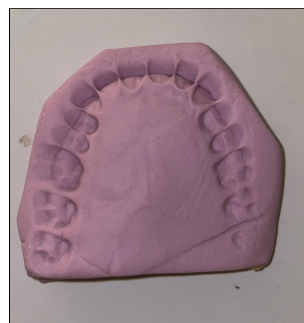
Pictures of trays encompassing the impressions measured and depicted in Figure B.

Picture of 3D model created to represent periodontal disease.

Discussion

In the research I conducted, it is very apparent that there is a correlation between inconsistency and bite mark evidence. About my case study, the specific court cases researched all displayed different parameters in assessing bite mark evidence. In the case "R v Mohan", little to no parameters were placed on bite mark evidence and DNA. The case specifically listed depth of bite marks made in the skin but no other requirements were present in its official presentation (Staff 1). This is similar to the evidence presented in the "Ray Krone" case. Ray Krone was "wrongfully convicted of murder" on solely bite mark evidence. Krone's case relied heavily on a "styrofoam compression" made towards the beginning of his trial (Innocence Project 1). Similar to that of R v Mohan, Krone was convicted on similar-looking impressions. This type of evaluation takes nothing into account such as periodontal disease. This type of evidence is

simply comparing physical appearance and claiming similarity. Such an assumption is easily mistaken and can lead to a wrongful conviction such as Ray Krone.

Taking into account the dental impressions created by my 3D-model, there are apparent numerical differences between each impression. In examining the chart, the only trays to share characteristics are that of the second and fourth impressions. All impressions were taken with the same model and same applied amount of force, so by the logic of bite mark evidence, there should be little to no difference amongst the impressions. These apparent numerical differences, however, show the likelihood of unreliability in bite mark evidence. Ultimately, in the assessment of both the case study and 3D-model, there are apparent misdoings amongst bite mark evidence. There is an obvious correlation between bite mark evidence and inconsistency. While bite mark evidence is claimed to be a "sound" science this research goes to show the need for parameters in evidence assessment and a reevaluation of the reliability of this evidence in a criminal conviction.

Nevertheless, there are limitations to this research. The 3D-model created was based on an individual with periodontal disease. As discussed previously, periodontal disease creates shifting teeth. The model created was made in adherence to this factor and featured a missing molar on the right side of the individual's mouth. Critique can be said towards the model not accurately representing periodontal disease. Besides, the model is simply a manufacturer of someone's bite and not an actual person. Both of these factors can be claimed towards the evidence and undermine its meaning. Nevertheless, this research was simply to find correlation and urge reevaluation of this type of evidence in Forensic science. Ultimately this research was to show an accurate representation and to never blatantly claim to bite mark science as unsound.

Conclusion

Touching back to the initial motive behind this research of bite mark analysis surrounds the ensured justice promised through the United States criminal justice system. The system present in our country is founded upon the principle of innocent until proven guilty. Such a principle holds the justice system to a higher standard. This, of course, encompasses the evidence used in a trial. This type of forensic evidence is involved in severe murder/assault charges. Thus the punishment placed upon the accused individual carries the same weight. From this research's results, it is apparent that a further look should be taken to ensure the soundness of bite mark evidence.

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Academic Paper

Note: Student samples are quoted verbatim and may contain spelling and grammatical errors.

Sample: H
Score: 2

This paper earned a score of 2. It did not earn a score of 1 as it contains a narrowing topic and an attempt at a method, albeit unreplicable. The topic, while broad, can be found on page 6: "… to truly research and evaluate the credibility of bite mark DNA in the criminal justice system." Additionally, the paper provides a narrowing research question found in the results section on page 9: "To what extent are the murder and/or assault convictions in the U.S. made off of bite mark DNA, evidently sound?" Finally, the paper has a method, found on pages 6 through 9 in which "past court cases pertaining to assualt [sic] /murder charges" are identified as case studies, although there is no rationale as to how cases were selected. The method continues to discuss how a 3D model was created but offers no reconciliation between the court cases and the periodontal disease mold, making this method unreplicable and preventing the paper from earning a score of 3.

Additionally, this paper did not earn a score of 3 as it only provides a single perspective in its investigation of the professional community, and there is no new understanding generated by applying the paper's methods. Thus the paper's alignment is problematic.