Review Article

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# Reliability of Bite Mark Analysis in Identification of an Individual: A review Running Title: Bite Mark Evidence

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**Abstract:**

Forensic odontology is a branch of dentistry that uses tooth in the identification of a human. Like a finger print tooth of an individual is very unique and it can be used for identification of an individual. When mass casualties, crime scenes, or terrorist attacks occur, it is crucial to identify the bodies of the victims. In many such cases forensic odontology played an important role. Bite mark is as unique as fingerprints and DNA. Individual bite marks are characterized by characteristics such as the distance and angle between teeth, missing teeth, fillings, and dental work which makes bite mark unique to an individual. A bite mark on a victim's body or other object at the scene of a crime can be used as an evidence if it is recorded and handled properly.But still the reliability of the bite mark analysis in establishing the identity of an individual is questionable. In this article we have searched and reviewed various articles related bite mark analysis and its limitation in establishing the identification of an individual.

**Keywords:** Bite Marks, mass causalities, evidence, analysis

## Introduction:

Forensic odontology involves the proper examination and handling of dental evidence in a court of law to deliver justice as a part of forensic medicinal sciences.

Bite mark is defined as a mark caused by the teeth either alone or in combination with other parts of the mouth[(1)]. Bite mark is unique for every individual as every person has unique pattern of teeth arrangement, rotation or misalignment of teeth. In a crime scene, it may be found on the body of the victim, on food, or on any object the suspect bite. Bite marks are involved in the violent crimes, child abuse or sporting events.

The class characteristics of the bite mark identify the group from which it originates: human, animal or others. Bite mark characteristics' and 'tooth class characteristics' are the two class characteristics[(2).]

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The range of conclusion that we can draw from the analysis of bite marks are excluded, inconclusive, possible biter, probable biter and reasonable medical certainty[(3).]

A guideline is laid down by ABFO to record the bite marks. The steps involved in Bite Mark recording is shown in table 1

| From victim | From suspect |
|---|---|
| Consent | Consent |
| History | History |
| Documentation | Clinical examination |
| Photography | Photographs |
| Saliva swab | Impressions |
| Impression and model | Bite samples |
| UV illumination | |
| First aid | |

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## Methodology:

Using goggle engine search articles on bite mark analysis were retrieved. The keywords like 'bite mark', 'evidence, crime scene','cases solved', 'controversy related to bite marks' were used to search the relevant articles. There were almost 30 articles related to the use of bite mark analysis and its implication in delivering the justice.

## Discussion :

In a case reported in year 1870 Ohio Vs Robinson[4] the accused was reportedly freed even though the bite mark present on the body of the victim was matched with the suspect with reasonable certainty.

Doyle v. State, Texas (in year 1954) was the first case in which bite mark left by Doyle in the process of committing a burglary, on a partially eaten piece of cheese was used as evidence[5].

The most important case that was related to use of bite mark analysis in the justice was the Ted Bundy case in which he was convicted based upon the presence of bite marks on the body of the victim. After more than a decade of denials, he confessed to 30 murders committed in seven states between 1974 and 1978.[6]. It was probably the first case in the history that has actually highlighted the importance of bite mark analysis in conviction of a suspect.

After that many cases were reportedly solved by the bite mark analysis[7,8].

If we look into the cases in the India one of the most important case in India solved by the bite mark analysis was Nirbhya gangrape case in 2013 The bite marks was analysed with the aid of computer software and it was confirmed that two of the bite marks were identical with two suspects. The submitted evidence was approved by the court on May 6, 2013[9].After that reportedly there were two more cases of rape was solved by bite mark analysis by the forensic odontologist from KEM Hospital Mumbai[10]. In one case the victim was murdered and, in another case, the victim was unable recollect anything about the rape incidence that took place. So, in both the cases the bite mark analysis played a very crucial role in delivering the justice.

Recently, however, there have been reports of incorrect bite mark analyses leading to wrong convictions. One of such case was Ray Krone case in 1991[13] in which he was wrongly convicted in rape and murder case and was sentenced to death. It took almost ten years for Krone to be exonerated after a re-evaluation of the case and DNA analysis left on the victim.

Similarly the case of Kennedy Brewer case in 1992 he was charged with murder of 3 year old daughter of his girlfriend based on the analysis of bite marks present on the body of the victim and was sentenced to death. After many years reinvestigation of the case and DNA test proved that Kennedy was innocent. [14]

A quarter of the exonerated Americans since 1989 were wrongly convicted because bite mark analysis was incorrect, according to the National Registry of Exonerations U.S.A.[13].

Such reports are definitely of big concern. When it comes to analysing bite marks, it is actually a pattern matching exercise, so there is room for error both during the recording and analysis of the bite marks.

Apart from that the human dentition consists of 32 teeth, each with five anatomical surfaces. Despite this, Bite marks analysis yields very little information because there are often only four to eight teeth found in Bite marks evidence. According to a study three dimensions models of dentition drawn from two different people from a sample of 500, whose six front teeth are found indistinguishably alike[15].

The bite marks are an important evidence left on the body of the victim by the culprit. Skin is not a good material for recording bite patterns, and the victim's struggle and movement during the assault further result in inaccurate and inappropriate recordings.

Skin is a highly viscoelastic material that means indentations left by teeth during biting will rebound, so that affects to the recording ability of skin by leaving no potentially record of the three-dimensional structure of the biting edges of teeth[16].

A bite mark's shape and clarity changes within a relatively short period of time, both in living and dead people.In cases of laceration and abrasion injuries, the time interval between examining and recovering evidence can result in distortion because of contraction and healing artifacts, which affects the dimensions and appearance of bite marks.[17]

Bite marks identification methods include direct or indirect comparison. In direct comparison dental model from the suspect can be directly placed over the photographs of Bite marks to demonstrate concordant points and in Indirect

comparison involves transparent overlay which is then placed over the scaled 1:1 photographs of Bite marks for comparison. Other methods such as odontometric triangle method and image perception software also used for the Analysis of Bitemark[18]

One of the most important drawback in the bite mark analysis is the technique that is being used by the forensic odontologist. For indiect or overlay method a variety of tecniques can be used like computer generated overlay or use of problems in Bite marks analysis is the wide variety of techniques and techniques using complex computer systems, special light sources, reflex and scanning electron microscope.

A survey was conducted on 72 odontologists and it was observed that 90% of them used overlay method for pattern analysis. The interesting observation was that 30% of the overlay used in the analysis were not computer generated and even 10% of them were hand-drawn.[19]

It means there is no definite protocol to do bite mark analysis. Overlays generated by computer are well documented to be superior to overlays generated by other methods. It should always be used for bite mark analysis for better matching of pattern.

The NAS report stated that "no thorough study has been conducted of large populations to establish the uniqueness of Bite marks"[20].

NAS report published in 2009 finds that many Forensic evidence including Bite marks is introduced in criminal trials without any meaningful scientific validation, determination of error rates, or reliability testing to explain the limits of discipline.[20].

If we talk about the reliability of a measuring instrument or a human examiner it means that we must be getting the same results again and again when it measures the same thing repeatedly. Intra examiner unreliability means when examiners examine the same evidence at different times, they give different conclusions. The bite marks identification is entirely subjective. Bite marks comparison does not have any minimum criteria for declaring a match. Absence of precise and objective criteria for declaring matches compromise the reliability of Bite marks Analysis. When computerized complex image analysis used for Bite marks analysis to make the process more objective and tested in the real legal case, a different biter was identified instead of the defendant who is already convicted on the basis of expert testimony[21].

Iain pretty and David sweet in 2001 conducted a study using digital overlays for comparing known and questions Bite marks and evaluation done by board-certified dentists. According to the study, "even though the overlay is widely effective, there is concern about the variation among odontologists in their performance. Intra-examiner agreement was found to be as low as 65%, false positives averaged 15.9%, and false negatives averaged 25% [22].

This finding indicates that the reliability of the forensic expert in examining the bite marks is variable and every forensic expert may not be competent enough to do the correct analysis of bite mark.

## Conclusion:

Bite mark is definitely very valuable circumstantial evidence. Its usefulness depends largely on the expertise and accuracy of the forensic expert recording and analyzing the bite mark.The ABFO should establish certain guidelines and conduct training programs for forensic experts so that they can correctly analyze bite marks.It will negatively impact the reliability of the bite mark as evidence if it is not implemented.

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