Awareness of bite mark analysis among dental students

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Abstract: Bite mark evaluation plays a crucial role in forensic investigations, relying on the principle that no two mouths are alike. This study assesses the knowledge and awareness of bite mark analysis among Bachelor of Dental Surgery (BDS) students in Chennai, India. A structured questionnaire was administered to 100 students aged 18-24, covering various aspects of bite mark identification, classification, and forensic applications. The findings reveal that 77.78% of students recognize teeth as a source of DNA, and 70.37% believe sex determination can be conducted through bite mark analysis. Additionally, 92.59% identify photography as the most common method for bite mark identification. The study underscores the significance of forensic odontology in criminal investigations and highlights the need for enhanced education and training in bite mark analysis among dental students.

Keywords: Bite mark analysis, forensic odontology, forensic dentistry, DNA identification, sex determination, dental evidence, forensic science, criminal investigations, dental students, forensic photography.

Introduction

Bite marks evaluation is primarily based totally at the precept that 'no mouths are alike'. Bite marks are thus, taken into consideration as a treasured opportunity to fingerprinting and DNA identity in forensic examinations. A bite mark is a mark created by teeth either alone or a combination of other oral structures (1). In different words, a bite mark can be described as a mark having happened because of both a bodily alteration in a medium due to the touch of tooth, or a consultant sample left in an item or tissue through the dental systems of an animal or human (2). Bite marks can be discovered truly on any part of the human frame, common sites being the face, neck, arm, hand, finger, shoulder, nose, ear, legs, etc (3). These are encountered in some of crimes especially in homicides, quarrels, abduction, child abuse instances, sexual assaults, throughout sports activities activities. While bite marks at the frame are deliberately caused, the ones discovered on the particular object are generally unnoticeably left through the offenders on the scene of crime (4). In order to become aware of the offender, the dental casts of suspected
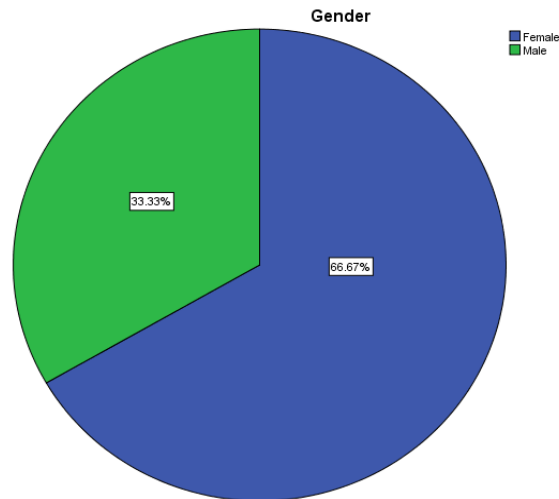
individuals are organized and matched. Bite marks if analyzed well can show the involvement of a specific gender, age, etc in a specific crime (5).

Materials and Methods

The study to evaluate knowledge of bite mark analysis was carried out among the students who were enrolled in the Bachelor of Dental Surgery (BDS) program in Chennai, India. The targeted population for the study was 100 dental students within the age groups of 18-24. In this study, there was a formulation and distribution of a survey/ questionnaire, which was conducted among the students. The questionnaire consisted of ten general questions to test not only their knowledge but also their awareness of the issue.

Results

With the collected data, 33.33% who have participated were females and 66.67% were males (Graph 1). By this study, I came to know that approximately 77.78% of the students knew teeth can serve as a source of DNA whereas 22.22% had the perception that it can not act as an important source when it comes to DNA (Graph 2). Approximately, 70.37% of the students agreed that sex determination be done with bite mark analysis, 25.93% disagreed it serves an important purpose and 3.70% sided with both or were unsure with their opinion. (Graph 3). Roughly 77.78% believed that enamel and dentin aid in age identification whereas 22.22% disagreed (Graph 4). Approximately, 18.52% of students believed signs if swelling was an indication of swelling, 70.37% all of the above, 3.70% redness or rash, heat on and around the site of the bite or sting, 3.70% swelling, pain in the affected area or in the muscles, heat on and around the site of the bite or sting, 3.70% swelling, redness or rash, pain in the affected area or in the muscles, itching, heat on and around the site of the bite or sting (Graph 5). Following the seven types of bite marks, 74.07% hemorrhage, 3.70% abrasion, 3.70% contusion, 18.52% avulsion (Graph 6). Approximately, 7.41% of the students thought that bite mark analysis involves only visualization and comparison, 22.22% for only court testimony, and 70.37% for all of the above (Graph 7). 18.52% believed that overlay was an analysis method for bite marks, 70.37% metric analysis, 3.70% three-dimensional analysis, 3.70% instance analysis, 3.70% none of the above (Graph 8). As one of the following given statements was false, 22.22% had chosen front teeth are the primary biting teeth in bite marks, 74.07% upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped, 3.70% lower central incisors and lateral incisors are uniformed in width and lower cuspids are cone shaped (Graph 9). Photography the most common method for identification of bite marks as it generated 92.59% whereas 7.41% for is not the most common method (Graph 10). As one of the following given statements was true, 85.19% had chosen the option penetrate skin and help visualize bite mark injury below skin surface, 7.41% does not penetrate skin and gives detailed image, and 7.41% require special filters, UV light source, and UV sensitive films (Graph 11).

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Graph 1: Pie-chart represents responses regarding the gender of the participants. 66.67% - females, 33.33% males.
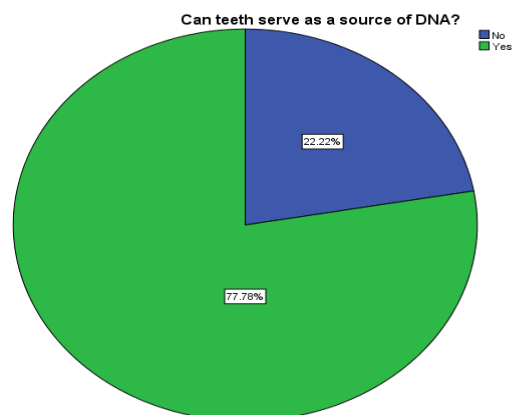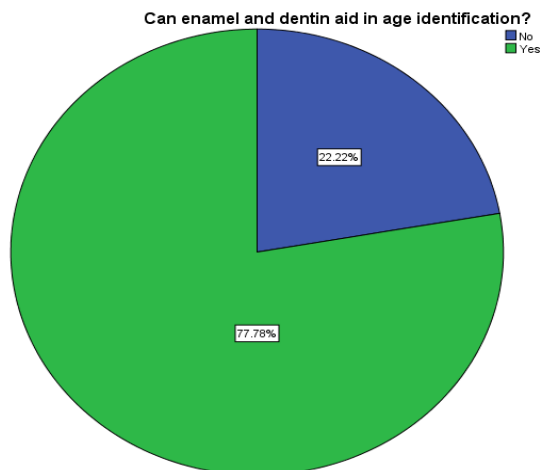

Graph 2: Pie-chart represents responses regarding whether teeth can serve as a source of DNA. 77.78% - yes, 22.22% no.
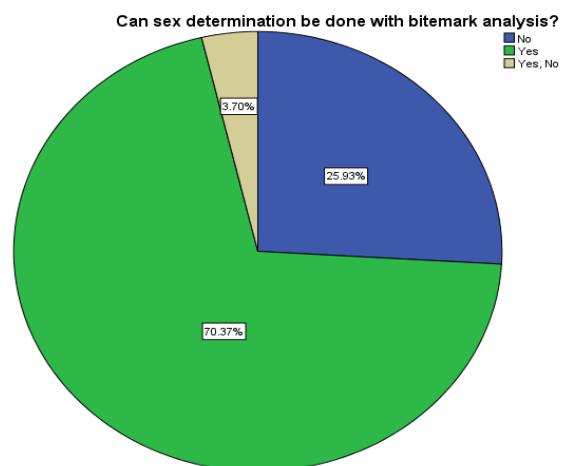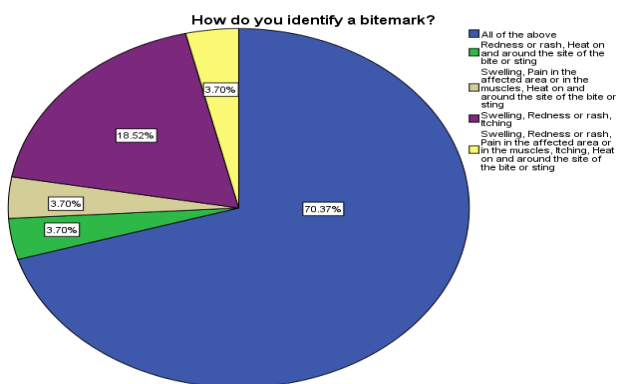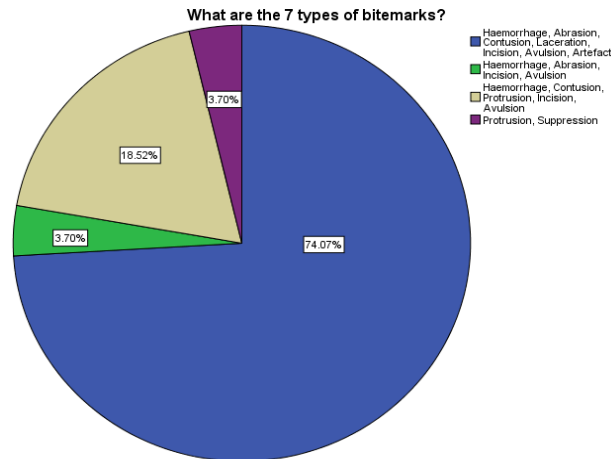
Graph 3: Pie-chart represents responses regarding whether sex determination can be done with bitemark analysis. 70.37% - yes, 25.93% - no, 3.70% - yes & no.
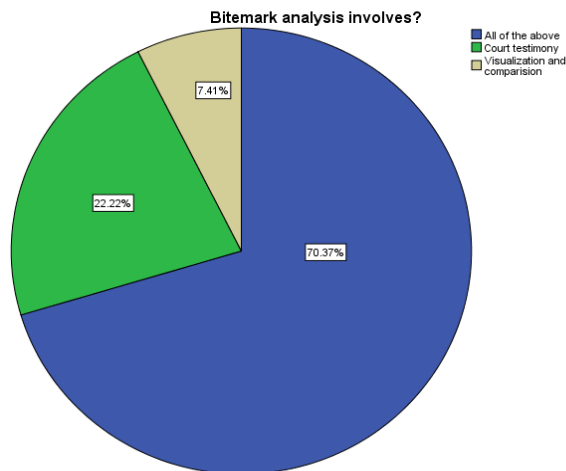

Graph 4: Pie-chart represents responses regarding whether enamel and dentin can aid in age identification. 77.78% - yes, 22.22% no.

Graph 5: Pie-chart represents responses regarding how a bite mark can be identified. 70.37% - all of the above, 3.70% - redness or rash, heat on and around the site of the bite or sting, 3.70% - swelling, pain in the affected area or in the muscles, heat on and around the site of the bite or sting, 18.52% - swelling, redness or rash, itching, 3.70% - swelling, redness or rash, pain in the affected area or in the muscles, itching, heat on and around the site of the bite or sting.

Graph 6: Pie-chart represents responses regarding the knowledge of the 7 types of bite marks. 74.07% - hemorrhage, 3.70% - abrasion, 3.70% - contusion, 18.52% - avulsion.
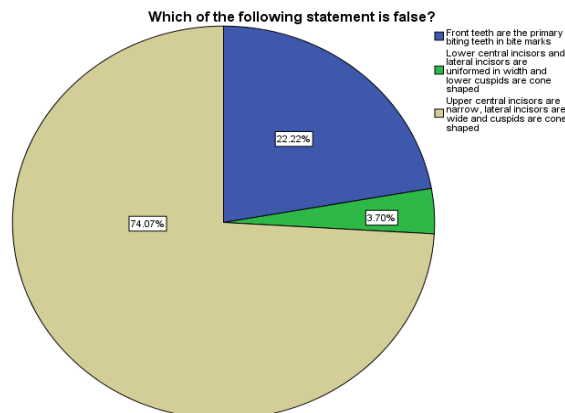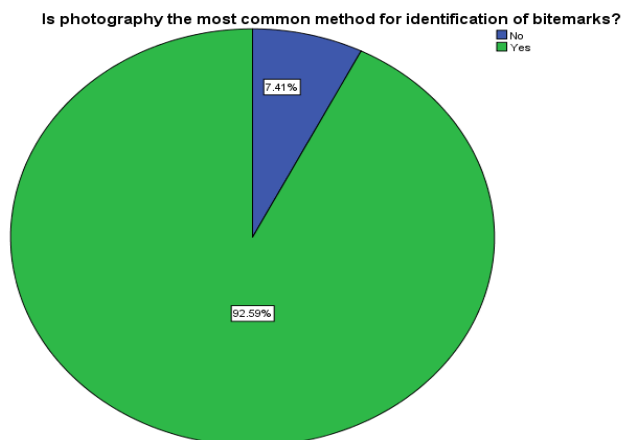

Graph 7: Pie-chart represents responses regarding the various methods that are involved in bite mark analysis. 70.37% - all of the above, 22.22% - court testimony, 7.41% - visualization and comparison.

Which of the following are analysis methods for bitemarks?

- Instance analysis
- None of the above
- Overlay
- Overlay, Metric analysis, Three dimensional analysis
- Overlay, Three dimensional analysis

3.70% 3.70% 3.70% 18.52% 70.37%
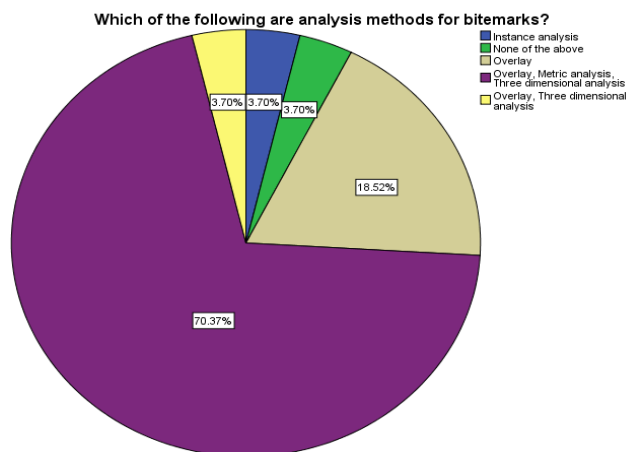
Graph 8: Pie-chart represents responses regarding the analysis methods for bitemarks. 70.37% - metric analysis, 3.70% - three dimensional analysis, 18.52% - overlay, 3.70% - none of the above, 3.70% - instance analysis.

Which of the following statement is false?

- Front teeth are the primary biting teeth in bite marks
- Lower central incisors and lateral incisors are uniformed in width and lower cuspids are cone shaped
- Upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped
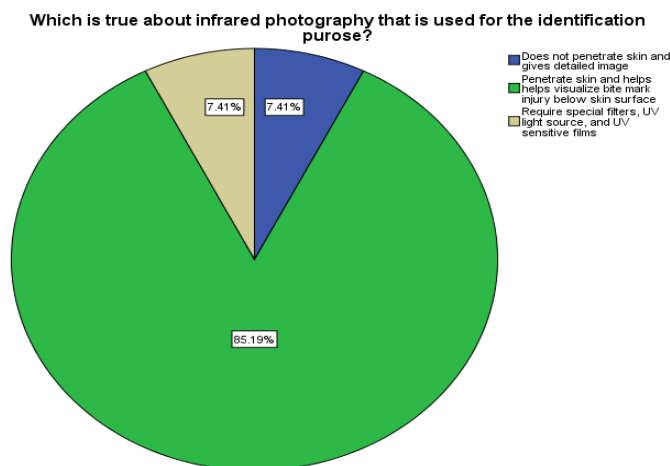
22.22% 3.70% 74.07%

Graph 9: Pie-chart represents responses regarding the knowledge of the false statement. 74.07% - upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped, 3.70% - lower central incisors and lateral incisors are uniformed in width and lower cuspids are cone shaped, 22.22% - front teeth are the primary biting teeth in bite marks.

Is photography the most common method for identification of bitemarks?
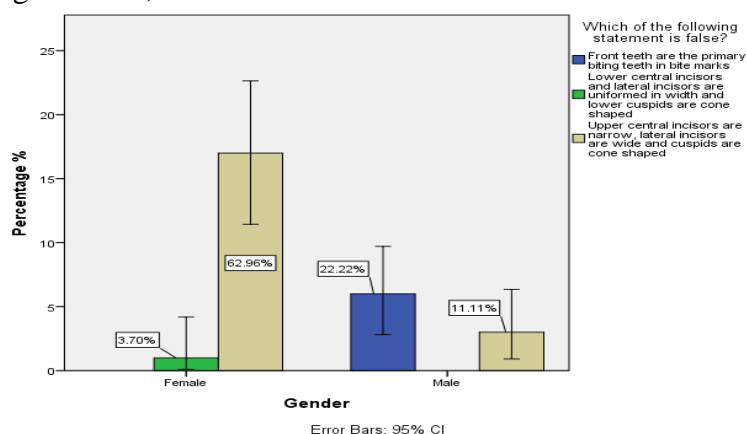
- No
- Yes

7.41% 92.59%

Graph 10: Pie-chart represents responses regarding whether photography is the most common method for identification of bitemarks. 92.59% - yes, 7.41% - no.

Which is true about infrared photography that is used for the identification purose?

- Does not penetrate skin and gives detailed image
- Penetrate skin and helps helps visualize bite mark injury below skin surface
- Require special filters, UV light source, and UV sensitive films

7.41%   7.41%

85.19%

Graph 11: Pie-chart represents responses regarding the true statement about infrared photography that is used for the identification purpose. 7.41% - does not penetrate skin and gives detailed image, 85.19% - penetrate skin and helps visualize bite mark injury below skin surface, 7.41% - require special filters, UV light source, and UV sensitive films.

Which of the following statement is false?

- Front teeth are the primary biting teeth in bite marks
- Lower central incisors and lateral incisors are uniformed in width and lower cuspids are cone shaped
- Upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped

3.70%   62.96%   22.22%   11.11%

Gender

Error Bars: 95% CI

Graph 12: Bar graph showing the association of responses based on different gender to the the statement which is false, where green denotes lower central incisors and lateral incisors are uniformed in width and lower cuspids are cone shaped, and brown denotes upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped, and blue denotes front teeth are the primary biting teeth in bite marks. X axis represents gender and Y axis represents percentage. Out of 100 participants, 3.70% responded to lower central incisors and lateral incisors are uniformed in width and lower cuspids are cone shaped and 62.96% upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped among females, 22.22% responded to front teeth are primary biting teeth in bite marks, 11.11% responded to upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped among males. Gender does not have an influence on the general opinion and perception. Pearson Chi-square value = 0.000, statistically significant.
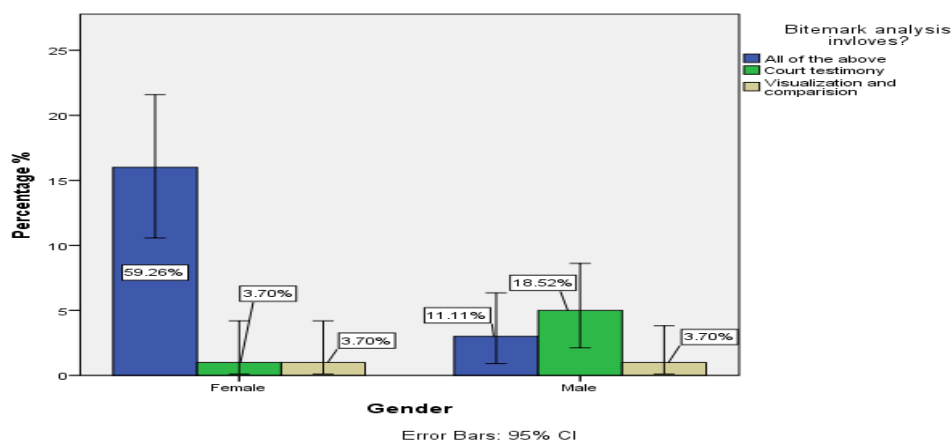
Graph 13: Bar graph showing the association of responses based on different gender to where bite mark analysis can be involved in, where blue denotes all the above, green denotes court testimony, and brown denotes visualization and comparison. X axis represents gender and Y axis represents percentage. Out of 100 participants, 59.26% responded to all of the above, 3.70% responded to court testimony and 3.70% responded to visualization and comparison among females, 1.11% responded to all of the above, 18.52% responded to court testimony, and 3.70% responded to visualization and comparison among males. Gender does not have an influence on the general opinion and perception. Pearson Chi-square value = 0.008, statistically significant.
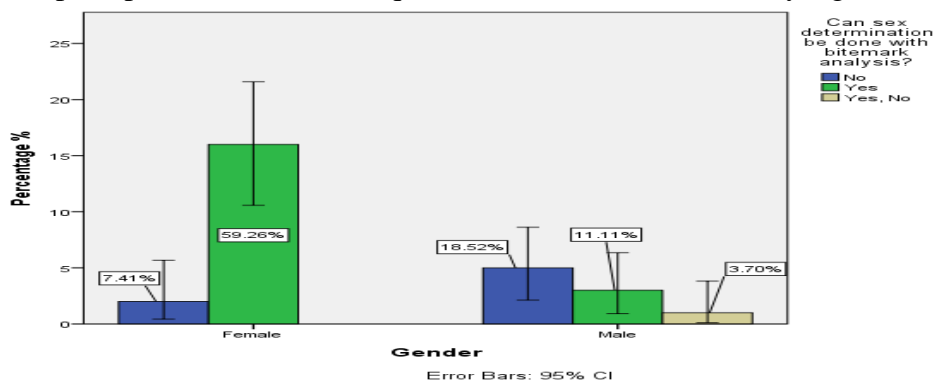
Graph 14: Bar graph showing the association of responses based on different gender to the wheather sex determination could be done with bitemark analysis, where blue denotes no, green denotes yes, brown denotes both yes and no. X axis represents gender and Y axis represents percentage. Out of 100 participants, 7.41% responded to no and 59.26% responded to yes among females, 18.52% responded to no, 11.11% responded to yes, and 3.70% responded to both yes and no. Gender does not have an influence on the general opinion and perception. Pearson Chi-square value = 0.010, statistically significant.

Discussion

Bite marks analysis can be classified into the general classification along with the applications within the forensic science field and many others. They can also be classified into the characteristics of class and individual.

1.1 Classification of Bite Marks

Bite marks may be widely categorized as 'non-human' (animal marks) and people inflicted through humans. Based on the way of causation, the bite marks may be non-criminal; in addition to criminal that may similarly be categorized into offensive (upon sufferer through assailant) and defensive (upon assailant through sufferer) bite marks (6).

There are seven types of bite marks; 'Haemorrhage' (a small bleeding spot), 'Abrasion' (non damaging mark on skin), 'Contusion' (ruptured blood vessels, bruise), 'Laceration' (near puncture of skin), 'Incision' (neat punctured or torn skin), 'Avulsion' (removal of skin), and 'Artefact' (bitten-off piece of body). These can be further classified into four degree impressions; 'Clearly defined' is caused by the application of significant pressure, the 'Obviously defined' is the effect of vicious pressure, and 'Quite Noticeable' is due to violent pressure and 'lacerated' when the skin is torn violently from the body (7).

The following categories of bite marks that have proven to be of great importance in practical applications are: (8)

Class I: Including diffuse bite marks, with limited category characteristics and no individual characteristics. Such as bruises, extended bite marks, smoking rings, or weak bite marks.

Class II: This pattern of injury is called a single arch bite or partial bite mark because it has certain individual characteristics of certain types.

Class III: This classification includes individual characteristics and class characteristics. This bite has great evidence value and is mainly used for comparison purposes (6). In several situations and cases, the main body parts of the bite are the shoulders, upper arms or chest. Maintained pressure and deep tissue penetration to record the lingual surface of the anterior teeth.

Class IV: Mainly avulsion or laceration is caused by bite. In this class, there are no class characteristics and personal characteristics. This type of bite usually occurs where the ear or finger is avulsed (2,6).

1.2 Characteristics of Bite Marks

1.2.1 Class Characteristics

According to the Manual of American Board of Forensic Odontology (ABFO), a class characteristic is a feature, characteristic, or pattern that distinguishes a bite mark from different patterned injuries (8,9). It helps to perceive the group from which the bite mark originates. While comparing the bite marks, the first step is to verify the presence of class traits. The 'teeth class traits' and the 'bite mark traits' are the two styles of class traits (10).

1.2.2 Individual Characteristics

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Individual characteristics are deviations from the standard class characteristics (3). They are the specific features found within the class characteristics which can be a feature, a trait or a pattern that represents an individual variation rather than an expected finding (11). Dental patterns, features, or traits may be seen in some individuals and not in others such as rotation, buccal or lingual version, and mesial or distal drifting of teeth etc. (12). Dental characteristic is specific to an individual tooth and differs from one another (11,12). The teeth of different individuals differ from one another with respect to their size, their position in the dental arches and in their shape (13). Individual differences may be formed by various physical and chemical injuries affecting the teeth over the years like attrition, abrasion, erosion, the teeth may be affected by caries due to poor oral hygiene, and there may be restorations of the carious teeth (14).

Conclusion

With the gathered results, I came to a conclusion that, teeth does serve as a source of DNA. Sex determination can also be done with bite mark analysis along with enamel and dentin which aids in age identification. Though there were various effects of bite marks, all of the above were ways to identify a bite mark. Haemorrhage, abrasion, contusion, laceration, incision, avulsion, and artefact were the seven types of bite marks. Bite mark analysis involves all the above statements which includes, visualization and comparison, formation of the opinion, and court testimony. Overlay, metric analysis, and three dimensional analysis are analysis methods for bite marks. 'Upper central incisors are narrow, lateral incisors are wide and cuspids are cone shaped' is stated as the false statement. Most students who participated knew photography the most common method for identification of bite marks and that infrared photography that is used for the identification purpose penetrates the skin and helps visualize bite mark injury below skin surface.

Ethical Clearance: Not applicable

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