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Original article

Intercanine distance and bite marks analysis using metric method[☆]Pratik Tarvadi^{a,*}, Shahnavaaz Manipady^b, Mahabalesh Shetty^b^a Department of Forensic Medicine & Toxicology, Pacific Institute of Medical Sciences, Sai Tirupati University, India^b Department of Forensic Medicine & Toxicology, K S Hegde Medical Academy, Nitte University, India

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ABSTRACT

Aim: Reliability of intercanine distance while analysing bite mark using metric method.**Materials and methods:** Impressions of both, maxillary as well as mandibular arches of 50 consenting volunteers were taken and dentition casts were prepared. The bite mark impression and the dentine measurements were compared using Microsoft Excel Software. Each parameter of the bite mark is compared to the similar parameter in the dentition of the volunteer. The relation of all parameters with intercanine distance was observed.**Results:** The findings resulted in 14 true positives, and considering only intercanine distance as parameter resulted in only 6 true positives. Observations showed a significant error of 72 and 88% respectively. **Conclusion:** We conclude that using intercanine distance as a parameter for bite mark analysis is an unreliable method.© 2016 The International Association of Law and Forensic Sciences (IALFS). Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Forensic Odontology of late is gaining importance in investigation for the identification in situations like mass disasters, skeletal remains, in unidentifiable bodies etc. It also deals with age estimation and bite mark analysis. Teeth have played a role in identification since roman times. Lollia Paulina, mistress of Roman Emperor Claudius, during 1st century CE, ordered to behead a woman and for confirmation that the right woman was beheaded, demanded to examine the teeth of the woman.

Bite Mark is "a mark made by the teeth either alone or in combination with other mouth parts".¹ Bite marks are based on the unique characteristic features possessed by the dentition of an individual.^{2,3} This has been accepted in the court of law, but scientific reliability is still under controversy.⁴ The most well-known case is of Murder of Lisa Levy by Ted Bundy, where Ted had bit the buttock of the victim Lisa, leaving his bite mark, helping the judiciary in convicting Ted in 1978.⁵ Use of bite marks as an evidence in a criminal court for the first time was in the case of Doyle v. State of Texas in 1954, wherein the probable accused had left his

bite mark on a cheese found at the crime scene.^{5,6} Bite marks have been introduced or noted in appeal, in more than 100 judicial cases in America. Even though nearly half of those cases have been accepted by the judiciary, controversy still persists with regard to its reliability. American Courts, to get streamlined, had started the use of Frey's test, which is now superseded by the Federal Rules of Evidence after the 1993 United States Supreme Court decision of Daubert v. Merrell Dow Pharmaceutical.⁶ The controversy deepened after Australian and American Courts acquitted people who were falsely accused and convicted based on bite mark analysis. Mississippi Bite mark case of 1992 and 1995, Mexico Bite Mark case 1989, and the Snaggletooth Killer case are the few cases to name, where bite mark analysis have been an instrumental evidence.^{7,8}

Bite mark is commonly caused by the anterior six teeth, namely central and lateral incisors, and canines. The bite mark are recorded by photography or by cast method. Bite mark analysis involves comparison of the bite mark with the probable biter by metric or non metric method. The non-metric method deals with pattern analysis while metric method involves various measurements such as mesio-distal width of the teeth, angular rotation and inter-canine distance. In the present study, direct cast method has been used for obtaining bite mark sample from live human volunteers, and samples were analysed using metric method. In our study, we aim to find the reliability of inter-canine distance in comparing the dentition of the suspect with that of the bite mark.

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2. Material & methods

The research was conducted at a Medical College in Mangalore. The sample size was of 50 volunteers with equal gender distribution and aged between 18 and 50 years.

■ Inclusion Criteria

- Signed informed consent from compliant volunteers.
- Volunteers in good general health.
- Presence of 4 canine teeth (2 maxillary and 2 mandibular).

■ Exclusion Criteria

- Major hard or soft tissue lesions or trauma.
- Absence of any of the canine teeth.
- Previous or current orthodontic treatment.

■ The dental impressions of the volunteers were collected (Fig. 1).

■ **Bite Mark Impression:** The volunteers were requested to bite on their clean and dried left forearm on its frontal aspect. Instructions were given to apply sufficient pressure while biting, with a caution not to injure themselves. To produce a negative impression of bite mark, the ultra-light body vinyl polysiloxane impression material was applied over the bitemark impression left on the skin immediately after the act of biting. The dried material was removed manually which acts as a negative

impression of bitemark. Dental stone material was laid on this impression, and was removed once it dried. This dental stone material acts as a positive impression of the bite mark (Fig. 2).

Measurement of Teeth and Inter-canine distance: There are totally 14 parameters, namely mesio-distal width of 12 anterior teeth (6 maxillary and 6 mandibular) and 2 inter-canine distance (1 maxillary and 1 mandibular). Using vernier callipers, the mesio-distal width of each of the tooth (incisors & canines) of the impression and inter-canine distance were recorded. Measurements are taken from the positive impression of the bite marks and the dentition of the volunteers.

■ **Metric analysis of the measurements:** The summation of measurements of every parameter in the positive impression of the bite mark and summation of measurements of every parameter in the dentition is done. Using Microsoft Excel Software, a value is drawn which gives the difference in measurement between the two summations. This value is the similarity index–BM1 for that particular test bite mark. Similarly two more similarity indices (ICD1 and ICD2) were obtained. ICD1–similarity index, wherein inter-canine distance comparison was not included and ICD2–similarity index was obtained based only on inter-canine distance measurement. These similarity indices were compared with the indices drawn out of 50 volunteers whose dentition was taken for analysis. The dentition which had the least index among all the 50 dentitions was considered positive. In the same manner all the 50 positive impression of the bite mark were individually compared with the dentitions of all 50 Volunteers.

Ethical clearance by the Institutional Ethical Committee has been taken.

3. Observations & results

Out of the 50 cross matches there were 14 positive matches and 36 negative matches for similarity index–BM1. The values remained same for the similarity index–ICD1. The similarity index–ICD2 showed still poorer results with only 6 positive matches and 44 negative matches. The positive matches indicate



Fig. 1. Dentition cast.

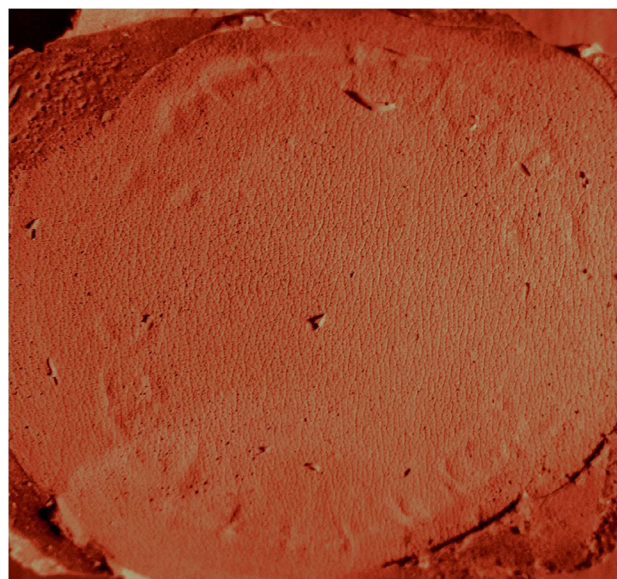


Fig. 2. Bite Mark Cast.

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