Investigation of Bite marks and its techniques on different fruit surfaces.

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ABSTRACT

In the considering of Forensic Investigations, Bite marks play a decisive task in recognition, individualization, and reconstruction of the scene of the atrocity. Bite marks likewise benefit as indispensable evidence which could be exploited in the court of law to exonerate the innocent and to put criminal behind the Bar. In this area of the study, the primary focus was accentuated on the disparities that prevail in the bite marks on different fruit surfaces. Four varied surfaces of fruits were chosen for consideration. Total 40 samples from 10 persons were studied on four specific surfaces and their research was carried out using various approaches and methods such as UV Photography using ABFO scale, Overlay technique, and casting method. The proceeding revealed the remarkable peculiarity in different Bite marks as a result of different surfaces used for the study. Thus it may be concluded that techniques which are implemented is traditional, suitable, timesaving, cheap, convenient, easy to examine and it also marked individualization factors among samples.

KEYWORDS- Forensic Odontology; Overlay Technique; Casting Dental; Bite Mark, ABFO Scale, Fruit surface, Human dentition

INTRODUCTION

The underlying purpose of Forensic Odontology is to establish human or animal dental remains based on teeth formation, teeth to teeth variations and their scientific information outcomes can be a critical clue in the court of law. Therefore, a methodical approach should have preferred for the investigation of bite marks which should serve fugitive in a court of law.[1,2,3] Bite marks are the pattern generated by teeth in a substrate form which can drift from minor abrasion to extensive bruising of the skin. Individuality of dentitions plays an important role in bite marks identification.[4] The human dentition has an unparalleled size and shapes and many variables of teeth have the potential of uniqueness. [5,6] Human bite marks may also consist of teeth injuries with alone or in combination of other mouth parts.[7] The main components such as fractured teeth, dental repairs, extractions, malalignment, malposition, impairment, spacing, likewise assist to an entity's particular bite mark on fruit, skin or any soft surface.[8]

Bite marks are frequently present on the skin of a victim or on food or food products.[9] As criminals encounter with food products in search of food at the scene of the crime because of hunger. In personal identification, the examination of bite marks plays an important role in criminal investigations[10]. Mostly in sexual abuse or rape cases, the bite marks are better conspicuous and distinguished. Based on uniqueness in the teeth formation and eventually the uniqueness in bitemarks may be examined by computer aided devices, especially in cases of identical twins.[11,12,13]

The bite marks are generally focused when found on human bodies but bite marks on food or food items also retian the importance in forensic investigation of a crime[14].The bite mark located on

foodstuff is an ominous proof, and its stability depends on the manner of bite and the extent of disintegration.

IDENTIFICATION OF BITE MARKS

Human teeth shows uniqueness factors which provides significant details rendered in bite marks identification. The bite marks found near the wounds undergoes examination and characterized either a bitemark or by other type of injury [15,16]. Identification of bite marks is based on scientifically logical assumptions, ABFO codes, precise scientific pieces of equipment, and its interpretation. The samples raised or secured from the location of the crime are studied where analogy and dissimilarity are justified. In this investigation endeavor, an undertaking has been carried out to determine different bite marks on various fruit surfaces.[17] In odontological examinations, forensic dentists and professionals have adopted ABFO scale with photography of bite marks.[18]

MATERIALS AND METHODLOGY

In the suggested effort, the samples were drawn from healthy individuals between 25 to35 years of age group. All samples had no impairment in teeth and free from Dental plague. Total 4 different fruit surface picked up were from Apple, Banana, Sapodilla, and Cucumber. Instruments and traditional methods tested for analysis of such bite marks on different fruits are-

1. All the samples were photographed under UV light for accurate visualization and their proportions were noted using the ABFO scale. [19]

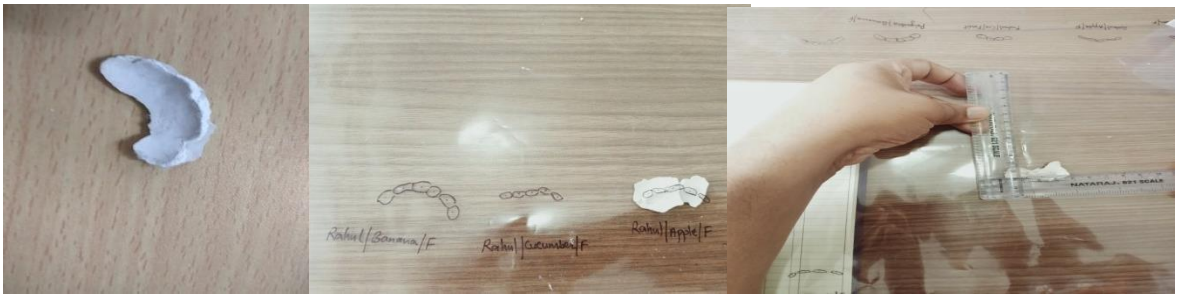
2. The casting of the samples was carried with the aid of dental casting material.

3. Superimposition technique was applied using light illumination phenomenon with the help of UV visible light source [20,21]

4. By overlay technique, all samples of different surfaces were anticipated with the help of transparent sheet. [22, 23]

5. Mechanical match / Comparison of casted and traced samples were done.

OBSERVATION

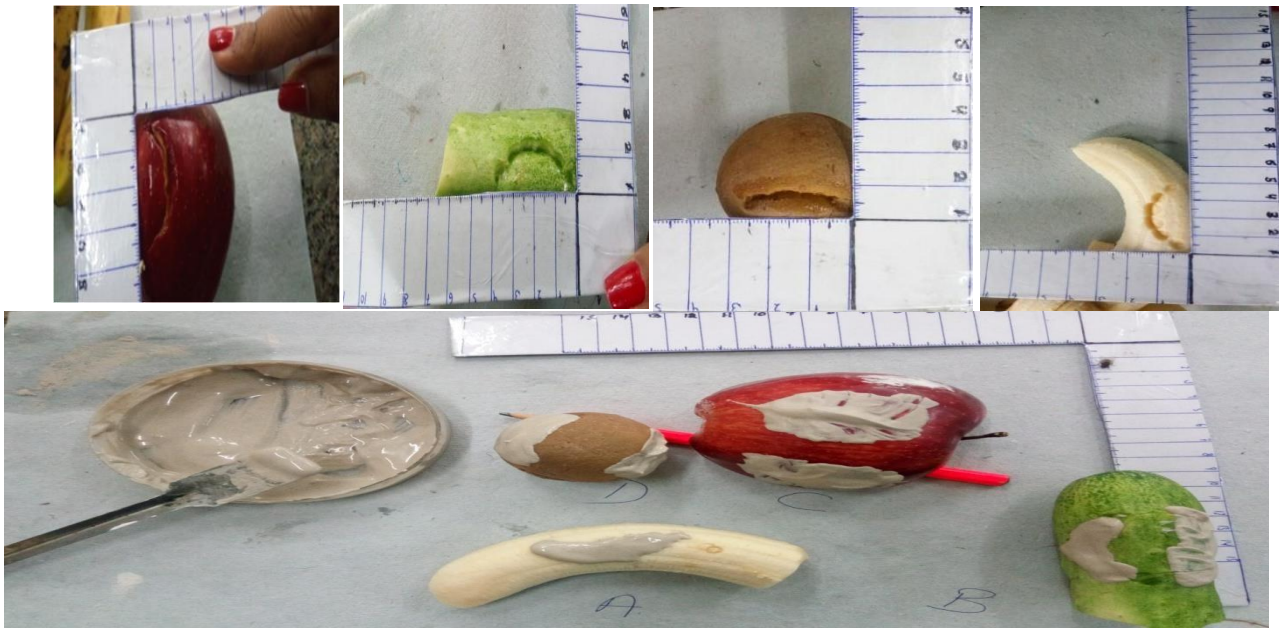


A.

B. **C** **D.**

Figure-1. Measurement of bite mark dimension on different fruits with the help of ABFO scale (A, B, C, D different fruits)

Figure-2. The Fruits are casted by the use of Dental Plaster and dried in room temperature.



(A) (B) (C)

Figure-3 The Casted dental (A), By the use of transparent sheet and pointed marker, the casted teeth were drawn on transparent sheet by overlay technique. (C) and ABFO scale was used for reading.

RESULTS

For the measurement of bite mark dimensions, four different techniques were employed that is measurement by ABFO Scale, scaling of dental cast and overlay. The bite mark dimensions that were considered were length, breadth and number of teeth. After calculating the values of these parameters, the descriptive statistics was done to know the minimum value, maximum value, mean and standard deviation.

Table 1- Descriptive Statistics for the Techniques Employed for Bitemark Dimensions

S. No.	Technique Applied	Measurement	Min.	Max.	Mean	S.D
1	**ABFO**	Length	1.9	4.6	3.12	0.64
		Breadth	0.3	2.2	1.03	0.37
		No.of teeth	2	6	5.17	1.05
2	**Casting**	Length	1.7	4.2	3.08	0.63
		breadth	0.4	2.2	1.07	0.36
		No.of teeth	2	6	5.17	1.05
3	**Overlay**	Length	1.8	4.3	3.18	0.64
		Breadth	0.5	1.7	1.1	0.31
		No.of teeth	2	6	5.17	1.05

All the techniques shows no significant variations in the mean values. While measuring the length of bite mark by ABFO the mean value was 3.12, in casting it is 3.08 and in overlay it is 3.18. The measurement of breadth by the three technique showed that the mean was 1.03,1.07 and 1.1 of ABFO, casting and overlay technique respectively as shown in Table1.

The bite impressions obtained on the different surfaces such as apple, cucumber, sapodilla and banana shows that the marks on the fruits varied according to the fruit surface. The mean values of apple, banana and cucumber were somewhat similar and shows no remarkable difference whereas sapodilla shows the difference in the values of mean in comparison of the other fruits subjected to the study.

Table 2- Descriptive Statistics for the Bitemark Dimensions on Four Different Fruit Surfaces

Parameters	Sapodilla		Apple		Banana		Cucumber	
	Mean	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
Length ABFO	2.65	0.56	3.06	0.62	3.22	0.61	3.58	0.47
Breadth ABFO	0.76	0.25	1.04	0.43	1.06	0.33	1.33	0.15
Length of casting	2.73	0.51	2.98	0.76	3.12	0.61	3.51	0.4
Breadth of casting	0.77	0.27	1.08	0.42	1.07	0.32	1.36	0.14
Length of overlay	2.82	0.49	3.05	0.74	3.23	0.62	3.65	0.41
Breadth of overlay	0.89	0.28	1.02	0.16			1.41	0.32

As shown in Table 2, while calculating the mean of all the readings obtained after calculating length of bite mark present from all the participants by ABFO scale from sapodilla was 2.65, from apple it was 3.06, in banana was 3.22 and in cucumber the value of mean was 3.58.

The pearson product-moment correlation coefficient (pearson's correlation) is a measure of the strength and direction of association that exists between two variables measured on at least an interval scale.

Table 3- Correlation Between Different Techniques Employed for Length Measurement

**correlation is significant at the 0.01 level (2-tailed)

		ABFO Length	**Casting Length**	**Overlay Length**
	Pearson correlation	1	.889**	.895**
ABFO Length	Sig. (2-tailed)		.000	.000
	N	40	40	40
	Pearson correlation	.889**	1	.993**
Casting Length	Sig. (2-tailed)	.000		.000
	N	40	40	40
	Pearson correlation	.895**	.993**	1
Overlay Length	Sig. (2-tailed)	.000	.000	
	N	40	40	40

A pearson product-moment correlation was run to determine the relationship between ABFO length, casting length and overlay length. There was a strong positive correlation between these techniques opted for the measurement of bitemark dimensions (length, breadth and number of teeth), which was statistically significant.

The correlation(r) value for ABFO length and casting length was 0.889, for casting length and overlay length was 0.993 whereas for overlay length and ABFO length was 0.895 ($p<0.001$) as shown in Table 3.

Table 4- Correlation Between Different Techniques Employed for Breadth Measurement

		ABFO Breadth	Casting Breadth	Overlay Breadth
	Pearson correlation	1	.970**	.648**
ABFO Breadth	Sig. (2-tailed)		.000	.000
	N	40	40	40
	Pearson correlation	.970**	1	.677**
Casting Breadth	Sig. (2-tailed)	.000		.000
	N	40	40	40
	Pearson correlation	.648**	.677**	1
Overlay Breadth	Sig. (2-tailed)	.000	.000	
	N	40	40	40

**correlation is significant at the 0.01 level (2-tailed)

The correlation(r) value for ABFO breadth and casting breadth was 0.970, for casting breadth and overlay breadth was 0.677 whereas for overlay breadth and ABFO breadth was 0.648 ($p<0.001$) as shown in Table 4.

Table 5-Correlation Between Different Techniques Employed for Number of Teeth Measurement

		ABFO No. of Teeth	Casting No. of Teeth	Overlay No. of Teeth
	Pearson correlation	1	1.000**	1.000**
ABFO No. of Teeth	Sig. (2-tailed)		.000	.000
	N	40	40	40
	Pearson correlation	1.000**	1	1.000**
Casting No. of Teeth	Sig. (2-tailed)	.000		.000
	N	40	40	40
	Pearson correlation	1.000**	1.000**	1
Overlay No. of Teeth	Sig. (2-tailed)	.000	.000	
	N	40	40	40

**correlation is significant at the 0.01 level (2-tailed)

The correlation(r) value for ABFO No. of teeth and casting No. of teeth was 1.000, for casting No. of teeth and overlay No. of teeth was 1.000 whereas for overlay No. of teeth and ABFO No. of teeth was 1.000 ($p<0.001$) as shown in Table 5.

DISCUSSIONS

In the present research work an attempt has been made to identify the bitemarks on different fruit surfaces (hard & soft), irrespective of its spherical shape and juicy pulp. Similarly in work of Daniel and Pazhani [24], apple and some milk products like chocolate, cheese, were considered in the study and identified through computer Overlay technique and manual docking procedure. The previous study concluded that chocolate and cheese possess more accuracy than apple.

In the present study the technique ABFO scale is found to be most accurate and effective with correlation value of 1 as compared to other techniques applied. According to Rai et al. [25] identification of the person ‘s bite mark was done through the direct comparison ie. ABFO scaling obtained more accurate results other than indirect comparison methods such as dental casting and overlay technique in clay and cheese samples.

CONCLUSION

Techniques used in human bitemarks identification shows no significant variations in the mean values i.e these techniques shows higher match frequency (for length & breadth measurement) and may be used for spherical fruits/ soft materials. Fruit Sapodilla shows the difference in the values of mean in comparison of the other fruits subjected to the study by ABFO scale, the possible reason behind this could be more softness and juice in pulp of fruit. A strong positive correlation between applied techniques opted for the measurement of bitemark dimensions (length, breadth and number of teeth) is statistically significant. It may be concluded that out of these all techniques which are implemented, ABFO scaling technique is more robust and transforms accuracy in hard fruit surfaces and can be a significant technique in recognizing the individual identification factors among samples.

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CONFLICT OF INTEREST

The authors whose names are listed in this manuscript certify that they have NO affiliations with or involvement in any other organization apart from mentioned above or entity with any financial interest or non financial interest.

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