

## **ANALYSIS AND COMPARISON OF BITE MARKS ON THE CHEESE AND BANANAS**

**Rakesh Kumar Gorea and O. P. Jasuja**

### **ABSTRACT**

It is very important to link the offender of the crime with the evidence left on the crime scene for the successful identification of the culprit, especially when there are no witnesses of the crime. After committing the offense like theft, perpetrators do not hesitate to plunder with the eatables at the scene of occurrence. Frequently, they will eat eatables which are readily available. Bananas and cheese are commonly present in the homes and they eat these and frequently leave behind parts of it on which are engraved their teeth marks. These bite marks can be useful evidence for identifying the offenders.

Keeping in mind this hypothesis, an experimental study has been done on these food items with the help of consenting volunteers; where these volunteers left bite marks on these food items. In present work, bite marks left on cheese and bananas are discussed. 50 volunteers were involved to leave bite marks on cheese and 143 volunteers were requested to leave bite marks on bananas. These bite marks were photographed, made life-sized and life-sized photographs were printed. Volunteers' dental impressions were taken using the dental plates and alginate powder. Dental casts were made using dental stone powder. Transparencies were printed using hand drawn, photocopying and scanning methods. Then these transparencies were matched with life-sized photographs by overlaying technique. In banana, there was an accuracy of 82.33% whereas in Paneer (A variety of cheese) accuracy was just 28.5% where volunteers could be linked to their bite marks. This study shows that different food materials have different rates of accuracy for linking the bite marks to the volunteers

**Keywords:** Bite marks, identification, forensic odontology

### **INTRODUCTION**

Bite marks analysis was considered one of the three important areas of forensic odontology (Dinkel and Captain, 1974). Bite mark analysis gained importance during the conferences from 1980-1987. In one such conference held in 1981, 30% of the total abstracts and in 1982, 55% of the total abstracts were on bite marks only

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(Katz and Cottone, 1988). Bite mark is usually an elliptical or circular injury which has the records of the teeth involved in biting (American Board of Forensic Odontology, 1995). The diameter of the bite mark is ranging from 25-40 mm and incisors producing rectangular marks and canines producing triangular marks (Sweet & Pretty, 2001).

Though bite marks are usually found during quarrels (Furness, 1971), sexual assaults (Levine, 1972) and child abuse (Pretty and Sweet, 2000) yet they are also found on the eatables at the crime scene (Furness, 1971). The bite marks on the foodstuff should never be overlooked as these can provide link to the offender (McGraw, 1984). Cheese has been studied by many researchers (McCullough, 1983; Bernitz *et al.*, 2000; Bernitz and Kloppers, 2002; Gorea *et al.*, 2005a), and fruits have also been studied by Gorea and Jasuja (2010) providing good success rate for identification.

Recording of the bite marks has been done by taking impressions (Gustafson, 1966) or by photography (Wright, 1998) and most of the forensic odontologists use the ABFO guidelines though some may not use it (McNamee and Sweet, 2003). Videography may also be done to record the bite marks (ABFO, 2016). Stimson (1982) used circular reference scale for photography of bite marks. American Board of Forensic Odontology [ABFO] also emphasizes the use of scale during photography to prevent distortion of the photographs. According to Hyzer and Krauss (1988) ABFO Scale no 2 utilizes both the linear and circular graduations and is very good in bite marks cases and this also helps in making the photograph life-sized (Dorion, 2005). Common impression materials used for bite mark analysis are alginate, rubber base, silicone and hydrocolloid (Dorion, 1977).

Transparencies can be prepared by hand drawing (Fearnhead, 1960), photocopying (McCullough, 1983; Dailey, 1991), CT scan (Rawson, 1990) or scanning (McNamee *et al.*, 2005). Another complex method was described by Metcalf (2008). Furness (1971) compared the life-sized photographs of the bite marks with superimposing the transparencies. There are many diverse methods of comparison which have been used but it depends on feasibility and availability of the resources (Kouble and Craig, 2004).

The basis of the conclusion depends on the individual experience and training of the odontologist (Sopher, 1976). It is easy to exclude a person (Dinkel and Captain, 1974) or opine that it could have been made by a person in question (Vale *et al.*, 1976). Kouble and Craig (2004) modified the scoring system for comparison and analysis. ABFO has issued guidelines to use this evidence in a way so that there is uniformity (Pretty and Sweet, 2001).

Pretty and Turnbull (2001) stressed upon great caution to be used while giving an opinion as there may not be sufficient features to give a definite opinion. In spite of all shortcomings, it has become an integral part of the crime scene investigation (Gorea *et al.* 2005b). There is a uniqueness of anterior dentition which helps in identification based on small differences (Kiessar *et al.*, 2008). With orthodontic treatment, there can be reduced matching (Sheets *et al.*, 2011). There are possibilities

of false positive results due to distortion in cases of bite marks on the skin (Bush *et al.*, 2011).

All the cases should be reviewed by a second reviewer and administrative review should be done to say that it followed the guidelines properly. Opinion should be given that the evidence is inconclusive or a human bite or not and the case can be excluded or the case cannot be excluded or (ABFO, 2016).

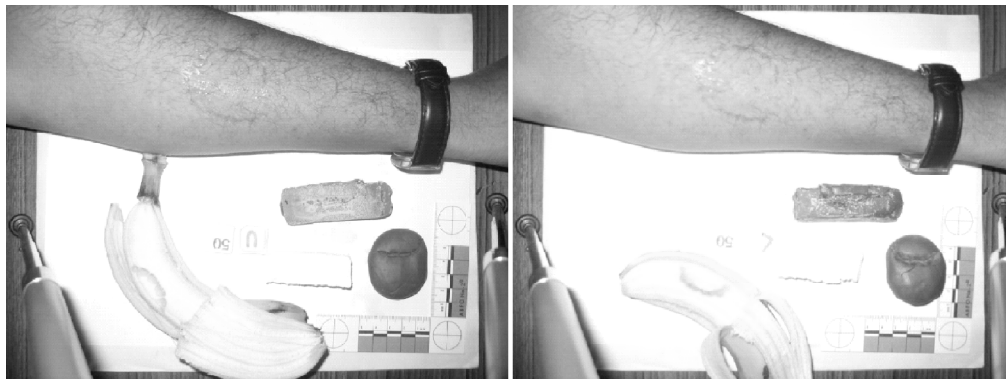
This study was done with the following aims and objectives:

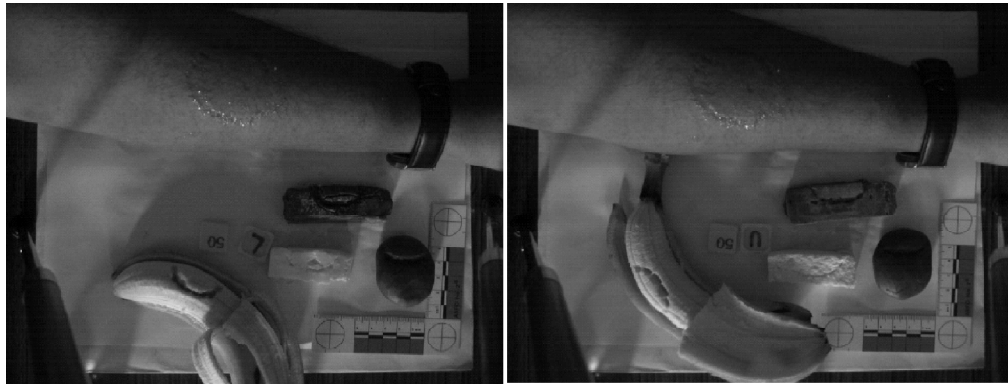
- To find out which object is the more suitable material to collect the sample bite marks for linking the volunteer to the bite marks?
- To compare which transparency is best – photocopy, hand-drawn transparency or digital scanned transparency?

### **MATERIALS AND METHODS**

In this study, informed consent was taken from the volunteers to participate in this research project. They were asked to bite on surfaces under study with a force so that they could produce bite marks on that surface. 143 volunteers left marks on the banana (N=143) and 50 volunteers left marks on the Cheese (Paneer) (N=50). These bite marks were photographed immediately along with ABFO number 2 scale with a digital camera and in some cases with auto-focus and SLR camera. Photographs were taken with inbuilt flash and without flash. Tripod stand was used in the majority of the cases for taking photographs. These photographs were made life size using Adobe Photoshop software and printed. Dental casts were prepared using dental plates, alginate powder, and dental stone. Hand drawn transparencies, photocopied transparencies and scanned transparencies were prepared. Life-size photographs were superimposed by transparent overlays and compared. Direct matching of the casts was also done. Dental arches and individual teeth were compared with the same on life-sized photographs.

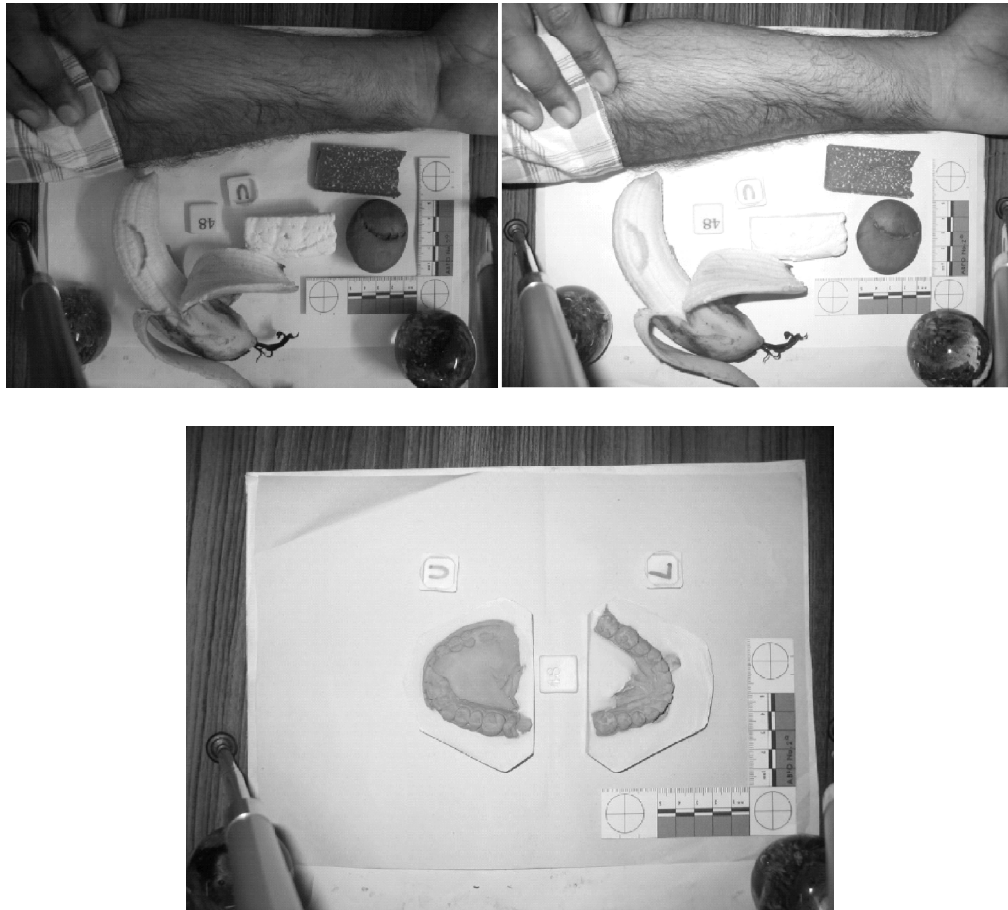
Photographs of bite marks on various items are depicted in two cases as sample photographs





**Figure 1-5: Bite marks on cheese and banana by one volunteer**





**Figure 6-10: Bite marks on cheese and banana by another volunteer**

At the time of study, observations were categorized as

- Medical Certainty
- Probable
- Possible
- Excluded
- Insufficient evidence

According to the latest guidelines of ABFO, Medical certainty, probable and possible comes under the category of the 'cannot be excluded'. Other categories may be 'Excluded' and 'insufficient evidence'.

## RESULTS

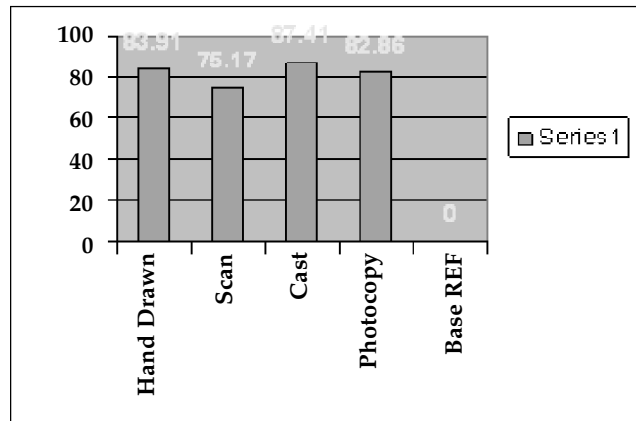


Figure 11: Cases of medical certainty observed on bite marks on bananas

In banana, medical certainty was observed in 87.41% by direct matching with casts method, 83.91% by hand-drawn method, 82.26% by photocopying method and 75.17% with scan method with an average accuracy of 82.33% as depicted in figure 11.

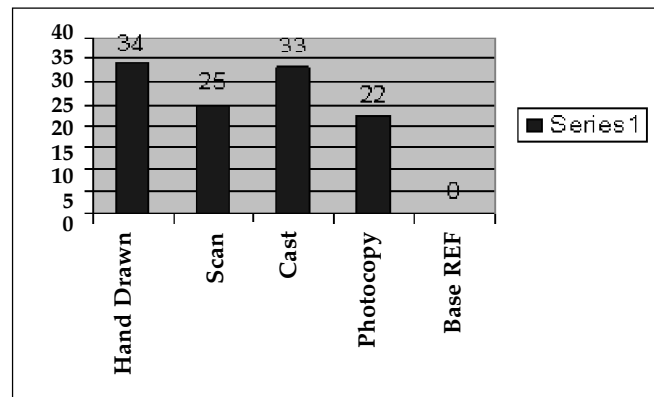


Figure 12: Cases of medical certainty observed on bite marks on Cheese

In Paneer (A variety of cheese) medical certainty was seen in 34% cases with the hand-drawn method, 33% with direct matching with casts method, 25% by scan method and 22% by photocopying method with an average accuracy of just 28.5% as depicted in figure 12.

It is observed that Hand drawn transparency method and comparison with direct casts was better than high-end scan and photocopying methods. Simple methods are better than cumbersome technology dependent methods.

## DISCUSSION

This study shows that different food materials have different rates of accuracy for linking the bite marks to the volunteers. If both banana and cheese are lying at the crime scene then banana is a better choice to study the bite marks as compared to the cheese.

According to Dinkel and Captain (1974) fruits provide excellent bite marks and same is observed in this study also as bananas are providing very good results for identification from bite marks in this study also as it depends upon the compressibility and elasticity of the material on which bite marks are studied and paneer having poor elasticity does not retain good bite marks and this is also evident in this study also. Now doubts have started on the bite marks analysis and it is said that dentition may not be unique by measurement (Bush *et al.* 2011b).

Reasons for insufficient evidence in which comparison of the life-sized photograph with different overlays and dental casts was not possible due to:

- Poor photography, a factor which can be improved by having more training for photography
- A poor impression of the bite on the surface studied. This is a factor which we will have to encounter in practice also.

## CONCLUSIONS

This study provides with a data which can be applied to the crime scenes where offenders have left bite marks. Harvesting and comparing the bite marks with the casts of the suspects can help to include or exclude the suspects in the investigation and better prosecution of the cases using the evidence of bite marks at the crime scene.

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