

Evidence Collection of a Tooth Mark in a Crime Scene: Importance of the Dental Materials in Forensic Dentistry

Cristiana Pereira *, Jorge Costa Santos **, Tore Solheim ***

Abstract: The forensic dentistry is commonly required to identify tooth marks from a crime scene. The methodology is unique according to the guidelines of American Board of Forensic Sciences (ABFO) and International Organization of Forensic Odontostomatology (IOFOS), using proper techniques for collection and preservation of evidence for the last stage comparison with suspects. This forensic case applies those guidelines to collect two set of tooth marks present on two pieces of cheese found at a crime scene. The dental impression and model materials are very important to preserving the physical evidence present on inanimate materials such as cheese to later on compare with the teeth of a suspected and make a conclusion.

Key-words: Forensic Dentistry; Bite mark; Crime Scene; Dental Materials; Stereomicroscopy

Resumo: A Medicina Dentária Forense é uma área importante na identificação de marcas de mordedura numa cena de crime. A metodologia é única e obedece às guidelines do American Board of Forensic Sciences (ABFO) e do International Organization of Forensic Odontostomatology (IOFOS). As técnicas forenses utilizadas são próprias para colecção e preservação de evidências. Estas são necessárias para a última etapa forense: a comparação com o presumível suspeito. Este caso forense aplica aquelas guidelines para colher os vestígios presentes em duas marcas de mordedura em dois pedaços de queijo, encontrados numa cena de crime. A impressão correcta dos perfis dentários e os materiais dentários utilizados na confecção dos modelos de estudo, são fundamentais para a conservação da evidência física. Principalmente, quando se trata de materiais inanimados como a superfície do queijo. O passo seguinte na investigação criminal consiste na comparação com o perfil dentário de um presumível suspeito e possível identificação positiva.

Palavras Chave: Medicina Dentária Forense; Marcas de mordedura; Cena de crime; Materiais Dentários; Estereomicroscopia

(Pereira C, Santos JC, Solheim T. Evidence Collection of a Tooth Mark in a Crime Scene: Importance of the Dental Materials in Forensic Dentistry. Rev Port Estomatol Cir Maxilofac 2009;50:141-144)

* National Institute of Legal Medicine- South Branch, Lisbon, Portugal.

** National Institute of Legal Medicine –South Branch, Lisbon, Portugal.

*** Department of Pathology and Forensic Odontology, Dental Faculty, University of Oslo, Norway.

INTRODUCTION

A tooth mark has been defined as “a mark caused by the teeth either alone or in combination with other mouth parts⁽¹⁾. Such marks may be found on for example, food (cheese, apple, chocolate, etc), chewing gum and skin⁽²⁾. The identification is based on the individuality of a dentition, which is used to match a tooth mark to a suspected dentition. Parameters like size, shape and alignment of teeth are used⁽³⁾. These variables are including in the two of the four stages of analysing a tooth mark, pattern association and metric analysis⁽⁴⁾.

The physical evidence of a tooth mark must be preserved until a suspect is found which may sometimes take years. It

is important to choose and use proper dental materials to take impression of the tooth marks and for making models of the marks from inanimate material such as cheese.

On the 27 of March 2007 a couple was attacked at home by four armed individual with the face covered in Faro, a town of south of Portugal (Algarve). During the crime scene investigation, two pieces of cheese with tooth marks were found by the Portuguese Police. The police took the cheese to the crime laboratory and requested the National Institute of Legal Medicine – South Department at Lisbon to help with the examination. The pieces of cheese were stored in the refrigerator at a temperature of 2°C until they were processed, respecting the integrity of the chain of custody.

OBJECTIVES

According to Portuguese law (*Portaria* nº. 522/2007 of 30 April)⁽⁵⁾ the National Institute of Legal Medicine have four departments since April 2007, including the Forensic Pathology and the Forensic Genetic and Biology. These two services were responsible for the investigation in these cases.

The first objective was to identify the genetic profile from the salivary traces in the marks by the Genetic Service. The second objective was to collect and identify the morphological tooth profile from the pieces of cheese by a cooperation of Forensic Pathology and Forensic Dentistry.

MATERIAL AND METHODS

The examination was performed were according to the American Board of Forensic Odontology (ABFO)⁽⁶⁾ and the guidelines for quality assurance of International Organization of Forensic Sciences⁽⁷⁾. Before the forensic odontologist made the evidence collection, the biologist made the swabs because the biological evidence must be the first step, before they are contaminated. The double swab method was used, which employs a wet swab (sterile distilled water) followed by a dry swab. This method has been shown to maximize the amount of dried saliva that can be recovered⁽⁶⁾.

1. Photographic Documentation

Each piece of cheese was photographed using digital photography using Nikon D80 camera. Photographs were exposed with and without a measuring device, such as a ruler, included in the image (Figure 1 and 2).

2. Impressions

The impression of surface of was taken with accurate and stable dental impression materials from 3M[®] commonly used for prosthodontic treatments, rubber impression material – vinylpolysiloxane; supplied in two consistencies: low viscosity (light body) and putty. The physical properties of these dental materials have been shown suitable for use to duplicate the contours and surface characteristics of the skin. In addition, silicones have the best recovery from deformation during removal of the impression. The manipulation was according to the manufactures instructions. The impressions were not disinfected, figure 3.

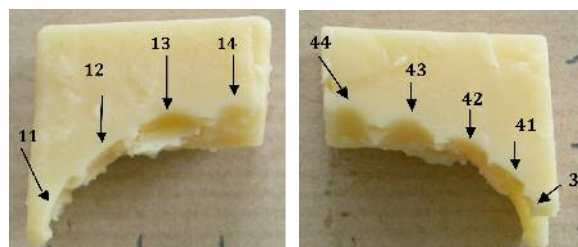


Figure 1 - Specimen identified as cheese 1 with upper and lower views of the same specimen from the left to right side of the image. Teeth are identified using the F.D.I nomenclature.

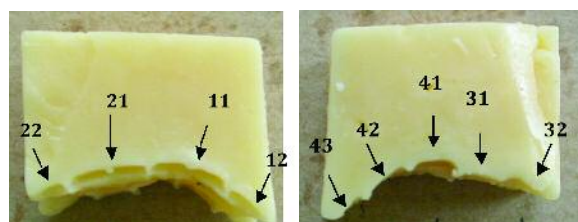


Figure 2 - Specimen identified as cheese 2 with upper and lower views of the same specimen from the left to the right side of the image. Teeth are identified using F.D.I nomenclature.

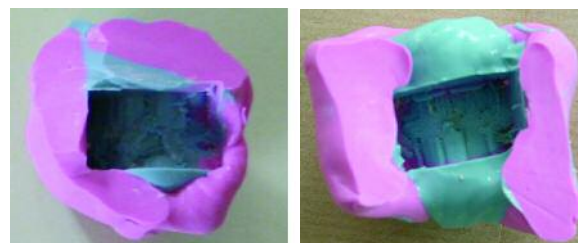


Figure 3 - Impressions of cheese 1 and 2 with light body (blue material) and putty (pink material).

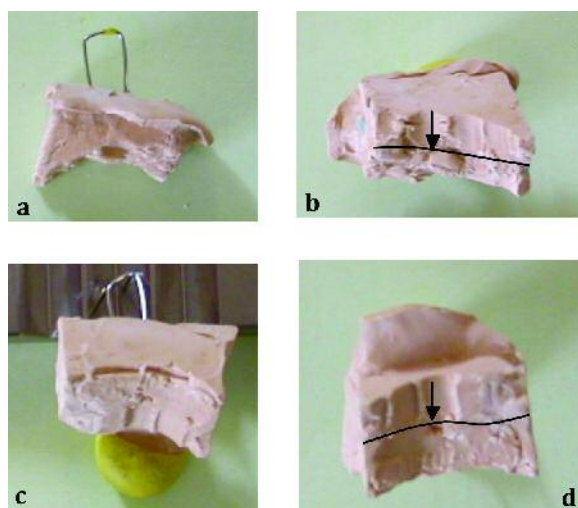


Figure 4 - Casts of cheese 1 – Figure a and b; and cheese 2 – Figure c and d; with bite of lower teeth at the picture b and d.

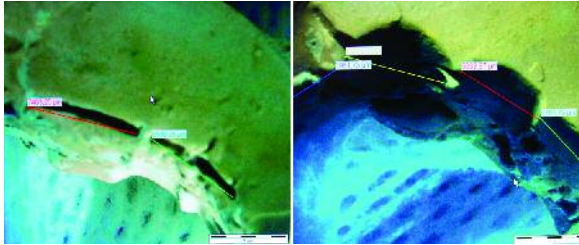


Figure 5 - Stereomicroscopy measures of cheese 2- upper jaw and cheese 1- lower jaw.

3. Models

The cast were made by dental stone type IV according to American Dental Association (ADA) – Fujirock®. The mixing was performed according to the manufactures instructions. For each specimen of cheese two models were made, figure 4.

4. Stereomicroscopy

Each model of stone for each tooth mark was analyzed by Stereomicroscopy 24 hours after the setting of the dental stone. Measurements were performed per individual teeth in the model (Figure 5).

RESULTS

After identification of the marks as human bite marks we identified the individual teeth responsible for in each mark. Both specimens of cheese showed marks of both upper and lower teeth as can be seen at figure 1 and 2. At specimen named cheese 1 (Figure 4 - a and b) about 3 mm bite into the cheese of upper teeth and about 7 mm deep bite of lower teeth can be seen. Specimen named cheese 2 (Figure 4 - c and d), about 1,5 mm in bite of upper teeth and 5 mm deep bite of lower teeth was seen. It was assessed that the marks from the upper jaw, specimen 1, are from tooth 11, 12 slightly lingual position, 13 in normal position and slight and indistinct mark from mesial corner from 14 (Figure 1). From the lower jaw we can see marks judged to be from 44, probably this tooth may be lower than the other teeth and is a slight and indistinct mark in the tooth mark; 43 in normal position and appearance; mark from 42 and 41 in an even line, with mesial corner 42 slightly vestibular of distal corner 41. Mark from mesial corner from 31 in a lingual position relative to 41.

In specimen 2, it was assessed that the marks from the upper teeth are distinct marks from 12, 11, 21 and 22, all well aligned. There are signs of mamellons in the incisal edges of 11 and 21. A small gap may be found between the central teeth (11 and 21) and the lateral teeth (12 and 22) on both sides. From the

lower teeth we can see a slight mark from what is judged to be from tooth 43. Then may be 2 marks from tooth 42 and 41 can be seen. The mesial corner of 42 is slightly vestibular for the corner of 41. Then an indistinct mark from tooth 31 in a lingual position relative to 41 is seen. The next mark from 32 is indistinct but in a slightly more vestibular position. The teeth are well aligned with exception of tooth 31.

The measurements by stereomicroscopy from each specimen, 1 and 2, from individual teeth 41, 42 and 11 on both stone models were slightly different. They are slightly smaller in the model from specimen 2 than 1 probably because of shrinkage of the cheese.

DISCUSSION

The tooth mark identification is based on the individuality of a dentition. The first step is to reconstruct the dental profile from the marks by using anatomical features and after that if the police have a suspect for comparison with his teeth, either exclude the suspect or judge how likely it is that he made the mark⁽⁸⁾.

To preserve physical evidence for a long period of time we need proper use and understanding of dental materials to perform the impressions and make models. Impression materials are used to make an accurate replica of the tooth mark. The impression gives a negative reproduction of the tooth mark, and by filling it with dental stone or other material, such as epoxy resin, a positive cast is made for study of tooth and the profile of the mark. The accuracy, detail, and quality of this final replica are of greatest importance for the results. Between the various types of impression materials currently available and the qualities they possess, the elastic impression rubber materials may be the choice. Alternatively, silicones may be the preference because of their physical and mechanical properties, such as lowest dimensional change on setting, lowest permanent deformation and highest detail reproduction.

The methods of comparison are many. When we do the measures with stereomicroscopy we may compare with the future dental stone of the suspect's teeth. A computer programme may also be used. The second model of each tooth mark may be used to perform Scanning Electron Microscopy to search any distinct anatomical feature in the tooth surface⁽⁹⁾.

In this case the pattern of biting into the cheese and not bite through is the same for both specimen. Also other characteristics such as even tooth arches except for 31 in more lingual position, is the same. This tooth 31 gave the wrong initial idea

that it was different for both specimens because of the contact between the upper and lower jaws were different during the biting for each piece, giving the impression to be from two individual. But it was probably wrong, and the two bites may be from the same individual.

However the measurements of the incisal edges from the comparing teeth of each specimen present, 41, 42 and 11 from stone models, are slightly different. If one assume that there is slightly more shrinkage in cheese piece 2 than in 1 also the tooth dimensions may have been the same.

All the laboratory steps were done simultaneous for both cheeses after arrive to the laboratory and according to the manufactures instructions for dental materials.

CONCLUSIONS

The first examination we concluded each piece of cheese was bite for two different individual based on lingual position of 31, depth of biting and measurements of incisal edge from 11, 41 and 42. Than after re-examination we concluded both tooth marks 1 and 2 are most likely from the same person. The person has signs of mamellons in the incisors indication it may be a young person. The dental arch in the upper jaw is even without crowding or malposition. The same is the case for the teeth in the lower jaw except for tooth 31 which is in a lingual position.

After examining the evidence we have wait for the police to find suspects to do the comparative analysis. One of the following conclusions may be used: identity with a high degree of certainty; identity probable; identity cannot be excluded and/or identity excluded⁽⁴⁾.

REFERENCES

- 1 - MacDonald DG. Bite mark recognition and interpretation. *J Forensic Sci Soc* 1974;14:229-233.
- 2 - Whittaker DK. Forensic dentistry in the identification of victims and assailants. *J Clinical Forensic Med* 1995; 2:145-151.
- 3 - Bernitz H, Van Heerden WFP, Solheim T, Owen JH. A technique to capture, analyze, and quantify anterior teeth rotations for application in court cases involving tooth marks. *J Forensic Sci* 2006;51:624-629.
- 4 - Bernitz H, Owen JH, Van Heerden WFP, Solheim T. An integrated technique for the analysis of skin bite marks. *J Forensic Sci* 2008;53:194-198.
- 5 - Portaria nº. 522/2007 de 30 DE Abril de 2007.
- 6 - ABFO.Guidelines for bitemark analysis. *JADA* 1986; 112:383-386.
- 7 - <http://www.odont.uio.no/foreninger/iofos/quality/Toothmarks-IOFOS.htm>.
- 8 - Bernitz H, Piper SE, Solheim T, Van Niekerk PJ, Swart TJ. Comparison of bite marks left in foodstuffs with models of the suspects' dentitions as a means of identifying a perpetrator. *J Forensic Odontostomatol* 2000;18:27-31.
- 9 - Solheim T, Leidal TI. Scanning electron microscopy in the investigation of bite marks in foodstuffs. *Forensic Science* 1975;6:205-215.