MAVEN e-ISSN: 2581-4443 | www.idahow.org

REVIEW ARTICLE

Bitemarks as evidence

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Abstract

Teeth have often been used as weapons of offence and defense and often dentists have been called to analyze these bitemarks. These article aims to bring to light the different methods of analysis of bitemark when used as evidence in various cases. (2018, Vol. 02; Issue 02: Page 63 - 68)

Key words: Bitemarks, Evidence, Analysis.

Introduction

Teeth as weapons of offence and defense are commonly used by both humans and animals. In times of attack teeth may be the only tools of defense available to hu- mans. On the other hand in crimes of sex- ual nature including sexual homicide, rape and child sexual abuse, assailants of- ten bite their victims as an expression of dominance, rage and animalistic behavior. Owing to the seriousness of the crimes in- volved it is necessary that the evidence should be properly collected, recorded, an- alyzed and preserved to be presented be- fore the court of law (if required) to bring the perpetrator to justice.

A bite mark may be defined as having oc- curred as a result of either a physical al- teration in a medium caused by the con- tact of the teeth, or a representative pat- tern left in an object or tissue by the dental structures of an animal or human. A pro- totypical human bite mark is described as being a circular – or oval – patterned in- jury consisting of two opposing symmet- rical, U-shaped arches separated at their bases by open spaces. Along the periphery of the arches can be a series of abrasions, contusions and/or lacerations indicative of the size, shape, arrangement and distri- bution of the contacting surfaces of the biting dentition (1).

History

The contemporary history of bitemark as evidence started with Sorup. In 1924, Sorup used transparent paper upon which biting edges of a suspect's dentition were rendered to compare with life size photo- graphs of a bite mark (2).

Perhaps the most highly publicized bite mark case in United States judicial history and possibly the catalyst for the surge in the use of bite mark evidence in courts around the United States during the 1980s, was the case involving serial killer

Theodore (Ted) Bundy. Bundy was con- victed of two counts of first-degree murder in 1979 and was sentenced to death. The principal items of evidence that resulted in Bundy's murder convictions included the identification testimony of a key witness who placed him at the scene of the crime moments before the murders and the ex- pert analysis of teeth marks found on the body of the one of the murder victims (3). The examination of the bite mark on one of the victims by a forensic odontologist in- volved the comparison of dental casts of Bundy's teeth to the photographed inden- tations in the victim's flesh. During his testimony the odontologist asserted that the indentations on the victim's body were made by Bundy. He was executed in the electric chair on 24 January 1989 at Flor- ida State Prison in Starke, Florida.

Anatomical location and presen- tation

It is also important to remember that bitemarks can be both attack injuries (and therefore present on the victim) and defen- sive wounds (and therefore present on the suspect) and all individuals suspected of involvement in a crime against a person need to be examined for such marks (4). Females were four times more likely to be bitten than males, and over 50% of the males in the study were the suspects in the case – reinforcing the need to examine carefully this group of individuals for bitemark evidence. Females were most likely to be bitten on the breast, arm and legs, and children on their genitals, legs and back. Most males were bitten on the hand, back or face (5). The anatomical lo- cation of a bitemark is also crucial in de- termining its potential to be analyzed.

The appearance of the bitemark depends on a number of factors which include

- the site of injury- the amount of fat, hard tissue, vascularity if the loca- tion, skin thickness etc
- number of teeth contacting the skin
- amount of force
- type and direction of biting action
- the biter's occlusion and oral health
- whether the victim was alive when the bite was inflicted

In living victims, the effect of healing will alter the appearance of a bitemark over time. Postmortem bites lack the classical erythema found with antemortem bites. Bites can also be found on foodstuffs and less frequently on a variety of other mate- rials such as chewing gum and paper tow- els.

Bites usually appear as oval or circular contusions, bruises or abrasions. Some- times indentations, lacerations or avul- sions made by specific teeth are seen on the skin surface. In most cases, bites have been identified with molar teeth repre- sented on the injury. A double-arched pattern is a common presentation of hu- man bites (6). So the typical representa- tion is semi-circular injury which com- prises two separate arcs (one from the up- per teeth, the other from the lower) with either a central area absent of injury, or with a diffuse bruise present. It is not un- usual to see only one arch of teeth on an injury and, if this is the case, it is most often the lower teeth that are present which relates to the mechanics of biting,

i.e. the maxilla remains stable while the mandible moves until the teeth meet (7).

Collection of bitemark evidence

Bitemark evidence is collected from both the bite victim and suspect, but it should be remembered that the bite victim could be the suspect in the case. In most in- stances the odontologist will collect the ev- idence from the bite suspect, as this in- volves techniques (such as impression taking) that can only be undertaken by a trained clinician. The American Board of Forensic Odontology (ABFO) has pub- lished guidelines that described the evi- dence that should be collected from both victim and suspect and they represent a sound basis for such collection. The most important item of evidence from the bite victim is photography. Numerous photographs of the injury should be taken. Shots would include:

- With and without the ABFO No. 2 scale;
- In colour and black and white;
- On and off camera flash (oblique flashes can highlight the three-di- mensional nature of some bites);
- An overall body shot showing the location of the injury;
- UV photography if the injury is fad- ing;
- If the bite is on a moveable anatom- ical location, then several body po- sitions should be adopted in order to assess the effect of movement (7).

Following photography a number of other items should be collected:

- Dental impression of the victim – This is to exclude them as self-bit- ing and for comparison to any bite injuries that may be discovered on a suspect.
- DNA swabbing of the injury site – This should be a double swab. The first swab is moistened with dis- tilled water and the second one is dry.
- Impression of the bite injury – This should only be performed if a sig- nificant degree of three-dimen- sional detail is present and, in the author's experience, rarely pro- duces anything of analytical value.

Skin removal – It is recommended by cer- tain authorities as it permits trans-illumi- nation of the bitemark but again has been shown to be flawed owing to skin contrac- tion and therefore few odontologists prac- tice this (8).

Collection of evidence from the bite suspect

The collection of evidence from the bite suspect must commence only after proper consent has been acquired. Once author- ity has been obtained, evidence collection begins, again, with photography. Shots that should be taken include:

- Overall facial shot;
- Close-up photograph of the teeth in normal occlusion and biting edge to edge;
- Photograph of the individual open- ing as wide as possible;
- Lateral view.

A thorough dental examination should be undertaken and a dental charting pro- duced detailing the presence and condi- tion of each of the teeth, as well as noting any recent dental treatments or dental modifications that have been undertaken. The next stage is to take two high quality impressions of both the upper and lower arches. If the individual wears a dental prosthesis, impressions should be taken with this being worn and also without (1).

Analysis of bitemark injuries

After examining the bitemark evidence as described above The American Board of Forensic Odontology provide a range of conclusions to describe whether or not an injury is a bitemark. These are:

Exclusion – The injury is not a bitemark. Possible bitemark – An injury showing a pattern that may or may not be caused by teeth, could be caused by other factors but biting cannot be ruled out.

Probable bitemark – The pattern strongly suggests or supports origin from teeth but could conceivably be caused by something else.

Definite bitemark – There is no reasonable doubt that teeth created the pattern

After it has been determined to be a bitemark then overlays are made from the casts of the suspect to compare with the marks on the skin.

Pattern analysis in bitemark evidence

Metric analyses of bitemarks –To compare the biting surfaces of teeth of the suspect to that found on the evidence are crucial within the analytical process. But the as- sessment of the bite pattern often serves to be the most revealing. This is usually conducted using a transparent overlay (Fig 1). Overlays are produced from the dental casts of suspects, and are a repre- sentation of the biting edges of the teeth reproduced on transparent sheets at life size (8). The overlays are then placed over the scaled 1:1 photographs of the bite in- juries and a comparison is undertaken. If overlay analyses are restricted to those bitemarks displaying unique characteris- tics, the process, in the hands of an expe- rienced odontologist, can be highly accu- rate.

There are a number of methods for pro- ducing bitemark overlays (9)

- Computer-based;
- Two types of radiographic;
- Xerographic; and
- Hand-traced.

For many years, hand-traced overlays were the method of choice and these were slowly replaced by a photocopier tech- nique. Sweet and Bowers determined that computer-generated overlays were by far the most accurate in terms of both tooth area and rotation.

A range of conclusions is available to od- ontologists to describe the results of a bitemark comparison:

Excluded – There are discrepancies be- tween the bitemark and suspect's denti- tion that exclude the individual from mak- ing the mark.

Inconclusive – There is insufficient forensic detail or evidence to draw any conclusion on the link between the suspect's denti- tion and the bitemark injury.

Possible biter – Teeth like the suspect's could be expected to create a mark like the one examined but so could other denti- tions.

Probable biter – Suspect most likely made the bite; most people in the population would not leave such a bite.

Reasonable medical certainty – Suspect is identified for all practical and reasonable purposes by the bitemark – any expert with similar training and experience, eval- uating the same evidence, should come to the same conclusion of certainty (2).

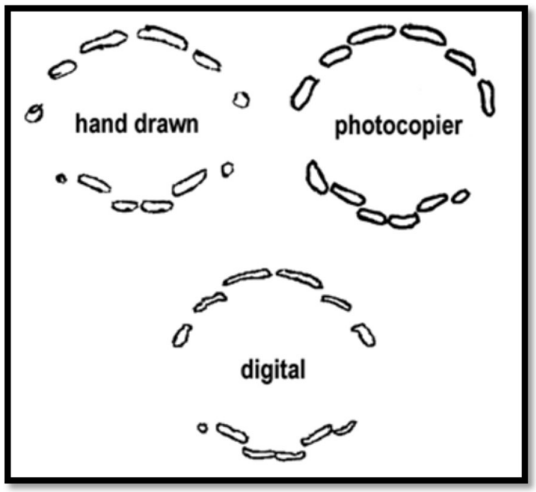

Fig 1: Overlay production methods: (a) hand-drawn technique using acetate sheets and marker pen; (b) photocopier technique; (c) digitally scanning cast.

Other methods of analysis

Analysis of DNA collected from bitemarks - In order to maximize the DNA collected, Sweet recommends that bitemarks should be 'double swabbed', the first swab being moistened with distilled water and the second being dry. The advents of polymer- ase chain reaction (PCR) techniques have ensured that DNA analysis will play a cru- cial role in investigation of bite injuries. DNA analysis avoids many of the pitfalls associated with physical bitemark com- parisons but it does not represent a foren- sic panacea. DNA analysis represents the most scientific, method of bite mark anal- ysis currently available to the forensic in- vestigator (10).

Recovery of Oral Streptococci from Bite Marks - The concept of recovering oral bacteria from bite marks for forensic pur- poses was first proposed in 1984 by Brown and colleagues from the Department of Oral Biology at the University of Adelaide, South Australia. These authors acknowl- edged that the establishment of a suitable "fingerprint" typing scheme for oral bacte- ria may provide evidence relating to the identity of a suspect in such cases. The human mouth contains over 500 distinct species of bacteria, and every individual will have a slightly different combination, dependent on, for example, oral hygiene status, dental status and the presence or absence of a prosthesis. One research group has suggested that the genotypic identification of oral streptococci may be of use in bitemark analyses and, while ac- cepting a number of limitations to the technique, have published findings which are encouraging (11).

Conclusion

Due to the seriousness of the cases in which bitemarks are found it is necessary that the highest levels of forensic stand- ards should be applied in the analyses of such cases. Apart from the studies of casts and overlays as described above research into more objective methods of bitemark analysis has produced techniques such as salivary DNA recovery and bacterial geno- typing which have been proven to be more reliable. But in our Indian settings more often cases report after the DNA evidence have been washed out by the victim and hence one has to rely on the overlay and cast technique in most cases.

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