

23 Forensics: Bitemark Analysis

David Bailey and Stephen Drew

Analysis of bitemarks is a developing and specialized field of forensic veterinary science. Bitemark analysts often are required to give professional and expert testimony in court on bitemarks from an animal that may have bitten another animal or person and cases where humans may have bitten animals.

Animal-to-animal bites may involve investigation of a crime involving wildlife, such as badger baiting by dogs. The bitemarks viewed and examined on the dogs need to be identified as being more likely to be from a badger than from any other animal, or even if the injuries were caused by objects such as barbed wire or undergrowth.

People who are bitten by animals are often injured by the event, and efforts to treat the injured person may not always have a forensic focus, thus leaving a large amount of valuable evidence that could have been retrieved at the time to go uncollected. On non-pigmented human skin, exposure to certain light wavelengths via forensic imaging techniques can allow visualization of a bitemark pattern long after visual wound healing has occurred (see: http://www.company7.com/library/nikon/Reflected_UV_Imaging_for_Forensics_V2.pdf).

In some instances, this can allow a stronger case to be presented in a report or courtroom if a claim is subsequently made against a responsible party. Dogs that are presented with a bite received from a human may not always be

identified correctly as a bite or a human bite, and the correct examination techniques, analysis and interpretation of these events requires considerable skill.

I have examined bitemarks where dogs have been involved in fights with other dogs (see Fig. 23.1) and dogs that have been bitten by badgers – a protected species in the UK (Fig. 23.2).

Figure 23.3 shows an example where a human pathologist will require the assistance of a veterinary forensic bitemark analyst to assist when a dog is suspected of a bite in a human.

Man and dog have long enjoyed a close relationship, with the dog adopting various roles from working animal and protector, to family companion. Inevitably this close association may sometimes result in conflict. Over 1 million dog bites occur every year in the USA alone (De Munnynck and Van de Voorde, 2002). Severe injury, disfigurement and occasionally fatalities occur, attracting significant media and public attention as they often involve young children and the family pet. An individual who owns, or is in control of a dog, is legally liable should that dog cause harm to another person. This provides an opportunity for the Forensic Veterinary Surgeon, acting as an expert witness, to aid the courts by employing bitemark analysis in the resolution of such legal disputes. However, in the absence of a victim with visible injuries, an assailant (the dog), and an owner with adequate insurance, there may not be reasonable grounds to pursue a case.



Fig. 23.1. A dog that had been seized, which had been in a fight. The owner claimed the wound on its back was due to him accidentally dropping a cup of very hot tea on the dog's back. It was the opinion of the author (David Bailey) that this bite was more likely to have been inflicted by another dog in a fight. The owner pleaded guilty prior to contest. (Copyright David Bailey.)



Fig. 23.2. Pictures of a dog's muzzle that had been de-gloved after being bitten by a badger. The dog in this photo has had most of its bottom lip removed. Badgers have very blunt canine teeth and their bites tend to be crushing and tearing rather than puncture. The microbiology from wounds also is of important evidential value. A bite with anaerobes is likely to be a puncture wound from a sharp canine whereas a blunt canine tooth injury could return a culture of anaerobes. Bitemark analysis as a sole determinant of a badger bite and therefore of evidence of interfering with a badger was not able to be determined from this analysis alone and a conviction was not successful against the owner. (Photograph copyright David Bailey.)

An accurate description of the distribution and nature of the injuries is essential. Weiss *et al.* (1998) found that only 30% of dog bite wounds to adults were on the head and neck, whereas 73% of injuries to children were on the face, head and neck. Brogan *et al.* (1995) and De Munnynck and Van de Voorde (2002) also identified this pattern of injuries to children. A veterinary surgeon is *not* entitled to examine the injuries to a human directly or pass expert opinion on such injuries. This is outside of their area of expertise and should be left to suitably qualified medical personnel. A veterinary surgeon can only examine the *images* obtained of any bitemarks on a human. A bitemark may be defined as 'a pattern produced by human or animal dentitions and associated structures in any substance capable of being marked by these means' (Clark, 1992). The importance of bitemarks on a victims skin, and on inanimate objects connected with a crime scene such as food items, bottle tops and pencils, have long been recognized in human forensic investigations. In 1979 at the trial of the infamous serial killer Theodore 'Ted' Bundy, the correlation between an outline of his front teeth and a bitemark on the left buttock of one of his victims was a pivotal piece of evidence in his conviction and subsequent execution. A Forensic Odontologist is 'an expert whose knowledge of dental anatomy is made use of

within a legal context' (Jackson and Jackson, 2011). Both the British Association for Forensic Odontology (BAFO) and the American Board of Forensic Odontology (ABFO) produce guidance for personnel involved in the photography of such wounds. ABFO recommends that 'when bitemarks are photographed as evidence, attempts are made to carefully control perspective variables in an effort to obtain an accurate representation of the bitemark for later comparative analysis' (ABFO, n.d.).

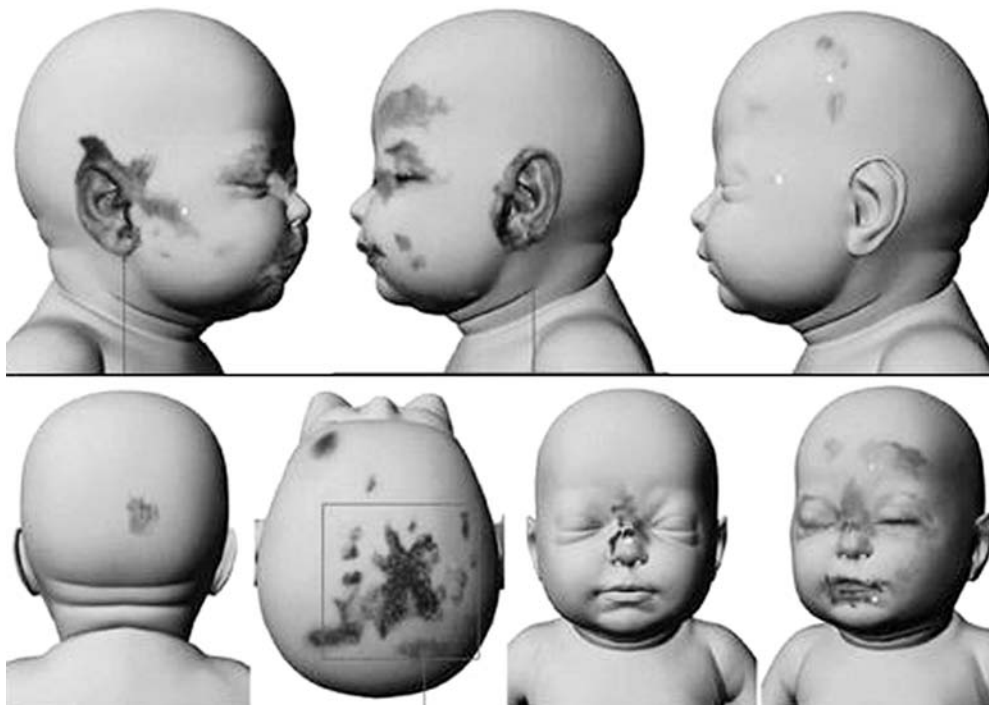


Fig. 23.3. Representations of injuries received on a baby in the UK who had died as a result of injuries received from its carers. Some of the wounds were suspected to have been dog bites. The suspect dog was not able to be examined as the owner had him destroyed. The lack of neck injuries to the victim was indicative, in this expert's opinion of the dog having been held by a lead and allowed to attack the face and head and not allowed to kill the baby quickly. Bruises and healing wounds on the victim suggest the abuse had been long running. (Copyright David Bailey.)

Photography of bite marks and similar types of two- and three-dimensional physical evidence should have the following features (Bowers and Johansen, 2004):

- Presence of a scale (Fig. 23.4) oriented on the same plane as the bitemark.
- The orientation of the camera back and the scale is parallel.
- The scale is on the same plane as the bitemark thus eliminating parallax distortion. The scale is used to reproduce a life-size image of the object. Its displacement below or above the object will make this later process inaccurate.

Both distant (for orientation) and close-up photographs should be obtained and provided for examination. As long as these are focused,

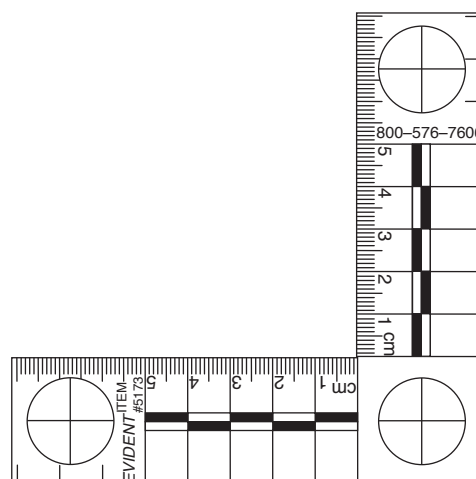


Fig. 23.4. Forensic scale (Copyright S. Drew).

clearly labelled, 1:1 scaled images of the bite-mark then they can be used for further analysis.

Human or Canine?

If there is no witness to the injury then it may be necessary to ascertain whether it is a dog (canine) bite. Children may bite themselves or each other and may also be bitten by adults in cases of abuse. The distribution of injuries is again important in this respect. For example, a child is not able to bite themselves on the face or neck and the larger adult human bite-marks found on abused children are more likely to be

in a less overt location. Bite-marks to the buttocks and breasts are not uncommon in human sexual assault cases. The anterior portion of the dental arch is much narrower in dogs than in humans and the canine teeth much larger with a curved and more conical outline (Clark, 1992) (Fig. 23.5).

Lessig *et al.* (2006) describes the characteristic human bite as 'superficial abrasion and/or sub-surface haemorrhage looking like an arch'.

Canine teeth of a dog anchor the victim, while other teeth bite and tear tissues.

De Munnynck and Van de Voorde (2002) suggested that the features to be considered 'pathognomic' for dog bites were:



Fig. 23.5. (a) Human dentition and (b) resultant bite-mark compared with (c and d) dog. (Copyright S. Drew)

- puncture wound(s)(caused by canine tooth);
- wounds with ragged irregular edges – stretch lacerations (caused by other teeth in the process of biting, shaking and tearing and sometimes including avulsed tissue with irregular borders resembling a dental arch outline); and
- claw marks (multiple, parallel, linear scratches or drying scuff abrasions).

In both humans and dogs the level of violence accompanying the bite, the size/breed of the assailant, the area of the body bitten, the position of the body part at the time of being bitten and the constitution of the skin (e.g. elderly versus young) can all cause distortions and variations to the bitemark, making analysis and interpretation challenging. It may be possible to draw a conclusion that the injury is likely or unlikely to be a dog bite, however, it may also be inconclusive. If this is the case, or if the suspected dog is not available for comparative examination, then there would be very little rationale to proceed.

Detailed Examination of the Bitemark

It must be remembered that the image of the bitemark used for analysis shows the bruising, puncture wounds and lacerations made by the teeth. It is *not* an accurate representation of individual teeth. Unique features such as those created by missing teeth, abnormally aligned teeth or damaged teeth form useful reference points. Measurements may also be taken between certain prominent marks, the commonest measurement taken being the inter-canine width (Fig. 23.6) as detailed by Murmann *et al.* (2006) and Tedeschi-Oliveira *et al.* (2011).

Examination of the Dog

The dog is a living piece of evidence (see Chapter 22). It is also an animal with a history of aggression. All appropriate precautions (such as a muzzle and the use of chemical restraint) must be taken to protect personnel involved in the examination while preserving the animal's



Fig. 23.6. Inter-canine width. (Copyright S. Drew)

welfare and following appropriate recording, sampling, handling and storage procedures to preserve the integrity and evidential value of any forensic evidence obtained. A full medical history should be ascertained prior to a thorough physical examination. Has there been any prior history of aggression? Have there been any previous injuries to the dog, which may have contributed to its propensity to bite? (Biting may be a defensive response if the dog itself has been a victim of abuse.)

The examination should be performed as soon as possible after the incident. There may be blood and other visible, or trace, evidence from the victim present on the dog. This is more likely in severe and sustained attacks. A sterile swab should be taken from the dogs' mouth and appropriately labelled and packaged for DNA analysis by a laboratory capable of analysing both human and canine short tandem repeats (STRs). According to Locard's Principle of Exchange, 'every contact leaves a trace'. The ability to demonstrate the two-way transfer of DNA between the dog and the victim, i.e. the dogs DNA in the wounds of the victim and the victims DNA in the mouth of the dog, is of greater evidential value than bitemark analysis alone, which is purely comparative. It is of course reliant on a swab of the victim's wounds being taken prior to medical treatment being implemented. Eichmann *et al.* (2004), Clarke and Vandenberg (2010) and Tsuji *et al.* (2008) all document the use of DNA analysis in the forensic investigation of dog bites on humans. When examining the mouth it would be recommended to use a dental chart such as that in Fig. 23.7, along with photographs, to aid the identification and recording of distinguishing features

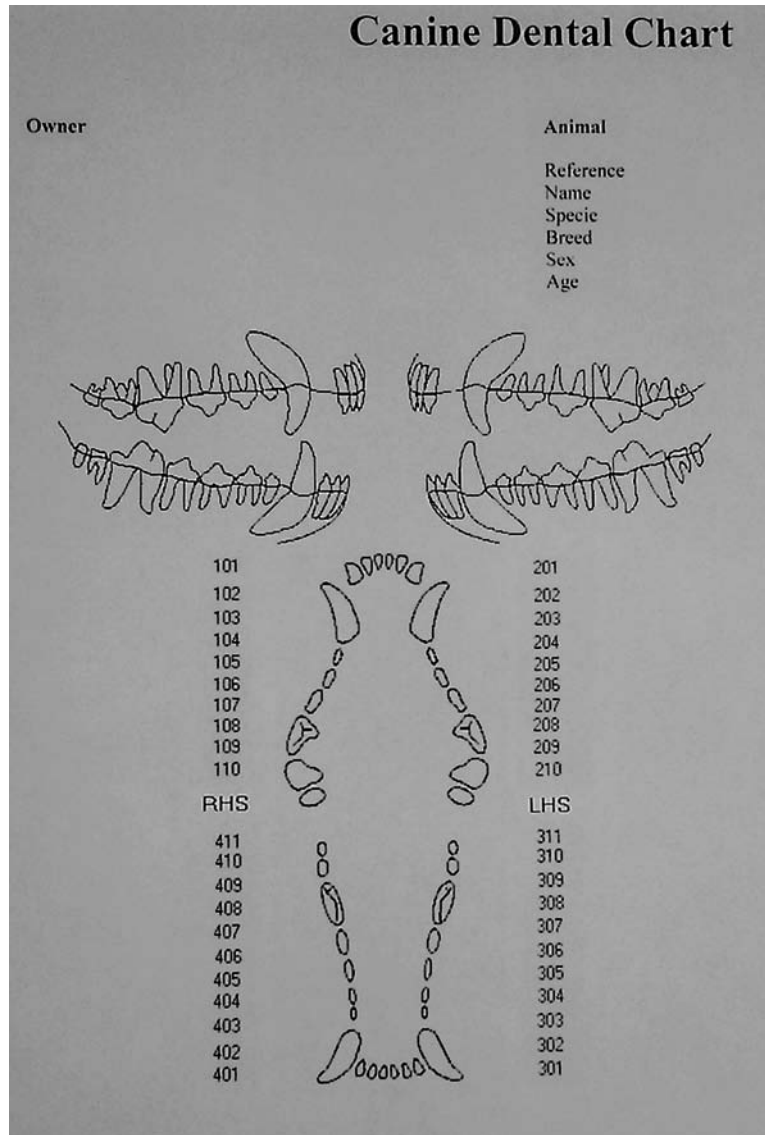


Fig. 23.7. Canine dental chart. (Copyright S. Drew)

such as missing, broken or misaligned teeth. Impressions taken of the upper and lower dental arcades using plasticine or wax can be photographed, following the same principles already discussed, and computer programs such as Microsoft Paint® or Adobe Photoshop® used to generate images that can be accurately measured and overlaid on to the images of the bite-mark from the victim in order to compare them.

Interpretation and Conclusion

The process of bite-mark comparison involves the superimposition of a suspect's dentition on to the image of the bite-mark, the aim being to identify sufficient correspondence between the size and shape of the two patterns to draw a valid, substantiated conclusion. The potential for distortion and inaccuracy during evidence

collection and interpretation can render bitemark comparison evidence highly controversial. Bernitz *et al.* (2012) 'warn against over interpretation of poor quality bite marks and a final conclusion of absolute certainty.' Pomara *et al.* (2011) cite evidence from a case where the son of the victim of a fatal dog pack attack was convicted for manslaughter and 'bitemark analysis provided conclusive evidence in identifying the offending animals.' It may be argued that

the only truly valid conclusion is one of exclusion, i.e. that an individual was very highly unlikely to have created the bitemark in question. The conclusion that a particular individual was very highly likely to have caused the bitemark may be difficult to achieve and would almost certainly rely on additional forensic evidence such as DNA analysis as well as the skill and experience of the Forensic Veterinary Surgeon.

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