Australian Society of Forensic Odontology Inc.

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# Guidelines

## for the conduct of

# Bitemark Analysis

## in Australia

Version 1.0 Oct 2013

# Guidelines For Bitemark Analysis

These guidelines are recommended practice but may be modified as operator experience or case circumstances dictate. The guidelines will be reviewed at least every three (3) years.

## Guideline 1

# Evidence Collection from the Victim

**Preamble**

Collection of bitemark evidence constitutes the first and most crucial phase of bitemark analysis. Opportunities to physically view the suspected bitemark are rarely presented other than during the initial examination due to a variety of reasons often beyond the odontologist's control. Collection of bitemark evidence should endeavour to obtain maximal information so as to enable meaningful analysis and comparison of the wound pattern with a potential source, with the assumption that further access to the material evidence will no longer possible after the primary examination. Every effort must be made to capture the true nature of the evidence at the time of collection by recording as much detail about the injury as possible.

**Scope**

This guideline details recommendations for the collection, recording and documentation of physical bitemark evidence from a living or deceased victim for subsequent use in either qualitative or comparative analysis. Detailed protocols for photography in the forensic setting are beyond the scope of these guidelines, and practitioners should refer to appropriate texts and documents for more detailed advice in this regard.

**1.1 Supervision.** In light of the sporadic nature of bitemark casework, it is likely that police photographers, crime scene technicians, medical personnel and other professional groups who may encounter such evidence may have had little personal experience in the collection of bitemark evidence.

1.1.1 Odontologists should make themselves available, where practical, to assist in the collection and recording of bitemark evidence in order to ensure that appropriate steps are taken to preserve accurate images of the latent marks.

1.1.2 Odontologists should direct appropriately trained photographers in the recording of bitemark evidence. Use of a forensic photographer is desirable in the majority of circumstances, as they are likely to have high-quality photography equipment on hand, in addition to knowledge of how to best use it to achieve the desired results. Such records will also form part of the official forensic documentation for any given case.

1.1.3 Some odontologists may prefer to take 'unofficial' or 'personal' photographs using their own digital cameras. While such photographs may provide a useful record for the odontologist's

personal case log, their use as images for subsequent forensic analysis is highly questionable given the potentially basic nature of the photographic equipment and the lack of official chain-of-evidence custody of the resultant images. The use of these images for forensic analysis should only proceed where it was considered not feasible to have photographs of the latent mark taken by a trained forensic photographer. Such situations are to be avoided where possible.

**1.2 DNA swab.** There is little doubt that DNA analysis provides a more robust means of identification than analysis and comparison of latent marks to source objects. During the process of biting and also during kissing and sucking, saliva is deposited on the skin's surface. The literature has demonstrated that this trace evidence is present in sufficient quantity and quality to enable PCR-based typing of the DNA that is present in saliva from white blood cells and sloughed epithelial cells. DNA from residual saliva should be considered as the primary means of identifying perpetrators when bitemark evidence is encountered, however, several factors influence whether or not DNA evidence in likely to be encountered in these situations, such as the material state of the body at the time of discovery, whether or not the victim has washed or been washed since the mark was inflicted.

1.2.1 The collection of salivary DNA should be the first priority following discovery of a potential bitemark. Detailed written and photographic documentation must also be undertaken, as reliance on DNA evidence from saliva may prove fruitless due to the many factors that influence the preservation of biological trace evidence in bitemarks.

1.2.2 Odontologists should also consider utilising bacterial DNA analysis techniques as applicable to the capability of their supporting institution.

1.2.3 Collection of DNA evidence from bitemark sites has been well documented. The most consistent, robust method of collecting trace DNA from saliva is that described by Sweet et al. (1997) using a double swab method.

1.2.3.1 This method involves first using a cotton swab that has been moistened with distilled water to collect DNA by swabbing the area from the centre of the latent mark outwards, using a circular motion. The swab should be 'rolled' over the surface of the wound, rather than being used in a scrubbing manner. Extension slightly beyond the periphery of the marks is desirable in order to collect salivary DNA that may have been left by the lips. A second, dry swab is then employed in the same manner as the first in order to collect the moisture left by the first swab.

1.2.3.2 Both swabs should be air dried (>30 mins) at room temperature prior to submission for analysis. They should not be stored in plastic bags or containers, but should be kept cool and dry in order to reduce bacterial growth that would otherwise further contaminate the sample (sealed paper bags are the container of choice). They may be refrigerated or frozen during storage.

1.2.3.3 Care should be taken so that samples from other bitemarks on the same victim are kept separate for analysis and do not cross-contaminate one another.

1.2.3.4 Use of powdered gloves should be avoided when collecting evidence for DNA analysis.

1.2.4 A reference sample from the victim is crucial in order to interpret a mixed sample and can be taken at this time using a standard buccal smear. A control smear from the skin elsewhere is also required. This is especially useful in cases where the injury has drawn the victim's blood, thus contaminating the area where the perpetrator's saliva is most likely to be found.

**1.3 Preparation of the bitemark area.** It is sometimes necessary to prepare the wound in order to allow accurate photographs to be taken.

1.3.1 Washing of the wound should only be carried out after the swab for DNA has been taken, and after the wound has been properly documented photographically in its unwashed state. Despite the fact that photographs of the unwashed wound are unlikely to prove useful from a comparison perspective, they form an important aspect of chain-of-evidence and may be useful for other members of the forensic team.

1.3.2 Areas of the body that may have excessive or dark-coloured hair, such as the head, arm, leg or genital regions may need to be shaved in order to accurately portray the bitemark. Extreme care should be taken not to nick or damage the skin further, and the importance of pre-procedural photographs cannot be overstated.

1.3.3 Examination of suspected marks on the deceased should occur when the cadaver is as close to room temperature as possible. This may not be practical when the body is severely decomposed, but should be considered in other cases.

1.3.4 Excision of whole areas of skin that contain a suspected bitemark injury on a deceased victim have been reported in the literature, in order to preserve them for later documentation and analysis. Excision of tissue in this regard requires an injunction from the Coroner in most jurisdictions in Australia. Despite several techniques being described, the potential for distortion in this process currently outweighs any advantages it may have for forensic comparison. While research continues in this area, and practitioners in the US are particularly noted for this technique, it remains unsupported by any advantages over the use of good digital photographic records for comparison, and cannot be reasonably endorsed as a method of bitemark evidence collection in Australia.

**1.4 Photographic records.** The method that has been documented in the literature as the most reliable for comparison of a suspected bitemark to a dentition involves using photographs of the injury. Direct comparison of a model dentition to the wound surface is perhaps unnecessarily traumatic for a living victim, and even if carried out on a deceased victim, is unlikely to produce any useful, reproducible evidence that can then be tendered in court.

1.4.1 As per guideline 1.1.2, forensic photographers should be employed where practical, under the supervision of the attending odontologist, to photographically document the injury. A single photograph is unlikely to yield useful information; proper recording of the suspect mark should involve several photographs, although it is recognised that ultimately only one or two of these may be used for comparative analysis with a suspected dentition.

1.4.2 The minimum recommended photographic equipment that will provide useful images suitable for forensic comparison consists of:

1.4.2.1 A digital camera with a 5 megapixel resolution should be considered the minimum technical requirement. Ideally, a 10 megapixel resolution capability is desirable, as this is a close approximation to standard 35mm film.

1.4.2.1.1 Digital images should be stored as lossless compression files, such as TIFF. While JPEG is commonly used for standard photography, it is not suitable for storing forensic images as it is a compression format and results in the continued loss of digital information each time the image is saved.

1.4.2.1.2 If it is impossible to shoot TIFF images at the scene then initial JPEG files should be converted to TIFF files and these used as the primary images for comparison.

1.4.2.2 Any multiple flash setup that illuminates the wound from multiple angles is superior to a single external flash that illuminates the wound from only one angle. A fixed internal flash is unsuitable for use in forensic photography. Where only a single external flash is available, indirect oblique application of the flash in order to 'bounce' the lighting will assist in avoiding specular reflection, or 'flash burnout'.

1.4.2.3 Film cameras are now rarely encountered, and should be considered inferior to digital cameras given the subsequent digitisation of the photograph that will be necessary in any case, in order to carry out a forensic comparison of the wound. Where it is only practical to employ a film camera, 35mm film should be considered the minimum standard, with both colour and monochrome film.

1.4.3 Orientation photographs that clearly show on what part of the body the wound is located should be taken. These should be taken from reasonable distance and are not meant to demonstrate the finer details of the injury, but to provide contextual information (such as the relative position of the injury) that may prove useful in later analysis.

1.4.4 'Close up' photographs should be taken that demonstrate the finer details of the injury. As a guide, the minimum wound-to-lens distance for 'close-up' photographs should be that which allows individual tooth or bruise marks (when present), to all appear in focus, when considering a single arch. The minimum 'useful' unit of the wound is considered to be a single arch form, either upper or lower, and thus the entire arch should be in focus in close-range shots. Due to the diffuse nature of cutaneous inflammatory responses, there is little detail likely to be recorded in a cutaneous wound pattern that will correspond with the surface features of individual teeth, thus close-up photographs that include only one or two discrete tooth marks in the reference frame, with the remainder of the arch out-of focus, are unlikely to be useful. This may not necessarily be true for bitemarks in or on inanimate objects, and thus the odontologist should use his or her discretion when ordering even tighter reference frames in these cases.

1.4.5 Wounds near flexor or extensor surfaces should be photographed with the limb in various positions, at least three shots at both minimum and maximum extension, in addition to one of mid-flexion. Such photographs will enable an assessment of the likely distortion of the

subsequent mark to be made. If the victim is co-operative, a photograph of the limb in the position that he or she states it was when the wound was inflicted may prove useful.

1.4.6 Photographs should be taken both with and without the presence of a scale. The inclusion of photographs taken from the same orientation but *without* the scale is important to demonstrate that no significant features are being accidentally hidden by the scale instrument.

1.4.7 An ABFO No. 2 scale should be considered the standard scaling tool in this regard. The ABFO No. 2 scale should be placed in the same horizontal *and* vertical plane as the central feature of the patterned portion of the injury. Where no ABFO scale is available, a standard linear forensic scale should be used. Plastic or wooden rulers should be avoided, unless there is no other reasonable choice. Stick-on scales, that follow the curve of the limb, should not be used as they do not allow accurate scaling correction in the digital image, although again, in the absence of anything else, they are better than having no scale at all.

1.4.8 Odontologists should consider inclusion of an accurate 50% grey patch (Kodak 18% neutral gray) or other colour reference patch for colour correction purposes. This may be of relevance when trying to document colour change in a bitemark over time.

1.4.9 Every effort should be made to ensure that photographs of the injury are taken with the long axis of the lens perpendicular to the area of interest in order to minimise distortion.

1.4.10 When there are distinct marks around a curved surface, it may be necessary to re-locate the scale relative to each mark (including potential upper and lower arch marks), being careful to orientate it correctly in accordance with the area of the wound being photographed, and take separate photographs in order to ensure accurate recording of each item of forensic interest. This is particularly true where the suspected bitemark is on a severely curved surface, such as an arm, where individual marks that make up the entire suspected injury pattern are likely to be on significantly different planes. This process is far more accurate than placing the scale in the same plane as the centre of the bitemark, which actually contains no patterned features useful for analysis, and which results in having the scale in neither plane that the most useful forensic features (i.e. the marks that have been made by teeth) are located.

1.4.11 When the odontologist deems it necessary to take separate images of the upper and lower portions of the injury, the long axis of the lens must likewise be perpendicular to each feature of interest in each photograph. This means that each of the photographs will be taken from a slightly different angle in order to preserve this orientation for each portion of the injury.

**1.5 Impressions of the bitemark area.** Generally speaking, the relative rarity of three-dimensional information associated with cutaneous bite injuries makes the routine recording of the wound via an impression unnecessary. However, if on inspection the odontologist feels there is three-dimensional information associated with the injury, impressions should be taken.

1.5.1 A low-viscosity polyvinylsiloxane (PVS) impression medium should be used in order to obtain maximum accuracy and dimensional stability. Alginate should *not* be considered a suitable material for impressions of suspected bitemark injuries.

1.5.2 The initial layer of low-viscosity (light-body) material should be supported by adequate bulk of high-viscosity material in order to protect the impression from tearing and distortion. Heavy-body PVS of the same brand as the low-viscosity material is adequate in this regard, and is preferred as it binds chemically to the low-viscosity material, reducing the potential for dimensional inaccuracies through slippage and shrinkage. Care should be taken not to distort the area of the bitemark if using putty-consistency material. Other methods include supporting the low-viscosity material with self-cure acrylic resin or dental stone, however, these have the disadvantage of being exothermic in their set, and on completion they are easily separated from the recording medium. These factors introduce potential errors associated with the dimensional accuracy of the resulting impression.

1.5.3 Once the impression is fully set, it should be poured in high-strength Type-IV dental stone. Plaster of Paris is not of sufficient strength or resistance in this regard, given the amount of handling that the resulting models may be subjected to.

**1.6 Documentation.** Documentation of the recording procedure is an essential step in order to maintain an accurate custodial record of the incident. As a minimum, the following is recommended:

1.6.1 The details of the examining odontologist and any other persons present or acting as a witness to the examination, including the time and date of the examination.

1.6.2 Any stone models resulting from impressions of the injury should be marked indelibly with suitable identification numbers / names as appropriate.

1.6.3 A detailed description of the injury, including notes on its size, orientation, and location on the body. A description of the type of tissue that the mark is on will also allow an assessment of the likelihood of distortion in the mark, such as the contour of the area, the presence of substantial muscle, adipose or elastic tissue beneath the mark, and whether or not the mark is close to any flexor / extensor surfaces or joints.

1.6.4 The number and type of photographs taken.

1.6.5 A sketch diagram of the site of the injury, with key measurements such as (supposed) inter-canine width labelled where possible. Such first-hand information will help verify the accuracy of the subsequent photographs during the analysis phase.

1.6.6 A brief case history may prove useful, however, the potential for this information to bias the analysing odontologist needs to be weighed against its potential to aid in answering the forensic question. If the question is one of corroboration of the injury as a bitemark, or of verification of an assault victim's version of the events leading to such an injury, then a case history may provide useful details for the analysing odontologist to compare. If the question is one of identity, the less information regarding the nature of the attack the better, in order to avoid potentially biasing information that may influence the analysing odontologist's opinion.

## Guideline 2

# Initial Assessment of Bitemark Evidence

**Preamble**

Odontologists may be called upon to provide an assessment of a cutaneous injury upon suspicion that it may have been caused by teeth. Initial assessment of a bitemark injury is best performed during examination of the injury itself, as opposed to assessing photographs, however, it is recognised that this opportunity rarely presents itself. For the purposes of qualitative assessment, assessment of the injury via good-quality photographs should be considered only slightly less advantageous than viewing the injury itself.

**Scope**

This guideline outlines the factors that an odontologist should consider when performing an initial assessment of an injury suspected to be a bitemark.

**2.1 Is the injury a bitemark?** The primary question in the initial assessment of cutaneous injuries is that of whether the injury represents a mark made by teeth or not. This approach should be considered in a logical way, assessing class, subclass and individual characteristics of the injury pattern, without the need to resort to 'suspicion', or 'experience' as reasoning for the opinion.

2.1.1 *Class characteristics*. The class characteristic of a bitemark is the presence of one or more arc-like cutaneous wounds, representing the approximate dimensions of a human dental arch form. An area of central ecchymosis is a variable class characteristic of a bitemark that may not be present in all injuries. Such an area is not necessarily representative of suction during the act of biting, is almost certainly *not* due to tongue-thrusting, but is likely to be a result of injury to small blood vessels as they are compressed during the bite.

2.1.2 *Sub-class characteristics.* The sub-class characteristics of a bitemark are represented by discrete portions of the injury that could reasonably be ascribed as having been made by individual teeth. It is mainly on the comparison of sub-class characteristics, such as position and degree of rotation, that associations are made between a dentition and a bitemark in human skin.

2.1.3 *Individual characteristics*. Even more discrete details that reveal information about individual teeth, such as areas attributable to notching and differential wear of teeth, are considered individual characteristics. It is doubtful that individual characteristics are represented with any accuracy on a cutaneous bitemark injury due to the nature of human

skin, however, individual characteristics may be represented in bitemarks on inanimate objects.

2.1.4 Parallel, linear marks, representing 'drag marks' that may be associated with individual (or groups of individual) teeth may also be a feature of a bitemark, however, in the absence of any other class characteristic, are unlikely to be sufficient evidence of biting injury by themselves.

**2.2 Human or animal.** It may be difficult to ascertain the origin of a bitemark as being human or not. Odontologists should render this opinion on the basis of class and sub-class characteristics, in addition to considering factors such as the size and shape of the injury.

**2.3 Possibility of self-infliction.** Odontologists should consider the possibility of self-inflicted bitemarks. The position of the wound on the body may obviously indicate whether the wound could have been self-inflicted or not.

**2.4 Ageing.** While most odontologists have training and experience in assessing cutaneous injuries, there is little evidence to support the notion that bitemarks can be aged with any degree of accuracy. Statements beyond that of claiming that an injury is either 'old' or 'recent' cannot be reasonably supported.

**2.5 Adult or child.** Arch width has often been cited in the odontology literature as a defining feature of an adult versus child bitemark. Such calls need to be made with caution as there is wide overlap between the possible ranges of inter-canine width for adults and children. Additionally, arch-width has been cited as one of the most distorted metrics in bitemarks on human flesh.

2.5.1 Indicative inter-canine widths of less than 25mm have been generally considered to represent that of a child's arch, but measurements of less than 21mm have been recorded for adults.

**2.6 Level of force.** No study has yet been conducted on the amount of force necessary to produce different types of bitemark injuries, which range from diffuse bruising to avulsion of portions of human flesh.

2.6.1 The presence of a bitemark, even one of diffuse bruising, implies a significant amount of force was generated during the time of injury. Beyond that, other factors such as the morphology of the teeth and the circumstances of the biting influence the appearance of the wound to an as yet unquantified degree.

2.6.2 The severity of a bitemark is not necessarily linearly proportional to the amount of force used or the degree of violence experienced by the victim, and odontologists should avoid making statements that imply such.

**2.7 Description of bitemark.** Odontologists should provide a detailed description of the suspected injury, even when photographs are taken. Anatomical and pathological terminology should be used where indicated to describe the location and nature of the injury. A description of the skin or object that the mark has been made in, including its colour and consistency,

should be included. Description of the injury should be made independent of any assumption that the injury has been caused by teeth.

**2.8 Quality of evidence.** Odontologist should consider the relative quality of both the material evidence as well as the bitemark itself, as this in turn should appropriately moderate any conclusions that are then drawn from assessment of the injury.

2.8.1 Assessment of the quality of the injury itself provides guidance on the potential forensic value that the bitemark has.

2.8.1.1 Injuries of medium severity usually represent the most forensically valuable material.

2.8.1.2 In general, injuries at the low end (diffuse bruising) and high end (complete avulsion) of the severity spectrum carry less forensically significant information. Odontologist's opinions should be appropriately weighted in order to account for this.

2.8.2 Assessment of material quality includes consideration of the technical aspects of photographs offered for assessment including:

2.8.2.1 The presence of an ABFO No. 2 scale, its alignment with the bitemark injury and its position in the same plane.

2.8.2.2 The position of the camera lens at the time the photograph was taken, and the resulting amount of distortion (and whether it is correctable or not).

2.8.2.3 The relative contrast and saturation of the bitemark images.

2.8.2.4 The presence of specular reflection that has potentially washed out surface details in the injury.

2.8.2.5 The number of other photographs of the injury, and the consistency of appearance of the injury in these alternative views.

# Guideline 3

# Evidence Collection from a Suspect

**Preamble**

Collection of dental evidence from a suspect is necessary in order to provide material for comparison with that collected from the victim. Suspected biters are usually cooperative, however, as the dental examination is considered a forensic procedure, their (or their guardian's) consent to undergo such an examination is generally considered necessary. The relevant *Crimes Act* in a federal, state or territorial jurisdiction authorises the carrying out of a forensic procedure on a suspect, serious offender or volunteer with the 'informed consent' of that person. Collection of dental evidence for bitemark comparison falls into this category. Courts, and in some cases, police officers, can compel unwilling suspects to undergo dental examination under various clauses of the *Crimes Act*, however, the legal technicalities of these situations are complex and beyond the scope of these guidelines. It is recommended that forensic odontologists seek legal advice if confronted with a refusal to undergo a forensic dental examination. Particular attention should be paid to the potential time lapse between the suspected biting and the dental examination. Odontologists should note that the dental status of the individual at the time of examination may have changed significantly since the suspected injury was inflicted, and this may affect any interpretation of the results of the dental examination.

**Scope**

This guideline details recommendations for the collection, recording and documentation of dental evidence from a suspected biter.

## 3.1 Consent and authority.

3.1.1 Most Australian jurisdictions require that the collection of physical evidence from a suspect be carried out either with a witness present, or that a video of the procedure is recorded. It is recommended that dental evidence collection from a suspect be carried out in the presence of a chaperone where possible, even in the presence of video recording equipment. This may be another health professional or law enforcement officer.

3.1.2 There is a legal requirement, under the *Health Practitioner Regulation National Law Act (2009)* for a registered dentist to take impressions and conduct dental charting in person on a living suspect. Such activities *may* be delegated to persons holding other forms of registration under the Act, (such as a dental hygienist or therapist) but only on the direct authority of a registered dental practitioner with whom they have a structured professional

relationship. In general, this situation should be avoided, and odontologists should be called to perform this examination. Forensic odontologists have undertaken training above and beyond general dental practitioners, which makes them best qualified to carry out a forensic dental examination of a suspect (however, see section 3.7 below).

**3.2 DNA swab.** A standard buccal swab should be taken for DNA comparison. Some laboratories may prefer a whole-blood sample, and this may vary between jurisdictions.

3.2.1 DNA samples need not be directly taken by the odontologist, but he or she should recommend to police that such reference samples will be required for comparison with the sample obtained from the wound area.

**3.3 Photographic records.** Photographic representation of the suspect's dentition is important to verify the accuracy of the models used in the analysis phase.

3.3.1 It has been recommended that full facial and profile shots be taken, however, their exact purpose remains undescribed in the literature. As a minimum, occlusal surface views, as well as frontal and lateral views of the dentition both in occlusion and with the jaws open should be taken.

3.3.2 An ABFO No. 2 scale should be included where possible in these photographs. It is important that this be present in the same plane as the dentition, and not that of the mirror, when using mirrors to obtain occlusal and lateral views.

**3.4 Dental charting.** A chart of the suspect's dentition should be recorded using standard FDI and charting protocols. It is recommended that a written description of each restoration is also recorded, rather than having to rely on interpretation of charting symbols when analysis proceeds at a later date.

3.4.1 A thorough dental examination should be conducted with a mirror, probe and good lighting, with the odontologist noting the details of any missing teeth, restorations, chips or defects present, especially in the anterior segment.

3.4.2 Maximal opening should be measured and recorded at this stage, as this may assist to exclude or include a suspect when compared with similar measurements taken from the suspect mark. Path of opening / closure should be noted, with any significant lateral deviations noted and measured.

3.4.3 Occlusal anomalies that may effect the mechanism of biting, such as a severe Class II Division I malocclusion should be noted.

3.4.4 Dental records need not necessarily be obtained, however, they may provide useful corroborating evidence regarding the nature and timing of any restorations carried out that may affect the morphology of the anterior teeth.

**3.5 Impressions and bite registration.** Impressions from a suspected biter are the most essential form of physical evidence for bitemark comparison exercises.

3.5.1 Upper and lower impressions should be taken in the highest-quality medium available. Ideally, they should be taken in a polyvinylsiloxane or other similar rubber-based medium

using a putty-wash technique, however this is not always practical if the suspect is in custody. Alginate impressions are reasonable alternatives providing they are handled appropriately (See 3.5.3), and it may be preferential to use a hydrophilic material where adequate facilities to dry the dentition prior to the impression are not available. Practitioners must bear in mind the potential need for multiple copies of the models when selecting the impression medium and deciding on the number of impressions to be taken.

3.5.2 The use of custom trays is not necessary, as the literature now demonstrates that well-fitted stock-tray impressions using modern PVS materials have minimal dimensional distortion that is unlikely to affect the morphology of the anterior dentition for the purposes of forensic comparison.

3.5.3 If a rubber-based material is not available, alginate may be used. Most alginate materials are now relatively dimensionally stable for at least 12 hours, providing they are stored correctly. The manufacturers instructions should be consulted in this regard.

3.5.4 Impressions with air bubbles or other defects on the incisal or occlusal portion of teeth must be categorically rejected and subsequently re-taken. It is unacceptable to 'alter' models once they are poured in order to correct for these defects.

3.5.5 Impressions should be poured as soon as practical after the procedure in Type IV stone (or another similar hard-wearing dental stone).

3.5.6 The use of rubber-based impressions will generally allow a second pour of each impression. In this case, the first should serve as a working set, with the other subject to as little handling as possible to serve as master models.

3.5.7 Alginate impressions should not be poured a second time. The material is likely to tear during removal from the first model, and in any case will likely undergo distortion during the exothermic set of the dental stone. Where impressions are taken in alginate, it is recommended that two upper and two lower impressions are taken, to serve as master and working models respectively.

3.5.8 A record of the suspect's occlusion should also be gathered via a bite registration. Base/catalyst bite registration materials such as BluMousse® (or similar products) should be considered first-line materials in this regard. Wax bites are dimensionally unstable over even short periods of time and are not the preferred means of recording occlusal relationships.

3.6 **Bite sample.** Collection of a bite sample is not the same as collection of a bite registration, and fulfils a different purpose. A bite registration is gathered in order to allow accurate association of upper and lower models. A bite sample demonstrates the pattern of the suspect's teeth during their own particular physiologic action of biting.

3.6.1 Bite samples are preferentially recorded in polyvinylsiloxane putty-consistency material. Wax bite wafers are subject to greater dimensional instability and should only be used when putty is not available. A single layer of baseplate wax should generally be considered unsuitable for recording a bite sample, and only used as a last resort.

3.6.2 A bite sample should not involve a through-and-through bite. There should be sufficient thickness of material between the upper and lower teeth in order that the sample maintains its rigidity once set. The goal is to record the indentations made by upper and lower teeth to a depth of only 1-2mm into the medium.

3.6.3 Where wax wafers are used, they should be photographed with an ABFO No. 2 scale in place as soon as they are recorded, in order to provide verification that no distortion has occurred between the recording of the bite and the comparison phase.

3.7 **Third-party evidence collection.** It is recognised that it is not always feasible for odontologists to obtain first-hand physical evidence from a suspect. While this situation is not ideal, occasionally the suspect may need to have impressions taken by a third-party practitioner who in all likelihood will not have had any forensic training.

3.7.1 In the event that a third-party examination provides the only practical means of gaining dental evidence from a suspect, it is recommended that the odontologist communicates with the practitioner responsible for collection of this evidence prior to the examination.

## Guideline 4

# Methods of Comparative Analysis of Suspect Dentitions to Bitemark Injuries

**Preamble**

Evidence collected from both victim and suspect are compared in the analytical phase of bitemark comparison. During the process of comparative analysis, the odontologist attempts to draw a conclusion regarding the nature of correspondence between a latent mark and the morphological features of the suspect dentition. This guideline should be read in conjunction with Guideline 7 regarding the potential for contextual bias and observer error in this process.

**Scope**

This guideline articulates recommended methods of comparison of a suspect dentition to a bitemark injury. Technical details of how these comparisons should be carried out are beyond the scope of this document. Relevant texts in forensic odontology should be consulted in this regard.

**4.1 Methods of comparison**. A dentition may be compared to a bitemark in both qualitative and quantitative ways.

4.1.1 The method endorsed by the literature as being the most accurate is that described by Johansen and Bowers (2003), using a qualitative 'overlay' technique. This should be considered the primary method of comparative analysis, although practitioners should be aware of the shortcomings of this method.

4.1.2 Other means of comparison should be considered supplementary to this method, but may prove useful in corroborating the opinion reached on the basis of qualitatively comparing hollow-volume overlays with the bitemark

4.1.3 Odontologists should be familiar with the principles of distortion and subsequent enhancement and correction of images as described in this method. A failure of this understanding, in addition to not being able to explain the principles and methods involved in its application to a judge or lay jury is likely to prove devastating to the odontologist's credibility as an expert witness.

**4.2 The overlay technique**. Production of an overlay should be achieved via the use of digital design software such as Adobe Photoshop®.

4.2.1 **Overlays.** Hollow-volume overlays should initially be produced from a scanned bite record, or in the absence of a bite record, a wax impression of the indentations made by the anterior teeth as made by the odontologist from the models of the suspect. This provides maximal level of detail, with minimal selection bias from either the odontologist or the computer software, and should serve as the primary overlay for comparison. Scanning should proceed at a minimum of 300 dpi. In order to minimise parallax error during scanning, objects should always be scanned at the same position on the platen in order to make them comparable.

4.2.1.1 Overlays may be produced via other methods, such as from scanned models (as suggested by Johansen and Bowers using the 'Magic Wand' tool in Photoshop), however, these methods introduce biases that cannot be compensated for. Consequently, they should be considered as supplementary, or secondary means of producing overlays. The use of the 'Magic Wand' tool to automatically select overlay outlines should be approached with caution, and the resulting overlay checked against known impressions of the teeth (for example in the occlusal record).

4.2.1.2 Compound overlays, as described by Johansen and Bowers, should likewise be considered as supplementary means of demonstrating the relationship between a dentition and a latent mark.

4.2.1.3 Production of hollow volume overlays may require assessing the relative influence of the palatal and lingual surfaces of the teeth as evidenced in the latent mark.

4.2.2 A photograph of the occlusal surfaces of the teeth can suffice in lieu of scanning, providing there is careful set up to ensure perpendicularity to the camera lens, adequate compensation for lens distortion by ensuring adequate distance from the object, and set up of an ABFO No. 2 scale parallel and in line with the occlusal plane. The potential for distortion through these shortcomings needs to be balanced with the potential for distortion through parallax error inherent in the scanning process.

4.2.3 **Bitemark image**. It is usually necessary to correct for distortion in the digital images of the latent mark, as rarely is the photography so perfect as to represent perpendicularity in two dimensions relative to the bitemark. A forensic imaging expert may be able to offer useful advice when the odontologist is not confident in performance or understanding of these techniques.

4.2.3.1 Correction for distortion involves both scaling (or re-sizing) in order to obtain a dimensionally comparable image with that of the overlay, and correction of angular distortion. The technique for this correction is well-described by Johansen and Bowers (2003).

4.2.3.2 Enhancement of image qualities such as contrast, brightness, colour, and opacity are acceptable, providing a record of these alterations are kept.

4.2.3.3 Dimensional alteration of the images, in order to correct for any other form of image distortion, introduce non-accountable errors and are not endorsed as a means of ‘correction for distortion’.

4.2.4 **Comparison.** The comparative phase of analysis occurs when the overlay and the digitally corrected image of the bitemark are compared with one another.

4.2.4.1 The primary means of comparison between a dentition and bitemark image should be one based on the similarity of morphology of the hollow-volume overlay and the digitally corrected image of the injury.

4.2.4.2 The metric, angular and non-metric methods described by Johnsen and Bowers for comparison should be considered supplementary techniques useful for supporting a conclusion based on comparison of the hollow-volume overlay and the corrected image of the bitemark. There is little support in the scientific literature for using these methods as a primary means of demonstrating concordance between a dentition and a bitemark.

**4.3 Other methods of analysis.** The method described by Johansen and Bowers is considered to be the most accurate means of overlay production and its use for subsequent comparative analysis has likewise been demonstrated to be the most reliable.

4.3.1 Hand-tracing of the incisal or occlusal surfaces of the dentition on clear acetate for use in subsequent comparison with a bitemark image is highly subjective and is not endorsed as either a primary or supplemental method of overlay production.

4.3.2 Similarly, the practice of directly comparing the overlay to life-sized photographs that have not been corrected for distortion is to be discouraged. This is not to say that these images cannot be used, however, they should be scanned appropriately and corrected for angular distortion prior to any comparison exercise being undertaken.

4.3.3 Radiographs produced from radiopaque material applied to a wax bite have been described as a useful method of generating a comparative tool, however its accuracy is still less than that of a digitally produced overlay method. It may have a role as a secondary means of analysis but should not form the primary means of comparison.

4.3.4 Use of acrylic templates of the suspect dentition has been described in the literature as a means of comparison with life-sized photographs via physical superimposition of the template over the image, however this has only been demonstrated in the form of a case study. No controlled, comparative study has been conducted regarding the accuracy of this technique and conclusions based on the association between direct placement of models on a cutaneous injury (or photograph of an injury) is highly subjective and potentially prejudicial.

4.3.5 The amount of distortion that injuries undergo when subject to excision from the body has not yet been established, but it is reasoned to be potentially significant. Comparison of a suspect dentition with a mark present on an excised portion of skin is likely to produce highly questionable associations. No conclusion of *any* degree of similarity can be reasonably held for comparisons conducted in this way.

4.3.6 Other myriad ways have been described both anecdotally and in the literature regarding methods of bitemark injury and dentition analysis that can lead to varying conclusions of association. Only four of these methods; digital production of overlays, hand tracing of overlays, production of overlays from a radiographic outline, or from a photocopy of a model; have been compared for accuracy via a scientific study. The use of any other technique for analysis of the dentition and image should be approached with caution.

## Guideline 5

# Terminology Regarding the Similarity Between Bitemark Injuries and Dentitions

**Preamble**

It is now rare for odontologists to be asked to identify suspects on the basis of a bitemark. The advent of other biological tools such as DNA analysis has resulted in other, more accurate means of proving identity and association between latent marks and source objects. Regardless, there are times when odontologists may be asked to draw inferences regarding the relationship between a bitemark injury and a suspect's dentition. The privilege of expert witnesses under our legal system allows such inferences to be drawn, however, this must be balanced with the scientific evidence regarding the ability to associate latent marks with individual dentitions. The literature is scant in this regard, and so a conservative stance is recommended.

**Scope**

This guideline specifies endorsed terminology for the conclusionary phase of analysis of a bitemark and suspect dentition.

**5.1 The forensic question.** Odontologists may be asked several questions regarding the nature of the relationship between a bitemark and a suspect's dentition. The conclusions reached by the odontologist at the end of the analysis phase need to accurately, yet conservatively, reflect the question posed by the requesting authority.

**5.2 Conclusions of identity.** Conclusions regarding the identity of a suspected biter are rarely justified. Terminologies relating to identity, as used in disaster victim identification protocols, with the possible exception of 'exclude', are <u>not</u> endorsed for use as conclusionary statements in bitemark comparison reports.

5.2.1 The literature does not support the notion that perpetrators can be positively identified from bitemarks in skin. The poor or even absent representation of the *individual characteristics* of teeth in bitemarks (as described in Guideline 2.1.3) that might otherwise have been used to physically identify an individual in DVI circumstances means that definitive identifications from bitemarks should be considered technically impossible. Accuracy rates for 'identifications' from bitemarks have been described in the order of 60 to 80 percent, however, these studies are deeply flawed, and have all involved small populations attempting to identify individuals on the basis of a very small number of cases and possible perpetrators. Consequently, use of the terms 'identified', 'positive identity', 'match', or any

other words that connote a definitive link between a particular suspect's dentition and the bitemark are not endorsed as conclusions regarding the relationship between them.

5.2.2 Use of the terms 'probable', 'likely' or 'more likely than not' are also not endorsed when describing the association between a dentition and a bitemark due to the inherent variation in their meanings between practitioners. The exception to this would be where an odontologist is asked to distinguish between multiple suspects as to the relative likelihood of one dentition being the origin of the bitemark when compared to another given dentition. Such conclusions may be warranted in these situations, however they then only refer to the probability within a given closed set of dentitions offered for analysis, and do not reflect the probability of *another* dentition having made the mark outside the range of exemplars given. This must be emphasised when tendering such opinions.

5.2.3 The term 'possible' may be acceptable, however, is unlikely to provide the agency with any meaningful information without a subsequent definition of what the odontologist defines as 'possible' and its converse, 'not possible'. Similarly, the term 'consistent with' is vague and appears to vary widely between individual practitioners as to its meaning. The most accurate, non-misleading term to convey the possibility that the dentition and mark may be related while recognising that they also may *not* be related, is that of 'inconclusive'.

5.2.4 There is evidence to suggest that it is possible to exclude suspects on the basis of comparison of a dentition with a bitemark. Such conclusions need to be based on obvious disparities between the bitemark and the geometric arrangement of the suspect's dentition in both pattern *and* metric analysis, and not simply on a qualitative comparison of a photograph and knowledge of a suspect dentition (i.e. opinion without analysis).

**5.3 Uniqueness**. Use of the term 'unique' or any similar phrase that connotes individuality of the dentition or of bitemark patterns on flesh or inanimate objects remains unsupported by any scientific literature and should be avoided. The terms 'unique', 'individual' and their related derivatives ('uniqueness', 'individualisation', 'individuality' and so forth) add little to the weight of argument for 'identifying' or otherwise potential suspects.

**5.4 Relationship between a bitemark and a dentition**. It is entirely appropriate for odontologists to describe the similarities and differences between a bitemark and the morphological features of a dentition. The hollow-volume overlay provides the primary tool for comparison in this regard. Association between a dentition and a bitemark is made primarily on the basis of accumulation of *sub-class characteristics*.

5.4.1 Terms used to describe the association between a dentition [overlay] and a bitemark may be used such as 'strong' or 'weak', however, conclusions in this regard should not simply consist of one or two word phrases. Odontologists should describe exactly what they mean when they use these terms. The following are given as examples:

5.4.1.1 *Strong association*: There are a number of points of correspondence between the dentition [overlay] of the suspect and the bitemark. There are no features in the bitemark pattern that cannot be subsequently correlated with the morphology of the anterior teeth.

5.4.1.2 *Weak association*: There are a number of points of correspondence between the dentition [overlay] of the suspect and the bitemark, however, there are some features present in the bitemark that do not correlate well with the morphology of the teeth, and/or the metric analysis suggests discrepancies in their spatial arrangement.

5.4.1.3 *Minimal association*: There are numerous features present in the bitemark that cannot be correlated with the morphology of the dentition, and/or the metric analysis suggests that there are numerous discrepancies in their spatial relationship. However, there are still some points of correspondence between the dentition [overlay] of the suspect and the bitemark.

5.4.1.4 *Significant disparity*: There are [virtually] no features that correlate between the bitemark and the morphology of the anterior teeth. There are multiple features of the bitemark that cannot be related to the morphology of the anterior teeth, and there are significant metric differences between the bitemark and the dentition in question.

5.4.2 The use of such terminology does not imply that there are minimum thresholds for points of correspondence (or points of disparity) for each of these phrases. Odontologists are entitled to and indeed should use their discretion when assessing the weight of the relative number of such features, but should then modify the relative strength of their opinion in accordance with this assessment.

**5.5 Use of statistical and probabilistic terms**. There is little evidence for the use of numerical terms when describing the likely association between a bitemark and a potential perpetrator. Large-scale studies attempting to describe the relative frequency of morphological arrangements of the dentition are yet to be conducted, although there is some data on the frequency of missing teeth. Such data are unlikely to significantly advance the argument for probabilistic association of a suspect with a bitemark at the current time.

5.5.1 Statements of numerical probability, expressed as either a percentage, decimal or other number are not endorsed given the current absence of relevant population data.

5.5.2 Statements of certainty, expressed as a number, percentage, or descriptive term carry no weight towards the acquisition of actual ground truth, and should be avoided. It is recognised that legal counsel have frequently asked expert witnesses in court ‘how certain’ they are regarding their conclusions, and in this circumstance the odontologist may be compelled to answer, however, inclusion of such a statement in a written report should be considered superfluous.

5.5.3 Statements of similarity should not be given in numerical or probabilistic terms, but should be given as descriptive phrases.

# Guideline 6

# Reporting

**Preamble**

Odontologists should produce written reports of their findings when undertaking any form of analysis of a suspected bitemark. These reports may be tendered as evidence in coronial, criminal or civil court proceedings, and should be written with this in mind. Reports are entitled to reflect the opinion of the expert witness, in accordance with the privileges allowed a professional under the Evidence Acts. However, these opinions should be in keeping with the scientific status of the discipline. Unsupported opinion, conjecture and *ipse dixit* bear no place in bitemark reports. This guideline should be read and applied in conjunction with Guideline 5 *Terminology Regarding the Similarity Between Bitemark Injuries and Dentitions.*

**Scope**

This guideline outlines the recommended content of a written report following assessment and analysis of a suspected bite injury. The format of the report may necessarily be dictated by individual jurisdiction guidelines.

**6.1 Introduction.** The report should contain a brief introduction that states how the odontologist came to examine the bitemark, including details of:

6.1.1 Who contacted the odontologist initially

6.1.2 Where the examination[s] took place and who was present.

6.1.3 What the examination[s] involved, and what records were taken. Odontologists should include details of the examination of both the victim and the suspect if they were involved in both.

**6.2 Description of the evidence.** The report should give a detailed description of the evidence, including both a description of the suspected bitemark injury and the suspected dentition. The description should use correct anatomical and pathological terms.

6.2.1 The description of the bitemark should include a description of where on the victim the mark was found, as well as a general description of its colour and form, including approximate measurements of the size of the injury.

6.2.2 An objective assessment of the quality of the evidence should be included in the report. Concerns with the material quality of the evidence should be noted.

**6.3 Statement regarding whether or not the injury is a bitemark.** If the injury is ascertained to be a bitemark, the report should state this as well as the reasons for reaching this conclusion. It should also state whether it would have been possible to self-inflict the injury, and any other information that was gleaned from the qualitative assessment of the injury.

**6.4 Comparative Analysis.** If a comparative analysis was carried out with a suspect dentition, a brief description of the types of analysis conducted should be given.

6.4.1 It is not generally necessary to specify how each step of the error correction and overlay production was performed, although the odontologist should bear in mind that they may be asked to explain this in detail should the case proceed to court.

6.4.2 This section is not necessarily limited to text. Diagrams should be used to explain points of correspondence, points of disparity and other remarkable features of the injury where considered necessary.

**6.5 Concluding opinion.** The odontologist should make clear the association [or otherwise] between the features of the bitemark and the morphology of the suspect dentition.

6.5.1 There is no need to resort to one or two-word phrases in order to summate the evidence. Odontologists should carefully and precisely explain the conclusions reached in order to accurately portray the foundation for [and limits of] their concluding statements.

6.5.2 Where one or more dentitions were compared, a statement regarding which of the dentitions was more likely to have produced the mark may be made, although a statement clarifying that this does not necessarily imply that it was the only dentition that could have inflicted the injury should accompany this.

6.5.3 Statements regarding the potential identity of the perpetrator, with the exception described in 6.5.2 above, are not endorsed under these guidelines.

6.5.4 Percentage or numerical probabilities that describe the likelihood of the dentition having made the bitemark are not appropriate without reference to relevant population data. Such data does not exist at the present time.

**6.6 Supporting documentation.** Associated diagrams generated during the analysis phase, photographs, overlays and other such media may be included as part of the report should the odontologist feel they are necessary.

**6.7 Signature block and date.** As a legal document, it is usually required that the odontologist physically signs the report and dates it accordingly. Details of postgraduate qualifications can usually be summarised here in post nominal form. There is little added benefit to including details of these qualifications in the text of the report. Should the case proceed to court, details of postgraduate qualifications, education and experience is usually explored in detail by legal counsel for the benefit of judge and jury, regardless of the text of the report.

# Guideline 7

# Contextual Bias, Cognitive Bias and Observer Effects in Bitemark Analysis

**Preamble**

Psychologists have long recognised the effects of contextual and extraneous information on decision making. Such information renders the subject susceptible to both motivational and cognitive bias, yet it is difficult to assess the extent to which these influence forensic odontologists opinions as there have been no studies to date on this subject. It appears that the current practice of bitemark analysis is rich in sources of potentially biasing influences. Cognitive bias specifically refers to the psychological sway towards one opinion versus another as a result of having information extraneous to the task at hand – in other words, bias induced by 'knowing' something.

Context effects — psychological influences on decision making induced by knowledge of circumstantial information extraneous to the immediate task at hand — most obviously give rise to motivational bias, which may be conscious or unconscious, however, they may also give rise to cognitive bias, particularly when there is ambiguity in the choice between two alternative hypotheses This latter form of bias is easily over-ridden when the evidence presents an obvious choice between two hypotheses, but becomes problematic when evidence is 'borderline', of poor quality, or ambiguous.

Bitemark analysis is particularly susceptible to both manifestations of bias due to the context in which it is collected and analysed, which is rich in subliminal information that renders the practitioner susceptible to motivational bias, and; due to the nature of the evidence itself – its ambiguity and potential for interpretation. In addition to the fundamental recognition that odontologists will be subject to some forms of bias, odontologists should also consider ways in which these effects can be minimised as they go about bitemark evidence collection, analysis, and comparison in order to minimise potential biasing effects until there is experimental data available to qualify under what circumstances, and to quantify to what extent, they influence our analysis and interpretation of bitemark evidence.

**Scope**

This guideline suggests various ways in which contextual bias and observer effects may be reduced in bitemark analysis.

**7.1 Cognitive bias**. It is important to recognise that biasing influences cannot be simply 'willed away', because by their very nature they are not under the conscious control of the individual.

7.1.1 Awareness of the forms of cognitive bias is not enough to combat its effects on practitioner performance.

**7.2 Role and conformity effects.** The potential to feel like an advocate of justice for the victim [or suspect] can be minimised by engaging as little as possible with the victim, law enforcement agencies and lawyers.

7.2.1 Analysis should be conducted independent of these influences. This is most practically achieved by separating the phases of collection and analysis of odontology evidence.

7.2.2 Where possible, the odontologist who is responsible for collecting the evidence should not be actively engaged in any subsequent analysis. While this is ideal, it is recognised that this is sometimes unavoidable. This suggestion is most practically achieved where multiple odontologists work for the one institution.

**7.3 Emotive influences**. These can further be avoided by limiting the amount of extraneous information available to the odontologist responsible for analysis of the bitemark.

7.3.1 This includes analysis of the bitemark independent of knowledge surrounding the case in order to minimize emotional influences, before any viewing of the suspect's dentition in order to minimize target shifting, and before any other circumstantial evidence is revealed, such as the presence (or absence) of the suspect's fingerprint, or DNA, to minimize confirmation bias.

**7.4 Target Shifting**. This occurs when ambiguous evidence is subject to bias in its interpretation due to prior information gathered about what features to look for in comparison with a suspect dentition. This can be avoided by attempting to identify the potentially relevant features of the mark prior to viewing the suspect dentition.

7.4.1 Potentially relevant features are those that indicate the class, subclass and individual characteristics of the dentition, for example; marks from the upper versus lower teeth; marks that indicate the relative position of the incisal edges and position of the canine cusp tips; unusual or distinctive spatial arrangements, or the potential presence or absence of certain teeth

7.4.2 Analysis of the dentition should also proceed separately from that of the bitemark. Ideally, more than one dentition, from persons who are unknown as to their involvement in the case to the odontologist, should be presented for analysis in order to avoid the generation of a purely confirmatory hypothesis.

7.4.3 Only having analysed both the mark and the dentition separately should the odontologist then attempt to combine this information in a single analytical technique. Following the combined analysis, other information, such as the reported position of the biter relative to the victim in an assault case, can be revealed so that the odontologist can assess the relevance of this new information to the former conclusion. This process still ensures that the odontologist receives information that affords them the greatest opportunity to generate meaningful conclusions while removing unnecessary and potentially biasing detail.

**7.5 Evidence quality**. Odontologists should consider avoiding analysis of bitemark evidence that is of poor or dubious quality, where the risk for contrast effects is greatest.

7.5.1 The susceptibility to contrast effects is demonstrated when the odontologist gradually begins to 'see' an association between the mark and the dentition, particularly after lengthy analysis.

7.5.2 In these circumstances, there is a real risk that the threshold for determining the significance of a particular feature of the bitemark is lowered as the analysis proceeds, and so the odontologist becomes susceptible to seeing things that aren't there.

**7.6 Avoiding statements of certainty**. Research has long demonstrated that there is no link between certainty and accuracy, and any statement regarding certainty is potentially misleading and irrelevant to proper assessment of the evidence.

7.6.1 Research has demonstrated that practitioners are generally over-confident in their ability to perform, particularly when performing routine or often-repeated tasks.

7.6.2 In addition to the potential for reaching a biased conclusion, overconfidence of the expert carries with it the sequelae of an unconscious biasing effect on juries and judges, who despite claims of impartiality, are still encouraged to include assessment of witness demeanour as part of the process of assessment of the expert's evidence.

**7.7 Independent verification**. Where practical, an independent evaluation of the analysis and comparative phases of the bitemark assessment should be carried out by another odontologist who has had no prior involvement in the case.

7.7.1 This practice follows that of other pattern-matching disciplines and acts as a quality control check. It may also highlight where an odontologist has potentially been unduly influence by cognitive bias.

7.7.2 The purpose of the review is to ensure that no obvious errors have been made in the conduct of the bitemark analysis. It is unnecessary for the reviewing odontologist to comment on whether or not he or she agrees with the opinion reached, bearing in mind that such opinions should not generally offer statements of identity.

7.7.3 If a verification of a particular conclusion is sought, the reviewing odontologist should undertake their own, independent analysis prior to viewing the original method and conclusion, so as to avoid bias themselves

# Guideline 8

# Presentation of Bitemark Evidence in Court

**Preamble**

Odontologists may be called to appear in court to give verbal evidence regarding the results of their conclusions about the association between a bitemark and the circumstances of a particular crime, including that of the potential identity of the suspected biter. The legal principles regarding the giving of expert evidence are complex, vary between jurisdictions, and are considered beyond the scope of this guideline. It is recommended that odontologists consult a legal text on expert evidence to familiarise themselves with these principles. Similarly, general principles of expert witness conduct are also beyond the scope of this guideline.

**Scope**

This guideline offers guidance for odontologists who are called to give evidence as an expert witness regarding bitemark evidence.

**8.1 Goal of Expert Testimony.** Odontologists should recognise that the goal of expert witness testimony is to assist the trier of fact [a judge or jury] by interpreting complex, scientific, or other specialised forms of evidence.

8.1.1 As part of the judicial process, it is the expert's role to furnish the trier of fact with the tools and information necessary to allow them to draw their *own* conclusions about the significance, or otherwise, of the evidence in question.

8.1.2 It is not considered the expert witness's role to comment on the likelihood of the suspect's guilt or innocence: this is the task that the judge or jury are assigned with.

**8.2 Questions of Identity.** Counsel may press odontologists for opinions on the identity of the suspect. Odontologists should bear in mind the principles espoused in these guidelines when giving answers to these questions.

8.2.1 Expert witnesses are usually allowed to qualify their answers to questions. Counsel are generally not permitted to insist on simple 'yes' or 'no' answers to questions when it is obvious that such answers are potentially misleading.

**8.3 Presentation of Evidence**. Counsel will usually advise on the best way for the expert witness to present their evidence. Such testimony does not have to be purely verbal, and the use of

computers, overhead projectors, diagrams and other physical aids can assist the trier of fact in understanding the odontology evidence.

8.3.1 Images from the digital analysis of the bitemark evidence should be considered key aspects of the evidence presented in court. Every effort to demonstrate them to the trier of fact should be made.

**8.4 Common errors associated with forensic expert testimony**. There have been instances, particularly in the United States, of forensic science testimony being excluded due to unreliable testimony by experts. While the admission of forensic science testimony is considered liberal by contrast in Australia, avoidance of the following pitfalls ensures not only assignment of appropriate weight to the odontological evidence by the courts, but also good scientific practice.

8.4.1 Odontologists should not attempt to provide statistical information unless such information is obtained via credible, scientific sources. 'Estimates' on incidence, likelihoods and other population statistics should be avoided.

8.4.2 Similarly, odontologists should not attempt to indicate the reliability of their technique by referencing incredulous error rates. Judges are finding that witnesses attempting to make an 'absolute' identification of the defendant, identifications 'to the exclusion of all others', or claiming extremely low, or even non-existent error rates are not relying on credible scientific reasoning.

8.4.3 Odontologists should adhere to endorsed methods and protocols within the field. Experts who have used their own methods without having good reason not to follow the endorsed protocols have invited controversy over the validity of their methods.

8.4.4 Odontologists should be able to appropriately explain their methodology in court. This is particularly true for evidence that has involved digital enhancement of images.

8.4.5 Odontologists may be required to tender original documentation of their assessment, or to recall details that were noted at the time. It is recommended that odontologists keep all notes made during the collection, analysis and comparison phases of bitemark assessment.

8.4.6 The existence of observer bias has been noted as strengthening the case for exclusion. While it has yet to be a significant issue in Australian courts, (although it has been alluded to in a number of high-profile bitemark cases), it is recommended that documented steps be taken to avoid potential sources of bias during bitemark assessment.

8.4.7 Experts must testify within their field of expertise. For odontologists, this field relates to the marks made by teeth as weapons of violence. Odontologists are generally not considered experts in facial mapping, offender profiling, or other peripherally related subjects, unless they can demonstrate by way of training, study or experience that they have specialised knowledge in these fields. One of the most common reasons for excluding, either in part or in whole, expert testimony in Australia is due to the witness attempting to opine on an area outside that deemed to be within their scope of expertise.

## Guideline 9

# Education, Training and Continuing Professional Development

**Preamble**

The education, training and continued professional development of odontologists in Australia is subject to oversight by regulatory authorities. Statutory authority for the practise of bitemark analysis as a registered Forensic Odontologist is derived from Australian Health Practitioner Act National Law, and enacted by the Australian Health Practitioner Regulation Agency via the Dental Board of Australia. The provisions for maintenance of registration as a forensic odontologist are also specified by the Dental Board, however, this guideline seeks to provide further recommendations specific to the practice of bitemark analysis by odontologists.

**Scope**

This guideline provides recommendations for training and CPD requirements in order to maintain currency in the field of bitemark analysis.

**9.1 Qualification as an Odontologist.** The Australian Health Practitioner Regulation Agency (AHPRA) via the Dental Board of Australia (DBA) have endorsed minimum education requirements in order to be registered as a Forensic Odontologist in Australia.

9.1.1 Use of the title *Forensic Odontologist* confers all of the rights of practice associated with this specialist area, including that of bitemark analysis.

9.1.2 Continued registration by the DBA is conditional on the maintenance of a 60-hour minimum Continuing Professional Development (CPD) cycle over each three-year period beginning in July 2010.

9.1.3 As a registered odontologist, it is *expected* that some proportion of CPD during this cycle will be devoted to continuing education in the area of bitemark analysis and interpretation. The form of this CPD may be in any of the formats recognised by the DBA for this purpose.

9.1.4 It is *recommended* that odontologists also undertake some form of expert witness training on a semi-regular basis.

**9.2 Qualification as an expert witness in bitemark analysis**. Legislation and the common law recognizes that witnesses can be considered ‘experts’ and can testify thereto an opinion

providing they can demonstrate they have specialised knowledge in the relevant field. Such knowledge may be gained through training, study or experience.

9.2.1 There is no tacit requirement under the *Evidence Acts* in any federal, state or territorial jurisdiction that an expert must be a registered forensic odontologist in order to testify regarding bitemark analysis, providing the court is satisfied that the witness meets the definition of having 'specialised knowledge' in the field.

9.2.2 However, the evidence of a witness who is not board-registered is likely to carry significantly less weight in court than that of someone with registration status. In keeping with best practice principles, it is expected that any dentist who wishes to practise bitemark analysis maintains registration as a forensic odontologist with the DBA.

**9.3 Maintenance of currency.** Bitemark evidence is rare in Australia, and presents very limited opportunity to engage in bitemark analysis via actual casework.

9.3.1 Mock casework should be considered an essential component of CPD given the relative infrequent opportunity that most practitioners will have to undertake genuine cases.

**9.4 Provision of education to other related disciplines.** Forensic odontologists should welcome the opportunity to engage with colleagues from other forensic disciplines, including law enforcement agencies.

9.4.1 Education of police photographers, forensic nurses, clinical forensic medicine specialists and rape/crisis centre workers should take priority as these professionals represent the primary recipients of living bitemark victims. Education regarding the appropriate procedures for contacting odontologists, and if necessary, collecting bitemark evidence from victims, is essential for these professionals and will only serve to enhance the services that odontologists can offer.

**9.5 Research**. There is a dire need to undertake further research into the validity of bitemark analysis. It is expected that odontologists who practise bitemark analysis will do their utmost to meaningfully participate in research of this nature as conducted by their colleagues.

# Suggested References

The following is an incomplete list of suggested references that act to support these guidelines


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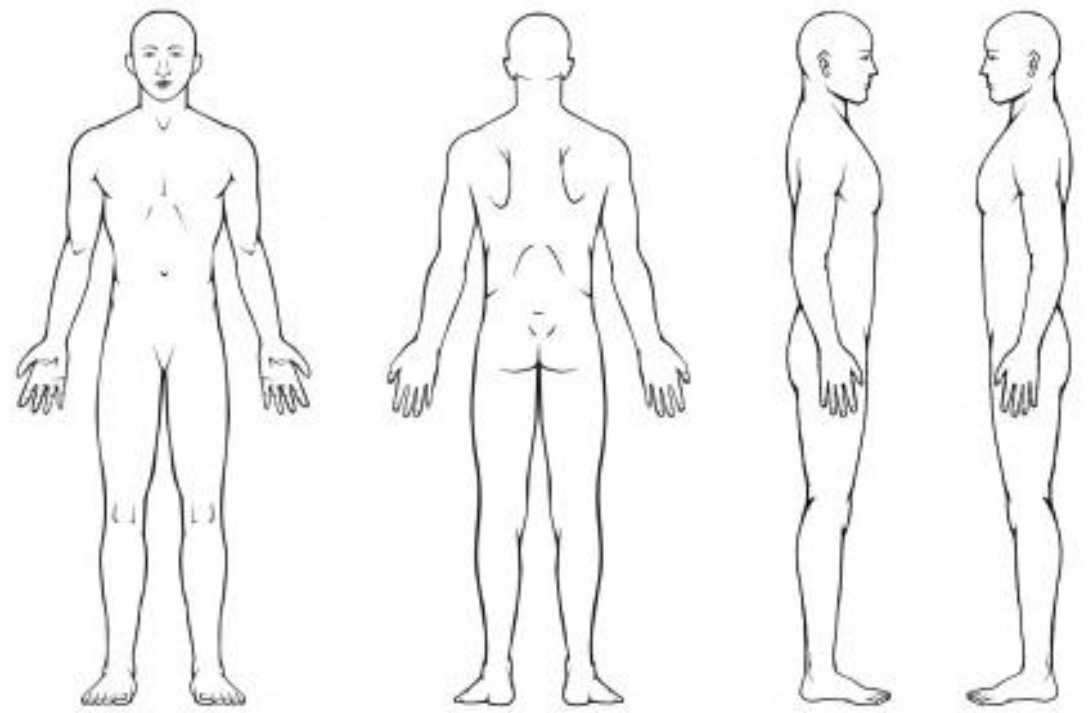
# Forensic Bitemark Examination

| Reference No. | |
|---|---|

| | | | |
|---|---|---|---|
| Victim Name | | D.O.B | |
| Examined At | | | |
| On (*Date*) | | Time | |
| By (*Odontologist/s*) | | | |
| Others Present (*Name*) | | | |



**Details** Diagram / Description / Comments / Measurements *etc.*

**Impressions** ☐ **Material** Alginate ☐ **Photographs** ☐ *Number*:

PVS ☐ **Swab** (DNA) ☐

*Number:*

Other ☐

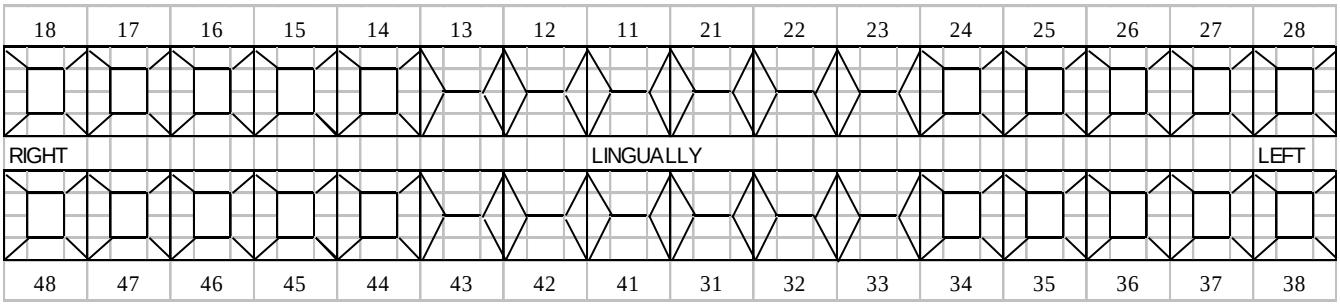
**Odontologist Signature**

# Forensic Dental Examination

| Reference No. | |
|---|---|

| | | | |
|---|---|---|---|
| Patient Name | | D.O.B | |
| Examined At | | | |
| On (*Date*) | | Time | |
| By (*Odontologist/s*) | | | |
| Others Present (*Name*) | | | |

| TOOTH | REMARKS | REMARKS | TOOTH |
|---|---|---|---|
| 11 | | | 21 |
| 12 | | | 22 |
| 13 | | | 23 |
| 14 | | | 24 |
| 15 | | | 25 |
| 16 | | | 26 |
| 17 | | | 27 |
| 18 | | | 28 |




| TOOTH | REMARKS | REMARKS | TOOTH |
|---|---|---|---|
| 48 | | | 38 |
| 47 | | | 37 |
| 46 | | | 36 |
| 45 | | | 35 |
| 44 | | | 34 |
| 43 | | | 33 |
| 42 | | | 32 |
| 41 | | | 31 |

**Overbite** | **Angles Classification** | **Midline Shift**

**Overjet** | **Maximal Opening** | **Mid Shift at Max Op**

**Comments** *(E.g. mobility status, unusual dental or oral features, etc)*

**Impressions** Upper ☐ Lower ☐

**Material** Alginate ☐ PVS ☐ Other ☐

**Records** Occlusal Record ☐ Bite Record ☐ Photographs ☐

**Odontologist Signature**