



Forensic Odontology: A Global Activity

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ABSTRACT

Forensic odontology is an important and expanding field of dentistry. The application of these forensic techniques in identification, criminal justice and dental liability are being practiced worldwide. In some mass disaster events, notably large commercial aircraft crashes, the traumatic forces are such that fragmentation and conflagration result in only the most durable of human tissues—dentition survive and become a potential source of identification.

PURPOSE OF PAPER

It is the purpose of the article to familiarize medical and dental personnel on the recognition of and appropriate response to dentally related matters most commonly encountered in professional offices and referred by public safety officials. The intent is to assist dental professionals to know how and under what condition it is necessary to initiate a response, and when it is necessary to seek the services of a colleague more advanced and versed in forensic odontology.

Forensic odontology is not one of the recognized specialties of dentistry but rather the application of a field of special interest in dentistry to matters of law. In recent years, research, technology and tribunal activities have resulted in a refinement of the criteria for those dentists interested in functioning as a forensic consultant and hence, expert witness for forensic odontology.

Forensic dentistry has major divisions of interest, which are: dental identification¹ and mass disaster management,² bite mark analysis,³ dental liability and malpractice^{4,5} fraud,⁶ age determination,⁷ and human abuse and neglect. All of these divisions of activity have structured formats and procedures to appropriately manage the acquisition, custody and analysis of evidence. In addition, there is established terminology to define the evaluation when



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composing a forensic dental report.⁸ It is an objective of this article to present various techniques that are customarily used to conduct a forensic odontology investigation.

There are organizations that offer structured programs of special training and education, such as the Armed Forces Institute of Pathology and the University of Texas in San Antonio. Some of these programs lead to supplemental credentials accepted by many courts, both within the U.S. and internationally, as verification that the witness has undertaken advanced training in forensic odontology.

Within a geographic area, usually a city or county, an individual functioning as a forensic odontologist has a responsibility to communicate pertinent information to enhance a professional relationship with local law enforcement, health and welfare agencies and social service organizations. Some of the signs of human abuse, often seen by emergency room and responding law enforcement personnel, can be manifested in injuries that may be difficult to initially identify as bite marks. It is a duty of the forensic dentist to conduct seminars designed to assist in the recognition of potential patterned injuries that might be of dental origin.⁵ The community odontologist should stand ready to educate such personnel on recognizing and collecting evidence pertaining to patterned injuries.

The seminars should include information on appropriate photography⁹ of the injury area as shown in a following portion of this article. The issue of elapsed time may be a critical factor in the capture of important features that

may be lost due to changes related to rapid tissue responses, fading and possibly distortion of the image.

It is common the only available photographs in a criminal or civil matter involving dental evidence are those taken by an individual other than the forensic dentist. Based on this history, it is in the best interest of both the forensic

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dentist and all those involved with the documentation of evidence that appropriate techniques are utilized.

In addition to forensic photography, the correct method to recover DNA evidence¹⁰ from bite mark sites must be included in the presentation of forensic investigative techniques. A positive match of DNA from a bite mark site and that of a suspect is a significant finding that adds to scientific certainty.

One method recognized as appropriate is known as double swabbing. One swab is dipped into sterile water and applied with a circular motion over the

pattern injury. The swab is then air dried and returned to a sterile glass tube, and a second swab is used dry and rubbed over the same area to absorb much of the moisture that remained from the first swabbing. This swab is also air dried and returned to the tube, which is sealed.

The objective of the second swabbing is to capture dried saliva cells containing DNA loosened by the first swabbing. A second tube of swabs is used in the same way on a separate non-injury area of the individual to act as a control.

Forensic Photography⁹

Scientific photography is essential to document and preserve images when conducting identifications, bite mark investigations and other dentally related forensic activities. In pattern injury cases, the photographic images of the pattern are used during the comparison with other objects or an overlay image of the incisal biting surfaces of a suspected individual.

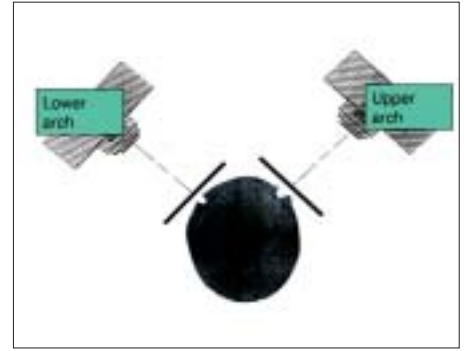
The photographs become a key element and an integral part of forensic investigations and are usually the basis for determinations of responsibility. Due to their central importance in these cases, it is required they be shared with other parties to a legal undertaking. Photography is equally important when performing identification to preserve images of the dentition.

Currently there are numerous manufacturers of quality digital and conventional 35-mm cameras available for forensic investigations. A primary criteria in the selection of a camera has the ability to provide high quality 1:1 close-up macro images.

It is suggested the photography be



Figure 1. Field of view, using a scale, shows area of interest.



Figures 2 and 3. Dividing the pattern into two portions and photographing each separately. Figure 3 also shows the camera oriented 90 degrees to the surface.

in black and white, as well as color. Other considerations are field of view, appropriate shutter speeds, f-stop settings for depth of field, and control of light intensity, source and angulation.

Field of view should show the area of interest centered and millimeters scale, preferably an ABFO No. 2,¹¹ close to but not obscuring any portion of the injury (Figure 1).

Curved Surfaces

In many situations, due to the curvature of an injury area, it is necessary to divide the pattern into two portions and photograph each as a separate image thus avoiding a common source of distortion (Figures 2 and 3).

Camera Angulation

Figure 3 also demonstrates the camera must be oriented 90 degrees to the surface. Attention to this matter will usually provide an accurate view without angulation related distortion.

Light Control and Angulation

Figure 4 demonstrates the use of four sample light source angulations. This issue is especially significant with situations where there is a depth or third

dimension to the injury area. The light source and angulation will determine the existence or position of shadows and highlights.

It is recommended the photographer take several pictures using the same camera orientation but varying the light source position, as illustrated. If the light-generating equipment has intensity controls, that feature may also be used to enhance the image quality.

Light control angulations render a specific variety of highlights and shadows to a bite mark, especially if it has a depth dimension.

Video Superimposition

By the use of two video cameras in conjunction with a digital mixing device, the overlay of one image over another, is an effective technique to compare two objects (Figures 5 and 6). For example, a life-size image of the incisal edges of a dentition can be superimposed over a life-size photograph of a bite mark. A definitive comparison may be possible if the bite mark displays specific registration of individual teeth such as the mesial to distal and facial to lingual dimensions, and arch alignment and any unusual characteris-



Figure 4. The use of four sample light source angulations.

tics such as misorientation or fractures of incisal edges.

Video superimposition provides the dynamic features of sweeps and other comparison views inherent in the programs of the digital mixing device.

The author has applied the video superimposition technique to bite mark analysis and identification cases. When the customary antemortem dental records and X-rays are not available, it is possible to achieve a positive identification by comparing antemortem photographs with remains.

This technique requires a considerable amount of equipment and is not necessarily recommended as a system to



Figure 5. Two video cameras superimposition.



Figure 6. Digital video mixing board.

be included in a forensic odontologist inventory. It is reasonable to seek assistance from those forensic dentists familiar with special methods when a consultation would enhance an investigation. In fact, it is not uncommon for forensic odontologists to seek peer review when conducting cases.

The author presents two cases: one an identification and the other a bite mark where superimposition was used to perform an analysis and arrive at determinations.

Identification

This identification case involves partially skeletonized human remains found in northern Mexico (Figure 7). It was determined the individual was probably from California. Mexican officials contacted the Missing and Unidentified Persons unit (MUPS) of the California Department of Justice (DOJ).

A search of the MUPS list of persons reported missing within the previous six months established only one individual had matching physical characteristics of height, gender, age and hair color.

The reporting person, a close relative, was contacted to obtain antemortem data helpful in an identification. Exhaustive efforts were able to provide only a recent photograph that

clearly showed the upper front teeth (Figure 8).

The remains were sent to the Sacramento facility for further analysis by the MUPS staff, and the author, who functions as a DOJ forensic odontology consultant. By the use of video superimposition, a positive identification was established (Figure 9).

The author has also used photographic superimposition in other cases where antemortem dental X-rays and records were not available. Some of these identifications were central issues in criminal matters and some required testimony in homicide cases.

Bite Mark Comparison

The following case involved a brutal assault by a male acquaintance who was stalking a woman. The incident took place at night while she was sleeping in her residence. After he gained entrance, he attacked her in her bed. She awoke with his hands around her neck, and the violent struggle ended with her rendering him unconscious by striking him with a heavy object.

When she gave her statement to the police detectives, she thought the marks on her neck were from his strangulation hold. The police photographer documented the injuries as a routine part of

the investigation.

At a later time, just before the trial, the detective was meeting with a local forensic dentist to discuss a review of photographs. He immediately recognized the neck pattern injury was a probable bite mark and not a handprint.

The dentist contacted the author to collaborate on the analysis of what was determined to be a bite mark with numerous significant and unique features for comparison. Plaster models of the suspects teeth were obtained and compared to the pattern injury using the customary overlay technique.

The comparison yielded an opinion that, within reasonable dental certainty, the dentition of the suspect did make the pattern injury bite mark. It has been the author's experience many suspected bite marks do not have sufficient specific detail to establish a cause and effect relationship to a specific dentition.

This case is an example of the usual analytical techniques of bite mark investigation. This is customarily to superimpose the overlays of the anterior incisal edges of the suspected dentition on photographs of the injury pattern. The degree of clarity the photograph displays the dimensions, or oddities of alignment or acquired unique features, will determine its evidential value.

The following pictures show facial view (mirror image) of suspect dentition (Figure 10); bite mark photograph (Figure 11); overlay of incisal view superimposed on bite mark (Figure 12); and incisal view (mirror image) (Figure 13).

The central incisors have an atypical rotated alignment, and chipped and worn biting edges that have a unique concordance with the drag marks in the bite mark image. In addition, the left lateral incisor is above the plane of occlusion and would not

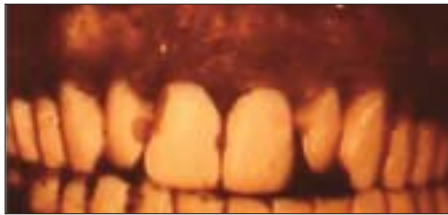


Figure 7. Remains from partially skeletonized human.



Figure 8. Antemortem photograph from relatives.

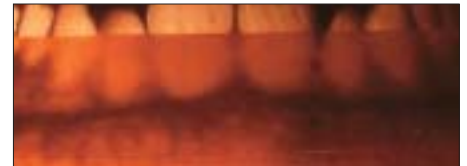


Figure 9. Superimposition of Figures 7 and 8.



Figure 10. Mirror image showing irregular incisal edges and left lateral above the plane of occlusion.



Figure 11. Bite mark displaying striated drag marks and a lack of marking in the position of a left lateral incisor.



Figure 12. The overlay of the maxillary anteriors and bicuspids superimposed on the bite mark photograph.



Figure 13. Mirror image incisal view of maxillary anterior teeth, upon which the overlay shown in Figure 12 was constructed.

Summary

It has been the author's experience that bite mark cases that consist of images with definitive features representing the responsible dentition, when appropriately documented with photography and other evidence management techniques, often result in a forensic report that garners a stipulated acceptance in a court of law.

The lesson learned from a variety of circumstances is that an observation of a pattern mark or injury should be properly documented by photography and presented to experts for analysis. In emergency and law enforcement responses, forensic dentists should be requested to participate in matters that have an initial suspicion or observation of being potentially a dental-related matter.

Organized forensic dentistry has incorporated the concept of disseminating community awareness of this scientific portion of dental practice.¹² In doing so, it will assist the general dentist to ascertain the need for an appropriate referral or when the necessity exists, to function correctly as the initial responding health care professional.

With increasing frequency, forensic odontology is being applied in a variety of cases of civil and criminal adjudication, including identification, homicide, abuse, fraud, malpractice, professional misconduct and liability. **CDA**

be expected to register on a bitten surface, a feature consistent in the bite mark photograph.

In the bite mark case presented, the prosecution had the advantage of a living victim who was able to positively identify the attacker. The suspect was also found by the police to be unconscious on the floor next to the victim's bed. This validated the findings of the odontologist, who was not informed of the sur-

rounding details until the analysis was completed and an opinion submitted.

DNA swabbings were not taken on this case because the initial investigation did not suspect the injury was due to a bite. The author has experienced other situations where a pattern injury, thought to be of some other origin, was in fact a bite mark. The opposite is also true, where an investigator suspected a bite mark that analysis determined otherwise.

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