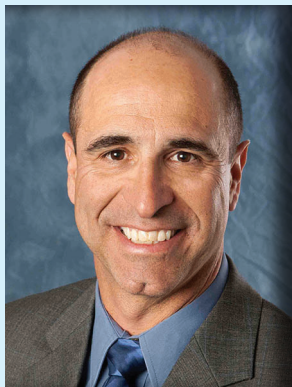


# Forensic Odontology



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The field of forensic odontology is the area of dentistry concerned with the application of law in both criminal and civil proceedings. There are two primary disciplines within forensic odontology: postmortem identification and bite mark (pattern injury) analysis. Forensic odontologists also assist authorities with multiple fatality incidents, age determination based on tooth development and recognition of child abuse/intimate partner violence (IPV). They also participate in civil proceedings as an expert witness.

## Dental Identification

As forensic dental identification specialists, we typically are the last conventional option for postmortem identification. DNA is now used, but due to its high cost and the extensive time required for analysis, it is used sparingly or when absolutely no other option exists. Other forms of postmortem identification include visual, personal effects, fingerprints, scars, marks, tattoos and medical radiographs.

Forensic dental identification has been successful because of the nature of the human dentition. The enamel is the hardest substance in the body and the only exposed portion of the skeletal system (**Figs. 1-2**). Teeth are extremely resistant to thermal damage and blunt-force trauma, and the dentition remains stable during tissue decomposition. In addition, the dentition is unique to a specific individual. This includes not only the morphology of the coronal portion of the tooth, but also the morphology of the roots, pulpal chamber and their relationship to their surrounding structures

(i.e., sinus proximity, mandibular canal proximity, interproximal bony trabecular patterns, etc.). Following the natural dentition, if you add man-made dental restorations, the unique combination for any given individual can factor into the millions.

There are numerous important reasons for identifying the deceased. A legal certification of death is necessary to consummate legal matters such as life insurance, wills, etc. There are family and personal reasons as well (closure). In criminal investigations, it is important to establish the identity of the victim to proceed with the criminal investigation and to identify the suspect. In a fire for instance, the bodies often are burned beyond visual recognition. (**Fig. 3**) Personal effects also are destroyed or lost in the fire. Even if the personal effects are recovered, they may not be considered reliable due to the typical calamity that surrounds a fire. A forensic anthropologist will examine the remains of the skeletal system and can then determine age, race and sex of the victim. Positive identification is best performed by examination of the surviving dentition by the forensic odontologist. In a fire where the temperatures may be extremely high (1,000° C), even the dental remains may be destroyed. Crowns may fracture or explode, leaving only the roots. The bone also may be completely consumed, leaving only scattered roots with no bony sockets for reference.

Forensic dental identification most often is accomplished by the comparison of the radiographs of the teeth of the decedent (post-mortem) (**Fig. 4**) with the dental radiographs

obtained from the dentist of the suspected victim (antemortem) (Fig. 5). Ideally, the antemortem radiographs furnished should be the *original* full-mouth series. Often, this is not the case. Children's radiographs are typically bitewings only unless they have orthodontic records as well. Oftentimes, duplicate radiographs — not the originals — are sent, and have been either poorly duplicated and/or are not labeled right and left for orientation. In addition, the antemortem radiographic image may be of poor quality due to improper operator technique (cone cuts, overlapping interproximals, elongation/foreshortening, etc.) or poor processing (contrast, burned images, etc.). When poor antemortem radiographs are compared to an ideal postmortem radiograph, the two may not appear consistent. This could seriously hamper the identification effort.

In forensic dental identification, it's stressed that good quality, properly mounted and labeled *original* antemortem radiographs be sent for comparison. In addition, copies of the victim's dental treatment progress notes should be submitted. This allows the forensic dentist to verify dental treatment that was performed subsequent to the date of the radiographs.

It is important as practicing dentists to keep complete patient records on file and continually update them, including the radiographs. One of your records may be needed for a postmortem dental identification.

## Bite Mark Analysis

The study of bite marks involves the analysis of teeth contacting another object or medium. Thus, bite mark analysis is a type of forensic pattern analysis similar to tool mark analysis. Unlike dental identification, which is a quantitative analysis, bite mark analysis relies on the odontologist's interpretation of the pattern; therefore, bite mark analysis primarily is subjective in nature. It's for this reason that bite mark opinions, though based on scientific methods and principles, can be highly variable based on the individual's interpretation of the pattern injury, resulting in experts often giving different levels of opinion on the same pattern injury. The consequence we see today is that bite mark analysis has become highly controversial. In the United States, there have been 28 exonerations of individuals after they had been previously charged or convicted where the charges/convictions were based partially on faulty bite mark evidence.



FIG. 1



FIG. 2



FIG. 3

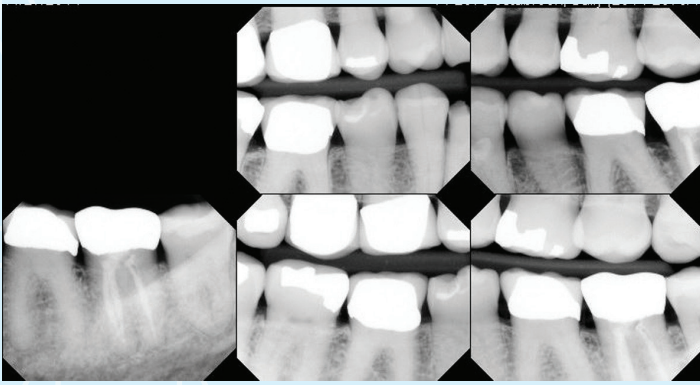


FIG. 4

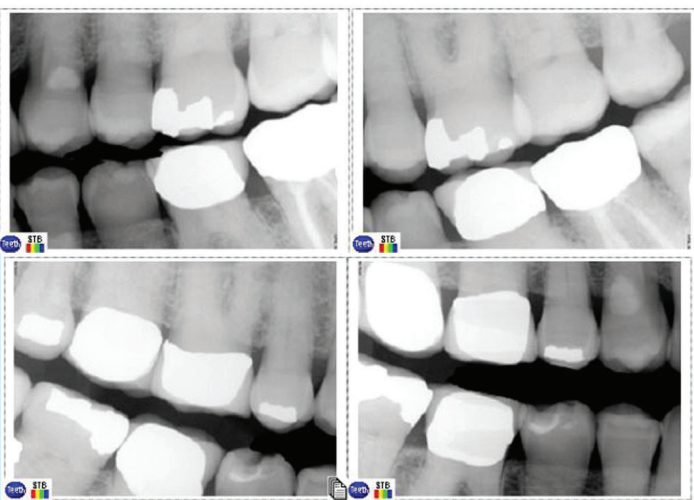


FIG.5

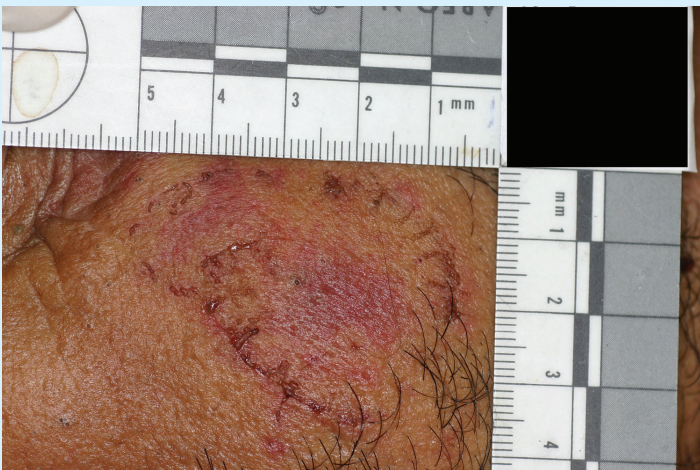


FIG. 6

The study of bite mark analysis involves the comparison of the pattern injury or bite mark to the suspect biter's dentition. The classic appearance of a bite mark is two semicircular or ovoid arches that oppose each other with a central ecchymosis (Fig. 6). The bite mark pattern is photographed from multiple angles with a scale present for reference. In addition, the bite mark is swabbed for possible suspect DNA. On the biter, it is necessary to take full-arch dental impressions of both the maxillary and mandibular arches. In addition, complete dental charting of all the present, missing and restored teeth, including charting anomalies such as fractures, spaces, rotations, etc., wax bites and intraoral photography should be taken. If the accused suspect biter is in jail, then collection of these records will require a court order and the individual has the right to have his attorney present (note: the biter also could be the victim who bit their attacker in self-defense).

Once all the records are collected on the bite mark and the suspect biter, then the odontologist can complete the analysis. The analysis consists of a comparison of the bite mark photo, which has been digitally resized to life-size 1:1 proportions to an overlay of the incisal/occlusal edges of the suspect biter's teeth. This is accomplished by creating a digital hollow volume overlay of the dental models by scanning the models using a flatbed scanner into the computer (Fig 7). Then with the use of photographic software, the incisal edge overlay can be inverted and superimposed onto the bite mark pattern photo for comparison and analysis (Fig 8).

Finally, the odontologist will submit the report to the entity that retained him/her. In this report, the odontologist will list all the steps taken to complete the analysis and formulate an opinion. The range of opinions are:

- ▲ can include biter in pool of suspect biters
- ▲ cannot include biter in pool of suspect biters
- ▲ exclusion (did not make the bite)
- ▲ inconclusive (not enough data or poor-quality data to formulate an opinion)

In summary, forensic odontology is an exciting field where dental health care professionals can use their skill and training in dentistry for a field completely outside of dentistry. Choosing a career path as a forensic odontologist or forensic dental autopsy technician (the auxiliary's role in forensic dentistry) should not be viewed as a hobby, but in fact, a second career *in addition* to your primary career in the field of dentistry. The hours can be long and the monetary return low or even non-existent, but the personal reward and satisfaction can be great.

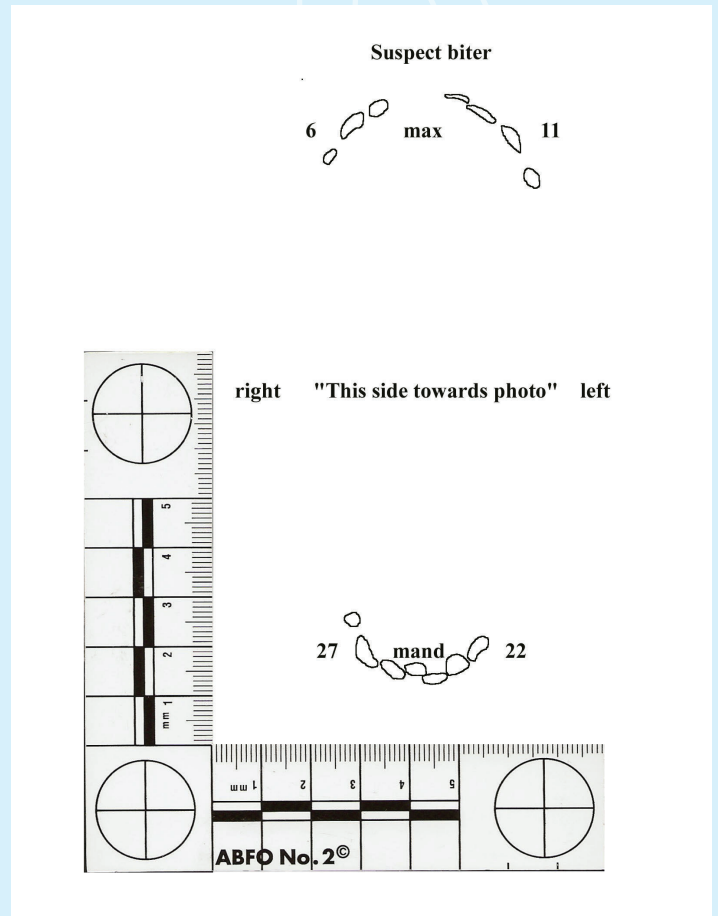


FIG. 7

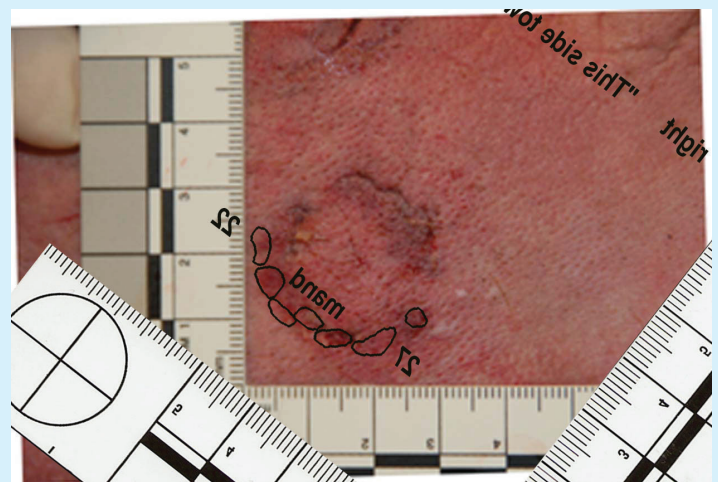


FIG. 8