Veronique F. Delattre,[1] *D.D.S.*

Burned Beyond Recognition: Systematic Approach to the Dental Identification of Charred Human Remains*

REFERENCE: Delattre VF. Burned beyond recognition: Systematic approach to the dental identification of charred human remains. J Forensic Sci 2000;45(3):589–596.

ABSTRACT: Forensic dental evaluation methods for use in a systematic approach to the dental identification of charred human remains are described. A systematic, conservative approach prevents the loss of valuable dental information before a thorough picture of the individual's dental remains has been adequately documented. The presenting conditions of fire victims are explained and illustrated with photographs, and a series of illustrations and text describe the damage seen in the dentition of the fire victim. A systematic four-stage process for gaining access to the intraoral structures of charred human remains is outlined and illustrated. Utilizing methods of access to the oral structures that maintain the integrity of the dentition through each stage of the evaluation of charred remains will prevent the loss of potential dental information before a thorough dental charting, intra-oral photographs, and radiographs can be obtained.

KEYWORDS: forensic science, forensic odontology, forensic dentistry, human identification, dental identification, forensic, dental records, odontological identification, dermal burn, burn injury

Burned Beyond Recognition—These are tragic words, which, when included in a motor vehicle accident or structural fire report, necessitate the services of either the forensic odontologist or DNA specialist for the positive identification of the victim. Due to the fragile nature of charred dental remains, forensic odontologists strive to utilize examination methods that will maintain the integrity of the dentition throughout each stage of the dental evaluation of charred human remains. A systematic approach prevents the loss of valuable dental information before a thorough picture of the individual's dental remains has been adequately documented. Compounding the difficulty of the dental evaluation procedures is the fact that the soft tissues and muscles of the charred individual may have become very hard or tight and difficult to manipulate without using heavy force, thereby causing the unintentional destruction of the dentition (1). Charred dental remains are by nature rather delicate. Charred and dessicated teeth tend to fall apart it they are not handled very gingerly. Color is often useful as a guide to relative fragility of dental tissues, with blackened remains usually less fragile than remains that are ashen gray in color. The enamel on the anterior surface of the anterior teeth (those most exposed to the fire) are known to simply crack off when touched. Once a tooth has crumbled into pieces, it is quite difficult to reconstruct sufficiently to take radiographs, photographs, or impressions to serve as postmortem evidence. It is imperative that the dental evidence not be destroyed through improper or careless handling until the proper radiographs, photographs, or impressions can be fabricated. A preplanned, systematic approach to preserving the charred dentition is crucial to the success of confirming the identity of charred individuals. This paper details suggestions for preserving the dental evidence of charred human remains.

[1] Forensic Dental Consultant, Harris County Medical Examiner's Office, and also Assistant Professor, Department of General Dentistry, University of Texas Dental Branch at Houston, Houston, TX 77030.

* Presented in part at the 51st Annual Meeting, American Academy of Forensic Sciences in Orlando, FL, February 1999.

Received 4 June 1999; and in revised form 2 Aug. 1999; accepted 2 Aug. 1999.

Presenting Condition of Fire Victims

The techniques used to gain access to the oral structures during a forensic dental evaluation are determined by the presenting condition of the fire victim's remains. The extent of damage to the fire victim is primarily dependent upon the temperature and length of exposure to the fire. Burns resulting from different agents are relatively specific and diagnostic. Dermal burns are typically described by one or more of the following categories: rope burn (also known as brush burn or mat burn, caused by friction of a rapidly moving object against the skin or ground into the skin); chemical burn (caused by dermal contact with a caustic chemical); flash burn (due to very brief exposure to an intense radiant heat source, such as that produced by an atomic explosion); radiation burn (caused by overexposure to radium, X-rays, atomic energy, or ultraviolet rays); and thermal burns (caused by exposure to an extreme heat source or flames).

The division of burns into "degrees" is indicative of the amount of tissue destruction. First-degree burns involve only the epidermis (the outer, protective layer of the skin), causing erythema (inflammatory redness of the skin) and edema (accumulation of excessive amount of watery fluid in tissues) without vesiculation (blistering), and consequently no significant alteration of the epidermis. Second-degree burns involve the dermis (the layer of skin below the epidermis, containing blood and lymph vessels, sweat glands, and nerve endings) as well as the epidermis and usually form blisters. There is destruction of the epidermis, while the dermis sustains reversible injuries. Third-degree burns involve destruction of the entire skin and interfere with epithelial regeneration. The irreversibly injured dermis must first be disposed of before a new layer of epithelium can be regenerated (2–4). The unofficial term "fourth-degree burns" is sometimes seen in autopsy reports and refers to burns resulting in the charring or incineration of human tissues, noncompatible with survival. More commonly, autopsy reports

will use the accepted term "total body surface area" burn to indicate the severity of damage to the charred body.

Condition of Dental Remains

During the early stages of exposure to fire, the cheeks and tongue have a tendency to some extent to physically protect the teeth. As the fire grows hotter or lasts longer, the lips and cheeks (as well as tissues covering other body areas such as the arms and legs) "tighten up" and become hard. Thus, the lips and cheeks may draw back exposing the anterior teeth and resulting in destruction of the anterior enamel and dentin (5). In many cases the anterior teeth become very brittle and must be managed very carefully (Figs. 1 and 2). It is in these situations that first spraying the teeth with hair lacquer or applying clear fingernail polish may assist in preserving the dental tissues for evaluation. This method of preserving charred dental evidence is also recommended for use by those individuals responsible for the initial fire scene investigation. All too often the dental evidence inadvertently becomes dislodged or lost during the placement of the remains in a body bag and transporation to the postmortem facility.

FIG. 1—*Dental remains of an individual exposed to extreme temperatures during an automobile fire. The lips are drawn back exposing the anterior teeth, resulting in the scorching of anterior surfaces. Care must be exercised by the forensic dentist to prevent further damage to the dentition during evaluation.*

The damage seen in the dental remains of a fire victim can generally be categorized as: intact (no damage due to fire), scorched (superficially parched and discolored), charred (reduced to carbon by incomplete combustion), incinerated (burned to ashes), or burst apart. Figures 3 to 6 illustrate the full range of fire damage to the dentition.

Illustrative Cases

In 1997, the last year with complete statistics, 300 fatal traffic accidents in Harris County, TX, killed 330 people. A little more than half were in Houston, with the rest in other cities and unincorporated areas. Houston's annual rate of 10.49 deaths by motor vehicle per 100 000 population is higher than some major cities but lower than others. It is average for larger Texas cities. Dallas is the highest in the state with 16.23/100 000 (6).

The automobile accident victim depicted in Fig. 3 was driving late at night down a long rural road, returning home after a holiday weekend. The driver veered off the roadway, probably due to driver fatigue, and struck a solid concrete barrier. The vehicle flipped over and quickly caught fire. Passersby attempted to re-

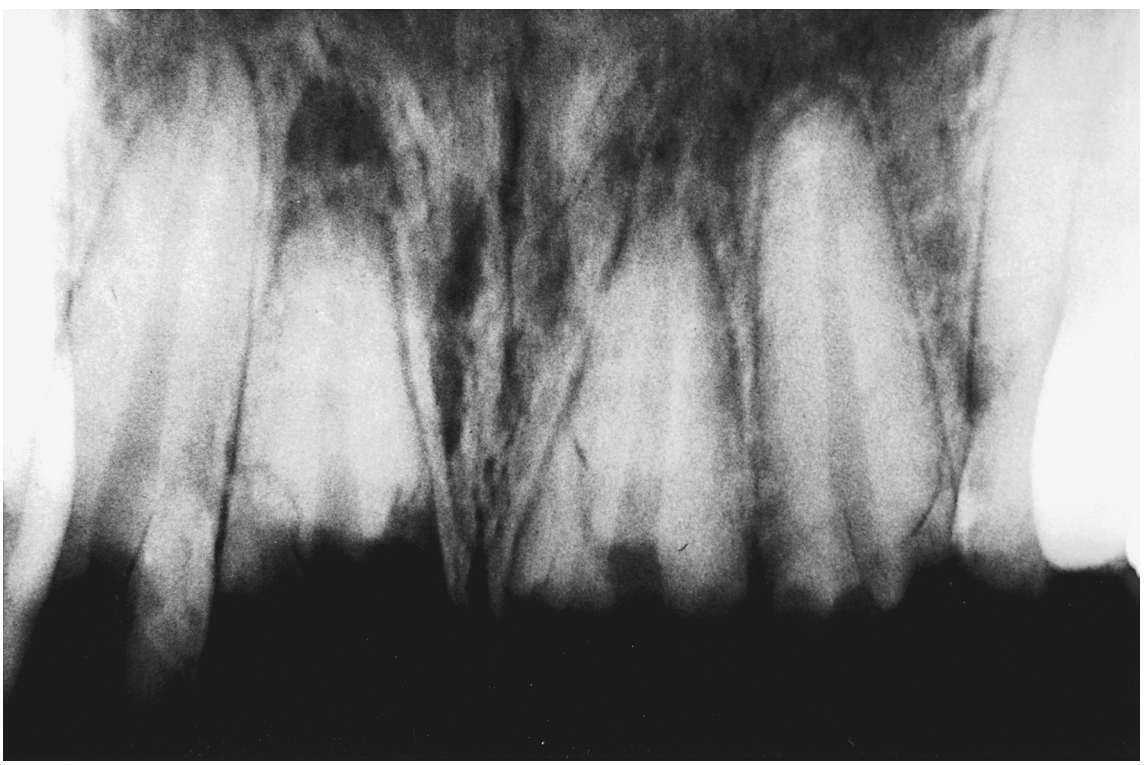

FIG. 2—*Radiograph of the maxillary anterior teeth from the remains in Fig. 1. Notice evidence of carbonization of the clinical crowns, which appear radio-opaque in the radiograph. Also note the fracture lines in the root structures occurring as a result of the exposure to intense heat.*

FIG. 3—*Intact and scorched teeth are evident in these dental remains of a motor vehicle fire victim.*

FIG. 4—*The maxillary central incisors were burst apart due to their exposure to intense heat. Note that the anterior portion of the palate had begun to scorch, while the more protected posterior palatal region remained pink.*

FIG. 5—*Considerable damage to the facial tissues and dentition as a result of an intense fire fueled by a flammable material.*

FIG. 6—*The buccal mandibular plate of these human remains was burned away due to a long lasting fire. The exposed roots are charred and the clinical crowns exhibit fracture lines.*

move the victim from the vehicle, but were unsuccessful due to the heat of the fire. The local volunteer fire department quickly responded and extinguished the fire. Although the victim did not survive, the facial and dental damage was moderate, with retraction of the lips leading to exposure and consequent charring of the anterior surfaces of the teeth. During the accident the mandible had been fractured on the left side between the second premolar and the first molar. The fractured mandible is the reason the mouth is hanging open in the photograph. All teeth were present and intact although no restorations were present. However, the presence of a significant diastema between the maxillary central incisors, along with dental radiographs, supported the positive identification of the individual (7–10). Since the oral structures were readily accessible for examination and radiographs, the method of access for the dental evaluation did not call for tissue resection or jaw resection.

Figure 4 is a postmortem photograph of another motor vehicle accident victim. The driver missed a freeway entrance ramp and struck a concrete pillar. The car caught fire and was extinguished relatively quickly. The posterior teeth and restorations remained intact, with some scorching of the dentition beginning, particularly on the lingual surface of the maxillary left lateral. The maxillary central incisors and right lateral incisor are burst apart due to their exposure to the flames. The anterior of the palate had begun to scorch, while the more protected posterior palatal region was still pink. As seen in the photograph, the charred lips were resected to determine the extent of charring to the teeth. As in the previous case, the oral structures were readily accessible for evaluation and radiographs without the need for jaw resection.

Figure 5 depicts the more extensive charring seen in the postmortem remains of a trucker hauling a flammable material. Although the fire department responded quickly, the extremely intense heat of the fire caused considerable damage to the dentition and facial tissues. Here we see more extensive charring of the teeth than in the previous case. The facial and temporomandibular muscles had become very hardened and mandibular resection was necessary to adequately access the oral structures for thorough evaluation and documentation.

Figure 6 demonstrates the effect of a house fire that in this particular situation was not as intense a heat as that found in an automobile accident, but burned for some time before being extinguished. The continued moderate heat affected the body by charring away the more external layers, exposing the more internal portions of the body. As seen in this photograph, the mandibular buccal plate has been burned away, the roots are charred, and the enamel of the clinical crowns exhibit fracture lines. Several of the teeth had fallen out during the fire and were not located. Since there was little or no tissue remaining in the facial region, there was minimal difficulty in evaluating and documenting this individual's postmortem dentition.

Figure 7 illustrates the effects of an extremely intense, high heat of long duration. The left side of the maxilla and a few other scattered teeth are all that were found of the pilot of a small aircraft that crash landed in a difficult to reach location. The plane and its occupant had virtually been incinerated by the time assistance arrived. The clinical crowns had burst off due to the steam pressure caused by the rapid heating of the pulpal tissues, and the remnants of the teeth were extremely fragile. In extreme cases such as this, there is also the added problem of shrinkage of the bone and teeth due to desiccation. Comparison of antemortem radiographs and postmortem socket and root morphology, as well as bone levels, can assist in the identification of the victim. Figure 8 is a close-up of a mandibular molar from the same aircraft fire

victim. The enamel crown had burst away from the more moist dentin, and the tooth was extensively desiccated and beginning to turn to ash.

Examination and Documentation of the Charred Dentition

A systematic set of procedures for gaining access to the intra-oral structures will insure that no dental information is lost during the examination process itself. The main objective of dividing the examination into the following four stages is to permit the forensic dentist to sequentially determine the extent of damage to the dentition in order to proceed in the most conservative manner possible.

Stage I

The first stage involves the noninvasive extra-oral visual examination of the charred remains (Fig. 9). It is wise to preliminarily chart the visible teeth in the event that further manipulation of the oral structures should cause them to further disintegrate. At this stage, extra-oral photographs can be taken for future orientation of dentition, should the need arise. If the forensic dentist determines that the dentition is charred to the point that attempting to open the mouth might result in damage to the teeth, she or he should proceed to the next stage.

Stage II

The second stage involves the removal of extra-oral soft tissue to allow direct visualization of more of the dentition, and to determine the fragility of the posterior teeth. Equipment recommended for this stage includes a large pair of scissors, surgical blade handle and surgical blade, large forceps, surgical crossbar lever, dental mirror and dental explorer (Figs. 10 and 11). After removing the extra-oral soft tissue, more of the dentition is readily visible (Fig. 12). The dentition should be cleaned of debris for a more accurate examination, assuming that to do so will not damage the teeth. More exten-

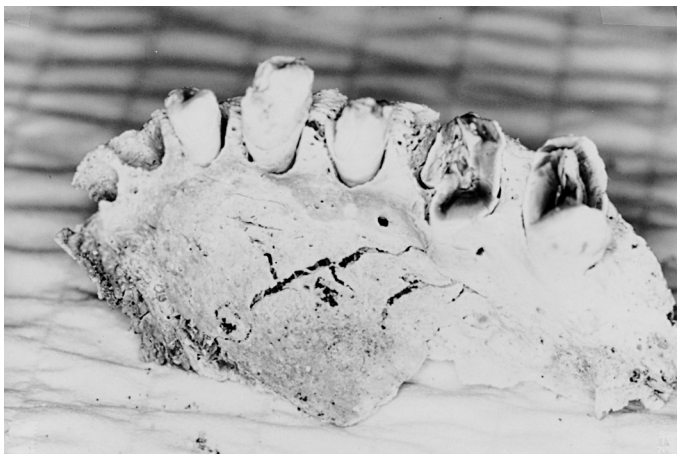

FIG. 7—*Incinerated and desiccated left maxilla, resulting from an airplane crash fire. Note the absence of clinical crowns.*

FIG. 9—*Stage I: Noninvasive extra-oral examination and photographs of nonaltered dental remains.*

FIG. 8—*Mandibular molar of the same dentition seen in the previous figure. The clinical crown has burst away from the dentin substructure due to increased internal steam pressure caused by the extreme heat of the fire.*

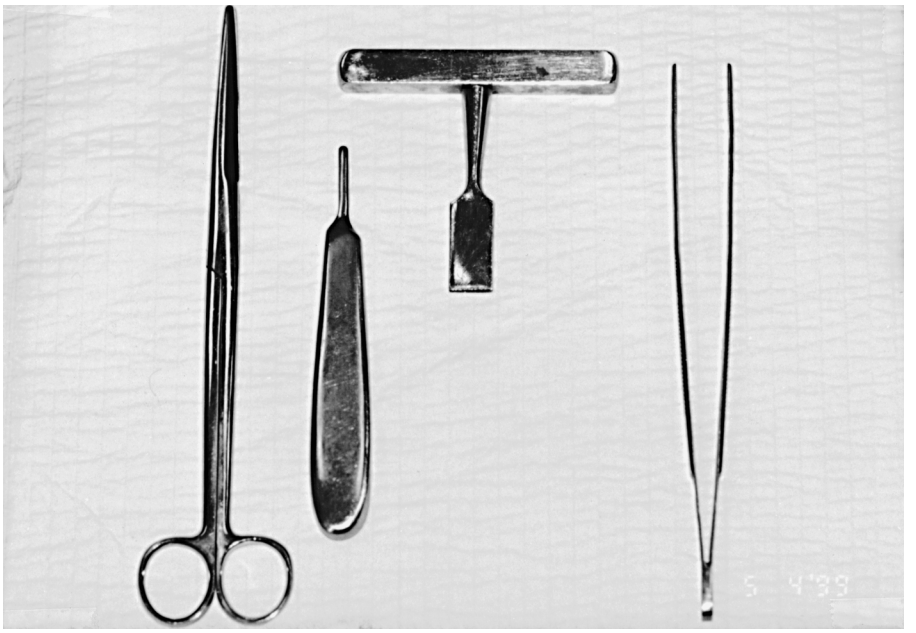

FIG. 10—*These instruments will help gain access to the intra-oral structures for evaluation: a large pair of scissors, surgical blade and surgical blade handle, surgical crossbar lever, large forceps. Once access has been achieved, also helpful are a dental mirror and explorer.*

FIG. 11—*Stage II: Soft tissue removal for direct visualization of dentition.*

FIG. 12—*After removing the extra-oral soft tissue, more of the dentition is readily visible when compared to Fig. 9.*

sive dental charting and photographs can now be achieved before attempting to pry open the jaws for intra-oral access. In those cases when the medical examiner has already removed the throat area for examination during the autopsy, it may be possible to take radiographs without opening the jaws and risking further damage to the dentition (Fig. 13). If opening the jaws manually or with the aid of the crossbar lever (Fig. 14) proves unsuccessful, proceed to Stage III.

Stage III

The third stage involves the surgical resection of the mandible alone, or both the mandible and maxilla (Fig. 15). Radiographs can now be made more readily and a more complete set of photographs can be taken. The dental charting can be thoroughly complete at this stage also. Any dental fragments or loose, individual teeth should be identified, radiographed, and documented.

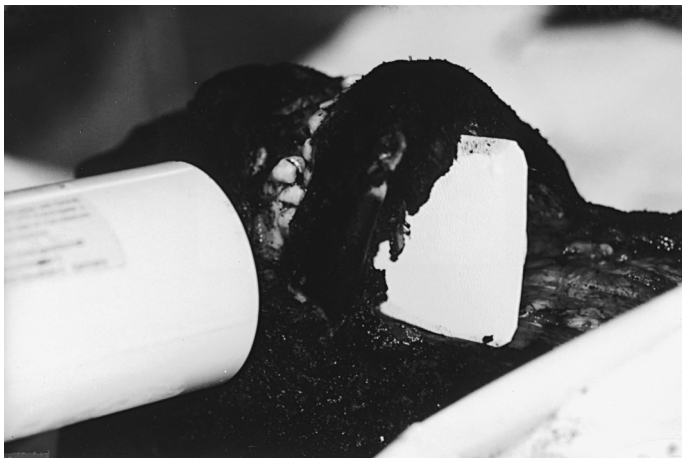

FIG. 13—*In those cases when the medical examiner has already removed the throat area for examination during the autopsy, it may be possible to take radiographs without opening the jaws and risking further damage to the dentition.*

FIG. 15—*Stage III: Resection. The maxilla from the remains of another victim was resected along with the mandible (not pictured). The orthodontic model on the left, along with antemortem radiographs, assisted in the positive identification of this individual.*

FIG. 14—*A surgical crossbar lever can be used when attempting to open the mouth. Care should be taken to avoid damaging the posterior teeth.*

TABLE 1—*Description of the steps included in the four stages of examination and documentation of the charred dentition.*

Stage I:	Noninvasive extra-oral visual examination
	Preliminary charting of visible teeth
	Extra-oral photography
Stage II:	Soft tissue removal for direct visualization of dentition
	Continue documenting and photographing the dentition
	Attempt to pry open the jaws for intra-oral access; if unsuccessful, go to Stage III
Stage III:	Mandibular/maxillary resection
	Radiographs and more photographs as needed
	Loose, individual teeth should be identified and radiographed
Stage IV:	Place all loose dentition and resected items in a labeled container

Stage IV

The fourth stage involves the proper containment of the dental evidence for possible future retrieval. All loose oral fragments, dentition, and resected items should be placed together in a labeled container and placed with the body to prevent loss or misplacement. It is then possible to return quickly and easily to the dental evidence if further evaluation is necessary. Table 1 summarizes the steps included in each of the four stages of the forensic dental evaluation of charred human remains.

Conclusion

As illustrated in the situations described in this paper, the forensic dental identification of the victims of fires is often a complex and challenging endeavor. The extraordinary usefulness of fire and its equally extraordinary dangers affect every human being from infancy onward, and ultimately for some, is the instrument of their death. In spite of all the benefits that humans derive from it, the mere word *fire* is one of the most dreaded expressions in every language, for fire is potentially as dangerous as it is useful. Utilizing methods of access to the oral structures which maintain the integrity of the dentition through each stage of the evaluation of charred remains will prevent causing the loss of potential dental information before a thorough picture of the individual's dental remains can be adequately documented.

Acknowledgments

The author wishes to thank Mrs. Janine Delattre for her encouragement, support, and assistance during the preparation of this paper.

References

1. Delattre VF, Stimson PG. Burned beyond recognition: Odontological identification of the charred remains of motor vehicle accident victims. Proc Am Acad Forensic Sci. 1999;5(2):152.
2. Stedman's Medical Dictionary, 24th ed. Baltimore: Williams and Wilkins, 1982;201–2.
3. Kissane JM, editor. Anderson's pathology, Volume One. St. Louis: The C. V. Mosby Company, 1985;129–48.
4. Constable JD. Thermal injuries of the head and neck. In: Stark RB, editor. Plastic surgery of the head and neck. New York: Churchill Livingstone, 1987:275–98.
5. Cottone JA. Outline of forensic dentistry. New York: Year Book Medical Publishers, 1982;73–87.
6. Feldstein D. Deadly driving. The Houston Chronicle 1998;Dec 20; Sect. C:1 (col.4).
7. Delattre VF, Stimson PG. Self-assessment of the forensic value of dental records. J Forensic Sci In Press-September 1999.
8. Delattre VF, Johnson CD. The forensic value of dental records of a local chapter of the national dental association. Nat Dent Assoc J 1999;Winter: 30–4.
9. Delattre VF, Stimson PG. Bite marks vs. other injuries—forensic odontological evaluation of a homicide. Proc Am Acad Forensic Sci 1998;4(2):133.
10. Delattre VF. Abstract: The forensic value of dental records: a self-assessment study. J Dent Educ 1999;63(1):43.

Additional information and reprint requests:
Veronique Delattre, D.D.S.
University of Texas Dental Branch at Houston
6516 John Freeman Avenue, Suite 28A
Houston, TX 77030