**Abstract**

The Cedar Fire burned a large area of San Diego County in October 2003. By the time it was extinguished in mid-November, it had consumed more acres than any fire in California’s history. Fifteen people lost their lives because of the fire. Forensic dentistry played a prominent role in the identification of the victims.

On Saturday, Oct. 25, 2003, a lost hunter lit a signal fire hoping to be rescued. Instead, he started a massive wildfire. When it finally was extinguished weeks later, it had consumed more acreage than any fire in California history. The hunter was in an area called Cedar Creek, just east of the community of Ramona in San Diego County, deep within the hills of the Cleveland National Forest. The area was generally inaccessible due to the rough terrain and 30 years of underbrush growth. In San Diego County, the average rainfall is nine inches per year. However, the average rainfall had been well below normal the past several years. As a result, the dead brush had a moisture content of 2 percent to 3 percent compared to paper, which has a moisture content of 10 percent.

The fire began at sunset under fairly calm wind conditions. However, because of the extremely dry brush, it spread very rapidly and covered much ground. Air tankers were not allowed to respond that evening due to night flight restrictions and firefighters could not reach the fire’s Ground Zero. The fire grew rapidly in size, moving west toward Ramona.

Suddenly, in the early evening, the Santa Ana winds increased and shifted direction. The front of the fire increased to a width of five miles and moved rapidly toward eastern Ramona, the Barona Indian Reservation, and Wildcat Canyon/Muth Valley. As the fire grew in size and ferocity, it grew into a force of incredible destruction. Raging through Wildcat Canyon, its speed approached 60 miles per hour. The fire consumed 33,000 acres in one hour, equal to nine acres per second. At that point, all rescue personnel could do was to focus on saving lives. “A hundred fire engines would not have been enough. The crews were there to rescue people.”

By 9 a.m. the next morning, the fire had consumed more than 150,000 acres and traveled almost 20 miles west through the communities of Ramona, Barona, Wildcat Canyon/Muth Valley, Lakeside/Eucalyptus Hills, Poway (south), and into Scripps Ranch moving up to and over the 10-lane Interstate 15. By Sunday night, the Cedar Fire raged south and east through the communities of Santee (north), El Cajon (east), Crest, Harbison Canyon, and Alpine. In its first full day,
it became the largest fire in San Diego County’s history. Three days later, the Cedar Fire earned the distinction of being the largest fire in California’s history consuming, more than 233,000 acres at an average of 6,000 acres per hour.3 The fire overran the entire community of Lake Cuyamaca, destroying 90 percent of the homes and devastating the surrounding state park. On Wednesday, the fire headed back toward Julian to the north and Pine Valley to the east. The fire raged for several more days and was not fully contained until Nov. 16, 2003.

The Cedar Fire ultimately burned more than 270,000 acres, destroying 2,232 homes. The fire was fought by 877 fire engines and 5,203 firefighters from 325 departments.4 The fire claimed 15 victims, including a firefighter from Novato, Calif.

Purpose of Dental Identification
Forensic dental identification specialists typically are the last conventional option for postmortem identification. DNA is also now utilized, but due to its high cost and the extensive time required for analysis, it is used sparingly or when no other option exists. This was seen recently in the identification of the remains of Laci Peterson, whose body was recovered headless and handless. 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. Enamel is the hardest substance in the body and the only exposed portion of the skeletal system. Teeth are resistant to thermal damage and blunt force trauma. Therefore, 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.). If dental restorations are added, the unique combination for any given individual can factor into the millions.

There are numerous important reasons for identifying the deceased.5 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, including closure. In criminal investigations, it is important to establish the identity of the victim in order to proceed with the criminal investigation and to identify the suspect.6

In a blaze such as the Cedar Fire, the bodies often are burned beyond visual recognition. Personal effects are also destroyed or lost in the fire. Even if the personal effects are recovered, they may not be considered reliable due to the typical calamity surrounding a fire. A forensic anthropologist can examine the remains of the skeletal system and often can determine age, race and sex of the victim. Positive identification is best performed by examination of the surviving dentition by the forensic odontologist. However, in cases such as the Cedar Fire, where the temperatures were at times very high (1000°C), even the dental remains may be destroyed. Crowns may fracture or explode leaving only the roots. The bone may also be completely consumed leaving only scattered roots with no bony sockets for reference.

Method of Dental Identification
Forensic dental identification is most often accomplished by comparing the radiographs of the teeth of the decedent (postmortem) with the dental radiographs obtained from the dentist of the suspected victim (antemortem). 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. Frequently, duplicate radiographs, rather than originals, are sent and they often 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 is emphasized 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 as well. This allows the forensic dentist to verify dental treatment that was performed subsequent to the date of the radiographs.

Identification of the Cedar Fire Victims
The majority of the Cedar Fire victims died the first night in the Wildcat Canyon/Muth Valley area. This was
due to the rapid movement of the fire along with the lack of advance warning to those in the path of the fire. Two more victims lost their lives after the first night. One victim died in the Alpine area; the other victim, a firefighter, died when flames overran the fire engine. Medical examiner investigators initially had difficulty recovering some of the bodies due to the persistent flames and the threat of injury. In addition, the severely burned remains were very fragile, which made recovery difficult.

The victims’ remains were examined by forensic pathologists and autopsies were performed. A forensic anthropologist then examined the remains and reassembled the skeletal structures when possible (Figure 1). While these examinations were occurring, investigators contacted each victim’s family, friends, physician, and dentist to collect information for use in identification.

In San Diego County, there are two primary forensic odontologists on call to perform postmortem dental exams, Norman “Skip” Sperber, DDS, and the author. Sperber was on call Oct. 28, 2003, and he examined the initial seven cases. The author was called the following day for the next set of exams. Due to the extreme heat, the victims’ remains were all badly charred; some were almost fully cremated.

With the antemortem radiographs in hand, the author took sufficient postmortem radiographs to allow for an adequate comparison. Sometimes, only one radiograph needs to be taken while at other times, a full mouth series must be completed. The author worked two evenings and one morning examining eight of the 15 victims. The examinations resulted in positive identifications for five of the eight victims. One of the unidentified victim’s remains was very severely charred. The only dental remains consisted of charred roots and fragments of burned bone (Figure 2). There were no bony socket fragments for orientation. Unfortunately, the only antemortem radiographs available were four bitewing X-rays taken when the decedent was a young teen, more than 10 years earlier. The root morphology could not be seen in the bitewings, so a comparison could not be made. The other two victims who could not be identified were almost fully cremated.

The next dental identifications were two severely burned bodies with intact skulls and jaws. The mandible and maxilla were resected and the dental identifications were completed (Figure 3). It is interesting to note that on one of the cases, the American dentist of record furnished his most recent radiographs (four bitewings) from about four years prior. Only the most recent radiographs had been requested by the medical examiner investigator. The decedent had subsequent major reconstructive dental treatment performed in

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**Figure 1.** The burned skeletal remains are reassembled by the forensic anthropologist for examination.

**Figure 2.** The dental fragmented remains of a fire victim. The remains were almost fully cremated.

**Figure 3.** The mandible and maxilla have been resected from the body and are now ready for dental charting and radiography. Note the maxillary removable partial denture.
dentist. While he no longer had any of his treatment records concerning the decedent, he did recall placing the bridge. The Mexican dentist signed a sworn affidavit at the U.S. Consulate in Tijuana, Mexico, certifying he placed the bridge five years earlier. Though this identification was not ideal, the medical examiner and the author had a high enough degree of confidence to complete this case.

Discussion

Fire often plays a role in mass disasters, and the identification of the victims of the Cedar Fire once again illustrated the significant role forensic dental identification plays in a mass disaster. When one looks at the enormity of the Cedar Fire, the number of victims who perished could have been much greater if not for the heroic response of all emergency personnel. The author experienced these heroics firsthand the second night of the fire. Authorities instructed the author to evacuate his family to a safe area. The fire came within 300 yards of his residence. During the evacuation, the author witnessed several neighboring homes burning on the hillside. Several

Mexico after the last bitewing X-rays were taken, but the medical examiner investigator was unable to obtain any of those records. Fortunately, the local dentist also furnished copies of all the treatment progress charts. The decedent’s subsequent treatment performed in Mexico was extensive, e.g., multiple extractions, full mouth porcelain fused to metal crowns and long span bridge-work, (Figure 4) and upon initial comparison to the bitewings, it appeared the postmortem radiographs were not consistent with this individual, except for evidence on the bitewing of an endodontic fill on No. 13. In the treatment notes, the local dentist had previously taken a full mouth series of radiographs. The author then contacted this dentist and he personally delivered the additional radiographs the same evening. The endodontic restoration was consistent and the identification was completed. This illustrates the importance of furnishing all the records on file.

With the following two cases, the decedents had suffered very extensive thermal damage, again almost to complete cremation. Only a small portion of the cranium remained, the jaws were almost completely missing except for select posterior molars. It was fortunate that in both cases the antemortem radiographs furnished were complete full mouth series. Identifications were completed for both.

The author’s final dental identification of the fire victims was one that involved international cooperation. On a set of remains that was nearly fully cremated, the medical examiner investigator was able to recover some dental root fragments and a three-unit porcelain fused to metal bridge (Figure 5). The victim’s family stated the decedent’s dental treatment was performed in Tijuana, Mexico. The medical examiner investigator spent nearly 10 weeks pursuing the leads in this case and finally was able to get the name of the decedent’s dentist in Mexico. Meanwhile, the author determined the bridge was a maxillary right posterior bridge with teeth Nos. 4 and 6 the abutments and No. 5 the pontic (Figure 6).

With the name of the Mexican dentist, the author contacted Leon Dychter, DDS, chief forensic odontologist for the Courts of the State of Baja California, Mexico. Dychter met with the Mexican dentist. While he no longer had any of his treatment records concerning the decedent, he did recall placing the bridge. The Mexican dentist signed a sworn affidavit at the U.S. Consulate in Tijuana, Mexico, certifying he placed the bridge five years earlier. Though this identification was not ideal, the medical examiner and the author had a high enough degree of confidence to complete this case.

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of the author’s patients, friends and colleagues lost their homes in the Cedar Fire. It is safe to say that everyone in this community was affected in some way.

Summary

In conclusion, it is noted California is well represented with dentists experienced in forensic odontology. California has the highest number of certified forensic odontologists compared to other states in the nation. In addition, we now have the California Dental Identification Team as a statewide resource.

To maximize the effectiveness of our forensic resources, it is important for practicing dentists to keep complete patient records on file and continually update them, including the radiographs. The records may be needed for postmortem dental identification.

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References