CASE REPORT

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Postmortem Examination of Incinerated Teeth with the Scanning Electron Microscope

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ABSTRACT: Fragments recovered from the burned wreckage of a gasoline truck and thought to be parts of teeth were confirmed as such after they were examined with a scanning electron microscope. The appearance of the fragments was compared with previously published descriptions of teeth which had been incinerated under laboratory conditions and also examined by scanning electron microscopy.

KEYWORDS: odontology, microscopy, dentition, fires

Although teeth and restorative materials are generally impervious to destruction, high temperatures as encountered in a fire can destroy or alter them greatly. This presents a challenge to the forensic scientist attempting to use the teeth to identify a victim. The present case illustrates application of the scanning electron microscope (SEM), an established tool of forensic science [*1-3*], including forensic odontology [*4-6*], to the characterization and study of subtotally destroyed dental remains.

Case Report

Two men died on 14 Aug. 1983 after a tank truck in which they were riding overturned and caught fire. The truck was carrying 32176 L (8500 gal) of gasoline. The accident occurred in New Orleans, LA on a curving and descending roadway leading to U.S. Highway 61 from the westbound lanes of Interstate Highway 10. This particular downramp had been the scene of a number of previous accidents, some of which also involved large trucks.

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The body of the man believed to have been driving the truck was found 9 m (30 ft) from the wreckage (Fig. 1). Though burned, it was the better preserved of the two, and numerous dental findings, including four amalgam restorations, were obtained by direct examination of the remains. The body of the man believed to be the passenger remained within the cab of the truck and was practically destroyed. The only dental evidence recovered from the passenger's body consisted of two carbonized tooth fragments. One was thought to be part of a lower molar and the other part of an upper or lower premolar. A scanning electron microscope was used to examine these fragments.

Since the teeth were in a desiccated state, no additional fixation, dehydration, or critical-point drying was required. The specimens were mounted on aluminum stubs using silver paint, and coated with gold-palladium in a sputter-coater. The thickness of the metal was approximately 25 nm (250 Å). Viewing and photography were done with a Joel T-300 SEM at an accelerating voltage of 20 kV.

Linear (Fig. 2) and cross-sectional (Fig. 3) views of dentinal tubules confirmed that the fragments were portions of teeth. Lack of globule or "pearl" formation of the dentin, described by Harsanyi [*7*] as occurring at 1000°C (1858°F), indicated that the teeth had not been at that temperature; however, the gray, cracked appearance of the root surface (Fig. 4) and lack of enamel suggested exposure to a temperature in excess of 500°C (958°F) [*7,8*].

Strong ground winds or a "chimney effect" of piled wreckage can elevate the temperature of a gasoline fire beyond the normal range found in still air (890 to 1093°C [1600-2000°F]) [*9*], and a sustained temperature in excess of 1300°C (2398°F) is capable of rendering a tooth morphologically unrecognizable, even if viewed with the SEM [*7*]. Conversely, tissue adjacent to teeth affords protection from destruction by fire [*10*], though this protection decreases as the tissue itself is consumed. Other factors influencing the effects of fire on teeth are duration of exposure [*9*], the presence of materials (in addition to tissue) interposed between the teeth and fire, and temperature alteration by substances used to quench the fire. The degree to which these or other factors were operative in the present case is unknown beyond stating that the temperature of the recovered tooth fragments had exceeded 500°C (958°F) and did not reach a sustained temperature beyond 1000°C (1858°F).

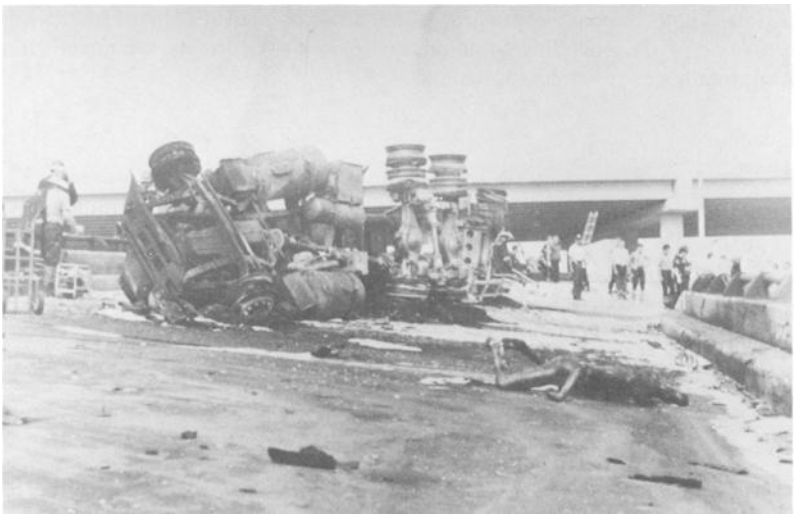

FIG. 1—*Scene of the accident with body of driver in foreground.*

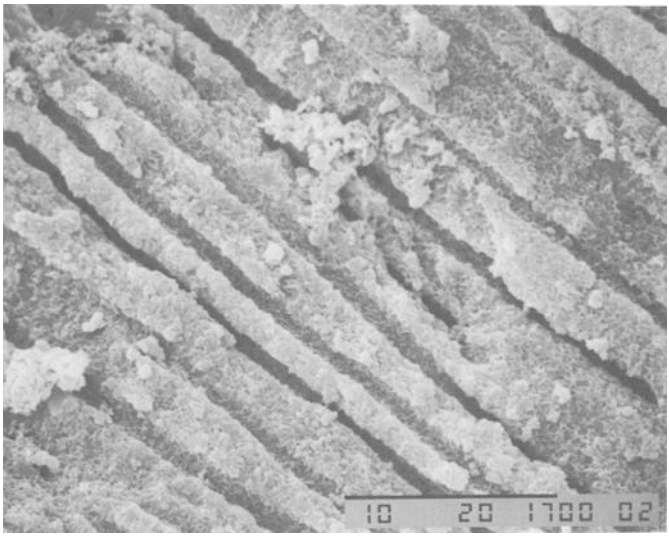

FIG. 2—*Tooth fragment recovered from cab of truck. Dentinal tubules are viewed longitudinally* ×*3500.*

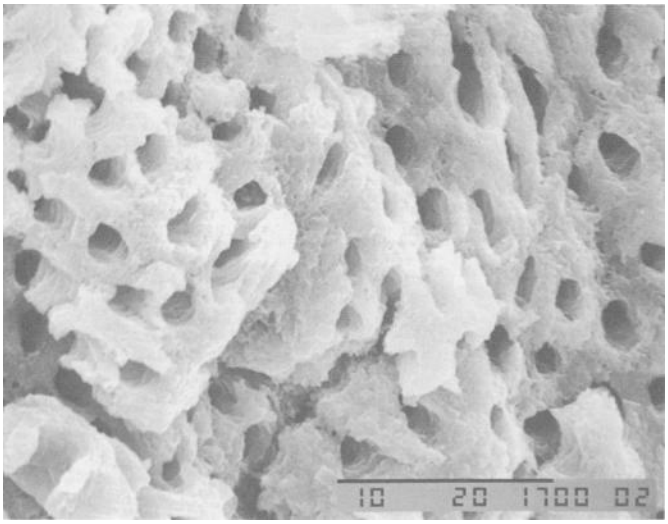

FIG. 3—*Dentinal tubules viewed cross sectionally* ×*3500.*

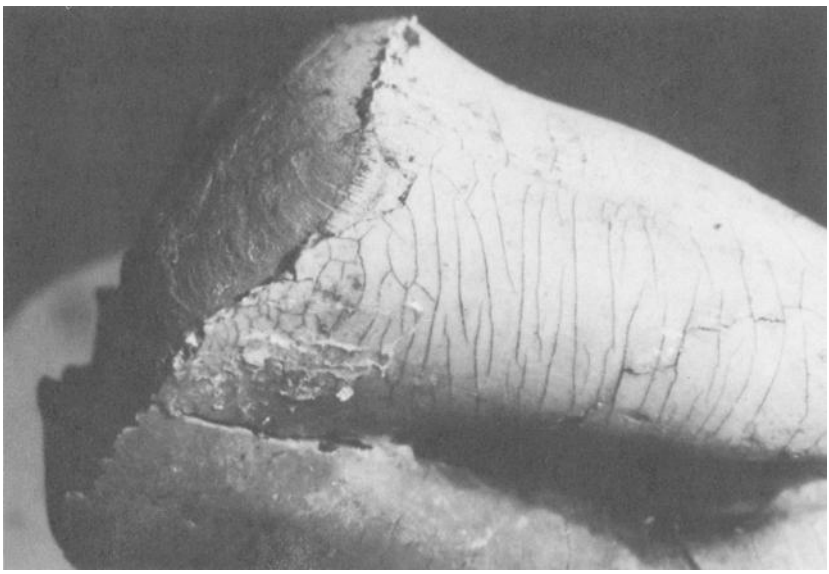

FIG. 4—*Tooth fragment believed to be remains of a lower molar. Enamel is lost, root surface has numerous cracks.*

Summary

When there has been severe damage to teeth and associated structures as a result of fire, and conventional means of dental identification are not possible, some evidence may be salvageable through use of the SEM. Dentinal tubules may be seen, as well as instrument (tool) marks and other defects. If an energy dispersive X-ray analyzer is coupled with the SEM, a profile of elements is obtained [*11*] which might indicate the presence of a particular type of dental material [*12*] and be of value in the identification process.

The SEM is especially useful in the analysis of severely burned teeth since it requires only a small sample and does not further destroy the already fragile specimen [*1*].

Acknowledgment

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