Patient fire during dental care

A case report and call for safety

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ABSTRACT

Background and Overview. Fire risk is present whenever there is a convergence of fuel, oxidizer, and an ignition source, which is called *the fire triangle*. A heightened awareness of fire risk is necessary whenever a fire triangle is present. The authors provide a sentinel event case report of fire in a dental office.

Case Description. A 72-year-old woman received second-degree facial burns from a fire that ignited near the nasal hood supplying a nitrous oxide–oxygen mixture. The presumed ignition source was heat generated during the preparation of a titanium post with a high-speed, irrigated carbide bur. The patient was transferred to the local emergency department and subsequently discharged after possible pulmonary complications were ruled out. The patient was then transferred to a regional burn unit and was discharged home with second-degree burns.

Conclusions and Practical Implications. When the source of a fuel cannot be removed from the immediate area, soaked with water, or covered with a water-soluble jelly, the dentist should stop the open flow of oxygen or nitrous oxide–oxygen mixtures to the patient for 1 minute before the use of a potential ignition source, and intraoral suction should be used to clear the ambient atmosphere of oxidizer-enriched exhaled gas.

Key Words. Dental fire; nitrous oxide; oxygen; fire triangle; ignition source; oxidizer-enriched atmosphere; fuel; burn.

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Patient fire—that is, burning of substances on or in a patient[1] during the delivery of dental care—is an infrequent but high-impact event that can result in disfigurement, disability, or death for both patients and dental staff members. To date, with only 1 dental-related case report in the literature to our knowledge,[2] the need for disseminating education about patient fire risk, prevention, and management cannot be overlooked. We add this case report to the literature to heighten awareness of the possibility of these preventable mishaps.

CASE REPORT

A 72-year-old patient arrived at her appointment to receive restorative dental care, which involved the preparation of a titanium post with a high-speed, irrigated dental drill. Her medical history included hypertension and hypothyroidism. A history of nasal polyps was noted, but she reported that it did not interfere with nasal breathing. As was customary before dental procedures, the patient applied a thin layer of petrolatum jelly to her lips. A disposable nasal hood with scavenging was placed on the patient's face, and a 70% oxygen and 30% nitrous oxide mix was administered. The mask had not been wiped with any antibacterial agent.

As stated by the patient, approximately 10 minutes into the procedure, she felt intense heat on her nose and face. The heat was localized to the left side of her face and eyebrow, and then her hair caught on fire.

The mask was removed from the patient, and the fire was immediately smothered. Paramedics were summoned, and they transported the patient to a local emergency department in which pulmonary function was monitored and intravenous steroids were administered.

When stable, the patient was transferred to a regional burn unit where she was monitored for 6 hours and discharged home with second-degree burns managed with topical agents and wound care hygiene (Figure 1). Medical personnel identified no internal burn or smoke inhalation injury in the pharynx or pulmonary system.

As stated by her dentist, a titanium post was being prepared for a crown with a high-speed irrigated carbide bur and high-velocity vacuum right against the tooth. Gauze was not present in the mouth. As the patient starting moving and the sight and smell of fire was sensed, the mask was removed and thrown to the ground where it smoldered (Figure 2). No spark was seen under the dental lights, and no sounds were heard at the time of ignition. Fire on the patient was immediately smothered. The patient was closely monitored until paramedics arrived.

Figure 1. Facial appearance 24 hours after the burn injury.

Figure 2. Appearance of the burned nasal hood.

DISCUSSION

Fire (combustion) is heat and light energy that results from the rapid combination of an oxidizer with a fuel that has been heated to its ignition temperature, at which point it exists in a vaporized, gaseous state. Fires are ignited and sustained only with sufficient and continual physical proximity of heat (ignition source), fuel, and oxidizer—the *fire triangle* (Figure 3). If any leg of this triangle is absent, exhausted, or removed, fire will not occur or will extinguish.

Fires start small, and as in this case, often come as a complete surprise. It is important to realize that fire ignition, especially in the presence of a localized oxidizer-enriched atmosphere (OEA), is near instantaneous, and varies from a flash fire to smoldering, depending on the amount of heat (duration, intensity, and proximity), flammability of fuel, and concentration of ambient oxidizer.

Ignition sources in the dental setting include any instrument or device capable of generating fuel vaporizing heat, such as an electrosurgical unit or a laser. These

Figure 3. The fire triangle.

high-risk ignition sources are the 2 most frequent ignition sources in surgical fires.[3] Heat can also be produced from sparks from dental burs cutting various dental materials such as titanium posts or zirconia (Box 1). Sparks can be more energetic or yield a more intense flash when in the presence of an OEA.

Fuels are any flammable (combustible) solid, liquid, or gas capable of burning (Box 1). Cotton or paper products, hair (notably including fine vellus hair (Figure 4), plastic, rubber, and alcohol-based solutions are commonly encountered fuels in the dental office. Lipstick, lip balm, or petrolatum-based products, often applied before lengthy dental procedures, are not considered to be fire risks in the surgical setting, as the ECRI Institute—formerly the Emergency Care Research Institute, an independent nonprofit organization that researches approaches to improving patient care—has been unable to identify even 1 case for which these products started a surgical fire in an OEA in more than 35 years. Hypothetically, such ointments could burn once the fire is started from other causes.[4]

Oxidizers include both oxygen and nitrous oxide (which readily exothermically dissociates to oxygen). Increased oxygen concentrations above the ambient 21% cause a dramatic increase in the ease of ignition and the speed and propagation of combustion. An OEA is a term used to characterize any environment containing greater than 23.5% oxygen,[5] or any mixture of oxygen and nitrous oxide. An OEA exists during open delivery oxygen or nitrous oxide via nasal cannula or nasal hood, which occurs in patients undergoing nitrous

ABBREVIATION KEY. **OEA:** Oxidizer-enriched atmosphere.