

## Review Article

### **Laser safety in dental practice**

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**Abstract:** Dental professionals are predisposed to a number of occupational hazards. These include exposure to ionizing radiation. Taking X-ray machines in the dental office predispose dentists to suffer from ionizing radiation. Non-ionizing radiation has recently become a concern since the use of composites and other resins, next to the use of lasers in dentistry procedures, which has added another potential hazard to eye and other tissues that may be directly exposed. Concerning prevention, the global literature focuses strictly on Lead aprons, periodic maintenance of the X-ray machine and radiation level sensors deal with radiation dangers. The current paper reviews studies relating to occupational health problems in dental practice.

**Keywords:** Laser safety, X-ray machines, ionizing radiation, occupational health.

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#### **INTRODUCTION**

The safe and appropriate use of lasers in the field of dentistry requires the conscious and cooperative efforts of health care providers, educational institutions, government, and the commercial sector. The responsibility for the safe application of lasers in dentistry therefore is one that is shared by all those concerned dentist, education, manufacturers and scientist. Each has a role, from design and development to practical application[1].

Dental laser safety includes not only an awareness of the potential risks and hazards related to how lasers are used, but also recognition of existing standards of care and a thorough understanding of safety control measures.

#### **CLASSIFICATION**

Laser hazard classification according to ANSI and UHSA standards [1].

Class	Description
I	low-powered lasers that are safe to view
IIa	low-powered visible lasers that are hazardous only when Viewed directly for longer than 1,000 sec
II	low-powered visible lasers that are hazardous when Viewed for longer than 0.25 sec
IIIa	Medium -powered lasers or systems that are normally Not hazardous if viewed for less than 0.25sec without magnifying optics
IIIb	Medium -powered lasers (0.5W maximum) that can be hazardous if viewed directly.
IV	High -powered lasers (>0.5W) that produce ocular, Skin and fire hazardous.

The types of hazards that may be encountered within clinical practice of dentistry may be grouped as follows[1].

1. Ocular injury
2. Tissue damage
3. Respiratory hazards
4. Fire and explosion
5. Electrical shock

#### **Ocular hazards**

Precautions for dental staff and patients are essential during laser procedures to protect non-target tissues particularly the eyes from stray beams [2]. Potential injury to the eye can occur either by direct emission from the laser or by reflection from specular (mirror like) surface, instruments and even polished restorations have potential to redirect laser energy [1].

Several structures of the eye may be injured as a result of laser emissions. The primary ocular injury that may result from a laser accident is a retinal or corneal burn. Retinal injury is possible with emissions in the visible and near- infrared spectral regions [1].

Approximately 95% of the incident radiation entering the eye is absorbed by pigmented epithelium of the retina and choroid layer. Irreversible retinal burns resulting in permanent blindness can occur by conversion of incident radiation to heat energy within a fraction of a second [1].

### Eye protection

The safe use of the laser requires certain special precautions in the operating theatre. Light produced by all class IV lasers presents a potential hazard for ocular damage by either viewing or reflection of the beam. Therefore serious consideration must be given to the need for protective eyewear. Different lasers require different safety glasses [1,3,4].

A number of factors must be considered when specifying suitable protective eyewear. Wavelength or wavelengths emitted by the laser (the wearing of the wrong goggles is more dangerous than not wearing any at all); the level of attention necessary to reduce the incident beam to less than the maximum permissible exposure; the extent to which the eyewear reduces the transmission of visible light, whether the lens material may be damaged by the laser beam; whether spectacles can be worn; and comfort [4].

Matte instruments are advisable, as are protective eyeglasses for patients and staff. CO<sub>2</sub> laser protection can be afforded with clear safety glasses, such as those that are normally worn during dental procedures. Clear safety glasses are worn by the patient as well, and as a backup measure, wet 2x2 gauze sponges are placed over the patient's eyes. For protection from Nd:YAG laser energy, both the doctor and staff need to wear green safety glasses; from the argon laser, orange safety glasses. One safety glass cannot be interchanged for the other, one should not wear clear safety glasses when using the Nd:YAG or argon laser nor green safety glasses when using the CO<sub>2</sub> laser [3].

Instruments that are highly reflective or that mirrored surfaces should be avoided as there could be reflection of the laser beam [3].

High-powered carbon dioxide lasers produce light with sufficient energy to burn tissue. Heat measured from reflected surgical laser exposure exceeds 53° at distance less than 7cm and thus is hazardous to patient and operator. This problem can be controlled with the use of non-reflective instruments [5].

Neiburger E.J. et al. [5] measure the intensity of reflected 10 W CO<sub>2</sub> light and its thermal effects on adjacent structures and concluded that reflected CO<sub>2</sub> laser light (10W) was a hazard to oral and surrounding tissues at distances up to 7.0 cm from the focal point

and advised the use of low reflective instruments and protective shielding during laser treatment.

### Environmental hazards

General anesthesia is commonly used for intra-oral laser surgery and this introduces hazards with the anaesthetic gases and the endotracheal tube. The thermal effects of CO<sub>2</sub> laser can cause the combustion of inflammable gases. The tube may ignite if it is plastic and may melt if it is rubber. This can be avoided by using a specifically designed endotracheal tube made of metal or covered with laser-resistant silicone.

The laser plume created when tissue vaporizes should be considered infectious. Use of an appropriate evacuation system to draw off and filter the plume is essential [6].

### Electrical hazards

Surgical lasers often use very high currents and high voltage power supplies. Electrical hazards of lasers can be grouped as electric shock hazards, electric fire hazards, or explosion hazards. Considerable effort has been made by biomedical and electrical engineers in the design and manufacture of safe laser systems. Insulated circuitry, shielding, grounding, and housing of high-voltage electrical components provide adequate protection under most circumstances from electrical injury [1].

### Respiratory hazards

The laser plume, which is the smoke or vapour emitted from the site of surgery during exposure to laser energy, is a special concern. Tomita et al in 1981, demonstrated that CO<sub>2</sub> laser smoke had harmful effects on the respiratory system in animal models [1].

Airborne contaminants may be controlled by ventilation, evacuation, or other methods of respiratory protection. Laser surgery within the oral cavity or near respiratory passages requires sufficient evacuation of the plume for patient protection [1].

Above all, staff who will operate a laser or attend laser procedures must be thoroughly trained to respect this powerful tool and follow standard protocols [6].

### CONCLUSION

The Unique Versatility and Vast Potential of Dental Lasers ALLOWS many procedures that enhance overall treatment success. Thus, lasers have become an indispensable clinical tool in a dental armamentarium. Proper safety measures as to be taken by the clinicians in dental practice.

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