

Short Communication

Dental lasers: A review of safety essentials

ABSTRACT

Dental professionals are predisposed to a number of occupational hazards. These include exposure to ionizing radiation and nonionizing radiation. The current paper reviews the studies relating to occupational health problems in dental practice.

Key words: Dental lasers; dental professional; occupational hazards; safety essentials.

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 commercial sector. The responsibility for the safe application of lasers in dentistry, therefore, is one that is shared by all those concerned namely dentist, academician, manufacturers, and scientist. Each has a specific 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 the recognition of existing standards of care and a thorough understanding of safety control measures.

Classification

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

Class Description

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|------|---|
| I | Low-powered lasers that are safe to view |
| Ila | Low-powered visible lasers that are hazardous only when viewed directly for longer than 1000 s |
| II | Low-powered visible lasers that are hazardous when viewed for longer than 0.25 s |
| IIla | Medium-powered lasers or systems that are normally not hazardous if viewed for < 0.25 s without magnifying optics |

- | | |
|------|--|
| IIIb | Medium-powered lasers (0.5 W maximum) that can be hazardous if viewed directly |
| IV | High-powered lasers (>0.5 W) that produce ocular, skin, and fire hazard. |

The types of hazards that may be encountered within the 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 nontarget 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,

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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. The 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 the 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 theater. The 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 prescribing suitable protective eyewear. These include the wavelengths or wavelengths emitted by the laser, the level of attention necessary to reduce the incident beam to less than the maximum permissible exposure and the extent to which the eyewear reduces the transmission of visible light, possibility of damage of the lense material by the laser beam and the comfort with which the eyewear can be worn.^[4] The wearing of the wrong goggles is more dangerous than not wearing any at all.

Matte instruments are advisable, as are protective eyeglasses for patients and staff. CO₂ laser protection can be provided 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 2 × 2 gauze sponges are placed over the patient's eyes. For protection from neodymium-doped : yttrium aluminium (Nd:YAG) laser energy, both the doctor and staff need to wear green safety glasses and for protection; from the argon laser, orange safety glasses are required. 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 CO₂ laser.^[3]

Instruments that are highly reflective or that have 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 a distance <7 cm and thus is hazardous to the patient and operator. This problem can be controlled with the use of nonreflective instruments.^[5]

Neiburger *et al.*^[5] measure the intensity of reflected 10 W CO₂ light and its thermal effects on adjacent structures and concluded that reflected CO₂ laser light (10 W) 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 intraoral laser surgery, and this introduces hazards associated with the anesthetic gases and the endotracheal tube. The thermal effects of CO₂ 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 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. The 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 vapor emitted from the site of surgery during exposure to laser energy, is a special concern. Tomita *et al.*, in 1981, demonstrated that CO₂ 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, personnel operating the laser or attending 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 allow 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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Conflicts of interest

There are no conflicts of interest.

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