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# A Review of Laser Threat and Safety Measures in Dental Practices


***Abstract: -*** Laser technology has become increasingly prevalent in modern dental practice, offering numerous benefits such as precise tissue ablation, hemostasis, and reduced patient discomfort. However, with the integration of lasers into routine dental procedures comes the imperative of ensuring safety for both patients and dental professionals. This review critically examines the potential hazards associated with the use of lasers in dental practice and elucidates strategies and protocols aimed at mitigating these risks. Topics covered include the types of dental lasers commonly utilized, the inherent risks of laser therapy, regulatory guidelines governing laser use in dentistry, and best practices for ensuring safe and effective laser applications. By comprehensively addressing the "laser menace" and providing evidence-based safety strategies, this review aims to equip dental practitioners with the knowledge and resources necessary to harness the full potential of laser technology while safeguarding the well-being of all stakeholders involved in dental care.

***Keywords:*** Laser safety, X-ray machines, ionizing radiation, occupational hazard, Health, well being.

## I. INTRODUCTION *(HEADING 1)*

The mechanically sharpened dental instruments used in the past have seen significant advancements. Patients find the noise and vibrations from the power-driven dental instruments bothersome, even with the significant advancements. The field of laser-based dental treatments has advanced continuously during the past ten years. When lasers were first discovered, it was thought that they would be a complicated technology that would not be used much in dentistry. Modern dentistry has seen a transformation thanks to lasers' remarkable advancement in effectiveness throughout time. Standard methods can have an auxiliary in the form of lasers. (1)

In Australia, lasers have been accessible to purchase for dental purposes since the 1990s; nevertheless, the technical performance and manoeuvrability of contemporary laser devices has significantly improved. (2,3) The Food and Drug Administration (FDA) has approved the use of lasers in dentistry for a number of procedures, including frenectomies, biopsies, coagulative procedures, gingival therapies like gingivectomy and gingivoplasty, treatment of oral lesions, and curing dental composites. Gingival therapy, endodontic obturation, and tooth sensitivity control are additional growing implementations. (4)

The acronym "LASER" has a fascinating effect on society and is expected to revolutionise modern dentistry. However, the use of laser units requires proper training and manoeuvring of the laser arsenal while acknowledging the risks to the dentist, dental assistants, and patients.

The widespread application of lasers in dental has raised a great deal of public consciousness about laser safety and the potential for mishaps. It is necessary to accurately record and adhere to precautionary control processes, current requirements of care, and femtosecond methodology.(5,6)

## II. CLASSIFICATION

The lasers can be classified into four groups according to the potential damage caused by biowarfare (Table 1). Depending on the amount of energy output, a laser can be classified into one of these four categories. Class IV lasers are extremely dangerous and present a significant risk to biological contamination, according to the classification system developed by the American National Standards Institute (ANSI) and the Centre for Devices and Radiological Health (CDRH). Generally speaking, this class includes laser discharges that are more than 500 mW (7-9).

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Table 1 : Class Description

| Class | Types of Laser |
|---|---|
| Class I | When used responsibly, these lasers are typically safe, but exercise caution. |
| Class I A | This group is generally safe under all normal conditions and assigned to the group “not intended for viewing” Maximum Permissible dose for Class I.A. is 4.0 mW. |
| Class II | Low-power lasers that emit only visible light. The output power is less than 1 mW. In this, the human aversion reaction to visible light will provide protection. |
| Class III A | Intermediate visible light lasers (cw: 1-5mW). These are dangerous only for intra beam viewing. Pen point lasers belong to this class. |
| Class III B | Moderate visible light lasers which can heat the sin and hazardous for eye exposure. The output power is 5-499 mW. |
| Class IV | These are highest and the most dangerous laser group (cw: 500 mW, pulsed: 10 J/cm$^2$ or the diffuse reflection limit). These are potentially devastating causing skin burn and permanent eye damage either due to diffuse, direct or indirect viewing of beam. |

## III. TYPES OF HAZARDS

Figure 1 illustrates the various categories in which laser dangers associated with dental treatments might be placed.

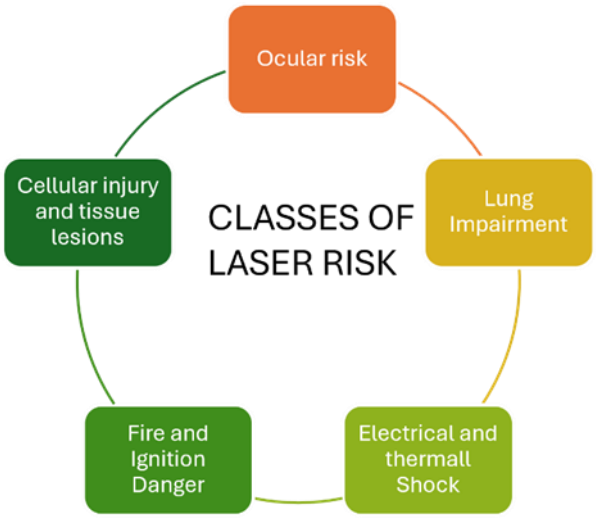


**Figure:1 Types of Laser Risks**

### A. *Eye menaces*

Either direct emission or backscattering from an object can cause ocular injury. Retinal or corneal burns are the most common kind of eye injuries. Ocular impairment may result from exposure to visible light (400–780 nm) as well as near infrared radiation (780–1400 nm). Destruction to the cornea and lens can result at moderately little either direct or reflected intensity because of the way they direct light. Permanently myopia is caused by irreversible retinal degeneration resulting from only a small portion of a second's change in incident electromagnetic power to thermal energy (5,10,11).

### B. *Damage to cells and tissues*

Because of their interaction with specific chromophores that the majority of laser wavelength have the potential to produce burns, tissues erosion, redness, and irritation in addition to other skin injuries. However, because of the ionising threat posed by these electromagnetic radiation, ultraviolet light lasers (wavelengths less than 400 nm) are not utilised in dentistry and shouldn't be employed in dental clinics. (6)

### C. *Pulmonary Hazards*

The interaction with laser wavelengths resulting in the production of plumes laser, or the fumes generated, which are harmful in terms of suspended particle matter and pathogenicity, is a unique problem from the surgical process site. Measures should be made to reduce airborne pollution, such as adequate ventilation, eviction, or other respiratory safety measures. In order to limit the propagation of infections caused by viruses using plume lasers, the surgical area must always have sufficient suction. For the particle evacuation system to effectively remove different particles as small as 0.3 μm, it must have an 80% efficacy rate. It is required that the surgeon and other related personnel wear masks. In order to protect oneself from splashes and laser light in the operating room, one should use customised protective gear, such as surgical masks, safety eyewear, face guards, head caps, and gowns (5,11).

### D. *Thermal and electric shock concerns*

These dangers are associated with the possibility of heat creation from thermal energy, primary reservoirs (compressed gas and water), and mobile motor generating machinery of a laser. It is important to recognise and avoid the risk of firing using flame tubes, different gases, or chemical agents (such as alcohol-based disinfectants) (5,6).

## IV. Laser therapy Safety Measures and Solutions

There are two categories for the safety protocol: *Generalized* & *Specialised precautions.*

### A. *Generalized precautions*

*a) Atmosphere of the clinical setting*

In a clinical context, a single handpiece system that consists of a lens system and a basic optic fibre is used to control laser output. A particular length will see a distinct amount of laser light divergence; beyond that point, the risk posed by the beam is reduced to a degree of safety. The area up to a few metres in size is known as the nominal hazard zone or distance (NHZ). According to this view, there is a protected area where all employees are safe. Labels identifying the hazardous locations and warning signs should be used to draw attention to the guarded zone. During laser treatments, this area's surfaces must have antiglare doors and windows with remote-controlled locks. (10,11).

When a laser beam strikes non-reflective equipment covered in a titanium oxide and aluminium oxide mixture, minimal destruction of tissue results. Operating a particular laser requires expertise, and staff members must be knowledgeable of related tissue outcomes. If appropriate safety precautions are implemented, often occurring laser accidents and damages can be avoided. (5,11)

*b) Safety representatives*

The purpose of the health officials' employment is to ensure that all laser safety procedures are implemented and adhered to (Table 2). The laser equipment should ideally be operated by a qualified and experienced helper.

| Table 2 :Responsibilities of the laser safety officer (LSO) include the following: [11,12] |
|---|
| • Approve class of the laser. |
| • Follow manufacturer guidelines regarding instillation, and working of the laser unit. |
| • Supervise the guarded zone and restrict access. |
| • Suitable warning signage must be followed post operatively. |
| • Insist use of personal protective equipment (ANSI approved eye wear and protective clothing) |
| • Undertake universal command for laser use and intersperse the treatment if any safety measures are not followed. |
| • Laser apparatus ought to be accurately congregated for operation. |
| • Retain a record of all laser operating treatments performed (regard to every patient, treatment and laser operational specifications). |
| • Record the mishaps during laser use in adverse effects reporting system. |
| • Supervise maintenance guidelines for laser equipment. |
| • Guide all the assistants regarding the safety usage of lasers. |

*c) Clinical Training*

All staff members must receive training before employing lasers in clinical settings to ensure safety.

*B.* ***Specialized safety measures include*** *(5,11,13)*

*a) Protocol with Laser safety*

Every laser unit must have embedded safety features that control the constant laser discharge: (Table 3)

**Table 3: Laser safety features**

| |
|---|
| • Shutters to avert discharge for proper delivery of the beam. |
| • Foot controlled switches to prevent fortuitous emission. |
| • Controlled framework to set the seal for accurate emanation of radiation. |
| • Radiation hazard signage to be accommodated (Audio and Visual). |
| • 'Emergency Safety Stop' button to be incorporated. |
| • Unwarranted permission to internal machinery should be avoided. |
| • The entire LASER unit should be password protected. |
| • Mechanized ignition-interlock. |

*b) Sheilding the eyes*

In order to provide an adequate amount of protection from accidental beam exposure, one should wear suitable protective glasses for lasers and avoid looking directly into the beam. There are many different kinds of safety glasses on the market.
It is imperative that laser safety eyewear is clearly marked with the the wavelength, being exposed, and optical density emitted. The eyeglasses should be checked for cracks and other damage on a regular basis.
The spectacles have an optical density (OD) marking. The term "optical density" (OD) refers to the protective filter's ability to reduce laser transmission at a given frequency to a safer level that is below the maximum permitted exposure (MPE) limit for human eyes. The OD value needs to be at least 5 in order to provide adequate safeguards (10,12).

*c) Access*

Dental procedures are carried out in operating rooms with substantial built-in doors and barriers. In the operating room, it is advisable to urge only a few people to avoid laser treatment.

*d) Test-firing*

The individual in charge needs to test the laser unit's firing before beginning any laser operations. This certifies that the lasers unit was properly correctly organised, guaranteeing accurate beam emission throughout the delivery tube. Every safety procedure needs to be strictly implemented and adhered to. The light source should be directed at the most energy-efficient fixture and function at an appropriate filter (water for longer frequencies, and deep coloured wrapping for shorter frequencies). After that, the electromagnetic radiation unit is turned off completely and placed in rest mode.

## V. Typical Laser-Assisted Infection Control Measures

The standard method of infection control for laser technology is steam sterilisation. Before being used again, different parts such as tips, handpieces, and fiberoptic tubes should be steam sterilised in pouches and kept there. A suitable disinfectant should be used to clean the entire LASER apparatus. (5,11).

## VI. Conclusion

The scientific research and recommendations on lasers safety that dentists should follow before using any lasers are included in this page. In addition to their benefits, lasers have several drawbacks that, if safety precautions are not taken, could pose a risk to both the patient and the operator. This article also discusses the crucial safety precautions that have been implemented when using lasers in dentistry. The dental staff is protected and a safe clinical environment is created by these high-level care

procedures. Compared to traditional approaches, dental practitioners that use laser therapy in their practice can offer and give the newest advances in dentistry.

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