




## Use of diode lasers in dentistry

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### Abstract

Use of diode lasers in dentistry has grown in popularity over the years. When used by a properly trained and licensed dental professional and proper protocols are observed, efficacy of diode laser use for many procedures is possible. It is important that specific protocols be followed when using the diode laser to ensure safety of both patients and providers.

**Keywords** Diode laser in dentistry · Indications for lasers in dentistry · Safety of lasers in dentistry

### Quick reference/description

The diode laser is a semiconductor that uses solid-state elements, such as gallium, arsenide, aluminum, and indium, to change electrical energy into light energy. The light energy from the diode is greatly absorbed by the soft tissue and poorly absorbed by the teeth and bones. Diode lasers are useful for oral soft tissue surgical procedures because their specific wavelength (810–980 nm) is absorbed not only by water (although less so than the carbon dioxide laser wavelength), but also by other chromophores, such as melanin, and in particular, oxyhemoglobin. Moreover, the exclusive use of the diode laser at an extremely close distance avoids damage, due to ‘beam escape,’ in an open field, which makes it much safer than other laser sources. Clinical experience suggests some advantages of the laser over scalpel surgical procedures on oral tissues. These advantages include greater precision, a relatively bloodless surgical and postsurgical course, sterilization of the surgical area,

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minimal swelling and scarring, coagulation, vaporization, minimal or no suturing, and postsurgical pain.

## Indications for diode laser

- Excisional and incisional biopsies
- Exposure of unerupted teeth
- Frenectomy
- Frenotomy
- Gingival troughing for crown impression
- Gingivectomy
- Gingivoplasty
- Gingival incision and excision
- Hemostasis and coagulation
- Implant recovery
- Abscess incision and drainage
- Laser removal of diseased, infected, inflamed, and necrosed soft tissue within the periodontal pocket
- Laser soft tissue curettage
- Leukoplakia
- Operculectomy
- Oral papillectomies
- Pulpotomy
- Pulpotomy as an adjunct to root canal therapy
- Reduction of gingival hypertrophy
- Soft tissue crown lengthening
- Sulcular debridement (removal of diseased, infected, inflamed, and necrosed soft tissue in the periodontal pocket to improve clinical indices including gingival index, gingival bleeding index, probe depth, attachment loss, and tooth mobility)
- Treatment of canker sores, herpetic, and aphthous ulcers of the oral mucosa
- Vestibuloplasty.

## Materials and instruments

There are many brands of diode lasers available for dental use. Pictured here is the Ultradent Gemini™ 810 + 980 soft tissue laser (Fig. 1). It is a dual-wavelength soft tissue diode laser with 20 W of peak super-pulsed power. The transparent electroluminescent display comes with 19 preset procedures to enhance ease of use. The tip of the handpiece illuminates, providing better visibility at the surgical site. Gemini also comes with a wireless foot pedal. The handpiece is autoclavable, allowing for simple sterilization between procedures.

**Fig. 1** Ultradent Gemini™  
810+980 soft tissue laser



### You will need

- Diode laser
- High-speed suction
- Safety glasses for diode lasers. You must know the wavelength of your diode laser and purchase the appropriate safety glasses to protect you for that specific wavelength.

### Procedure

Diode Laser uses an optic fiber to aim the laser beam on soft tissues. Optic fibers are available in different diameters. The recommended technique is “paint brush”-type strokes keeping the tip about 1–2 mm away from the tissues. Occasional cleaning of the tip during the procedure is recommended to avoid debris from accumulating at the end of the tip, which affects the intensity of the transmitted beam. Most diode lasers provide the option of regulating various aspects of the beam like power setting and frequency. It is also programmed with preset settings for the given procedures to decrease the chances of tissue damage and increase precision. The following are examples of the uses of laser with their specific settings:

- For detection of caries and subgingival calculus laser can be used at a 655 nm wavelength.
- Soft tissue surgery: lasers used in surgery have shown improved healing, precision and ease during the procedure and patient comfort. A comparative study by Kaur et al. evaluated wound healing using both laser and conventional uncovering of implants in second-stage surgery. Their findings demonstrated that laser surgery was more effective, giving the patient better overall healing allowing the dentist a clean site for same day impression.
- Disinfection of periodontal pockets and root canals: 810–980 nm. Diode laser’s optic fiber is inserted in the canals, 3 mm short of the apex and from that point, it

is withdrawn gradually (about 1 min per canal). Bacteria like *Prevotella Intermedia* and *Porphyromonas Gingivalis* would absorb the laser, which causes coagulation due to increased temperature.

- Shantala et al. describe: “Diodes laser can be an effective tool for cleaning and disinfecting the root canal system when used alone or in combination as canal irrigants at 2.5 power setting and 5 s exposure time with cycle repeated 4 times”
- Photothermal bleaching 810–980 nm. Laser activates hydrogen peroxide within the bleaching agent.
- Pulpotomy: At 810-nm wavelength, diode laser has the ability to remove part of the pulp achieving immediate hemostasis and disinfection. Studies by Kaur et al, proposed that 1–3-s exposure time at 2 W power setting could be recommended to achieve hemostasis in a pulpotomy.
- Low-level laser therapy (LLLT): also known as “biostimulation” or Soft laser therapy”. Diode laser has a positive effect in fibroblast production, collagen synthesis and neurotransmitters.
- Use of a hotdog or an apple can simulate soft tissue when practicing the use of a laser.

## Pitfalls and complications

There are limited international guidelines for use of diode lasers in dentistry. In the United States, the American National Standards Institute (ANSI) establishes the process required for the safe use of laser through the Laser Institute of America (LIA). LIA is in charge of providing guidelines and recommendation for the correct use of lasers specifically in dental offices. ANSI updates the documents on workplace safety entitled ANSI Z136.1-2014 Safe Use of Lasers and ANSI Z136.3-2011 Safe Use of Lasers in Health Care. ANSI also classifies lasers according to its hazards to provide with appropriate controls for each type: Class I, IM, 2, 2M, 3R, 3B, and 4. Laser manufacturers are required to label the type of laser and classification. In general, diode lasers used in dentistry are Type 4, the least hazardous type. Dental offices with class 3B or class 4 laser are required to have a laser safety officer (LSO) who is trained with the knowledge of the ANSI standards and will ensure the safe use of laser in the dental office.

Laser hazards can include fumes and vapors, collateral radiation, flammability of laser beam enclosures, eye injury that can lead to blindness, thermal injury, skin hyperpigmentation, and erythema.

The Nominal Hazard Zone (NHZ) is defined as the area within which the level of direct, reflected or scattered radiation (working wavelength of the laser), during normal operation, poses a hazard to the skin and eyes. During use of the laser, the NHZ should be defined as a closed operatory. Patient and personnel within the NHZ must follow the ANSI standards (Fig. 2). The guidelines include:

- 1) Use of laser unit is limited to individuals who have had certified training in the use of a diode laser for dental procedures.



**Fig. 2** Safe use of diode laser should include protective eyewear for the patient and dental providers. A high-speed suction should be utilized to remove fumes from the area. It is preferable to use a laser in a closed room



**Fig. 3** Warning signs when diode laser is in use should be posted at the entrance to the dental operator

- 2) An enclosed operator is best for patients scheduled for procedures involving use of the laser unit. Access should be limited to avoid individuals without proper protective eyewear from entering.
- 3) Consent for use of the laser will be explained to the patient and added to the surgical consent form for signature.
- 4) Prior to the diode laser being used, signs should be placed in the operator doors to warn others not to enter without proper eyewear (Fig. 3).
- 5) All individuals (dentist, assistant, observers and the patient) in the operator must have protective “Laser safety glasses” when the laser is in use.

- 6) The laser unit will be turned on immediately prior to its use once all individuals in the room have their safety glasses on.
- 7) Combustible material, like alcohol, anesthetic gases and oxygen should never come in contact with the working beam of the laser.
- 8) When utilizing general anesthesia and the laser, precaution should be taken to use non-combustible gases.
- 9) Nitrous oxide can be used as long as the scavenger system is in place.
- 10) Proper management of laser fumes. The use of masks is mandatory as the fumes have the ability to carry microorganisms. High-volume evacuation system is required during laser use.
- 11) Use of surgical drapes and gowns made of flame retardant material is recommended.
- 12) Disposable tips are to be disposed of in a sharps container.
- 13) After a procedure is completed, the laser unit should be turned off immediately decreasing the risk of exposure.

A few recommendations to avoid complications related to use of a diode laser in a dental office are:

- 1) Laser Safety Officer (LSO) should be designated in large dental practices. The responsibilities for the LSO will be:
  - Ensures that all appropriate protocols have been established and are being followed
  - Ensures that staff has been appropriately trained on laser use and safety.
  - Responsible for management and reporting of accidents or occurrences of any laser-induced injury.
  - LSO is typically an auxiliary staff member
  - In the United States, some states require the LSO obtain formal training in laser use and safety. Additionally, the LSO should be registered with the state.
- 2) Disinfecting Laser after Patient treatment:
  - After each use, the disposable tip will be disposed of in the sharps container
  - After each use, the diode laser unit should be wiped down with a surface disinfectant.
  - Handpieces and bending tools should be autoclaved after each use
  - If any supplies or malfunctions are noted, the user should notify the Laser Safety Officer immediately.

## Further reading

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