Laser Use For Dental Esthetics

Selecting the right laser for different clinical situations

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Traditionally, cosmetic therapies in the oral cavity were performed with mechanical or rotary instruments. Lasers were used by restorative dentists for tissue contouring and troughing prior to impression making and by specialists for gross oral soft tissue removal and biopsies. That is now changing, however. With the current emphasis on cosmetic concerns and esthetics in dentistry, lasers are increasingly being used to accomplish esthetic treatment goals, and they are generally beginning to realize their true potential in all phases of dentistry.[1-7]

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Types and Indications

Incorporation of lasers in dental practice requires an understanding of the differences among laser types. Dental lasers can generally be divided into two categories—soft-tissue or hard-tissue/all-tissue laser—and, in a different scheme, pigment-based or water-based lasers. Different lasers are preferentially absorbed in different substances (Table 1).

One of the main characteristics used to differentiate lasers is wavelength. Laser wavelength plays an important role in laser–tissue interaction and dictates the procedures that can be performed with a particular laser. Diode and neodymium-doped yttrium-aluminum-garnet (Nd:YAG) lasers are located at the near infrared part of the electromagnetic spectrum, whereas the erbium (Er) and CO_2 types are at the mid-infrared and far infrared, respectively.

Wavelength also determines which tissue will interact best with a specific laser, explaining why one laser is chosen over another for specific procedures. Diode and Nd:YAG lasers have a high affinity for tissue components that have melanin and hemoglobin. Because they basically interact with soft tissues, they are known as soft-tissue lasers. They are widely used for frenectomies, soft-tissue recontouring, and periodontal disease treatment without loss of volume of tissue.

Er-based lasers have high absorption in anything that has water and hydroxyapatite. As water is present in all soft and hard tissues, these specific types of lasers will have an effect on both soft and hard tissues, which is why they are considered to be "all-tissue" lasers. Their characteristics enable them to be used for both soft- and hard-tissue crown elongation apart from gingival contouring and other soft tissue–related procedures.[8-10]

Like the Er lasers, CO_2 lasers have a high affinity for both water and hydroxyapatite. However, they are considered more to be


FIG. 1


FIG. 2


FIG. 3

(1.) Case 1 pretreatment view prior to tissue removal with CO_2 laser. **(2.)** Note that an instrument is placed between the soft tissue and the teeth due to the aggressive interaction of CO_2 with hydroxyapatite **(3.)** Case 1 at 3 weeks post-treatment.

soft-tissue lasers and are used for tooth uncovering, frenectomies, and gingival recontouring. Even though they have also been used successfully for remineralization of white spot lesions;[11] care must be taken due to their rather aggressive interaction with hydroxyapatite.

Clinical Advantages

Advantages of laser use in dentistry include generally reduced anesthesia requirement (often only high-strength topical anesthetics); good visibility in the surgical site due to little or no bleeding; bactericidal effects; reduced post-treatment morbidity (less pain and swelling); no need for sutures; less scarring; and bio-stimulatory effects.

Most soft-tissue cosmetic procedures can be safely performed with all of the currently available laser types. Hard-tissue (eg, bony) crown elongation can only be safely performed with an Er type laser. Selection of the laser type to use depends in part on the nature of the tissues being treated.

It is not the purpose of this discussion to provide a comprehensive course on lasers, but rather to highlight/demonstrate laser use to correct certain esthetic problems. When considering the treatment of any oral problem, a thorough understanding of anatomy, histology, and function is required. Training and understanding of laser physics and laser tissue interaction is also essential. Basic information can be found in several sources.[12,13] General uses of dental lasers to improve esthetics are highlighted below.

(4.) Case 2 pretreatment. **(5.)** Case 2 immediately post-treatment. **(6.)** Case 2 healing at 3 years showing maintenance of favorable contours. **(7.)** Case 3 pretreatment. **(8.)** Case 3 establishing/measuring the desired clinical crown length. **(9.)** Case 3 soft-tissue collar removal with appropriate laser setting and tip. **(10.)** Case 3's bone soundings completed. The desired depth of bone removal has been marked on the laser tip. Different laser settings are used for bone removal/recontouring. **(11.)** Case 3's 6-month post-treatment view. Patient now desires treatment for other teeth.

TABLE 1

Commonly Used Lasers in Dentistry

LASER	WAVELENGTH	CHROMOPHORES	TYPE	ESTHETIC PROCEDURE
Diode	810-980 nm	Melanin, Hb	Soft tissue	Frenectomy, soft tissue recontouring
Nd:YAG	1,064 nm	Melanin, Hb	Soft tissue	Frenectomy, periodontal disease treatment
Er,Cr:YSGG	2,780 nm	Water, HA	All tissue	Frenectomy, gingivectomy, soft- and hard-tissue CE, tooth uncovering
Er:YAG	2,940 nm	Water, HA	All tissue	Frenectomy, gingivectomy, soft and hard tissue CE, tooth uncovering
CO2	10,600 nm	Water, HA	Soft tissue	Frenectomy, gingivectomy, tooth uncovering

CE = crown elongation; Er,Cr:YSGG = erbium, chromium, yttrium-scandium-gallium-garnet; Er:YAG = erbium-doped yttrium-aluminum-garnet; HA = hydroxyapatite; Hb = hemoglobin; Nd:YAG = neodymium-doped yttrium-aluminum-garnet.

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FIG. 12


FIG. 13


FIG. 14

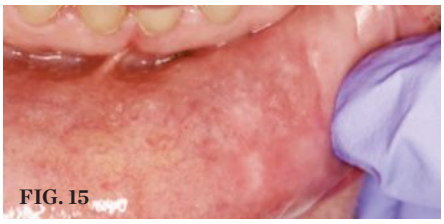
FIG. 15

(12.) Case 4 pretreatment. **(13.)** Case 4 at 6 months post-treatment. **(14.)** Case 5 pretreatment. Nd:YAG laser used in non-contact to coagulate the stagnant blood. **(15.)** Case 5 at 4 weeks post-treatment.

Specific settings for the different lasers, which depend upon the procedure, are provided by the manufacturer and are also easily found on the laser console/screen, so few details are provided here. However, laser operators must be thoroughly familiar with the action and indication of each laser to effectively and safely use the device and minimize untoward sequelae.

Clinical Examples

Some of the many cosmetic applications of various dental lasers are presented here.

Case 1. A 47-year-old man taking calcium channel blocker medication presented with a lower anterior papillary overgrowth. After local anesthetic infiltration was performed, he was treated with a CO_2 laser in continuous wave delivery mode at 3.0 W/30 Hz. The CO_2 laser treatment was performed in a shaving motion due to its limited penetration. Hemostasis was excellent and healing was uneventful (Figure 1 through Figure 3).

Case 2. An esthetically fastidious female patient received tissue-contouring treatment with a diode laser. After a strong topical anesthetic was applied for 3 minutes, an 810-nm diode laser was used with initiated tip at 1.5 W/30 Hz in continuous wave mode to reshape tissue. Her healing was uneventful, and she was pleased with the results (Figure 4 through Figure 6).

Case 3. In this case, esthetic crown lengthening was performed on upper anterior teeth No. 8 and No. 9 prior to veneer placement. Because both soft- and hard-tissue modification were needed, an Er,Cr:YSGG (erbium, chromium, yttrium-scandium-gallium-garnet) laser was used under local anesthesia in H mode, at 1.75 W/30 Hz with a MT-4 tip for soft tissue removal; then at 2.0 W/20 Hz, with MZ-6 tip for bone removal. For both applications, 11% air and 11% water was used. Once the soft tissue contour was established, the biologic width was measured by sounding, the amount of bone height reduction needed was calculated, and the tip was marked as a depth guide. Bleeding was minimal and finger pressure was used to adapt the soft tissue. No sutures were needed. Because full-flap reflection was not performed, postoperative discomfort was minimal (Figure 7 through Figure 11).

Case 4. In this case, gingiva mesial tooth No. 9 was depigmented with an Nd:YAG laser using local anesthesia without a vasoconstrictor. A free-running pulsed Nd:YAG laser was used in ablation mode (100 µsec/20 Hz/3.6 W) in contact to remove epithelium and pigmented connective tissue. There was no

TABLE 2

Examples of Currently Available Dental Lasers

CO2 LASERS

Spectra DENTA
Lutronic
www.lutronic.com

SupraPulseCO2
Technology 4 Medicine
www.t4med.com

UltraSpeed™ CO2 Smart US20 D
DEKA Laser Technologies Inc.
www.dekalasers.com

DIODE LASERS

Picasso®
AMD Lasers
www.amdlasers.com

Odyssey®
Ivoclar Vivadent
www.ivoclarvivadent.com

iLase™
Biolase Technologies, Inc.
www.biolase.com

SIROLaser
Sirona Dental
www.sirona.com

ERBIUM LASERS

Er:YAG
LightWalker ST-E
Technology 4 Medicine
www.t4med.com

Er, Cr:YSGG
Waterlase MD and iPlus™
Biolase Technologies, Inc.
www.biolase.com

Er:YAG and Nd:YAG
LightWalker AT and DT
Technology 4 Medicine
www.t4med.com

ND:YAG LASER

PerioLase® MVP-7™
Millennium Dental Technologies, Inc.
www.lanap.com

bleeding and the postoperative course was uneventful (Figure 12 and Figure 13).[14,15]

Case 5. A 45-year-old woman presented with a hemangioma (venous lake) of several years duration on her lower lip. Using only a strong topical anesthetic, the lesion was treated with a free-running pulsed Nd:YAG laser at a longer pulse duration (550 µsec) and 3.6 W/20 Hz. This was performed without contact to congeal/coagulate the stagnant blood, which turns grey/white, after which the body removes the debris (Figure 14 and Figure 15).

Conclusion

This article has explained and shown some of the many uses of lasers to accomplish and/or enhance esthetic outcomes in dentistry. When properly used, lasers of different types can be used effectively and safely for many dental procedures. Clinicians must realize that different lasers have different capabilities, and one size certainly does not fit all. Overall, dental lasers can be used not only to improve esthetics, but to positively impact dental health as well.

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