The diode laser as an electrosurgery replacement

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_Introduction

In 2008, Dr. Gordon Christensen wrote an article in JADA comparing the soft tissue cutting abilities of diode lasers to those of electrosurgery (radiosurgery) units.[1] In comparing these two technologies against each other, he found that both dental lasers and the less expensive electrosurgery units have advantages and disadvantages, and he summarized with several key points:

1. Although, there was considerable overlap in their uses and both technologies were effective, Christensen found that diode lasers were able to be used around metal (amalgam and gold) as well as with dental implants.
2. He stated that lasers did not harm dental hard tissues (bone) or soft tissues (pulp), and that the clinician could use the laser with less anesthetic, and finally he mentioned that lasers were antimicrobial (antibacterial).
3. The acceptance and use of lasers, especially the diode laser, was increasing in dentistry, and that lasers attract patients because of their recognized and accepted role within the field of medicine (LASIK eye surgery).
4. Electrosurgery units were "far less expensive than the least expensive diode lasers" and he questioned whether "the advantages of the diode laser were significant enough to compensate for the additional cost."

There are two basic types of electrosurgical units that can be purchased in dentistry:

- Monopolar, in which a single electrode exists and the current travels from the unit down a single wire to the surgical site. The patient must be grounded with a pad placed behind the patient's back (a part of the procedure that many patients may question). Heat is produced when the electrode contacts the tissue, and due to pain that is produced, anesthetic must be used.
- Bipolar, in which two electrodes are placed in very close proximity to each other. Bipolar units are more expensive than diode lasers and the electrical current flows from one electrode to the other, thus eliminating the need for a grounding pad. Bipolar units, because of the two wires, create less of a precise cut than the monopolar or diode laser.

Although electrosurgical units are inexpensive, require no safety glasses and can remove large amounts of tissue quickly, diode lasers have become much more common in dental operatories in the four years since Christensen's article was published. The primary reasons for their increased popularity are that diode lasers have a small footprint, are reliable and durable lasers, and are portable. Where a few short years ago, diode lasers could cost in the range of $10,000 to $15,000, they are now cost effective and can be purchased for less than $2,500.

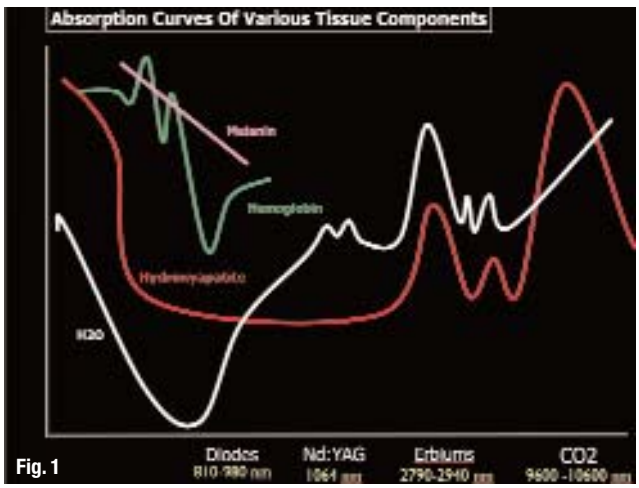

Fig. 1

Fig. 1_Absorption curve of various tissue components shows diode lasers to be well absorbed in melanin (pigment), hemoglobin and to some degree water. (Images/Provided by Glenn A. van As, BSc, DMD)


Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6

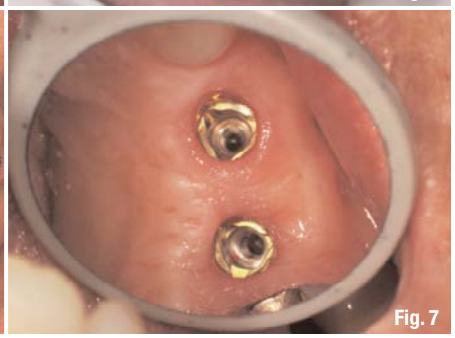
Fig. 7

_Advantages of diode lasers over electrosurgery

Ability to work around metals intraorally

Diode lasers in the range of 810–1,064 nm are well absorbed in hemoglobin, melanin (pigment) and to some degree water (Fig. 1). These mid infrared dental wavelengths in the absorption spectrum offer the dental clinician the ability to ablate soft tissues precisely while controlling hemostasis, providing the clinician with an excellent view of the surgical site with a reduced reliance on sutures. Diode lasers have features that make them attractive as mentioned earlier, but they also have several advantages in function over electrosurgical units[2] (Table 1). Perhaps the greatest benefit of these lasers is that they allow the clinician to work safely around metals. The literature has shown that monopolar electrosurge units can accidentally create catastrophic results when touching metal intraorally. Published reports have shown that contact for very short periods of time with the electrode of a monopolar electrosurgical unit can cause both pulpal and periodontal problems,[3] bone loss,[4] severe intraoral burns,[5] arcing, and that within three seconds of exposure to a dental implant electrosurgical units can cause failure of osseointegration and loss of an implant.[6, 7] In clinical practice, with today's emphasis on the more esthetically pleasing composite resins and newer porcelains, there are still many metallic materials used intraorally, including cast partial denture frameworks, gold, amalgam, orthodontic brackets and semi-precious alloys. Diode lasers, unlike their electrosurgical counterparts, show little interaction with metallic objects used intraorally. It is important to remember that due to the laser's ability to reflect off mirrored surfaces and potentially cause eye damage, that all members of the dental team as well as the patient must wear laser safety glasses for eye protection if they are within the nominal ocular hazard zone (NOHZ) during laser operation. This zone is most often between 3 and 7 feet, but some diodes can have extended NOHZ ranges of 40 feet. Orthodontic patients will often exhibit gingival hyperplasia when in brackets that can make it difficult to work on them. This overgrowth of tissue can be due to poor oral hygiene, space-closing mechanics, excess cement or a combination of factors. The diode laser can be used for gingivectomies to safely remove and recontour the excess tissue and healing can be remarkable in a very short period of time (Figs. 2–4).

Fig. 2_Gingival hyperplasia around orthodontic appliances.
Fig. 3_Immediate post-op after diode laser gingivectomy completed.
Fig. 4_Eight-day healing of soft tissue around brackets.
Fig. 5_Diode laser for second-stage implant uncovery in edentulous maxilla.
Fig. 6_Four healing cuffs in place in maxilla immediately after uncovery with the diode laser.
Fig. 7_Replace select implant fixtures for upper right premolars.

Table 1_Comparison of diode laser versus monopolar electrosurgery units.

Diode Laser vs Electrosurgery

Feature	Electrosurgery	Diode Lasers
Work around Metals	No - causes sparks, pulp death etc.	Yes and safe.
Pacemakers	No cannot be used	Yes can be used
Anesthetic	Local Anesthetic needed	Sometimes topical only
Antibacterial	No antibacterial qualities	Yes kills bacteria.
Lateral Thermal damage	Can cause recession when used.	Less Likely to cause recession.
Uses	Good for large tissue removal	Multiple uses as seen today

Table I

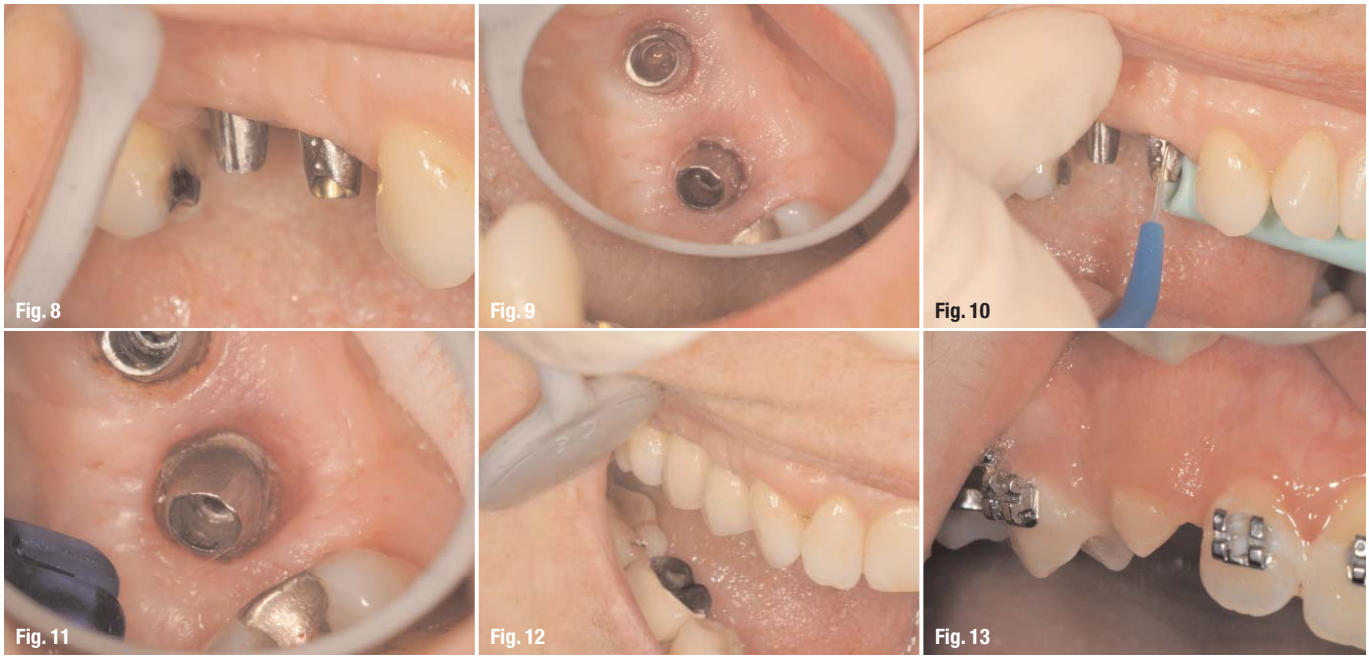

Fig. 8_Abutments in place for both teeth.
Fig. 9_Soft tissue on margins preventing full seating of crowns.
Fig. 10_Picasso Lite diode laser removing tissue on abutment margins.
Fig. 11_Note tissue off the margins of abutments after diode use.
Fig. 12_Final crowns cemented onto abutments without soft tissue impingement.
Fig. 13_Partially exposed canine requires orthodontic bracket.

Ability to work around dental implants safely

Various laser wavelengths that are available today can offer the clinician who needs to expose an implant during second stage surgery an alternative to traditional methodologies. The ability of the diode laser to ablate tissue, at times without the need for local anesthetic, while controlling hemostasis, provides the clinician a great view of the surgical site. In addition, the diode wavelength, like all laser wavelengths, provides for decontamination of the implant site through its antibacterial actions. Bacterial reduction with the diode laser can lead to an almost sterile operative field (98 per cent reduction of pathogenic bacteria). Finally, there is a growing body of evidence that suggests that lasers used at lower energy settings can have a biostimulatory effect on tissue which in turn can reduce postoperative discomfort, improve healing and shorten healing times while even improving early osseointegration.[8–12] As an aside, there have been clinicians who routinely use monopolar electrosurgery units to expose implants. It is imperative to realize that although more expensive bipolar (two electrodes) electrosurgery units can be used safely around implants, that the more commonly purchased single electrode (monopolar) units may damage the implant surface and can cause complete loss of osseointegration with resulting implant failure with contact times as short as three seconds.[13,14] Lasers, in contrast, can be used safely with tremendous coagulation and a reduction in pain postoperatively for the patient[15] (Figs. 5 & 6) Diode lasers are also useful when it comes time to seat the final abutment and restoration. Tissue management around dental implant restorations can be difficult, be it for the initial cementation or, even worse, if an implant-restored crown comes loose. Tissue quickly slumps onto the abutment, and subgingival margins can be almost impossible to retrieve with traditional methodologies. The laser can truly be a "life-saver" for these situations where soft tissue must be safely and quickly removed to allow for ideal cementation of the implant retained crowns onto the abutments (Figs. 7–12).

Reduced need for anesthetic

Monopolar electrosurgery units do not have the ability to be used routinely without local anesthetic. In contrast, diode lasers can often be used either with low wattages or in pulsed modes to remove minor to moderate amounts of soft tissue with only topical anesthetics. Although at times this may not seem significant to the clinician, there are many instances where soft tissue acts as a barrier to ideal restorative treatment, and if local anesthetic can be eliminated it becomes a big selling point to patients. Many patients are looking for alternatives to local anesthetic, and when the occasion allows for the procedure to be completed without the patient being numb, the overwhelming majority of patients are grateful for this. Situations such as laser gingival crown troughing for tissue management around endodontically treated teeth, exposure of partially erupted canines for orthodontic brackets and gingivectomies around moderately sized Class V lesions in geriatric patients are all situations where the author has been able to routinely and consistently complete soft tissue ablation with only a stronger topical anesthetic. In fact, the literature has shown that a variety of soft tissue procedures (even frenectomies) can be completed on with only topical anesthetic[16–18] (Figs. 13–16).


Fig. 14


Fig. 15


Fig. 16


Fig. 17


Fig. 18


Fig. 19

Ability to do gingivectomies and crown troughing with less recession

White et al have mentioned that laser gingivectomies are the most common soft tissue procedure done with diode lasers[19], and when combined with esthetic porcelain restorations the simple recontouring of tissue can take a good case and make it great.[20–24] A key difference from electrosurgery ablation of soft tissue is that alterations to the symmetry of the soft tissue contours in the maxillary anterior teeth can be safely and precisely completed on the same day as the preparation and impressions of these teeth. The risk of recession and exposure of margins can be far less with a diode laser than with other techniques, particularly when adequate magnification (e.g., 4.0X loupes) and cautious settings (0.6–0.9 W continuous wave) are used for the recontouring. When biologic width is respected, and adequate attached and keratinized tissue exists, then judicious recontouring of the gingiva on the same day as the preparations can yield stunning results (Figs. 17–19). The diode laser has become a popular technology as an alternative for tissue management compared to the traditional methodology of placing a single or double retraction cord in the sulcus. The diode laser can be used in almost all instances to produce gingival retraction as an alternative to cord with excellent results both in terms of gingival retraction and margin delineation for the laboratory. Unlike electrosurgical units where recession can be an issue, as can postoperative pain, diode lasers offer the clinician the ability to precisely remove overhanging, inflamed tissue while creating a gingival trough that is not likely to cause damage to bone, cementum or pulp tissue like electrosurgical units can. In addition, there is research that suggests that the lateral thermal damage done with lasers is significantly lower than that with electrosurgery.[25]

Ability to photocoagulate vascular lesions and treat oral lesions

One of the advantages of a diode laser is the ability to treat oral lesions, including: recurrent aphthous ulcers (RAU), venous lake lesions of the lips, and herpetic lesions. Research has shown that lasers can be safely used to treat these lesions[26–28], and in addition it is possible that if caught early during the prodromal stage that herpetic lesions can be aborted or significantly reduced in terms of length of time they are present.[29] In addition, it has been the author's experience that, once treated with the laser, the lesions are often less likely to reappear in the same area. In fact some evidence suggests that herpetic lesions treated in the early stages with the diode laser can cut the healing time in half and create a remission period that is twice as long before it reoccurs.[30,31] Vascular lesions called venous lakes or hemangiomas can occur on soft tissue areas including the upper and lower lips, buccal mucosa and palate. These lesions can be difficult to treat with traditional methods where significant bleeding may occur. The diode wavelengths are rapidly absorbed by hemoglobin and therefore can be used to coagulate and eradicate these esthetically undesirable purplish lesions often with only topical anesthetic. Literature has shown that the diode can be used in almost 100 per cent of cases to eliminate these lesions, most often in only a single session lasting only a couple of minutes[32–35] (Figs. 20–22).

Anti-bacterial capabilities of lasers

Many articles in the literature have demonstrated the tremendous ability of all lasers with re-

Fig. 14_Topical gel placed on soft tissue prior to gingivectomy to uncover soft tissue.
Fig. 15_Pulsed mode at 1.4 W shows removal of attached tissue to expose canine.
Fig. 16_Brackets in place on both canines — immediate post-op view.
Fig. 17_Pre-op prior to maxillary incisor veneers.
Fig. 18_After recontouring of lateral incisors and laser crown troughing for tissue management prior to impressions.
Fig. 19_Immediate postoperative result for four e.max veneers.


Fig. 20


Fig. 21


Fig. 22


Fig. 23


Fig. 24


Fig. 25

Fig. 20_Pre-op view of venous lake on lower lip.
Fig. 21_Immediate post-op appearance.
Fig. 22_Two-week healing of lesion on lip is complete.
Fig. 23_Diode direct pulp cap to lower bacteria count on MO cavity preparation.
Fig. 24_Diode laser in gingival sulcus lowering bacteria count (image of diode pulse captured with video camera on operating microscope — typically the image is not visible to the human eye).
Fig. 25_Diode laser used to reduce bacterial counts inside a DB canal of upper right second molar after completion of instrumentation and prior to obturation of the canals.

spect to the reduction of bacterial and even fungal infections.[36–43] The excellent antibacterial capabilities make lasers effective and desirable in many areas in the oral cavity where the risk of postoperative infection may be reduced. Electrosurgical units do not typically possess the same ability to provide bacterial reduction as lasers do. Particular interest is now occurring with the role of lasers in endodontic, periodontic and peri-implantitis cases where the need to reduce bacterial loads without such a great deal of reliance on antibiotics might be exciting. Although more research is needed on how the bactericidal capabilities of the diode laser might be beneficial in these areas, there is no debating that all lasers can help healing through decreasing the risk of infection through laser light alone (Figs. 23–25). In addition, growing research has demonstrated that the risk of high bacterial loads in periodontal pockets and in particular in endodontic situations may be reduced by lasers. These newer articles have implications for improving traditional methodologies locally where used, and in helping to reduce the potential greater systemic health risks generally. The role of lasers continues to be researched today, but present research has shown that diode lasers can be used safely within root canals with minimal fear of developing iatrogenic complications when conservative settings are used.[44–48]

_Conclusion

The diode laser has become the "soft tissue handpiece" in many dental offices. The advantages of being able to work around metals including dental implants, a reduced need for anesthetic, a reduced risk of recession postoperatively, the ability to reduce bacteria, and to use the diode to photocoagulate vascular lesions have all provided dentists with a new alternative for soft tissue surgery. Lasers have two added benefits in that they do not require a pad to be placed under the patient for grounding, and they can be used safely with pacemakers. Diode lasers have found their place in dentistry. Once considered an application looking for a purpose, these small, cost-effective and reliable lasers have discovered their niche as the new go to solution for many soft tissue problems in our daily dental practices._

Editorial note: A list of references is available from the publisher.

_author laser

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