The diode laser as an electrosurgery replacement

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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. 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 are antimicrobial (antibacterial) 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 suction. Diode lasers have features that make them attractive as mentioned earlier, but they also have several advantages in function over electrosurgical units (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 electrosurgery 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.

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 inter-action 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.

Table 1: Comparison of diode laser versus monopolar electrosurgery units.

<table>
<thead>
<tr>
<th>Laser Type</th>
<th>Monopolar</th>
<th>Diode Laser</th>
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</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td>Electrical current flows from one electrode to the other</td>
<td>Electrical current flows from one electrode to another</td>
</tr>
<tr>
<td>Advantages</td>
<td>Cost effective, uses no safety glasses</td>
<td>Cost effective, uses no safety glasses</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Requires grounding pad</td>
<td>Does not require grounding pad</td>
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</tbody>
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Advantages of the diode laser over electrosurgery:

- Ability to work around metals intraorally
- Diode lasers in the range of 800-1,064 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 suction.
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This zone is most often between 3 and 7 years, but some diodes can have extended NOFE ranges of 40s.

Orthodontic patients will often ex- hibit overhanging cement in brackets that can make it difficult to work on them. This overgrowth of cement 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 remarkably as a very short period of time (Figs. 2 -4).

Ability to work around dental im- plants safely

Various laser wavelengths that are available today can offer the cli- nician who needs to expose an implant during second stage surgery an alter- native to traditional methodologies. The ability of the diode laser to ablate tissue, at times without the need for local anesthesia, 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 op- erative field (98 percent 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 which can help to reduce postoperative discomfort, improve healing and shorten healing times even while improving early osseointegration.11-14

As an aside, there have been clini- cians who routinely use monopolar electrosurgery units to expose im- plants. It is imperative to realize that although more expensive bipolar (the “tissue handpiece” in many dental of- fices) 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.15 Lasers, in contrast, can be used safely with tremendous coagulation and a reduction in pain postoperatively for the patients (Fig. 5-8).

Diode lasers are also useful when it comes to seal the final abut- ment and restoration. Tissue man- agement around dental implant restorations can be difficult, be it for the initial cementation or, even if an implant-restored prosthesis comes loose. Tissue quickly slumps to the abutment and sub-gingival margins can be almost impossible to retrieve with traditional meth- odologies. The laser can truly be a “life- saver” for these situations where soft tissue must be safely and quickly removed to allow for ideal cementa- tion of the implant retained crowns onto the abutments (Figs. 5-7).

Reduced need for anesthetic

Monopolar electrosurgery units do not have the ability to be used rou- tinely without local anesthesia. 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. Al- though 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 anesthesia can be eliminated it becomes a big sell- ing point to patients.

Many patients are looking for alter- natives to local anesthesia, and when the occasion allows for the procedure to be performed in a setting where the patient is not being numbed, the overwhelming majority of patients are grateful for this. Situations such as laser gingival crown tunneling for tissue manage- ment around endodontically treated teeth, exposure of partially erupted canines for orthodontic brackets and gingivectomies around moderately involved Class V lesions in geriatric pa- tients are all situations where the au- thor has been able to routine and consistently complete soft tissue ablation with only a stronger topical anesthetic. In fact, the literature has shown that there is a variety of soft-tissue procedures (even frenectomies) can be completed without topical anes- thetic.16-18 (Figs. 13-16)

Ability to do gingivectomies and crown tunneling with less reces- sion

White et al have mentioned that laser gingivectomies are the most common soft tissue procedure in dentistry. In contrast, combination with esthetic porcelain outcome can be completed with minimal marginal re- covery of tissue can take a good case and make it great19. 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 mar- gins can be far less with a diode laser than with other techniques, particu- larly when adequate magnification (e.g., 4.0X loupes) and cautious set- tings (0.5-0.9 w continuous wave) are used for the recontouring.

When biologic width is respected, or adequate attached kerati- nized 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 pop- ular technology as an alternative for tissue management compared to the traditional methodology of plac- ing a single or double retraction cord in the sulcus. The diode laser can be used in almost any situation to pro- duce gingival retraction as an alter- native to cord with excellent results both in terms of gingival retraction and margin delineation for the labo- ratory.

Unlike electrosurgical units where recession can be an issue, as can postoperative pain, diode lasers offer the clinician the ability to precisely remove overlapping, inflamed tis- sue 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.19

Ability to photoocoagulate vascular lesions and treat oral lesions

One of the advantages of a diode la- ser is the ability to treat oral lesions, including: recurrent aphthous ulcers (RAU), venous lake lesions of the lips and herpetiform lesions. Research has shown that lasers can be safely used to treat these lesions,26-28 and in addi- tion it is possible that if caught early during the prodromal stage that her- petiform lesions can be aborted or signif- icantly 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 re- appear in the same area. In fact some evidence suggests that herpetiform les- ions 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 recurs.30

Vascular lesions called venous lakes or hemangiomas can be safely used 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 erad-icate these esthetically undesirable the p lips purplish lesions often with only top- ical anesthetics.15 The diode laser can be used in almost any situation to pro- duce vascular lesions without such a great reliance on how the bactericidal capabilities of the diode laser might be benefi- cial in these areas, there is no doubt that all lasers can help healing through decreasing the risk of infec- tion through laser light alone (Figs. 16 -19). In addition, growing research has demonstrated that the risk of high bacterial loads in periodontal pockets and in particular in endo-dontic situations may be reduced by lasers.

This latest research has implications for improving traditional meth- odologies locally where used, and in helping to reduce the potential greater systemic health risks gener- ally. The role of lasers continues to be researched today, and present re- search has shown that diode lasers can be safely used within root canals with minimal fear of denoising or iatrogenic complications when con- servative settings are used.31-34

Conclusion

The diode laser has become the “soft- tissue handpiece” in many dental of- fices. The advantages of being able to work around metals including den- tal implants, a reduced need for an- esthetic, a reduced risk of recession postoperatively, the ability to reduce bacteria, and to use the diode to pho- toocoagulate vascular lesions have all been demonstrated. This 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 powerful lasers have discovered their niche as the new go to solution for many soft tissue problems in our daily dental practices.

References