The diode laser as an electrosurgery replacement

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."

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**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)
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 operations 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.

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

<table>
<thead>
<tr>
<th>Feature</th>
<th>Electrosurgery</th>
<th>Diode Lasers</th>
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<tbody>
<tr>
<td>Work around Metals</td>
<td>No - causes sparks, pup death etc</td>
<td>Yes and safe.</td>
</tr>
<tr>
<td>Pacemakers</td>
<td>No cannot be used</td>
<td>Yes can be used</td>
</tr>
<tr>
<td>Anesthetic</td>
<td>Local Anesthetic needed</td>
<td>Sometimes topical only</td>
</tr>
<tr>
<td>Antibacterial</td>
<td>No antibacterial qualities</td>
<td>Yes kills bacteria.</td>
</tr>
<tr>
<td>Lateral Thermal damage</td>
<td>Can cause recession when used.</td>
<td>Less Likely to cause recession.</td>
</tr>
<tr>
<td>Uses</td>
<td>Good for large tissue removal.</td>
<td>Multiple uses as seen today</td>
</tr>
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**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 uncover in edentulous maxilla.
Advantages of the diode laser 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 (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 electrosurgical units can cause both pulpal and periodontal problems, bone loss, severe intraoral burns, arcing, and that within three seconds of exposure to a dental implant electrosurgical units can cause failure of osseointegration and loss of an implant.

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 nomi-
nal 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).

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 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 on tissue, which in turn can reduce postoperative discomfort, improve healing and shorten healing times while even improving early osseointegration.

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. Lasers, in contrast, can be used safely with tremendous coagulation and a reduction in pain postoperatively for the patient (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 with only topical anesthetic (Figs. 13–16).

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, and when combined with esthetic porcelain restorations, the simple recontouring of tissue can take a good case and make it great. 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.25,26

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 percent of cases to eliminate these lesions, most often in only a single session lasting only a couple of minutes32–35 (Figs. 20–22).

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

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Anti-bacterial capabilities of lasers

Many articles in the literature have demonstrated the tremendous ability of all lasers with respect 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 there is need to reduce bacterial loads without such a great reliance on antibiotics. 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.

This latest research has 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 different applications for use. 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 different applications for use. 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 different applications for use.

References


