The Diode Laser as an Electrosurgery Replacement

by Glenn A. van As, BSc, DMD

Introduction

In 2008, Dr. Gordon Christensen wrote an article in *JADA* comparing the soft tissue cutting ability of diode lasers versus that of electrosurgery (radiosurgery) units.[1] In that article, he compared these two technologies against each other, and cited advantages and disadvantages of each alternative. In choosing between the two technologies at that time, he made several points:

1. Although, there was considerable overlap in their uses, and both technologies were effective, Christensen found there were a few potential uses that did not overlap. These included the use of diode lasers around metal (amalgam and gold) as well as implants, that lasers did not harm dental hard tissues (bone) or soft tissues (pulp), that the clinician could use the laser with less anesthetic, and finally that lasers were antimicrobial (antibacterial).
2. The use of the laser, 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).
3. Electrosurgery units were "far less expensive than the least expensive diode lasers" and he questioned whether "the advantages of the diode laser significant enough to compensate for the additional cost."

Now, less than two years later, a tremendous surge in diode laser interest has occurred. This is in due in no small part to the drop in the price range of diode lasers from around the $10,000-$12,000 in 2008 for the least expensive diode semiconductor lasers to a price range of $2,500 (see AMD Lasers' Picasso Lite). This dramatic price drop of more than 75 percent in the price of these units, has allowed diode lasers to become less expensive than some bipolar electrosurgery units and comparable, but still more expensive than many monopolar electrosurgery units. These monopolar electrosurgery units can be purchased for $1,000 or less, but the question as to whether the added benefits of diode lasers cited by Christensen are now enough to make them a soft-tissue alternative to these units for the average clinician. In this article I will review these questions again, and suggest that for many dental practices a simple diode laser might replace their electrosurgery unit as the methodology of choice for soft-tissue laser surgery.

Advantages of Diode Lasers Over Electrosurgery

As Christensen mentioned in his article, the term "electrosurgery" is not as well known or as accepted by many patients as the term "lasers." Having said this, the acceptance of this technology in both medicine and dentistry, as a viable method of soft-tissue alteration has made electrosurgery an accepted alternative to the scalpel. There are two basic types of electrosurgical units:

Monopolar, in which a single electrode exists and the current travels from the unit down a single wire to the surgical site. The patient is grounded with a pad placed behind the patients 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 that are in very close proximity exist on these units. 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. Electrosurgical units will typically cut larger amounts of tissue with greater speed than diode lasers can, and this can be important if very large amounts of tissue must be removed. In many cases, with routine dentistry, soft-tissue ablation is of the minor to moderate amount in nature, and in this case speed is not an issue.

Tissue Troughing with the Diode Laser

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. Many CEREC users routinely use the diode laser to enhance the gingival trough when the margin is either equi-gingival or subgingival, prior to powdering their prep for their digital impression. 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. Diodes, like electrosurgical units, offer the clinician the ability to work in a bloodless field for the impressions because of the hemostasis that occurs during the procedure. 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.

A small learning curve exists, in knowing when and how to properly diode laser trough *(see clinical case 1 and table 1).* Once the learning curve is conquered most clinicians will almost completely eliminate cord from their practice. In critically aesthetic areas where thin tissue genotypes exist, or if the patient is changing the color of the tooth significantly from the existing stump shade, then care with diode troughing must be taken.

In the author's experience, with the introduction of adequate levels of magnification (Loupes 4.0X or greater or an operating microscope) and the careful use of lower powers on the diode laser (for example 0.6-0.9 watts of power in Continuous Wave), the diode laser tissue management can be done with confidence in not having gingival recession occur post-operatively, and often can be done with only topical anesthetics. This is particularly enticing in situations where the tooth has had previous endodontic therapy and tissue troughing can be completed with the use of stronger topical anesthetics (Cetycaine, Tricaine Blue, TAC 20, EMLA) and lower settings with the laser. Use of the electrosurgery unit mandates the need for chemical anesthetic (injections of local anesthetic) in order to complete the tissue troughing. In addition, there is research that suggests that the lateral thermal damage done with lasers is significantly lower than that with electrosurgery.

Table 1: Seven-step Clinical Procedure for Laser Crown Troughing

1. Initial gross reduction and margin placement equi-gingival
2. Diode laser troughing: suggested settings 0.6-1.1 w CW (less in anterior)
3. Final margin placement subgingivally as needed for aesthetics
4. Hydrogen Peroxide or wet cotton pellet to remove tissue tags
5. Lateral distention of tissue if needed (Expasyl, Traxodent)
6. Rinse and take PVS impression
7. Provisional fabrication – careful to make sure no overhangs

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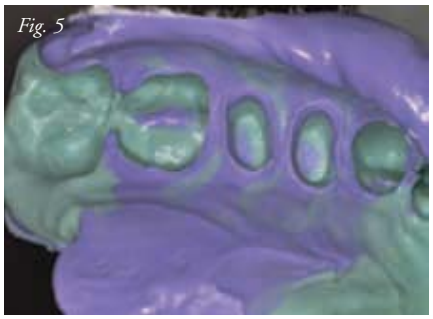
Clinical Case 1: Comparing Diode Laser Troughing to Retraction Cord



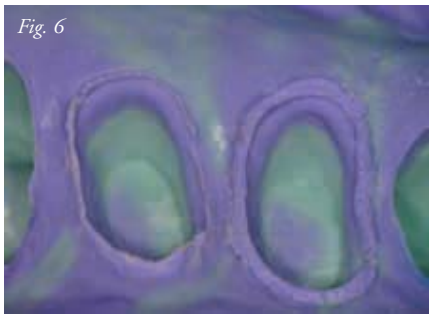


Fig. 1: Preop of cracked premolars needing full coverage restorations.
Fig. 2: Diode laser being used to "laser trough" around first premolar.
Fig. 3: Retraction cord being placed on second premolar of case.
Fig. 4: Occlusal view of two teeth treated with alternative technologies.
Fig. 5: Low magnification view of impression.
Fig. 6: High magnification view showing differences in impression of gingival sulcus with cord (left) and laser (right) but acceptable results with both methods.
Fig. 7: Occlusal view of healed tissue after provisionals removed after two weeks.
Fig. 8: LAVA crowns in place on both teeth – occlusal view immediately post-op.
Fig. 9: LAVA crowns in place on both teeth – labial view immediately post-op.

The safety of lasers for gingival retraction procedures has been documented in the literature by Gherlone, et. al.[2] who found that lasers (diode and NdYAG) when compared to the conventional techniques of double cord or electrosurgery yielded less gingival bleeding, and also less gingival recession. Their interesting conclusion was that although both techniques are satisfactory that the laser techniques were in fact "less traumatic to the periodontal tissues."

Diode Laser Usage Around Metals

The diode laser has the added benefit of being able to be used with less concern over damage to hard or soft dental tissues, or damage to dental prosthesis that can occur with the less expensive monopolar electrosurgery units.[3-6] The diode laser can be used safely around gold crowns and amalgam restorations without fear of pulpal damage (Figs. 10-14) and lasers can be safely used around implants with minimal fear of introducing iatrogenic damage to the implant or bone, and in new research there are suggestions that the diode lasers when used at lower levels of power (Low Level Laser Therapy) may in fact improve the early healing of tissues and can also be used in cases of peri-implantitis (Figs. 15-20).[7-14]


Fig. 10


Fig. 11


Fig. 12


Fig. 13


Fig. 14


Fig. 15


Fig. 16


Fig. 17


Fig. 18


Fig. 19


Fig. 20


Fig. 21

Fig. 10: Large buccal amalgam on UR 2nd Molar.
Fig. 11: Amalgam partially removed – gingivectomy needed to remove rest of amalgam.
Fig. 12: Laser gingivectomy completed without bleeding or fear of sparking.
Fig. 13: Rest of amalgam restorative material removed.
Fig. 14: Restoration completed on labial.
Fig. 15: Flipper partial over top of implant healing cap for right upper central incisor.
Fig. 16: Healing cap in place after Flipper partial removed.
Fig. 17: Topical on tissue to allow for gingivectomy around implant on mesial to provide for provisional crown to be seated properly.
Fig. 18: Immediate postoperative view after laser gingivectomy.
Fig. 19: Provisional crown placed.
Fig. 20: Note healing of tissue prior to final PFM crown placement (Three months healing of provisional crown).
Fig. 21: Final crown in place.

Use of Anesthetic

One of the key benefits of the diode laser over electrosurgery units is the reduced need for local anesthetics. Some minor recontouring for aesthetics and for orthodontics can be accomplished with only topical anesthetic. The literature shows that lasers can safely be used for both cosmetic and orthodontics[15-18] and there are an increasing number of clinicians buying lasers for this very fact alone. As I am fond of saying, "Dentists are fine with needles and drills… it's the patients who are seeking alternatives." Electrosurgery units and scalpels almost always require the usage of local anes-

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thetic. Figures 22-30 show cases of cosmetic and orthodontics done with no local anesthetic.

Cosmetic "Smile Lifts"

Lasers have been shown to be effective in cosmetic dentistry cases.[19-22] The lure of the laser is to help with "gummy smile" cases where an excessive or asymmetrical amount of tissue appears in a smile. All too often, we as dentists focus on the "white" parts of the smile and fail to observe gingival asymmetries (pink part of the smile) which, if corrected, could significantly improve the overall aesthetic outcome of the case.

Conventional periodontal surgery consists of full or partial thickness flaps, and osseous surgery to remove bone, followed by sutures and 12-16 weeks of healing. There is nothing wrong with viewing the overall architecture of the underlying biology of bone, roots and soft tissue, however there are times when more minimally invasive techniques may be used with equally impressive results but with perhaps much less healing time.


Fig. 22


Fig. 23


Fig. 24


Fig. 25


Fig. 26


Fig. 27


Fig. 28


Fig. 29


Fig. 30


Fig. 31

Fig. 22: Pre-op view of canines requiring exposure of clinical crown to place orthodontic bracket.
Fig. 23: Higher magnification of upper right canine.
Fig. 24: Topical gel (compounding pharmacy) applied to labial tissue.
Fig. 25: Diode exposure of clinical crown with 1.2-1.4 w pulsed setting.
Fig. 26: Final view of brackets in place on both upper canines.
Fig. 27: Pre-op view of pigmented lesion on attached tissue noticed by patient.
Fig. 28: Higher magnification view of lesion.
Fig. 29: Immediate postoperative appearance after laser ablation at 1.2w pulsed.
Fig. 30: Ten day healing photo of tissue.
Fig. 31: High magnification view of healing showing complete disappearance of lesion.

One of the causes of "short tooth syndrome" where a lack of the clinical crown is displayed when smiling is altered passive eruption. In these cases, the osseous level subgingival has receded apical to the CEJ. The gingival margins in Active Passive Eruption (APE) has not moved coronal enough to the level of the CEJ. This often leaves large amounts of Keratinized tissue which can be removed via a diode laser gingivectomy.

In cases where a "gummy smile" exists, the clinical crowns are short, but the bone is not apical to the CEJ, (altered active eruption is one cause), then diode laser gingivectomies will not lead to a stable clinical result. Osseous surgery either in a full flap scenario or at times with closed flap laser techniques using both diode and erbium lasers, can provide tremendous results for the patient with shortened healing times (Figures 32-37).[23-25]


Fig. 32


Fig. 33


Fig. 34


Fig. 35


Fig. 36


Fig. 37

Fig. 32: Preoperative smile shows "small tooth syndrome.
Fig. 33: Shows existing 3/4 porcelain crowns on maxilllary incisors.
Fig. 34: Shows Er:YAG closed flap crown lengthening (smile lift) and provisionals immediately post-op.
Fig. 35: Shows diode laser tissue management four weeks afterwards prior to impressions.
Fig. 36: Postoperative result shows longer clinical crowns and optimum tissue health.
Fig. 37: Shows closeup of final result.

Anti-bacterial Capabilities of Lasers

Many articles in the literature have demonstrated the tremendous ability of all lasers with respect to bacterial and even fungal reduction.[26-33] This feature alone makes lasers effective and desirable in many areas in the oral cavity where the risk of postoperative infection may be reduced with lasers. 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. 38-42). 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.[34-38]

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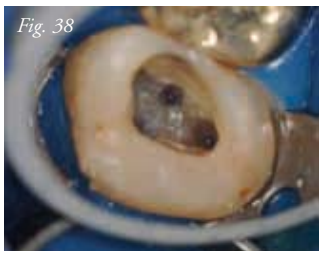
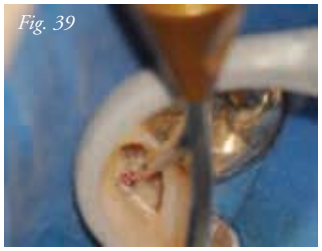
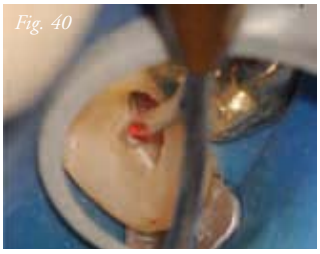






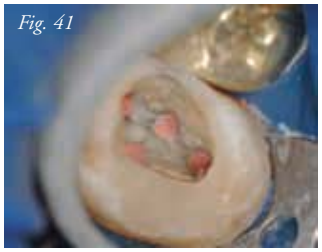


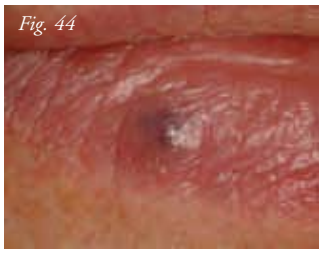
Fig. 38: Four canal upper second molar prior to obturation.
Fig. 39: 400 micron diode fiber in DB canal for bacterial reduction.
Fig. 40: Diode laser for bacterial reduction in canal.
Fig. 41: Final view of obturated four canals in second molar.
Fig. 42: Preoperative and postoperative radiographs of above case

Treatment of 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 (Figs. 43-49). Research has shown that lasers can be safely used to treat these lesions,[39-41] and in addition it is possible that if caught early during the prodromal stage that the lesions can be aborted or significantly reduced in terms of length of time they are present.[42] 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.

Venous Lake lesions of the lower lip have been traditionally one of the more difficult lesions to treat. There is a growing body of evidence to show that a diode laser can often without anesthetic completely eliminate these purplish lesions which occur frequently on the lips in one single treatment, often with only topical anesthetic.[14,15, 43, 44]

Fig. 43: Pre-op appearance of venous lake on lower right lip.
Fig. 44: High mag preoperative appearance.
Fig. 45: Diode laser coagulating venous lake (note uninitated tip).
Fig. 46: Immediate postoperative appearance of lesion.
Fig. 47: High mag appearance of venous lake immediately postoperative.
Fig. 48: One-week healing of lip-lesion considerably smaller.
Fig. 49: Two-week healing of lip (lesion is now fully disappeared).



Conclusion

In the last two years, diode lasers have become a staple of many dental practices for their cost effective solution to many clinical problems that are seen daily in private practice. The laser as an "electrosurgery replacement" has become a reality with

these newer units, which provide numerous advantages to everyday dentistry.

The advantages of diode laser tissue troughing as a replacement in many instances for cord, in being safely used around metals (implants, amalgam, gold, orthodontic brackets), hard and soft tissue, cannot be overlooked. In many instances small amounts of tissue can be removed with only topical anesthetics (Cetycaine, EMLA, Tricaine Blue, and TAC 20) and diode lasers are great soft-tissue lasers for many orthodontic and cosmetic procedures as well. If one adds in the antibacterial capabilities of these lasers and their ability to be used in many soft-tissue surgeries including frenectomies, fibroma removals, and the treatment of oral lesions, then it can be seen that perhaps the soft tissue laser is on its way to being an important and essential part of not only every dental practice, but perhaps in the not-too-distant future, an integral part of every dental operatory. ■

Author's Bio

Dr. Glenn van As graduated from the University of British Columbia in 1987 and is internationally known for digital documentation of laser procedures captured with the operating microscope. He achieved Advanced Proficiency from the Academy of Laser Dentistry and received the 2006 Leon Goldman Award for clinical excellence. He is also a founder and past president of the Academy of Microscope Enhanced Dentistry.

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