Implementing the Diode Laser in Your Orthodontic Practice: “Ground Rules” for Success

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**INTRODUCTION:** Diode lasers are finding their way into today’s top orthodontic practices, helping doctors manage common soft tissue problems associated with patients in braces. Launching this technology safely and successfully depends largely on the doctor’s commitment to doing it right: committing time and resources to making an educated purchase and engage in training, and to developing systems for integrating procedures into the schedule. The following five ground rules greatly facilitate laser implementation and improve the orthodontist’s knowledge, confidence, and enjoyment of the routine daily use of the diode laser.

**Ground Rule #1: “You get what you pay for.”**

A variety of dental diode lasers (DDLs) are available to orthodontists. The costs at the time of this article range from $8000 to $15,000. Rather than purchase just ANY surgical instrument on price alone, the orthodontist must remember that the “You get what you pay for” adage is especially true with regard to DDLs.

Since lasers use light energy to perform, specific aspects of this characteristic should be the primary means of deciding which DDL is best-suited for an orthodontist’s practice, specifically: (1) wavelength; (2) pulse characteristics, and (3) maximum wattage.
WAVELENGTHS:

Current DDLs operate in three wavelengths: 810, 940, and 980 nanometers (nm). Each has different effects on soft tissue. Table 2 shows these wavelengths’ tendencies for absorption in three compounds: hemoglobin, oxyhemoglobin, and water.

810 nm – Lowest absorption by water of the three categories, allowing for excellent hemostasis during procedures requiring incision and excellent penetration when used at low levels for biostimulation.

940 nm – Highest overall absorption by hemoglobin, oxyhemoglobin, and water – highly effective for both clean surgical incisions (low carbonization) with excellent hemostasis.

980 nm – Highest absorption by water for clean cutting (low carbonization) with good hemostasis.

PULSE CHARACTERISTICS:

All late-generation DDLs provide laser energy in both Continuous Wave (CW) and Pulsed (P) modes. Uninterrupted continuous wave laser energy does not allow for thermal relaxation of the tissue, while pulsed modes allow for thermal recovery (cooling) between energy pulses. Importantly, not all pulsing lasers provide energy in the same frequency or duration. In fact, most simply “chop” the laser energy, with energy pulses equal to rest intervals at a 1:1 ratio. This evenly chopped or gated delivery is commonly referred to as a 50:50 duty cycle, meaning it is cycling half-on and half-off. In these lasers, the tissue experiences exactly one-half the power in pulsed mode as delivered in continuous wave mode. Consequently, selecting a laser capable of a maximum of 2 watts CW will never allow more than 1 watt of effective or average power in pulsed mode.
Average power becomes important when the orthodontist discovers that most soft tissue procedures performed with DDLs require between 1 and 2 watts of power. In other words, pulsed modes of 2-watt and 3-watt lasers will not deliver the amount of energy necessary to cut heavily fibrous tissue, requiring the orthodontist to revert to continuous wave mode to complete the procedure. In these instances, the tissues are inevitably more prone to thermal damage and charring, absent the cooling periods between pulses. Thermal damage has implications in patient comfort, both during the procedure and in their post-operative healing experience.

Variable pulse modes available with some lasers are necessary for the doctor who enjoys delivering a more refined surgical and post-surgical experience for patients. The most sophisticated DDLs alter the delivery ratio of laser firing time to cooling or recovery time. For example, the “Comfort Pulse” mode on the ezlase 940 allows the laser to fire for .05 milliseconds and then gives the tissue 0.20 milliseconds to cool, for a 1:4 ratio. Lasers without variable pulse capabilities typically deliver 20 millisecond pulses (400 times longer) with equal thermal recovery times, resulting in overheated tissues. The 1:4 energy ratio has been shown to result in transient elevations in tissue temperature too low to induce injury. In my practice, I see little to no charring when performing post-orthodontic soft tissue esthetic recontouring using the short 0.05 msec laser pulses and 0.20 msec rest intervals described. Thermal relaxation times of 0.15 to 0.20 msec are critical to keeping internal tissue temperatures within biologically viable parameters.

Most impressive about DDLs with a wide range of selectable pulse settings is that they can usually be used without anesthesia due to the nature of laser energy and to rest intervals. Unless a DDL provides fully adjustable pulse lengths and rest intervals, this important benefit to the orthodontic practice is missed.
**MAXIMUM WATTAGE:**

A DDL’s maximum wattage affects how much *effective* or *average* wattage can be delivered to the tissue, extremely important when using pulsed modes. For example, a DDL with a maximum 2 watts of power delivering pulses lengths equal to pulse intervals (50:50) delivers an average power of 1 watt. Why is this important? With a labial frenectomy, my experience has been that an average power closer to 1.8 watts is needed to cut the tough fibrous connective tissue found internally. While the laser could be used in continuous wave mode, the energy would char the tissue and result in the need for anesthesia, and greater post-operative discomfort and scarring – components commonly seen with electrosurgery.

On the other hand, a DDL delivering a greater maximum wattage with adjustable pulses can provide average wattages kinder to the tissues (discussed in-depth in the next section). For example, a 0.10 msec pulse with 0.20 msec rest intervals delivers just 33% of the maximum selected power. To deliver the average 1.8 watts needed to cut fibrous connective tissue in this pulsed mode, a maximum wattage of 5.6 watts is needed.

Regarding “you get what you pay for,” consider manufacturer’s training. In 1993, the Society of Photo-Optical Instrumentation Engineers published guidelines to help ensure that dentists using lasers are properly educated about safety. At the least, a new user should attend a course that satisfies the guidelines’ “Standard Proficiency Course” definition, with both didactic and hands-on experiences AND safety assessments in both; from a medico legal standpoint, it is only prudent.

If a manufacturer includes training with the purchase of a laser, ask if it includes live instruction, if it is specific to orthodontics, and if it includes patients in the course (live, via video, or both).
If called upon as evidence of competency, such a course would carry great weight. More strength would be borne attending a course recognized by an accrediting entity of continuing dental education credits.

**Ground Rule #2: “Safety First”**

DDLs are medical devices regulated by the Food and Drug Administration for good reason: they emit dangerous levels of laser radiation. Without delving deeply into physics, keep in mind that the beam is a tightly collimated ray of energy capable of destroying soft tissue. For example, the vascular retina is hemoglobin-rich. Transient exposure to a DDL beam can cause irreversible harm – even instant blindness. The FDA’s concern is for patient safety. All of the safety engineering in DDLs helps ensure patient safety, but only if the doctor and the staff are fully knowledgeable about them.

The Occupation Safety and Health Administration focuses on employees exposed to the laser in their everyday work lives. Three components ensure maximum safe operating procedures: personal protective equipment (safety glasses), adequate training, and treatment area modifications. Complete OSHA guidelines regarding laser safety can be found at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1705

**EYE PROTECTION:**

Without question, eye protection is paramount. NO ONE MUST BE IN THE TREATMENT AREA WHEN THE DENTAL LASER IS IN USE UNLESS THEY ARE WEARING THE CORRECT SAFETY GLASSES. “Correct” safety glasses have proper filtration to the specific wavelength of laser light. *Laser safety glasses are not transferable between various wavelengths used.*
OSHA states: “You must provide safety goggles specifically designed to protect the employees' eyes from the specific intensity of light produced by the laser... If your employees are exposed to laser beams, you must determine the maximum power density, or intensity, that the lasers can produce...and select lenses that will protect against this maximum intensity.”

Assessing power output, divergence, and beam configuration, a nominal ocular hazard distance can be assessed – the distance from the laser emission, beyond which the eye risk is below the maximum permissible exposure level. For a Class IV dental laser, it is approximately 10 feet.

Finally, the doctor must also wear eye protection. If the orthodontist uses magnifying loupes in practice, special filters that fit inside the lenses can be purchased. Ultimately, the person who has specific laser safety responsibility of turning on the laser and making sure all the safety features are operational during the process must also be responsible for proper laser eye protection.

**TRAINING AND DOCUMENTATION:**

Someone within the practice must be designated the Laser Safety Officer (LSO). This person is trained to monitor and enforce the control of laser hazards, administering the overall laser safety program:

1. Confirming the classification of laser used;
2. Doing the nominal hazard zone evaluation;
3. Assuring that proper control measures are in place and approving substitute controls;
4. Approving standard operating procedures;
5. Approving eyewear and other protective equipment;
6. Ensuring special appropriate signs and labels and overall facility controls; and,
7. Effecting proper laser safety training.
The LSO ensures that employees assigned to work around laser equipment be appropriately qualified and trained. The names of all persons trained and the date of training should be documented.

Training is specific to the FDA classification of the DDL in use; most DDLs are Class IV. Training begins with the information contained in the operation and maintenance manuals of the laser, along with additional basic safety literature of a general nature. Additional training is recommended that provides a complete understanding of the requirements of a safe laser environment, including discussions of hazards, safety devices required, procedures related to equipment operation, warning sign requirements, and descriptions of medical surveillance practices, with emphasis placed on practical, safe laser techniques and procedures, as well as on safety devices that provide a safe environment.

**TREATMENT AREA MODIFICATIONS:**

Class IV lasers (continuous wave >500 mW) are hazardous to view under any condition, whether directly or diffusely scattered, and are potential fire and skin hazards. ANSI requires posting areas where Class IV lasers are in use with the DANGER sign. →

The absence of reflective materials in the laser use area ensures beam containment. In addition, high volume evacuation must be used to remove the laser plume, which could be laden with viral particles. Using the laser in the open bay environment of orthodontics is not recommended unless all persons wear protective eyewear and adjacent reflective surfaces are covered.
**Ground Rule #3: “Communication is the Key”**

An important component regarding smooth integration of the DDL into practice is communication to patients, dentists, and neighboring specialists. Obtaining a patient’s informed consent is often an obstacle for new orthodontic laser users. It is the doctor’s responsibility to use forms to properly document informed patient consent. Manufacturers’ trainings may provide a template for the doctors to adapt for practice; private vendors also provide them. Whatever the source, the forms should be reviewed and approved by legal counsel before use. I found that adding the laser language to my conventional informed consent form works well, since I consider laser procedures an integral part of orthodontic practice.

Properly communicating newly available laser services to referring dentists, as well as to local periodontists and oral surgeons, is equally important. Be proactive and up-front. DDLs benefit orthodontic patients through shorter treatment times, better hygiene access, improved esthetics, and more. Let the doctors know first-hand you are providing laser services and explain why. Expect some backlash. You might find a few periodontists have not accepted dental lasers as viable treatment options. Do not allow a “doubting Thomas” to keep your patients from benefiting from a proven treatment entity.

Consider a mailing to your fellow dentists, explaining the laser you use and why – emphasizing orthodontic uses. Provide a Saturday morning “Open House” where you explain how the laser helps patients every day in the ways mentioned above. Refrain from becoming defensive if challenged about “stepping on periodontists’ toes” or of using a laser to “pad the bottom line.” You will find that DDLs play a major role in kinder patient care, like through routine laser-facilitated access for bracket placement, absent the drama of IV sedation and referral to another doctor. Patients and parents will love you for it, and that is what matters most.
Ground Rule #4: “Baby Steps”

With any new endeavor, proper implementation involves a series of steps. Introducing a laser to your practice means taking a series of “baby steps” (careful and calculated), ensuring everyone’s safety and satisfaction. These steps include laser selection, establishing your limits, scheduling, anesthesia, and others.

**Laser Selection:**

You probably have some idea of the DDLs available and how to select one. Consider factors like anesthesia (to be addressed soon): Will you routinely administer local anesthesia in your practice? Some DDLs will require it; others will not. Will you whiten teeth? I do not recommend doing that, out of respect for referring dentists. However, if you DO want to use a DDL for that, consider the 810 nm version. For daily soft-tissue procedures in orthodontics, a 940-980 nm diode dental laser works best.

**Know Your Limits:**

Here is a personal story . . . one that ended happily. A doctor who was scheduled to be present and train me the first day I used a dental laser, at the last minute, could not show up. My patient was scheduled for a lingual frenectomy. With an educational DVD in my laptop, I felt confident and decided to proceed. Imagine my surprise when the DVD’s narrator said, “Do not attempt a lingual frenectomy as your first procedure…” Well, I did and the results were tremendously gratifying to not only me, but to the patient and his parents as well.

The range of FDA-approved DDL soft tissue procedures is extensive; certain ones will dominate your practice: gingivectomy for bracket placement; esthetic gingival recontouring; frenectomy;
fibromotomy; and opeculectomy. Occasionally you might expose a palatally soft tissue-impacted tooth to facilitate eruption.

Considering the list in Table 3 of potential procedures, I recommend you begin your laser career with procedures you feel most comfortable with. Keeping in mind the vascular-rich area beneath the tongue, I trust it will not be a lingual frenectomy!

### Table 3

<table>
<thead>
<tr>
<th>Procedure</th>
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<tbody>
<tr>
<td>Gingivectomy (Pre-Tx, Mid-Tx, Post-Tx)</td>
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<tr>
<td>Gingivoplasty / Recontouring</td>
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<tr>
<td>Hemostasis</td>
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<tr>
<td>Exposure of unerupted teeth</td>
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<tr>
<td>Fibroma removal</td>
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<tr>
<td>Frenectomy and frenotomy</td>
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<tr>
<td>Operculectomy</td>
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<tr>
<td>Fiberotomy*</td>
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<tr>
<td>Soft tissue crown lengthening</td>
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<tr>
<td>Treatment of aphthous ulcers and herpetic lesions</td>
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<tr>
<td>Exposure of TAD’s</td>
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### SCHEDULING:

Uncertainties accompany anything new, so consider setting aside “laser days” for your initial procedures. Schedule an hour per procedure, allowing you and the staff to prepare for each. Eventually you will routinely include laser procedures in your scheduling template, with the staff trained to have the patient ready for the brief procedure.

### ANESTHESIA:

The level of anesthesia needed with laser procedures varies from ‘none’ to the use of local anesthetic infiltration. Dental lasers have significant favorable neuropharmacologic effects on the synthesis, release, and metabolism of histamine and prostaglandin, on decreased c-fiber activity, bradykinin release, and favorably altered pain thresholds. Understanding that patients often do not differentiate non-painful sensations from overt pain, you should be proactive to not allow any chance of pseudo-pain sensation that might spiral the patient into a state of anxiety, releasing endogenous chemicals local anesthesia might not eliminate; I use topical anesthesia on all of my laser patients.
A topical known as TAC-Alternative (“TAC” stands for tetracaine, adrenaline, cocaine) works well, providing up to 2.5 mm deep anesthesia – adequate for most laser procedures. The onset is 3 minutes and duration as long as 20 minutes. If possible, the medication can be placed beneath an operculum to facilitate the procedure. TAC-Alternative is a thick, proprietary gel sold in 20-gram light protected jars and is comprised of 20% lidocaine, 4% tetracaine, and 2% phenylephrine. It can be purchased from Professional Arts Pharmacy (888-237-4737).

When a topical anesthetic is inadequate, a local anesthetic may be needed. Refrain from those with a vasoconstrictor, which may impede the ability of the laser to act on the needed hemoglobin pigmentation.

**Ground Rule #5: “It’s in the Details”**

Of course, how you manage your laser fees, bill your patients, and help with insurance is up to you. The simplest method is using a superbill with commonly used procedures, letting the patient file for reimbursement. You will probably not charge for all procedures (i.e., ones that facilitate treatment and make your job easier, like a gingivectomy to facilitate bracket placement).

Here are some simple guidelines to help minimize problems:

1. Create and use a laser consultation sheet – procedure, tooth number(s), etc.
2. Probe all cases, chart, and submit for insurance.
3. Use the latest CDT codes, as published by the ADA.
4. Research fees and charge in the 95th percentile.
5. Never discount periodontal procedures (undercut periodontists’ fees).
**IN SUMMARY:** Just as any clinical dental technology now in use may have been met with skepticism, the dental laser is overcoming obstacles just as earlier new techniques like the high-speed handpiece and composites did. Dental lasers truly offer benefits for both the patients and the doctor. Because there is no one standard, careful selection and training are paramount to successful and safe implementation and use in orthodontic practice.

**Bios:** Dr. Bob Waugh is 1989 graduate of Baylor College of Dentistry Orthodontic Program. He is an Assistant Professor at Medical College of Georgia, where he introduced lasers into the orthodontic residency program. He is the first orthodontist to present applications of the YSGG Waterlase and diode laser at the 2005 WCLI Super Symposium. Dr. Waugh lectures nationally on a variety of orthodontic topics. His training company, intelliDENT solutions, inc., was selected by Biolase Technology, Inc. as the U.S. training center for the ezlase 940 diode laser. Dr. Waugh is a member of the International College and American College of Dentists, an ABO Diplomate, and is a member of the Academy of Laser Dentistry.