CORPORATE MEMBER 2010

ALD

Academy of Laser Dentistry

Experience the Excitement of Lasers in Everyday Dentistry

A Hands-on Workshop

Scott D. Benjamin, D.D.S.
Technology@DentalAIM.com
www.DentalAIM.com
607-563-3927

Buffalo Niagara Dental Meeting
November 3, 2011
www.GLIDM.org

Procedures and Applications Performed with a Soft Tissue Diode Laser

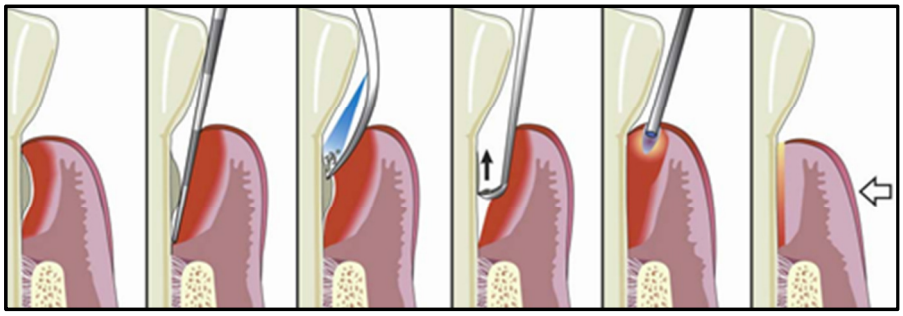
Basic Functions of a Soft Tissue Laser

- Vaporize (Ablate) Soft Tissue
    - Incise Soft Tissue
    - Excise Soft Tissue
    - Ablate (Erase) Soft Tissue
- Photobiomodulate (Stimulate) Tissue Responses

A Partial List of Specific Procedures That Can be Performed with the Assistance of a Soft Tissue Laser

- Gingivectomy
- Gingivoplasty
- Gingival Troughing
- Periodontal Pocket Debridement Laser Therapy (PDLT)
- Biopsies
- Fibroma Removal
- Implant Uncovering
- Flap Surgery
- Soft Tissue Incisions
- Soft Tissue Excisions
- Destruction of Lesions
- Distal / Proximal Wedge
- Operculectomies
- Excision of Pericoronal Gingiva
- Soft Tissue Crown Lengthening
- Removal of Hyperplastic Tissue
- Exposure of Un-erupted Teeth
- Vestibuloplasty / Frenuloplasty
- Frenectomy / Frenotomy
- Incision and Drainage
- Assisting in Bleaching of Dentition

Laser Assisted Periodontal Care
Pocket Debridement Laser Therapy (PDLT)



Overview

When utilizing a laser in periodontal care the historical goals, principles of the causes, treatment, and management of periodontal disease, does not change. The primary goals in the treatment of periodontal disease are to:

- Debride and decontaminate the infected tissue of the periodontal structures
- Decrease the pathogenic bacteria in the periodontal pocket
- Arrest the progressive destruction of periodontal attachment
- Establish a periodontal architecture that can be properly maintained with adequate home care
- Create an environment to facilitate the regeneration of the lost periodontium, whenever possible.

The purpose of laser assisted periodontal care is to restore the periodontal health so that the diseased sulcular and pocket epithelium is eliminated and the pocket (intrasulcular) bacterial activities are minimized. When these goals are accomplished, pocket depths should be minimal and able to be maintained with proper routine homecare, bleeding on probing should be eliminated, and the apical migration of the epithelial attachment halted.

Treatment Considerations

Comprehensive examination and diagnostic procedures need to be performed to establish an accurate diagnosis of the periodontal status. Prudent clinical judgment is required and the practitioner and the patient need to have realistic expectations for the desired outcomes. Informed consent from the patient on the treatment objectives, prognosis and possibility of tooth loss should be established before any treatment is rendered.

The Role of the Laser in Laser Assisted Periodontal Care / Periodontal Pocket Debridement Laser Therapy (PDLT)

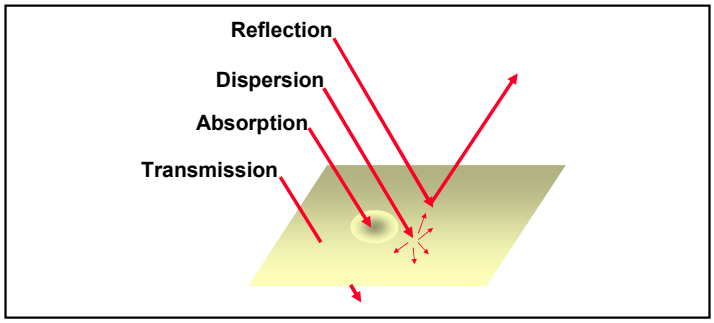
A soft tissue laser is an adjunctive device primarily used in closed subgingival instrumentation procedures without the displacement (flapping) of the gingiva. These procedures might include root planning and scaling, gingivoplasty, and gingivectomy or a combination of these procedures. The laser's role is not to replace any of the normal procedures or instrumentation, but is used in addition to the normal ultrasonic and hand instrumentation to obtain a better outcome. The laser's primary role is to reduce or eliminate the bacteria along with the diseased, inflamed, or inappropriate soft tissue in the periodontal pocket, and gingiva. This is accomplished by the clinician thoroughly applying photonic energy to the entire soft tissue lining of the periodontal pocket and the extra sulcular diseased epithelium where deemed necessary. The laser also plays a significant role in creating the proper environment for the establishment and organization of a sufficient and stable clot to promote healing. Initiating and maintaining this healing process is imperative in the re-establishment of the periodontal attachment architecture to the root structure of the tooth, thus minimizing pocket depths and to arresting the apical migration of the attachment.

Practitioners need to have a comprehensive understanding of the disease processes, the benefits and limitations of periodontal pocket debridement laser therapy (PDLT) and the present periodontal status of the patient as well as the patient's overall oral and systemic health. The clinician and patient need to understand and remember that periodontal pocket debridement laser therapy (PDLT) is only part of the comprehensive treatment regime, and care that is required to achieve successful outcomes.

Effects of Light Energy

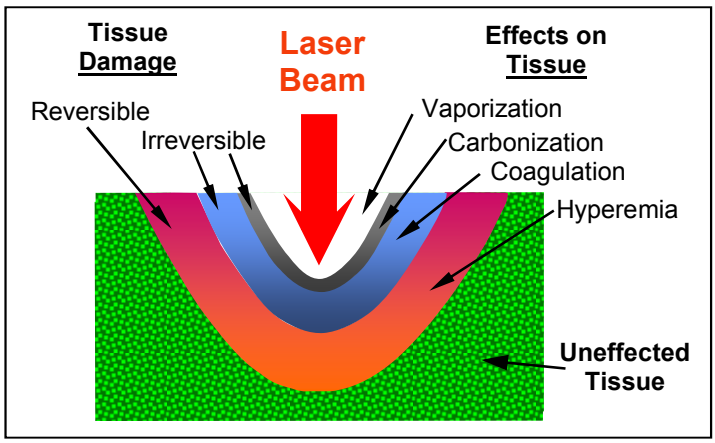
Effects of Light on Target Tissue

- Transmission
- Reflection
- Dispersion / Scattering
- Absorption



Effects of Light Energy on Target Subjects

- Photo-thermal Effects
  - Coagulation
  - Vaporization
- Photo-acoustic Effects
  - Disruption
  - Plasma effect
- Light-Induced Fluorescence
  - Caries detection
  - Mucosal evaluation
- Photo-chemical Effects
  - Stimulate chemical reactions
  - Creates chemical bonds
  - Break chemical bonds
- Photobiomodulation
  - Pain relief
  - Wound healing



Thermal Effect of Laser Energy on Tissue

Tissue Temperature (C°)	Observed Effect
37-50°	Hyperthermia
50-60°	Protein Denaturation
> 60°	Coagulation
70-90°	Welding
100-150°	Vaporization
>200°	Carbonization

There is a linear relationship between the energy of the pulse and the size of the ablation crater.

Increasing the power lowers the ablation threshold and accelerates the ablation process, thus decreasing thermal side effects.

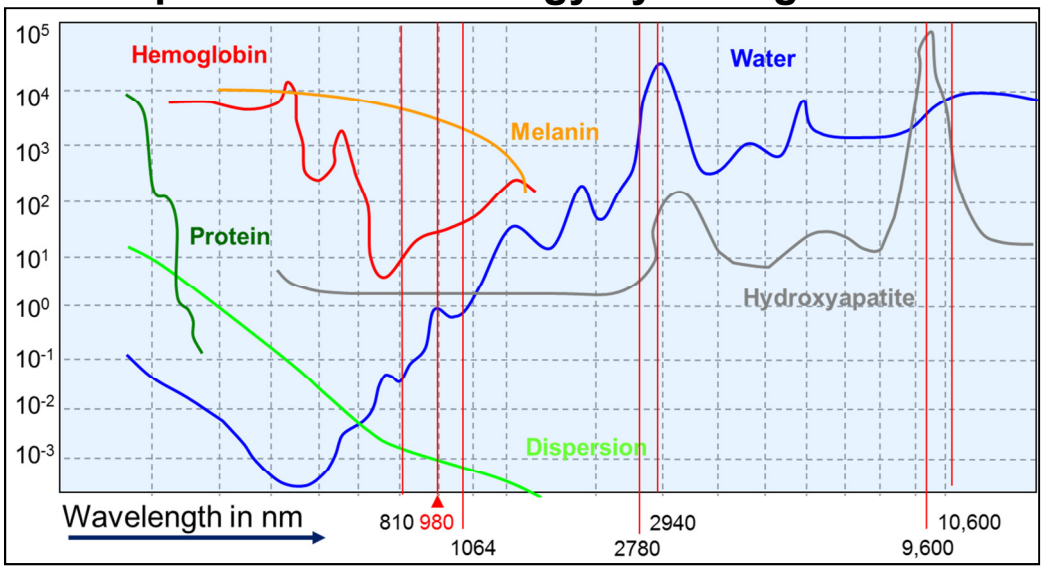
Variables Effecting Laser Tissue Interaction

- Wavelength
- Target Composition
  - Chromophores- Substances that absorbs light energy
  - Fluorophores- - Substances that emits (produces) light, often when stimulated with light energy
- Interaction Time
  - Temporal Mode
  - Hand Speed
  - Total Interaction Time
- Power
- Energy Transfer Mode
  - Contact vs. Non-Contact
- Spot Size
  - Fiber size (320 micron vs. 200 micron)
- Operator's Knowledge and Experience

Maximizing the Tissue Interaction Requires:

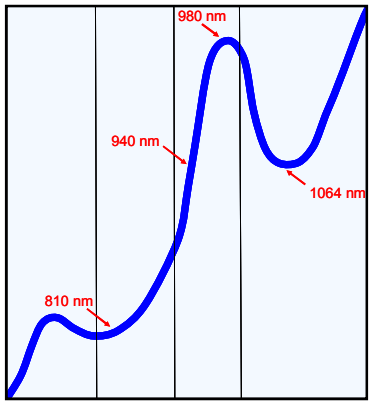
Matching the proper wavelength with the adequate amount of power with the chromophores present in the tissue.

Absorption of Laser Energy by Biological Tissue



Source: Hale GM, Querry MR, "*Optical constants of water in the 200 nm to 200 µm wavelength region*" Appl. Opt.,12, 555-563

Transmission & Absorption of Near Infrared (NIR) Light Energy in Water



The Coefficient of Light Transmission in Pure Water is:

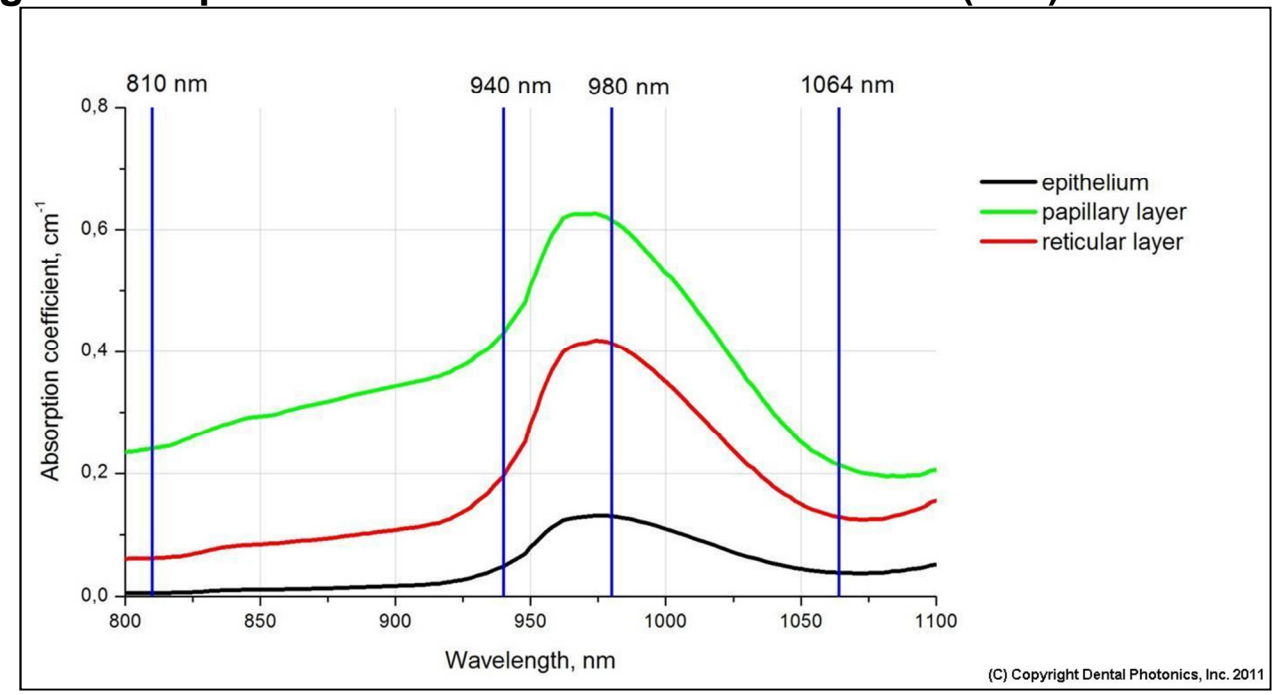
97 % at 810 nm
85 % at 1064 nm
65 % at 980 nm

The Absorption of Light Energy in Water is:

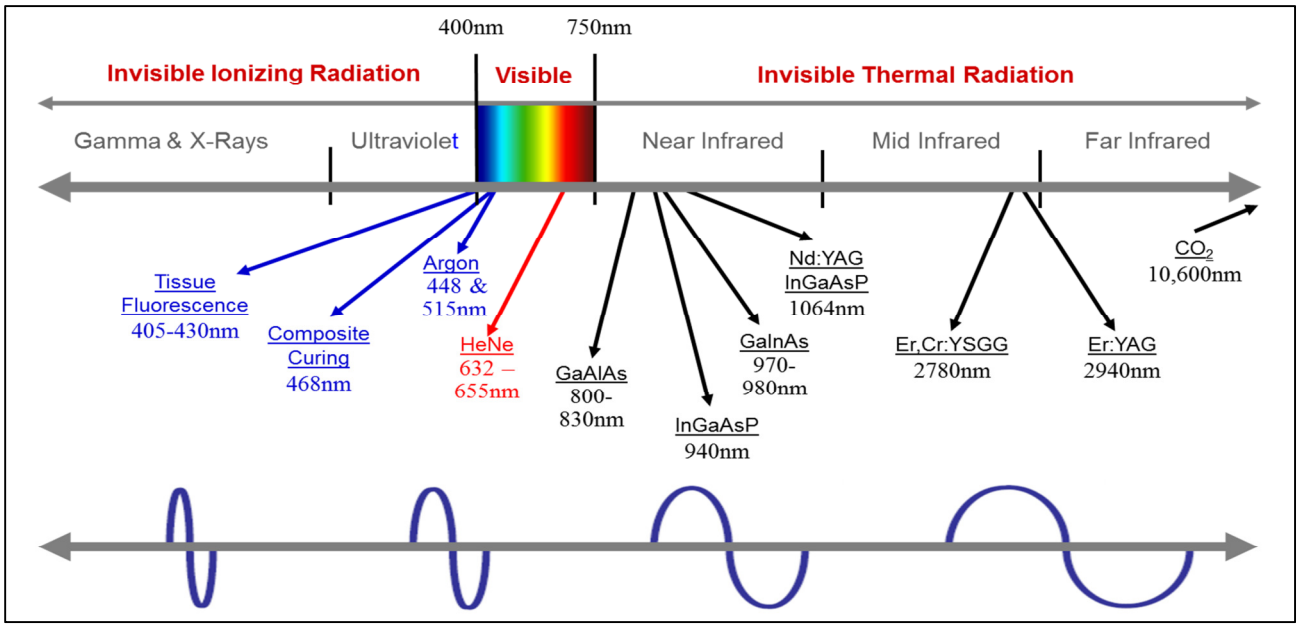
3% at 810nm
15% at 1064nm
35% at 980nm

Cecchetti W, Guazzieri C, Tasca A, Dal Bianco M, Zattoni F, Pagano F
980 nm Diode Laser and Fiber Optic Resectoscope in Endourological Surgery
European Biomedical Optics Week, BiOS Europe '96

Light Absorption of Mucosa for the Near Infrared (NIR) Laser Range



Wavelengths of Light Energy Used in Dentistry on the Electromagnetic Spectrum



Active Mediums & Wavelengths of Surgical Dental Lasers

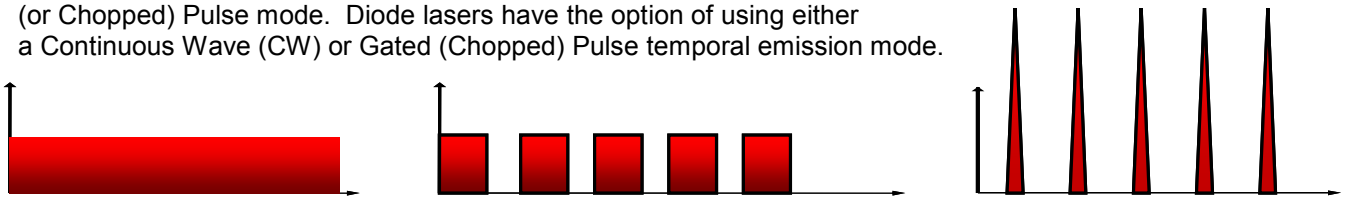
Active Medium	Wavelength(s)
▪ Argon	488-515 nm
▪ Diode	630-1064 nm
• HeNe	630-655 nm
• GaAlAs	805-830 nm
• InGaAsP	940 nm
• GaInAs	970-980 nm
• InGaAsP	1064 nm
▪ Nd:YAG	1064 nm
▪ Erbium,Cr:YSGG	2780 nm
▪ Erbium:YAG	2940 nm
▪ CO_2	10,600 nm

Water Content By Percentage (%) in Biological Components

Component / Tissue	Percentage of Water
Mucosa	70%
Skin	70%
Blood	83%
Cartilage	75%
Bone	10-30%
Dentin	12%
Enamel	1-3%

Temporal Emission Modes

Temporal Emission Mode -Managing tissue interaction by controlling the amount of time that laser energy interacts with the tissue, by allowing or not allowing time for the remaining tissue to cool between the pulses of energy being emitted by the laser. The 3 basic temporal emission modes used in dentistry are Continuous Wave (CW), Gated (or Chopped) Pulse, and Free Running Pulse. All the other terms used are variations of the Gated (or Chopped) Pulse mode. Diode lasers have the option of using either a Continuous Wave (CW) or Gated (Chopped) Pulse temporal emission mode.



Continuous Wave (CW) **Gated (or Chopped) Pulse** **Free Running Pulse**

Thermal Relaxation Time (TRT) -The time when the laser energy is not being emitted (or is off). The purpose of the thermal relaxation time (TRT) is to give the surrounding tissue (the non target tissue) time to cool between the pulses of laser energy thus minimizing the collateral damage and the zones of thermal necrosis and thermal conduction. The longer the TRT the more tissue cooling that occurs.

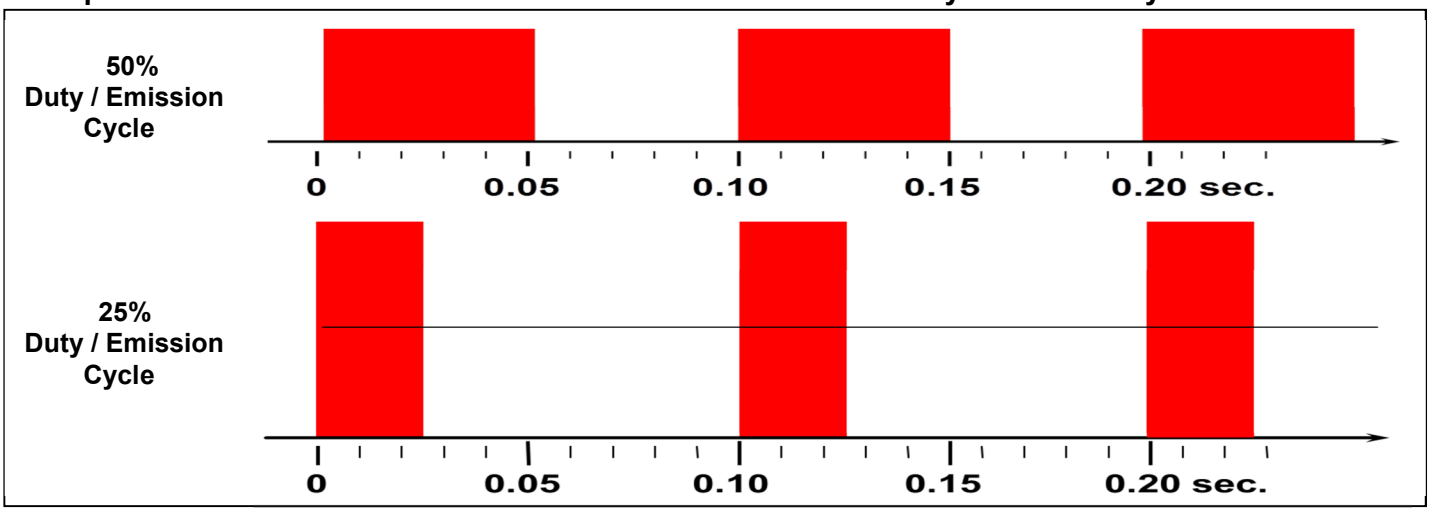
- **Continuous Wave (CW) Mode -Does NOT allow for any Thermal Relaxation Time (TRT)**
  - CW has the greatest amount of collateral damage and creates the largest zones of thermal necrosis and thermal conduction and therefore has the greatest amount of coagulation.
- **Free Running Pulse Mode** -Provide a long and excellent Thermal Relaxation Time (TRT)
- **Gated (or Chopped) Pulse Mode - Does allow for Thermal Relaxation Time (TRT)**
  - **It creates considerably less thermal damage when compared to Continuous Wave (CW).**
  - The 980nm diode SIROLaser provides the ability to use water or a liquid for convection cooling and can further reduce the collateral heat spread and damage. When used in a Gated Pulse Mode provides for an even better result by minimizing the zones of thermal necrosis and thermal conduction.

Duty Cycle (Emission Cycle) –The temporal duty cycle (often referred to as an emission cycle) is the percentage (%) of time that the laser is Emitting Laser Energy vs. the Thermal Relaxation Time (TRT) within a single pulse. Simply put, it is the percentage of time the laser is on vs. off per pulse cycle.

Duty Cycle (Emission Cycle) and the Value of Controlling It

An adjustable duty cycle allows the clinician to adjust the duty percentage of time that the energy is being emitted from 1 to 100% of the emission or pulse cycle. This allows for maximum control of the Thermal Relaxation Time (TRT) by extending the TRT as long as desired or even completely eliminating it. This enables the practitioner to accomplish the ideal treatment objective desired and greatly improved outcomes.

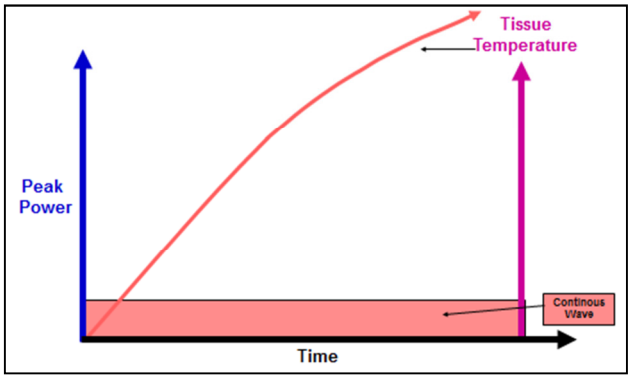
A Comparison of the Thermal Relaxation Time of a 50% and 25% Duty / Emission Cycle



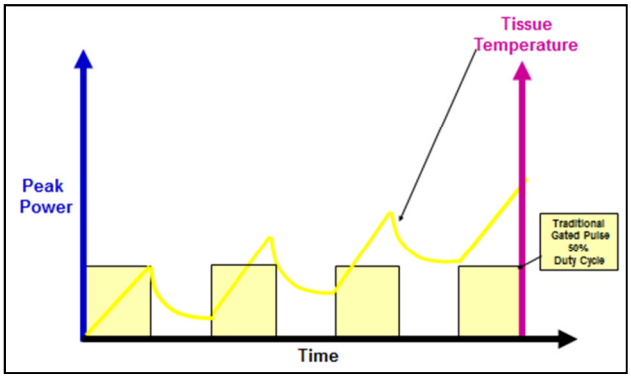
Temporal Emission Modes

(Continued)

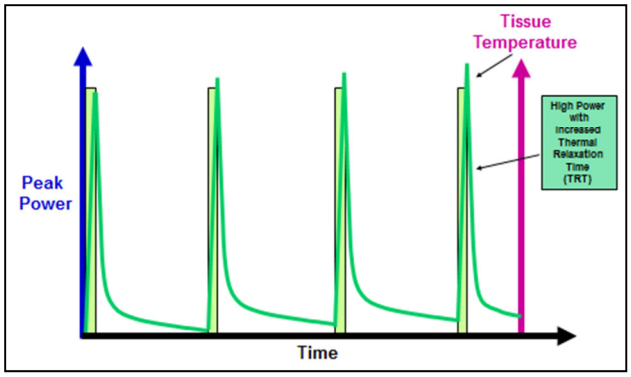
Continues Wave Temporal Mode
Notice the Continuous Rise in Tissue Temperature
(Solid Red Line)



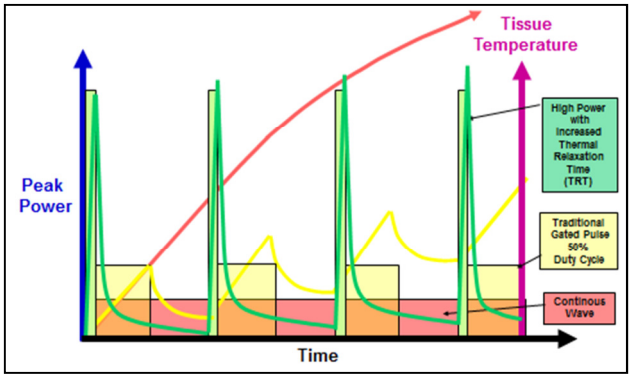
Gated Pulsed Temporal Mode 50% Duty Cycle
Notice the Rise & Fall in Tissue Temperature
(Zig-Zag Yellow Line)



Gated Pulsed Temporal Mode 12% Duty Cycle
Notice the Minimal Rise in Tissue Temperature
(Zig-Zag Green Line)



Comparison of Different Temporal Modes
Notice the Difference in Tissue Temperature
Between Red – Yellow – Green Lines



Comparison of Different Temporal Pulse Modes and Duty / Emission Cycle Effects on Coagulation

Free Running Pulsed or Gated Pulsed 10% Duty Cycle	Gated Pulsed 25% Duty Cycle	Gated Pulsed 50% Duty Cycle	Gated Pulsed 75% Duty Cycle	Continuous Wave
No Coagulation				**Maximum Coagulation**
Least Amount of Collateral Thermal Damage				**Most Amount of Collateral Thermal Damage**

Continuous Wave (CW) Mode Will Provide
Maximum Coagulation and Cause the Most Thermal Damage

Laser Device Specifications
&
Worksheets for Comments & Notes

Use the following pages to record
your thoughts and comments on your experience with each device

For further information and details on these laser devices you can visit their booths on the exhibit floor or contact the companies through their websites and telephone number listed with each device.

For additional information on the use of lasers in dentistry contact the:

Academy of Laser Dentistry

www.LaserDentistry.org

Telephone: 954-346-3776

The following are the devices used today in our hands-on workshop:

Laser Model:	**Waterlase MD Turbo**
Website & Telephone:	www.Biolase.com
Primary Function:	Hard and Soft Tissue Procedures
Wavelength & Medium:	2780 nm Er,Cr:YSGG
Max. Average Power:	8 Watts (Pulse Energy 0-300 mJ)
Nominal Ocular Hazard Distance (NOHD)	2 inches (5 cm)
Temporal Modes:	Free Running Pulsed (10-50 Hz)
Duty Cycle / Pulse Duration:	60 & 700 µsec
Delivery System:	Optical fiber
Tip Design:	Multi use and single use tips
Control Mechanism:	Wireless Foot Control
Powered By:	110v AC
Training / Education:	Several options available
Warranty:	1 Year
Purchased Through:	Henry Schein, or Benco, or Direct from Manufacturer

Mfg: **Biolase Technology, Inc.,**
800-645-6594

Comments:

Laser Model: **ezLase** Mfg: **Biolase Technology, Inc.,**

Website & Telephone: www.Biolase.com 800-645-6594

Primary Function: All Soft Tissue Procedures,

Wavelength & Medium: 940 nm Diode

Max. Peak Power: 7 Watts

Nominal Ocular Hazard Distance (NOHD) 38 feet 8 inches (11.8 meters)

Temporal Modes: Continuous Wave and Pulsed

Duty Cycle: Variable

Delivery System: Optical fiber

Tip Design: Single Use Tip

Control Mechanism: Wireless Foot Control

Powered By: 110v AC

Training / Education: DVD and Available for purchase

Warranty: 2 Years

Purchased Through: Henry Schein, or Benco, or Direct from Manufacturer

Comments:

Laser Model: **iLase** Mfg: **Biolase Technology, Inc.,**

Website & Telephone: www.Biolase.com 800-645-6594

Primary Function: All Soft Tissue Procedures

Wavelength & Medium: 940 nm Diode

Max. Peak Power: 5 Watts

Nominal Ocular Hazard Distance (NOHD) 8 feet 7 inches (2.61 meters)

Temporal Modes: Continuous Wave and Pulsed

Duty Cycle: Variable

Delivery System: Optical Fiber

Tip Design: Single Use Tip

Control Mechanism: Finger switch

Powered By: Rechargeable Li-Ion Battery

Training / Education: DVD and Available for purchase

Warranty: 2 Years

Purchased Through: Henry Schein, or Benco, or Direct from Manufacturer

Comments:

Laser Model: **SIROLaser Advance**

Mfg: **Sirona Dental Systems**

Website & Telephone: www.SIROLaserTraining.com 800-659-5977

Primary Function: All Soft Tissue Procedures
Wavelength & Medium: 970 nm Diode
Max Peak Power: 14 Watts
Nominal Ocular Hazard Distance (NOHD) 5 Feet (1.5 meters)
Temporal Modes: Continuous Wave & Pulsed
Duty Cycle: Variable from 1-100%
Delivery System: Optical fiber (320 micron & 200 micron)
Tip Design: Single Use Canula & Reusable Autoclavable Fiber
Control Mechanism: Finger Switch (Optional Wireless Foot Pedal)
Powered By: Rechargeable Battery Powered (4 Hours) or 110v AC
Training / Education: 8 Credit Hour Hands-On Device Specific Training Included
Warranty: 2 year
Purchased From: Major Dental Dealers

Comments:

Laser Model: **DioDent Micro 980**

Mfg: **Hoya ConBio, Inc.,**

Website & Telephone: www.ConBio.com 800-532-1064

Primary Function: All Soft Tissue Procedures
Wavelength & Medium: 980 nm Diode
Max Peak Power: 3.5 Watts
Nominal Ocular Hazard Distance (NOHD) 13 Feet
Temporal Modes: Continuous Wave & Pulsed
Duty Cycle: 50% Fixed Duty Cycle
Delivery System: Optical fiber 300 or 400 microns
Tip Design: Disposable Canulas
Control Mechanism: Tethered foot control
Powered By: 110 vAC
Training / Education: Online and free full day off site training
Warranty: 2 years
Purchased From: Direct from manufacturer

Comments:

Laser Model: **SL3 – Soft Tissue Laser** Mfg: **Discus Dental**

Website & Telephone: www.discusdental.com/lasers 800-217-8822

Primary Function: All Soft Tissue Procedures

Wavelength & Medium: 808 nm Diode

Max Peak Power: 3 Watts

Nominal Ocular Hazard Distance (NOHD): 4 feet 8 inches (1.43 Meters)

Temporal Modes: Continuous Wave & Pulsed at 10Hz

Duty / Emission Cycle: Fixed 50% Duty Cycle (50 msec pulse in pulsed mode)

Delivery System: Optical fiber (400 micron)

Tip Design: Single Use 400 Micron Fiber Tip

Control Mechanism: Wireless Foot Pedal (2.4 GHz RF)

Powered By: 9 VDC +/- 5%, 3.5A or Rechargeable Li-Ion Battery

Training / Education: Full day 8-CE course through Advanced Laser Training, Inc

Warranty: 2 Years

Purchased From: Direct from Manufacturer

Laser Model: **NV Microlaser** Mfg: **Discus Dental**

Website & Telephone: www.discusdental.com/lasers 800-217-8822

Primary Function: All Soft Tissue Procedures

Wavelength & Medium: 808 nm Diode

Max Peak Power: 2 Watts

Nominal Ocular Hazard Distance (NOHD): 3 feet (90.2cm)

Temporal Modes: Continuous Wave & Pulsed at 10Hz

Duty / Emission Cycle: Fixed 50 % Duty Cycle (50 msec pulse in pulsed mode)

Delivery System: Optical fiber (400 micron)

Tip Design: Single Use 400 Micron Fiber Tip

Control Mechanism: Wireless Foot Pedal (2.4 GHz RF)

Powered By: Rechargeable Lithium Ion Battery (Approximately 10 short procedures on full charge)

Training / Education: Full day 8-CE course through Advanced Laser Training, Inc

Warranty: 1 Year

Purchased From: Direct from Manufacturer

Comments:

Laser Model: **Odyssey Navigator** Mfg: **Ivoclar Vivadent**

Website & Telephone: www.IvoclarVivadent.com/odyssey 800-533-6825

Primary Function: All Soft Tissue Procedures
Wavelength & Medium: 810 nm Diode
Max Peak Power: 3 Watts
Nominal Ocular Hazard Distance (NOHD) 13 Feet (154.55 inches)
Temporal Modes: Continuous Wave & Pulsed
Duty Cycle: 50% Fixed Duty Cycle
Delivery System: Optical fiber (400 micron)
Tip Design: Single Use 400 Micron Fiber Tip in 3.5mm or 6mm lengths
Control Mechanism: Wireless Foot Pedal
Powered By: Rechargeable Battery Powered (45 minutes) or 110v AC
Training / Education: Full-day training session at an Ivoclar Vivadent training center
Warranty: 2 years for laser, 1 year for battery, 6 months for fiber optic handpiece
Purchased From: Major Dental Dealers

Comments:

Laser Model: **Odyssey 2.4G Diode Laser** Mfg: **Ivoclar Vivadent**

Website & Telephone: www.IvoclarVivadent.com/odyssey 800-533-6825

Primary Function: All Soft Tissue Procedures
Wavelength & Medium: 810 nm Diode
Max Peak Power: 5 Watts
Nominal Ocular Hazard Distance (NOHD) 10 Feet (119.72 inches)
Temporal Modes: Continuous Wave & Pulsed
Duty Cycle: 50% Fixed Duty Cycle
Delivery System: Optical fiber (400 micron)
Tip Design: Disposable Canulas
Control Mechanism: Wireless Foot Pedal
Powered By: 110v AC
Training / Education: Full-day training session at an Ivoclar Vivadent training center
Warranty: 2 years
Purchased From: Major Dental Dealers

Comments: