

**LASER LECTURES, LTD.
STANDARD PROFICIENCY
CERTIFICATION COURSE
TRAINING MANUAL**

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WARNING!

This 2 day ALD Certification Course is based 100% on the PEER-REVIEWED LITERATURE. This course is NOT based on manufacturer's exaggerations or claims. This course is NOT based on what people have written in Dental Town or Dental Products Reports or Dental Economics or other free non-peer-reviewed magazines. There will be NO OPINIONS expressed in this course – there WILL BE a discussion of the MOST RECENT peer-reviewed literature.

PLEASE DO NOT return to your offices and speak to your colleagues/partners (or in the case of hygienists, your bosses) and say that Dr. Convissar SAID.....because the ONLY THING that Dr. Convissar will be saying is what is proven in the peer-reviewed literature.

If you have a problem or a disagreement with anything I say, please DO NOT take it up with Dr. Convissar – do not blame Dr. Convissar for what the peer-reviewed literature says. Please take it up with the authors of the papers that Dr. Convissar quotes during the course. Dr. Convissar is here to TEACH.....NOT TO SELL lasers.

Thank you

Educational Objectives and Learner Outcomes:

The faculty of this course consists of full-time “wet-fingered” practicing dentists. The educational objective of this course is quite simple: to prepare the student for practice of laser dentistry. The student will have a complete clinical knowledge of the following wavelengths uses in dentistry: Erbium, Diode, CO₂, Nd:YAG. Each one of these wavelengths will be discussed in detail in the following disciplines:

- 1) Surgical, Non Surgical and Regenerative Periodontics
- 2) Fixed Prosthetics
- 3) Implantology
- 4) Removable Prosthetics and Pre-Prosthetic Care
- 5) Pediatrics/Orthodontics
- 6) Oral Surgery/Oral Medicine/Oral Pathology
- 7) Cosmetics/Esthetics
- 8) Endodontics
- 9) Neonatal Dentistry
- 10) Hard Tissue Procedures
- 11) Laser Physics/Laser-Tissue Interaction
- 12) Laser Practice Management

Upon completion of this course, passing the clinical and written examinations, and fulfilling the on-line requirements of the Academy of Laser Dentistry, Standard Proficiency Certification will be awarded to the student. Though this course contains all of the theoretical knowledge necessary to pass the examinations, the main thrust of this course is clinical dentistry. The educational objective is to produce a dentist well-versed in the field of laser dentistry.

OUTLINE OF CURRICULUM

- I) LASER – commercial/entertainment/medical/industrial

- II) Periodontics
 - A) Microbiologic rationale for laser periodontal treatment
 - B) Scaling/root planing/curettage/pocket decontamination
 - C) Flap surgery
 - 1) tissue tags
 - 2) furcations
 - 3) sterilization of surgical site
 - D) Free gingival graft surgery/Vestibuloplasty
 - E) Frenectomy
 - F) Gingivectomy/gingivoplasty
 - G) Guided tissue regeneration/laser de-epithelialization
 - H) Root surface modification – osseous regeneration/fibroblast reattachment

- III) Fixed prosthetics
 - A) Soft tissue crown and bridge management
 - B) Crown lengthening
 - C) Troughing
 - D) Ovate pontic site formation

- IV) Implantology
 - A) Second stage recovery
 - B) Peri-implantitis
 - C) Soft tissue modification around implant collars/troughing

- V) Removable Prosthetics/Preprosthetic Surgery
 - A) Epulis Fissuratum
 - B) Denture stomatitis
 - C) Flipper placement/ridge modification
 - D) Tuberosity reduction
 - E) Torus removal

- VI) Pediatrics/Orthodontics
 - A) Exposure of teeth to aid eruption
 - B) Soft tissue management of orthodontic gingival pathologies
 - C) Neonatal Dentistry

- VII) Oral Surgery/Oral Medicine/Oral Pathology
 - A) Biopsy
 - B) Aphthous/herpetic lesions
 - C) Operculectomy
 - D) Apicoectomy
 - E) Flap Procedures

- VIII) Cosmetics/Esthetics
 - A) Bleaching
 - B) Soft tissue modification around laminate preparations
 - C) Altered passive eruption
 - D) Smile Lift Procedures

- IX) Endodontics
 - A) Canal debridement
 - B) Canal instrumentation
 - C) Removal of smear layer
 - D) Canal sterilization
 - E) Sealing accessory canals
 - F) Effects on PDL
 - G) Effects on RC Cements

- X) Hard Tissue Procedures
 - A) Desensitization
 - B) Caries Removal
 - C) Osseous Procedures

- XI) Physics/Fundamentals
 - A) History of development
 - B) Bohr Model
 - C) Stimulated Emission
 - D) Electromagnetic Spectrum
 - 1) Argon
 - 2) Diodes
 - 3) Nd.YAG
 - 4) Erbiums
 - 5) CO2
 - 6) Other Wavelengths
 - E) Properties of Laser Light
 - 1) Collimation
 - 2) Coherence
 - 3) Monochromatism
 - F) Laser Cavity
 - 1) Active Medium
 - 2) Pumping Mechanism
 - 3) Optical Resonator
 - G) Delivery Systems
 - 1) Fiber optic cable
 - 2) Wave Guide
 - 3) Articulated Arms
 - H) Laser/tissue interaction
 - 1) scatter
 - 2) absorption
 - 3) reflection
 - 4) transmission

- I) Spot Size/Temporal Emission Modes
 - 1) CW
 - 2) Pulsed
 - 3) Gated
 - 4) Power
 - 5) Energy
 - 6) Power Density
 - 7) Fluence
 - 8) Hz
 - J) Photothermal / Photoacoustic/ Photochemical Effects
 - 1) vaporization
 - 2) protein denaturing
 - 3) necrosis
 - 4) coagulation
 - 5) spallation
 - K) Safety
 - 1) Glasses/goggles
 - 2) Tissue Protection
 - 3) Plume masks
 - 4) Signage
 - 5) Laser Safety Officer/OSHA/Mechanisms
 - 6) Federal Regulations/ANSI Codes/CDRH
 - L) Advantages/Summary
- XII) Written Examination
- XIII) Hands-on clinical simulation
- 1) Gingival troughing- pig jaw
 - 2) Crown lengthening (soft and hard tissue) – pig jaw
 - 3) Biopsy (soft tissue) – pig jaw
 - 4) Gingivectomy – pig jaw
 - 5) Caries removal in enamel and dentin – extracted tooth
 - 6) Preventative Resin Restoration – extracted tooth
 - 7) Assistance in raising of a flap – pig jaw
 - 8) Laser Device Set-up
 - 9) Laser Delivery System Set-up
 - 10) Laser Safety Features
 - 11) Laser Delivery System Breakdown
 - 12) Laser System Sterilization
- XIII) Clinical Proficiency Simulation Examination

- XIV) Practice Management
 - A) Staff Training
 - 1) record keeping
 - 2) adverse effects log
 - 3) marketing
 - 4) informed consent
 - 5) payment arrangements
 - a) insurance submission
 - b) non-coverage of procedures
 - B) Patient Education
 - C) Ethics
 - 1) advertising
 - 2) malpractice
 - 3) jurisprudence

- XV) Research
 - A) OCT
 - B) Caries Resistance
 - C) Calculus removal
 - D) New Wavelengths
 - E) LLLT
 - F) Fluorescence

- XVI) Course Evaluation/Delivery of Certificates of Attendance

STANDARD PROFICIENCY TEST

THERE IS ONLY ONE CORRECT ANSWER FOR EACH QUESTION – PLEASE SELECT THE ONE CHOICE THAT YOU BELIEVE BEST ANSWERS THE QUESTION

Minimum Passing Grade for Certification: 75%

- 1) Lasers have been proven to destroy periodontal pathogenic bacteria:
 - a) In Vivo
 - b) In Vitro
 - c) Both of the above
 - d) Neither of the above

- 2) What are the implications of laser proteolytic action in periodontal pockets?
 - a) Cessation of inflammatory response
 - b) Cessation of periodontal breakdown
 - c) Restoration of periodontal health
 - d) All of the above

- 3) Guided tissue regeneration is most successful with
 - a) Membranes only
 - b) Membranes combined with bone graft
 - c) Laser only
 - d) Laser combined with bone graft

- 4) Laser deepithelialization for guided tissue regeneration has been proven histologically in:
 - a) Monkeys
 - b) Beagles
 - c) Humans
 - d) All of the above

- 5) In full thickness flap surgery, lasers may be used for:
 - a) Debridement of tissue tags
 - b) Cleaning out of furcations
 - c) Reduction of bacteria at surgical site
 - d) All of the above

- 6) Laser use in fixed prosthetics include:
 - a) Gingival troughing
 - b) Formation of ovate pontic sites
 - c) Soft tissue crown lengthening
 - d) All of the above

- 7) Use of lasers for exposure of subgingival class V caries includes:
 - a) Absorption of crevicular fluid
 - b) Creation of a clear, dry field
 - c) Removal of gingival tissue interfering with operative procedure
 - d) All of the above

- 8) A hypertensive patient with a pacemaker/defibrillator who takes aspirin daily would be best served by:
 - a) Electrosurgical periodontal surgery
 - b) Scalpel periodontal surgery
 - c) Laser periodontal surgery
 - d) Any of the above

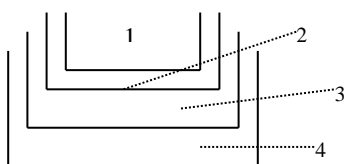
- 9) Which of the following lasers has been proven in multiple peer-reviewed studies to result in the formation of new bone in treatment of peri-implantitis?
- Nd.YAG
 - CO₂
 - Diodes
 - Erbiums
- 10) Lasers can be useful in:
- Flap surgery
 - Guided tissue regeneration
 - Frenectomy
 - All of the above
- 11) Lasers have been successfully used in:
- Second stage recovery of implants
 - Soft tissue modification around implant collars
 - Both of the above
 - Neither
- 12) Lasers have been successfully used in:
- Treatment of epulis fissuratum
 - Assistance in torus reduction
 - Soft tissue tuberosity reduction
 - All of the above
- 13) The advantages of laser treatment of epulis fissuratum compared to scalpel include:
- Less shrinkage of the surgical wound
 - Less keloid formation
 - Both of the above
 - Neither
- 14) Which of the following lasers is contraindicated for use on gingiva surrounding primary (deciduous) teeth?
- CO₂
 - Diode
 - Nd.YAG
 - None of the above
- 15) Which of the following lasers is contraindicated for operative dentistry on primary teeth?
- Diode
 - Er.YAG
 - Er.Cr.YSGG
 - Nd.YAG
- 16) Which of the following lasers may be used to aid in surgical exposure of primary and permanent teeth?
- CO₂
 - Nd.YAG
 - Diode
 - All of the above
- 17) Which of the following lasers is contraindicated around orthodontic appliances?
- CO₂
 - Nd.YAG
 - Diode
 - None of the above

- 18) Lasers are contraindicated for use in:
- a) Aphthous ulcers
 - b) Mucocoeles
 - c) Nicotinic Stomatitis
 - d) None of the above
- 19) The advantage of lasers over scalpels in operculectomy include:
- a) Antibacterial effect of laser energy
 - b) Less need for post-operative medications
 - c) Better hemostasis
 - d) All of the above
- 20) The advantages of lasers over scalpels in biopsy include:
- a) Better hemostasis
 - b) Less need for post-operative medication
 - c) Both of the above
 - d) Neither
- 21) During a biopsy procedure, lasers may:
- a) Char the specimen
 - b) Have no effect on the pathologist's ability to read the specimen
 - c) Either of the above
 - d) None of the above
- 22) Lasers are contraindicated in treatment of which of the following patients:
- a) Pregnant patients
 - b) HIV positive patients
 - c) Hepatitis patients
 - d) None of the above
- 23) Plume studies have found the following in laser plume:
- a) Formaldehyde
 - b) Benzene
 - c) DNA
 - d) All of the above
- 24) For an Incision and Drainage procedure (I & D), lasers are
- a) Indicated due to their bactericidal properties
 - b) Contraindicated due to the possibility of the spread of infection
 - c) Neither superior nor inferior to scalpel
 - d) None of the above
- 25) Lasers are contraindicated for:
- a) Tongue lesions
 - b) Lesions due to sexually transmitted diseases
 - c) Malignant lesions
 - d) None of the above
- 26) The advantages of soft tissue laser use in apicoectomy include:
- a) Removal of the apical granuloma/cyst
 - b) Hemostasis at the surgical site
 - c) Both of the above
 - d) Neither

- 27) Hard tissue lasers are indicated for:
- a) Class I decay
 - b) Class V decay
 - c) Root caries in geriatric patients
 - d) All of the above
- 28) Hard tissue lasers may be used for:
- a) Caries removal
 - b) Etching
 - c) Both of the above
 - d) Neither
- 29) In full thickness flap procedures, lasers may be used to:
- a) Desensitize root surfaces
 - b) Prepare the root surface for reattachment of fibroblasts
 - c) Both of the above
 - d) Neither
- 30) Hard tissue lasers:
- a) cannot cut through the dentin/enamel junction without causing discomfort
 - b) are less specific for decay removal than air abrasion
 - c) Both of the above
 - d) Neither
- 31) The CO₂ and Nd:YAG lasers were invented in:
- a) 1950's
 - b) 1960's
 - c) 1970's
 - d) 1980's
- 32) Laser light is:
- a) Collimated
 - b) Coherent
 - c) Monochromatic
 - d) All of the above
- 33) Active media:
- a) Give the lasers their name
 - b) Can be solid, liquid, or gas
 - c) Can be electronic circuits
 - d) All of the above
- 34) All lasers need an excitation source to create a(n)
- a) Optical resonator
 - b) Population inversion
 - c) Lasing medium
 - d) All of the above
- 35) Excitation sources for lasers include:
- a) Radio frequency
 - b) Light
 - c) Both
 - d) Neither

- 36) Power density increases as spot size
- Increases
 - Decreases
 - Power density is never affected by spot size
 - Can increase or decrease, depending on the delivery system of the laser
- 37) Therapeutic laser/soft tissue interactions include:
- Absorption
 - Reflection
 - Transmission
 - All of the above
- 38) The relationship between wavelength and energy is:
- Direct
 - Inverse
 - There is no relationship between wavelength and energy
 - Dependent upon which part of the electromagnetic spectrum the wavelength is found
- 39) Scattering of laser energy is:
- Important in laser composite curing
 - The reason safety glasses are worn in the operator
 - Produced by all laser wavelengths to the same extent during soft tissue surgery
 - All of the above
- 40) A Joule is a measurement of:
- Energy
 - Power
 - Fluence
 - Power Density
- 41) In order to coagulate a bleeding site during surgery, the surgeon should
- Increase the power
 - Decrease the power
 - Move closer to the tissue
 - Change from continuous delivery to pulsed delivery

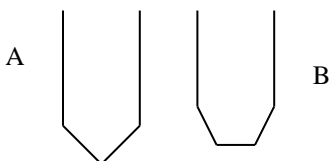
For questions 42-45, please refer to the illustration of the surgical site below:



- 42) The area labeled #1 is the zone of
- Necrosis
 - Coagulation
 - Vaporization
 - Normal tissue
- 43) The area labeled #2 is the zone of:
- Necrosis
 - Coagulation
 - Vaporization
 - Normal tissue

- 44) The area labeled # 3 is the zone of:
- Necrosis
 - Coagulation
 - Vaporization
 - Normal tissue
- 45) Laser parameters that are preset by the manufacturer
- Are the best settings to use for every patient
 - Are only suggestions for starting points
 - Should be modified according to the tissue biotype
 - Two of the above

For questions # 46-49, please refer to the illustration below. Assume 5W of power is going through each tip



- 46) Beam A will deliver a _____ cut compared to Beam B
- Shallower, Wider
 - Shallower, Narrower
 - Deeper, Wider
 - Deeper, Narrower
- 47) To create the same incision at the tissue surface, you can:
- Move Beam A closer to the tissue (keep B where it is)
 - Move Beam A further from the tissue (keep B where it is)
 - Move Beam B further from the tissue (keep A where it is)
 - Two of the above
- 48) The difference at the tissue surface between Beam A and Beam B can be described in terms of:
- Power density
 - Fluence
 - Energy
 - Two of the above
- 49) If bleeding occurs during a procedure, which of the following would help coagulate the surgical site?
- Move Beam A away from tissue surface
 - Move Beam B away from tissue surface
 - Both of the above would create coagulation
 - Moving the beams would not affect coagulation
- 50) Protective eyewear is MANDATORY for the following personnel in the operatory:
- The dentist
 - The assistant
 - The patient
 - All of the above
- 51) An Adverse Report should be filed with the FDA
- Only when a malpractice suit is to be filed
 - Only when a patient is seriously injured
 - At the discretion of the dentist
 - Whenever the laser fails to function properly and causes harm

- 52) Laser Safety Officers are necessary
- Only in hospitals
 - Only in facilities with more than 10 employees
 - In any facility where a laser is used to treat patients
 - At the discretion of the laser owner
- 53) Which of the following statements regarding protective eyewear is true?
- All protective eyewear is interchangeable from one laser wavelength to another
 - Magnifying loupes and telescopes may be used in place of protective eyewear for all lasers
 - Erbium lasers do not need special safety glasses
 - None of the above
- 54) Which of the following devices is NOT standard emergency equipment on ALL lasers:
- Remote interlock
 - Emergency shut off switch
 - Circuit breaker
 - Covered foot pedal
- 55) Laser safety regulations require which of the following?
- Danger signs posted outside laser rooms
 - Side shields on safety glasses
 - Both
 - Neither
- 56) Surgical lasers are classified as which type of device?
- Class I
 - Class II
 - Class III
 - Class IV
- 57) The US Government agency responsible for governing the manufacturers of lasers is:
- Food and Drug Administration
 - U.S. Surgeon General
 - American National Standards Institute
- 58) Which of the following lasers has the shortest wavelength?
- Nd.YAG
 - CO₂
 - Diode
 - Er.YAG
- 59) Which of the following lasers is in the visible part of the spectrum:
- HeNe
 - Nd.YAG
 - Er.YAG
 - CO₂
- 60) Which of the following lasers has a gaseous active medium?
- HeNe
 - CO₂
 - Both
 - Neither

- 61) Which of the following laser wavelengths contains the most energy?
- Diode
 - CO₂
 - Er.YAG
 - Argon
- 62) Which of the following laser wavelengths cannot pass through conventional fiber optic cables?
- Er.YAG
 - Er.Cr.YSGG
 - CO₂
 - All of the above
- 63) Which of the following lasers may be manufactured with an articulating arm delivery system?
- Er.YAG
 - CO₂
 - Both
 - Neither
- 64) Which of the following lasers is classified as a free-running laser?
- Nd.YAG
 - CO₂
 - HeNe
 - All of the above
- 65) Which of the following lasers has an emission spectrum similar to the absorption spectrum of water?
- CO₂
 - Er.YAG
 - Nd.YAG
 - Two of the above
- 66) Which of the following lasers is well-absorbed by pigmented tissue?
- CO₂
 - Diode
 - Er.YSGG
 - HeNe
- 67) Which of the following lasers may be used in a CW (Continuous Wave) setting?
- CO₂ and Diode
 - Diode and Nd.YAG
 - Nd.YAG and Er.YAG
 - CO₂ and Nd.YAG
- 68) The CO₂ wavelength is absorbed by which part of the eye?
- Sclera
 - Cornea
 - Iris
 - Lens
- 69) The Nd.YAG wavelength is absorbed by which part of the eye?
- Sclera
 - Cornea
 - Iris
 - Retina

- 70) The American National Standards Institute recommends which of the following?
- a) Matte finished instruments should be used
 - b) Notifying OSHA of your purchase of a laser
 - c) Both of the above
 - d) Neither of the above
- 71) A significant contribution to control of laser plume in the dental operator is the use of:
- a) Any type of dental mask
 - b) Hi-speed suction
 - c) Laminar air flow
 - d) Saliva ejector
- 72) Which of the following affects the amount of thermal damage to the surrounding tissue?
- a) Vascularity
 - b) Thermal conductivity of the tissue
 - c) Effectiveness of absorption of the wavelength
 - d) All of the above
- 73) After each use, laser tips and fibers should be:
- a) Wiped down with CoeFoam (or CoeCide)
 - b) Wiped down with Alcohol Gauze
 - c) Autoclaved
 - d) Cleaned with Alcohol Gauze or CoeFoam, depending on if a soft or hard tissue procedure is being performed
- 74) Which of the following use similar fiber optic cables?
- a) Nd.YAG and Er.YAG
 - b) Nd.YAG and Diode
 - c) Er.YAG and Diode
 - d) None of the above
- 75) There is no difference between average and peak power in:
- a) FRP laser
 - b) Gated pulse mode
 - c) Superpulse mode
 - d) CW mode

COURSE NOTES

LASER - An acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.
Albert Einstein -1917. Schalow/Townes/Bell Labs & Columbia Univ. –1958. Maiman -
1960

Lasers are ubiquitous in the medical field – lasers are routinely used in ophthalmology, plastic surgery, ENT, gynecologic surgery, etc. Just about every dental patient is aware of the miracles of laser medicine. People use lasers every day – CD-ROM, DVD, and bar-code scanner. Its time for dentistry to get into the act!

Periodontics

Microbiologic Rationale for laser use:

Lasers have been shown in numerous studies to be bactericidal instruments (Rooney, et al; Henry, Dyer and Judy; Neill and Mellonig, Moritz). Since periodontal disease is a bacterial infection, removal of the biologic insult to the tissue (removal of the microorganisms) will restore the tissue to health. Bacteria secrete exo- and endo toxins – these toxins are enzymes (proteins) that break down periodontal tissue (hyaluronidase, collagenase, etc.). These toxins are denatured by the laser energy. Immune system interaction/response.

Flap Surgery/Free Gingival Graft Surgery/Frenectomy/Gingivectomy/Gingivoplasty

Most dentists can raise and suture flaps. The most demanding aspect of flap surgery is the debridement of tissue tags, especially in furcas and infrabony pockets. Lasers can be used to debride, and sterilize (as discussed above) the surgical site (Rossmann and Israel). The most painful site of free gingival graft surgery is usually the donor site (the palate or tuberosity area). Lasers can be used to palliate the donor site. A simple frenectomy can be performed bloodlessly without the need for sutures. All gingival surgeries can be performed bloodlessly, since lasers coagulate and cauterize as they cut. The field of vision is clear and unobscured by blood. Since lasers are bactericidal instruments, the possibility of infected surgical sites are much more remote with lasers than with cold steel. (Pecaro and Garehime). Drug-induced gingival hyperplasia (calcium-channel blocker, cyclosporine, or dilantin induced) can be treated easily and atraumatically with lasers (Pick).

Guided Tissue Regeneration

Lasers have been proven histologically in monkeys, beagles and humans to stimulate creation of new cementum and new bone. The technique of laser de-epithelialization, or laser assisted guided tissue regeneration has been proven to fill in furcas and create new bone and cementum with result superior to that of Goretex and other membrane techniques. Furcas have been filled in with over 2 mm of new attachment (Rossmann and Israel). Controlled studies showed laser guided tissue regeneration created 1.5 mm – 1.7 mm more new attachment when compared to non-lased control sites (Centy). Lasers can be used to prepare the root surface for reattachment of fibroblasts (Crespi)

Summary of Periodontal Therapy (Wigdor)

- 1) Bloodless – better field of vision – clear, dry field
- 2) Less possibility of infected surgical site
- 3) Less mechanical trauma to surgical site
- 4) Less psychological trauma to some patients
- 5) Less postoperative swelling and scarring
- 6) Minimal post-operative pain

Fixed Prosthetics/Removable Prosthetics/Implantology/Cosmetic and Esthetic Dentistry

The purpose of retraction cord is twofold: mechanical separation of the gingival tissue from the tooth, and absorption of crevicular fluid. Lasers do both: at low power, the laser can vaporize the crevicular fluid and remove a small amount of the inner epithelial lining, or dehydrate it enough so that there is a wide open sulcus ready for impression material to flow. Lasers can also be used for soft tissue crown lengthening, and removal of excess gingival tissue around implant healing caps/abutments/analogs before the pickup/impression is made. Lasers can be used for second stage implant surgery. Lasers can recontour edentulous areas to form ovate pontic sites (Rice). Uses of lasers in removable prosthetics includes soft tissue tuberosity removal; assistance in torus removal; removal of epulis fissuratum; treatment of denture stomatitis; recontouring of gingiva during placement of immediate insertion prostheses (Pogrel; Convissar and Gharemani), vestibuloplasty (Strauss). Lasers are extremely effective for treatment of peri-implantitis (Deppe). Lasers can be used in bleaching techniques; altered passive eruption as a solitary technique, and as part of laminate veneer placement (Sun).

Pediatrics/Orthodontics

Orthodontically induced gingival hyperplasia, and mouth-breathing-induced hyperplasia can be removed safely and effectively with lasers (Convissar, Diamond and Fazekas). Exposure of teeth to aid in eruption, operculectomy, and treatment of ankyloglossia have been documented (Parkins). Frenectomy in conjunction with orthodontic therapy to close diastemas. Laser fiberotomies to treat orthodontically rotated teeth. Lasers are increasingly being used in place of formocresol and other medications for pulpotomy (Elliot). Lasers in pediatric operative dentistry will be discussed with hard tissue procedures

Oral Surgery/Oral Medicine/Oral Pathology

An entire textbook has been written on this subject (Catone and Alling – see bibliography). Lasers can be utilized in just every aspect of this field – all incisional and excisional procedures, including biopsy and lesion removal; apicoectomy; flap procedures; hemostasis of vascular lesions (hemangioma); LAUP; cosmetic laser surgery; arthroscopic TMJ surgery (Strauss). Treatment of aphthous lesions (Convissar and Massoumi; Parkins; Colvard and Kuo). Operculectomy as a treatment for pericoronitis – a bacterial infection. Incision and drainage of bacterial infections – bactericidal properties of laser energy, as discussed in periodontal therapy section.

Hard Tissue Procedures

Pediatric, adolescent and adult operative dentistry can be performed with Erbium wavelengths. F.D.A. clearance is for all classes of caries – Class I – Class VI. Composite and glass ionomer restorations can be removed with lasers (Gimbel). Lasers can be contrasted with air abrasion: depth you can excavate without anesthesia; effectiveness with leathery decay. Spallation – laser/hard tissue interaction. Photoacoustics. Hard tissue crown lengthening.

Endodontics

Canal debridement/instrumentation/removal of smear layer/sterilization/sealing accessory canals/increasing adhesion of gutta percha to canal walls.

Laser Physics/Fundamentals

Einstein's theory of stimulated emission. The Bohr model discusses electron shells. Electrons within atoms may be raised to higher energy levels via absorption of energy. That energy is then emitted in the form of a photon. Because all of the photons come from the same source, the light is collimated, coherent and monochromatic. A laser cavity contains an active medium (solid, liquid, or gas – the active medium gives the laser its name – a CO₂ laser has CO₂ gas as its active medium, etc); pumping mechanism (to pump up the energy of the electrons to a higher energy shell, which will create a population inversion) and optical resonators (mirrors to collimate the laser beam). Electromagnetic spectrum – ultraviolet (invisible, ionizing part of the spectrum), visible (to the human eye), infrared (invisible non-ionizing). Continuous vs. pulsed delivery. Continuous wave CO₂ lasers are gated lasers thus delivering energy through a constant emission without interruption by depressing the pedal. Pulsed delivery transfers energy on to tissue in bursts, provided the laser is set on repeat mode. In UltraSpeed mode with continuous emission, the laser energy appears to be continuous wave. However, the pulse width and repetition rate governs the flow of UltraSpeed pulses. Gated pulses can be controlled by a shutter, superpulses and UltraSpeed are controlled via microprocessor. Power density and fluence: These terms describe the amount of density per sq. cm. One joule (measurement of density) = one watt (measurement of energy) x one second.

Fiber optic, waveguide and articulated arm delivery systems are the 3 systems utilized in dentistry. The laser beam can interact with tissue 4 ways: scatter (the beam of energy is scattered in underlying tissue); transmission (beam passes through the tissue with no therapeutic effect); reflection (beam is reflected without any interaction of the tissue – hence the need for safety glasses – without therapeutic effect on the target tissue); absorption (the energy is absorbed by the tissue, and a therapeutic effect is observed). To maximize absorption, select a wavelength that is maximally absorbed water. Different laser wavelengths have different absorption characteristics in varying tissue structures, i.e., water, hemoglobin, melanin and hydroxyapatite (HA).

CO₂ – highly absorbed by water, the primary component of oral mucosa, and a significant component of hard tissue structure (enamel, dentin, cementum, bone)

Nd:YAG – absorbed by pigmented tissue/melanin. The darker the tissue, the better absorbed the Nd:YAG beam

Er:YAG and **Er, Cr:YSGG** – well absorbed by water, absorbed by minerals in HA

Semiconductor Diode – absorbed by pigment

HeNe – used as an aiming beam on fiber-optic delivered lasers – also used for LLLT.

Argon – 2 wavelengths: 488nm for curing of composite materials (scatter is important) and 514 nm for surgical procedures. Very well absorbed by hemoglobin – perfect wavelength for hemangiomas and other vascular lesions

The wider the tip (fiber) at the tissue surface (spot size), the less power per sq. cm. of tissue. If you change from a wide tip to a narrow tip, you will increase the power per sq. mm. hitting the tissue. Use the minimum energy necessary to create the therapeutic effect. Laser energy causes a zone of vaporization, surrounded by a zone of necrosis, surrounded by a zone of coagulation, surrounded by normal tissue. Ideal treatment maximizes the zone of vaporization and minimizes the zone of necrosis.

Laser Safety

Glasses/goggles/masks/signage/plume avoidance/laser safety officer/wires on floor/inhalation anesthetics/adverse event reporting/FDA/ANSI.

Everyone in the operatory must wear eye protection. The eye protection is wavelength-specific. Different wavelengths require glasses with different optical densities. All safety glasses must have side shields. Patients must wear wavelength-specific goggles. Warning signs must be placed outside the treatment rooms describing the specific wavelength in use. Access to the treatment room must be limited during laser use. The staff must be aware of the potential of laser plume to cause illness. More definitive studies need to be done regarding laser plume. The literature is not definitive regarding infectivity of laser plume. Higher-filtration masks are highly recommended. Laser plume masks are available from most dental supply companies. TB masks are also acceptable. High-speed suction must always carry away as much plume as possible. If high-speed suction is not powerful enough, smoke evacuators must be used. Laser safety officers are responsible for the safe utilization of the device. Every office must delegate a staff member to be the laser safety officer. The officer is responsible for much of the paperwork regarding regulations of laser use – including familiarity with and adherence to ANSI and OSHA rules, laser safety training for new staff, insuring the laser is being operated safely, electrical cords are out of the way of foot traffic in the operatory, maintenance of the proper eyewear, operating manual. Combustible gases (nitrogen is combustible; oxygen supports combustion) must be kept out of the operatory during laser use. Individual private practitioners are strongly encouraged to report adverse effects of the laser to the FDA.

Safety equipment on laser: emergency shutoff; automatic cycle back to standby mode; key switch; remote interlock; foot pedal.

Summary

New technology/hi tech

Aseptic (“sterilizes”)

Hemostatic-Coagulates/Cauterizes

Precise/Controllable

All of the advantages discussed in each section are reviewed

SELECTED REFERENCES

One of the best reference sources for any topic in dentistry is the American Dental Association Library. The reference librarians will be glad to perform a literature search for you, and send you the results of the search. They will also photocopy any articles for you that the literature search discovers.

If you have a specific topic that you want information on, just tell the reference librarian the topic and they will do the rest.

Following is a list of specific topics in laser dentistry and key authors for a literature search:

- 1) Non-Surgical Periodontal Therapy/ADA Clinical Practice Guidelines – JADA July 2015..... Guided tissue regeneration/laser deepithelialization: J Rossmann, M. Israel,
- 2) Prosthetics: A Pogrel, R. Convissar, J. Rice
- 3) Oral Medicine: S. Silverman, R.A. Strauss
- 4) Pediatric Dentistry: F. Parkins, L. Kotlow
- 5) Caries removal: C. Gimbel, F. Parkins, R. Hibst
- 6) Oral Surgery: RA Strauss
- 7) Cosmetics/Esthetics: R. Reyto, G. Sun
- 8) Endodontics: A. Stabholz, N. Gutknecht, A. Mehl, F. Takeda
- 9) Implantology/Periimplantitis – Deppe

It is important to review the selected references with a critical eye. The fact that one particular wavelength has proven its therapeutic effect does not automatically mean that every wavelength produces the same therapeutic effect. The most striking example of this would be discussion of periodontal regeneration of osseous structure. There are more than ½ dozen papers on laser guided tissue regeneration (laser de-epithelialization) utilizing the CO2 wavelength. This wavelength has been shown in these papers to cause the formation of new periodontal attachment both in animal studies (monkeys, beagles) and in humans. Though there is anecdotal evidence and case studies discussing the formation of new attachment using other wavelengths (notably Nd:YAG and diode), it has yet to be proven histologically with animal studies, or with human studies. It is therefore impossible to extrapolate the results of a study performed with one laser wavelength to cover other laser wavelengths.

If you are connected to the internet, you can perform a literature search yourself either via the A.D.A. website, or via Medline (the National Library of Medicine's search engine), or any other number of medical library websites (grateful med, etc).

For an overall picture of the field of laser dentistry, the following textbooks are suggested:

- 1) Principles and Practice of Laser Dentistry 2nd edition by Convissar
Published by Elsevier/Mosby/Saunders. 800-545-2522 www.Elsevierhealth.com
Approximately 400 pages with over 1500 illustrations. This textbook is the standard textbook for all laser dentistry procedures.
- 2) Color Atlas of Tongue Tie and Lip Tie Laser Frenectomy – this is the first textbook of its kind anywhere in the world – a MUST READ for any health care practitioner who performs infant and neonatal dentistry. www.laserfrenectomybook.com
- 3) Lasers in Oral and Maxillofacial Surgery
G. Catone and C. Ailing, Editors
W.B. Saunders
This book was originally written for the oral and maxillofacial surgeon, but has excellent chapters on laser physics, laser-tissue interaction, and some basic techniques (biopsy, etc) that general practitioners can learn about. When first published, the book sold for over \$100. These days, it can be found on Amazon.com and other websites for about \$25. If you can find it, buy it!!

Developments in Laser Technology

1917 – Einstein's Principle of Stimulated Emission

1956 – Schalow & Townes – "Laser" Principle

1960 – Maiman – Ruby Laser

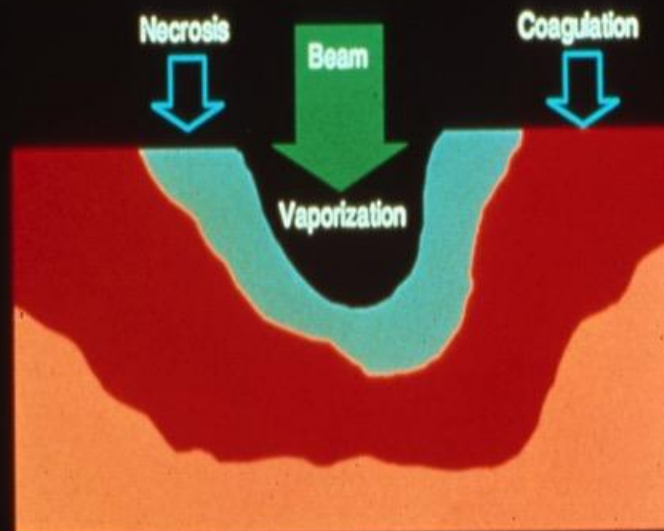
1962 – G.E developed first diode laser

1964 – Patel – CO₂ Laser

1964 Stern and Sognaes – Ruby Laser Vaporized Enamel

1965 Goldman and Goldman

Zones of Tissue Effect

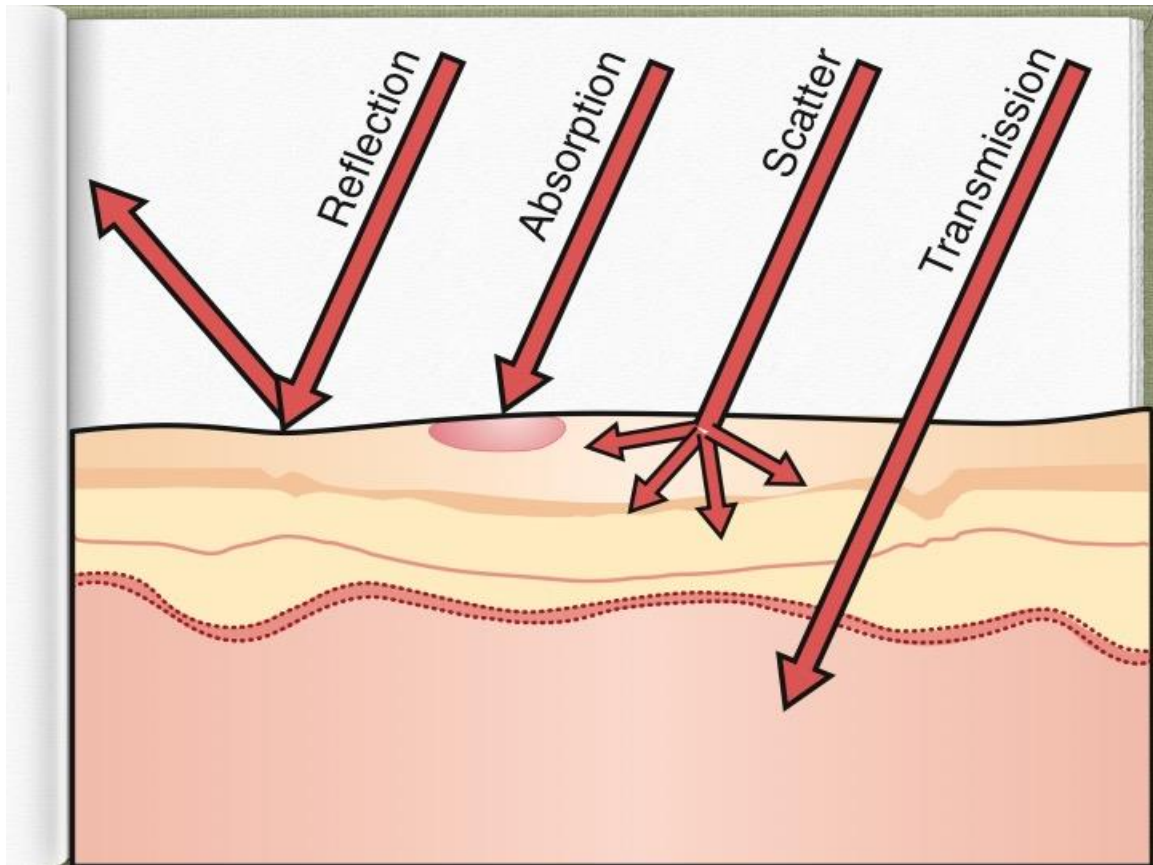


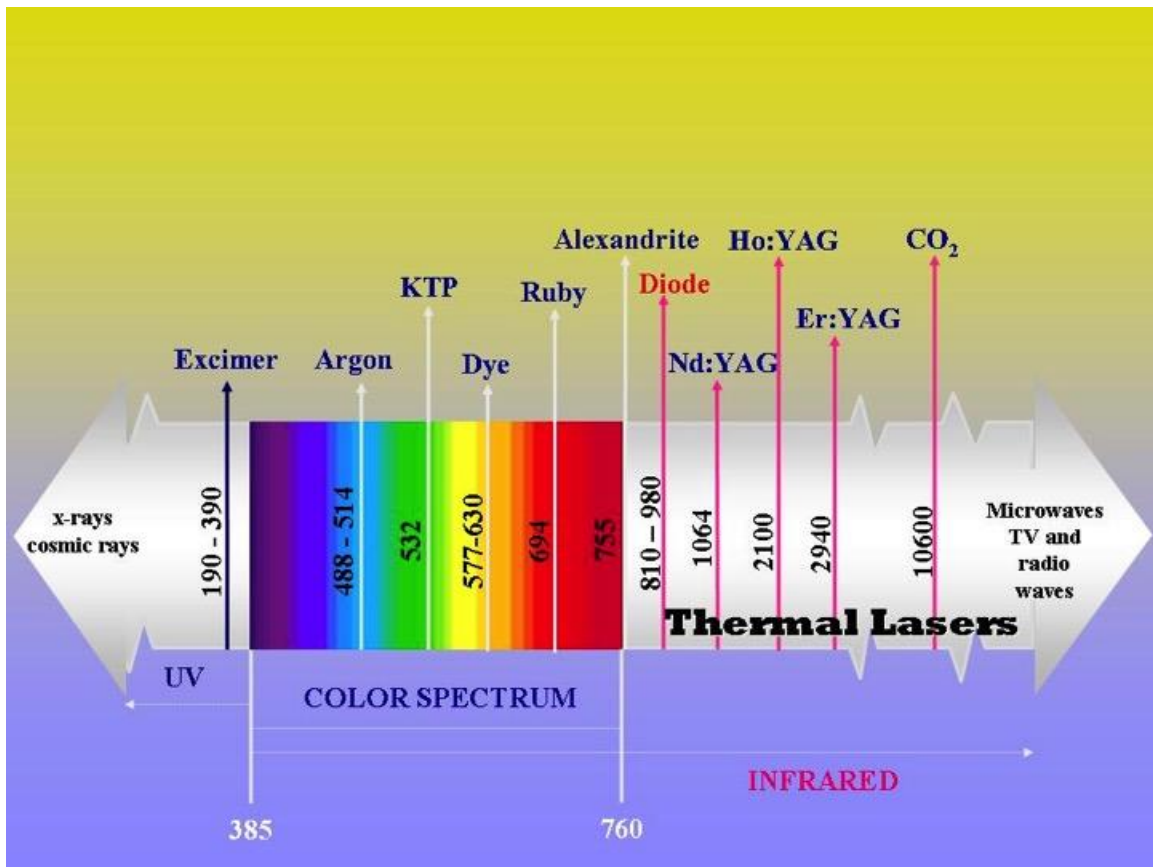
Vocabulary

PhotoThermal – Light energy is changed to heat energy- a RISE IN TISSUE TEMP. results

PhotoAcoustic – Light energy is changed to acoustic – sound – energy

PhotoChemical – Light energy is used to catalyze a chemical reaction





SELECTED BIBLIOGRAPHY

Following are some papers that are “keystones” in various fields of laser dentistry. These papers were selected for their complete treatment of specific topics within laser dentistry – not necessarily because they were the first papers published on the specific topic. Many of these papers are referred to in the course notes. The list is by no means an exhaustive list of the references available for the field. For a more complete list of references, please refer to the list of selected references in this manual.

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COURSE EVALUATION FORM

Course Date _____ Location _____ Instructor(s) _____ Name (optional) _____

Please rate the course on a scale of 1-5 with *one being the worst, and 5 being the best*

Comments

1) Effectiveness of slides/videos	1	2	3	4	5	use back of form for more comments
2) Effectiveness of workbook	1	2	3	4	5	
3) Effectiveness of Q and A	1	2	3	4	5	
4) Organization of material	1	2	3	4	5	
5) Clarity of material	1	2	3	4	5	
6) Comprehensiveness of material	1	2	3	4	5	
7) Overall evaluation of program content	1	2	3	4	5	
a) introduction	1	2	3	4	5	
b) periodontics	1	2	3	4	5	
c) prosthetics	1	2	3	4	5	
d) oral surgery/medicine/pathology	1	2	3	4	5	
e) pediatrics/orthodontics	1	2	3	4	5	
f) esthetics	1	2	3	4	5	
g) endodontics	1	2	3	4	5	
h) hard tissue/erbium	1	2	3	4	5	
i) practice management	1	2	3	4	5	
j) laser physics	1	2	3	4	5	
k) written exam	1	2	3	4	5	
l) clinical simulation	1	2	3	4	5	
m) clinical simulation exam	1	2	3	4	5	
8) Overall evaluation of speaker	1	2	3	4	5	
9) Relevance and applicability to your practice	1	2	3	4	5	
10) Did the course meet your expectations?	1	2	3	4	5	
11) Would you recommend this course to a friend?	1	2	3	4	5	
12) Please rate the facilities for the course	1	2	3	4	5	

CLINICAL PROFICIENCY SIMULATION EXAMINATION

Minimum Passing Grade for Certification: 75%

Candidate Name (PLEASE PRINT) _____ Degree _____

Examiner Name _____

Exam Date/Location _____

Procedures:

Gingivectomy Frenectomy Crown Lengthening Perio Pocket Disinfection Biopsy Troughing

Device Wavelength/Manufacturer/Model number _____

- 1) Knowledge of laser units/safety issues 32 points (4 points each)
 - a) Laser Safety Officer
 - b) Laser Safety Mechanisms
 - c) Adverse Effects Reporting Mechanism
 - d) Eye Protection/Tissue Protection
 - e) Signs
 - f) Cords/Connections
 - 1) water quick connect
 - 2) air quick connect
 - 3) electric cord
 - 4) fiber optic/waveguide
 - g) Gases
 - a) Bunsen burners
 - b) anesthetics
 - h) high volume suction/smoke evacuation/plume avoidance/universal safety precautions
- 2) Power up/down of unit 20 points (4 points each)
 - a) Set-up and assembly of fiber/handpiece/waveguide
 - b) Breakdown of fiber/handpiece/waveguide
 - c) Sterilization of fiber/handpiece/waveguide
 - d) Test fire on tongue depressor/into cup of water
 - e) Maintenance of components
- 3) Laser Parameters/Treatment Plan 48 points (6 points each)
 - a) Adjust joules
 - b) Adjust hertz
 - c) CW/gated/pulsed
 - d) Treatment objective/settings
 - e) Surgical technique/hazard zones
 - 1) sterile technique
 - 2) operative technique
 - 3) sharps disposal/fiber tip/cleaving/contact tips
 - f) Patient management/post-op management/char layer
 - g) Management of complications
 - h) Healing assessment

Examiner Certification and

Signature _____

STANDARD PROFICIENCY CERTIFICATION FORM

Please ***PRINT*** all of the information to ensure that your certificate is filled out properly

Name _____ Degree _____

Address _____

City, State, Zip _____

Phone _____ Fax _____

E-Mail address _____

Website _____

Please circle all of the following that apply:

- 1) I would like to join the Academy of Laser Dentistry.
- 2) I already am a member of the Academy of Laser Dentistry
- 3) I do NOT wish to be contacted by the Academy of Laser Dentistry

I currently own the following lasers in my practice: (Name and/or wavelength) _____

I plan to purchase the following laser(s) (wavelength)
