Abstract
The purchase of capital equipment must be guided by sound financial decisions. The purchase of a high tech device, such as a dental laser, must also be guided by intelligent decision making. Very often dentists buy lasers without understanding the costs to the practice of such a purchase. While dentists may be able to determine which wavelength will work well in their practice, criteria such as operating costs vs. purchase price, type of delivery system, the importance of training and much more must be evaluated before the wrong purchase is made for the practice. Lasers can be game-changing devices for a practice, but only if the right laser for that practice is selected.

Educational Objectives:
At the conclusion of this educational activity the participant will be able to:
1. Describe the criteria used for selecting the best laser for their practice/their needs
2. Realize the importance of training when considering the purchase of a laser
3. Discuss the difference between operating costs and purchase price of lasers
4. Discuss the advantages of laser use for virtually every type of dental practice, both generalist and specialist

Author Profile
Dr. Convissar has 23 years of experience with CO₂, Diode, Erbium, and Nd:YAG wavelengths. The author of peer-reviewed papers and contributing editor of 4 laser dentistry textbooks, his textbook “Principles and Practice of Laser Dentistry” is the best selling laser dentistry textbook in the world. Dr. Convissar lectures internationally and practices laser dentistry in New York City. He can be reached at laserbobdds@gmail.com.

Author Disclosure
Dr. Convissar is Director of Full Spectrum Seminars, dedicated to training laser dentists.
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Abstract
The purchase of capital equipment must be guided by sound financial decisions. The purchase of a high tech device, such as a dental laser, must also be guided by intelligent decision making. Very often dentists buy lasers without understanding the costs to the practice of such a purchase. While dentists may be able to determine which wavelength will work well in their practice, criteria such as operating costs vs. purchase price, type of delivery system, the importance of training and much more must be evaluated before the wrong purchase is made for the practice. Lasers can be game-changing devices for a practice, but only if the right laser for that practice is selected.

The purchase of capital equipment must be guided by sound financial decisions. A new device must be able to pay for itself. Ideally, the equipment should create enough "buzz" within the community that it becomes a powerful driving force for new patients to enter the practice. In addition to driving new patients to the practice, the equipment must also be capable of improving the bottom line of the dental practice in other ways. A piece of equipment that increases the dentist’s or hygienist’s productivity would certainly be welcome in any practice. As an example, think of a capital piece of equipment that most dentists have purchased: digital radiography. Not only does digital radiography create “buzz” in the community (“my doc has x-ray units that use less radiation”), the instant images obtained through the use of this equipment certainly increase productivity of the entire office staff. Most capital equipment purchases pay for themselves via these two routes: the “buzz” and the increased productivity. For a piece of capital equipment to truly be worth its weight in gold, it must do more than just create a buzz and increase productivity. It must be able to allow the dentist to keep more procedures in-house, rather than refer those procedures out to a specialist. A game changer should have the power to transform the “average” dental office into a superior dental office because of the procedures it can perform and because of the results it can create for the patient. There is one type of device that fulfills all of these requirements of a game changer – a dental laser.

Not just any dental laser – but a dental laser that gives you the best possible training, which allows the entire dental team to take the office to another level of care. A dental laser that can perform dozens of procedures that you currently refer out. A dental laser that transforms the “average” 3-unit bridge, into 3 magnificent natural looking teeth with beautiful emergence profiles that nobody can tell is a bridge. What’s the secret? A great laser, of course, but equally important, great training. You could purchase the best laser in the world and receive poor to no training. You will end up with at best, average results. You could purchase the worst laser in the world, but with proper training, you could get some passable results. The combination of the best laser for your needs with the best possible training will permit you to take your practice to the next level, both in terms of the quality of the dentistry performed, and increased income.

When dentists decide to purchase a laser, more often than not, they do so for the wrong reasons. When asked what they want to use a laser for in their practices, most dentists respond with a simple answer: they want to perform gingival troughing for their restorative cases and they want to perform periodontal pocket treatment and nothing more. The purpose of a laser is not to perform the same procedures the dentist performs, only with a different technique. How will using a laser for gingival retraction significantly impact the practice’s bottom line? By obtaining better impressions? Fewer remakes? Fewer adjustments of restorations when they return from the lab? A few minutes less chair time per patient? All admirable reasons, but not a significant factor to impact the practice’s bottom line. There are wonderful ways to perform gingival retraction that do not involve a laser, e.g. retraction cord, retraction materials such as Expasyl®, copper bands, etc. Performing the same procedures you always do using a different technique will save some time, and give you better results, but will not significantly impact the practice’s bottom line. Purchasing a laser for this reason is certainly not a game-changer for the practice.

How about periodontal pocket therapy? Many dentists love the idea of periodontal pocket disinfection. They expect the laser to be a “magic wand” and miraculously control periodontal disease in all of their patients on a routine basis. Unfortunately, in the real world, it does not always work out that way. Lasers can be excellent tools for periodontal pocket therapy – but once again, the magic word is not laser, the magic word is training. Case selection is critical. Technique is critical. Use of a wavelength supported by peer-reviewed literature that shows its safety for the procedure is critical. Want a simple way to greatly improve your patient’s periodontal health? Something backed up by a great deal of peer-reviewed literature? Something that has been shown in multiple university-based studies to be of great help in combating periodontal disease? Try quadrant
by quadrant scaling and root planning with injection anes-
thetia. Want to do more than scaling and root planing? Get
the right laser for the job, and get trained correctly to do the
job the right way. Lasers are not magic wands – they will
not control periodontal disease in every patient. Not every
patient will derive benefit from this procedure. Patients
who are not compliant with their home care, for example,
will not benefit unless their home care improves.

Many dentists buy lasers based on price, rather than
on operating costs. This can turn into an error that, rather
than driving the income dramatically upwards,
drives the income up incrementally due to the cost of
disposables. As an example: a well-trained dental office
should use their laser on at least ten patients per day.
Emphasis is placed on the words “well-trained”. Many
dentists reading this will state that there is no way that
they could possibly use their laser ten times per day. My
response is simple: a dental office that just bought a la-
ser will not know how to use a laser ten times per day. A
generic diode laser provides an example of operating cost
differentials. Some diode lasers come with 3-meter long
fiber optic cables. Every time the laser is used, the cable
must be cleaved. Once or twice a day the cable needs to
be stripped. Each of these procedures takes about 10–20
seconds to perform. The cost per patient when a fiber
optic cable is used is less than 40 cents. Compare this to
many diode lasers that have pre-cleaved single patient use
disposable tips. Each disposable tip is a minimum of $5 –
$7, depending on the manufacturer. For argument’s sake,
compare very conservative numbers:

50 cents for a disposable fiber optic cable vs. $5 for a
disposable tip; and you only use the laser 5 times per day.
That brings your daily overhead to $2.50 vs. $25. For a
four-day week, that brings your overhead to $10/week vs.
$100/week. For a practice that operates 46 weeks per year
(allowing for 6 full weeks where the practice is closed, the
difference in overhead is $460 vs. $4600 – a difference of
over $4100.00. Plug in your numbers for the cost of your
disposable tips, and see the numbers rise to an unaccept-
able level. At $7/tip using 5 tips/day, the cost differential
is almost $6000.00. At ten times/day, the cost is astro-
nomical. Many diode manufacturers will respond that dis-
posable tips have many advantages: single use tips decrease
the possibility of cross-contamination. Fiber optic cables
and handpieces are; however, sterilized between patients.
Manufacturers will state that it’s faster and simpler to
unwrap a disposable tip than strip and cleave a fiber optic
cable. That’s absolutely true – if you are not trained to do
so. A well-trained dental assistant can prepare the fiber
optic cable in 20 seconds or less. There are many other
advantages to long fiber optic cables, but that is something
that should be left for discussion at training sessions.

Operating costs affect all lasers, not just diodes. Some
Erbiun lasers have expensive fiber optic cables that cost
thousands of dollars to replace, rather than hundreds of
dollars. Some have annual maintenance contracts that cost
thousands of dollars per year. Some have hard tissue cut-
ting tips that cost up to $100 or more per tip. When com-
paring CO₂ lasers, there are tremendous differences in the
type of gas tubes in the units. Some have blown-glass tubes
filled with the gas. These tubes have a limited life span and
need to be replaced at a considerable expense of three to
five thousand dollars. Other units have sealed metal tubes
with extended life spans that can simply be recharged for
at least a thousand dollars less than the glass tubes. When
all of these costs are taken into consideration, a laser with a
high price tag but lower operating costs is usually the better
bargain in the long term.

Lasers can create the buzz to drive new patients to the
office. Patients are aware of lasers. Nearly every patient in
the average dental practice has a friend or relative that had
laser photorefractive keratotomy so they no longer need
to wear glasses; laser treatment of diabetic retinopathy;
laser treatment of vocal cord or uterine polyps; laser face
lifts, laser dermatologic procedures, laser varicose vein
procedures, etc. The idea of dental laser technology is a
great driving force to bring new patients to your practice.
Lasers unquestionably increase productivity in so many
ways but you want the laser to do more. So how can a laser
be a true game changer? Table 1 lists many uses of lasers
in the average general practice, all of which have peer-
reviewed literature that discusses the procedure. Make this
list your checklist to see how much of a game changer the
laser will be in your hands. Count how many of these pro-
cedures you currently refer out: for example, periodontal
regenerative surgery, where you actually use the results of
multiple peer-reviewed studies to “grow” new bone, new
cementum, and new connective tissue attachment, rather
than a long junctional epithelium attachment. Count how
many of the procedures listed below you should perform
on a regular basis but just don’t: for example: ovate site
formation for a fixed bridge in the esthetic zone, a proce-
dure that changes a nice, functional, esthetically acceptable
fixed bridge into magnificent natural looking teeth with
perfect emergence profiles. Take the list into your practice
and count the number of procedures on the list that you see
in a typical week.

Virtually every dental specialty is represented by the
procedures in Table 1. Even orthodontists, who commonly
do not use anesthetic syringes and needles in their offices
are embracing lasers. Frenectomies, tooth uncovering, and
other procedures orthodontists used to refer back to the
general dentist are now being kept in-house. The question
then is: what’s the best laser for my practice? In summary,
the best laser to purchase is one that will:

1. produce more dentistry per unit time – per day, per
week, per month, or however your practice manage-
ment profile measures that parameter.
Table 1. Laser Procedures

<table>
<thead>
<tr>
<th>I. Periodontics</th>
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<tbody>
<tr>
<td>A. Initial periodontal pocket therapy/pocket disinfection</td>
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<tr>
<td>B. Gingivectomy</td>
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<tr>
<td>C. Frenectomy</td>
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<tr>
<td>D. Regenerative Periodontal Surgery</td>
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<tr>
<td>E. Mucogingival Surgery</td>
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<tr>
<td>F. Graft Surgery</td>
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<tr>
<td>G. Tissue Modification</td>
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<tr>
<td>1. Debulking unaesthetic free gingival grafts</td>
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<tr>
<td>2. Gummy Smile-Lifts</td>
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<tr>
<td>3. Gingival Zenith alignments</td>
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<tr>
<td>II. Fixed Prosthetics/Cosmetic Dentistry</td>
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<tr>
<td>A. Troughing</td>
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<tr>
<td>B. Crown Lengthening</td>
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<tr>
<td>C. Biologic Width Modification</td>
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<tr>
<td>D. Emergence Profile Modification</td>
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<tr>
<td>E. Ovate Pontic Formation</td>
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<td>F. Bleaching</td>
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<td>G. Depigmentation</td>
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<td>III. Implantology</td>
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<td>A. Site Preparation</td>
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<td>B. Assistance in Sinus Elevation</td>
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<tr>
<td>C. Assistance in Placement</td>
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<tr>
<td>D. Implant Uncovering</td>
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<tr>
<td>E. Failing Implant Therapy</td>
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<tr>
<td>1. Mucositis</td>
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<tr>
<td>2. Perimplantitis</td>
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<tr>
<td>IV. Removable Prosthetics</td>
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<tr>
<td>A. Tuberosity Reduction</td>
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<td>B. Torus Reduction</td>
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<td>C. Eulpis Reduction</td>
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<tr>
<td>D. Residual Ridge Modification</td>
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<td>E. Vestibuloplasty</td>
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<td>F. Papillary Hyperplasia</td>
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<td>G. Angular Cheilitis</td>
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<tr>
<td>V. Pediatric Dentistry</td>
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<tr>
<td>A. Tongue-Tie/Frenectomy/Nursing Issues</td>
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<tr>
<td>B. Gingival Hyperplasia</td>
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<tr>
<td>C. Herpes/Aphthous Ulcers</td>
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<tr>
<td>D. Pericorinitis/Operculitis</td>
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<tr>
<td>E. Mesiodens Removal</td>
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<tr>
<td>F. Pulpotomy</td>
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<td>VI. Orthodontics</td>
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<tr>
<td>A. Surgical Laser Use</td>
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<tr>
<td>1. Gingivectomy for tooth exposure/bracket placement/ opium removal</td>
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<td>2. Gingivectomy for space maintainer placement</td>
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<td>3. Gingivectomy for gingival hyperplasia treatment</td>
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<tr>
<td>4. Gingivectomy for Cosmetic treatment/creation of ideal tooth proportions</td>
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<tr>
<td>B. Miscellaneous Surgical Treatments</td>
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<tr>
<td>1. Labial Frenectomy</td>
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<td>2. Lingual Frenectomy</td>
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<td>3. Circumferential fiberotomy</td>
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<td>4. Aphthous Ulcer Treatment</td>
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<td>VII. Minor Oral Surgery/Oral Medicine</td>
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<tr>
<td>A. Biopsy</td>
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<tr>
<td>B. Operculectomy</td>
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<td>C. Aphthous Ulcers</td>
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<td>D. Hemangioma/Venous Lakes</td>
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<tr>
<td>E. Apicoectomy</td>
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<tr>
<td>VIII. Endodontics</td>
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<tr>
<td>A. Pulpotomy</td>
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<tr>
<td>B. Canal disinfection</td>
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<tr>
<td>IX. Unusual Procedures/Special Patient Care</td>
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<tr>
<td>A. Drug induced Gingival Hyperplasia</td>
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<tr>
<td>1. Cyclosporin/Transplant Cases</td>
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<tr>
<td>2. Calcium Channel Blockers</td>
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<td>3. Dilantin</td>
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<tr>
<td>4. Rheumatoid Arthritis/Myasthenia Gravis/Others</td>
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<tr>
<td>B. Dental Sleep Medicine/Lingual Frenum Release</td>
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</table>

2. keep more procedures/more patients in-house and refer fewer patients.
3. enable you to perform all of the procedures on your wish list efficiently, effectively, and competently.

Bottom line? It’s the laser with the wavelength that best suits your practice AND gives you the best possible training and legitimate certification. The Academy of Laser Dentistry is an international organization with members from around the globe. A total of 32 countries have members in the Academy. In the USA, the Academy has members from 48 of the 50 states. The Academy is devoted to clinical education, research, and the development of standards and guidelines for the safe and effective use of laser technology worldwide. Their Curriculum Guidelines and Standards for Dental Laser Education have been adopted by more than 75 dental and health organizations, universities, and manufacturers worldwide. These guidelines are the internationally recognized standards for dental laser use. They establish standards of education in the use of lasers in dentistry and define standards for the demonstration of competency in the safe and effective use of lasers by dental professionals. Their certification programs are minimum 12 hour courses that include both didactic and hands-on training. Just as dentists must perform dental procedures according to the community standard of care, the Academy of Laser Dentistry makes certain that its certified members practice the best possible laser dental treatment. State regulatory boards often seek information from the Academy of Laser Dentistry. One of the marketing advantages the Academy provides is a press release that can be customized. This press release can get the word out in your community that you not only have a laser, but that you keep up with the latest information on laser dentistry by attending the conferences on the subject. Another marketing advantage is the ability to send out a special letter to all the patients in your database. A sample letter that can be sent to patients in the states that do not yet require certification may be worded as follows:

“This past weekend both my hygienist and I attended an Academy of Laser Dentistry Standard Proficiency Certification Course. The ALD is an international organization of over 800 laser dentists from 32 countries. Though certification is not yet required in our state, we have decided to proactively achieve ALD certification in order to give you, our patients, the best possible, most up-to-date, 21st century dental treatment. The advantages of laser dentistry include: reduced possibility of infection; reduced need for injections of anesthetic; faster, more pain free healing, and many, many more. Please visit our website at www.DrXXXX.com and read much more about our wonderful new laser.”

This letter should be sent to every single patient in your database. It has the potential to reactivate patients that...
have strayed from the practice, which will help your bottom line and help your practice grow.

Once a decision is made to purchase a laser, a wavelength must be selected. There are currently nine wavelengths available in the U.S.:

- Nd.YAG
- Erbium YAG
- Erbium Cr.YSGG
- CO₂ 10.6 μm
- CO₂ 9.3 μm
- Diode 810 nm
- Diode 940 nm
- Diode 980 nm
- Diode 1064 nm

Diode is listed four times as there are four different wavelengths. A diode is a type of laser, not a specific laser. The differences between each of the four diode lasers is quite significant. Each diode is a different, distinct wavelength. Each wavelength will be absorbed (or not) to different extents by the target tissue. Each will be more or less effective on the target tissue due to its unique and distinct wavelength. Each wavelength has a different amount of peer-reviewed literature to justify its use in the oral cavity. When comparing lasers, peer-reviewed literature should be available. If you are considering a 940 nm diode laser, for example, and the manufacturer gives you literature discussing an 810 nm diode, that literature is irrelevant to your 940 nm unit. Peer-reviewed literature to justify the use of a laser for a specific procedure is well advised and you will have operating parameters to guide you in performing that procedure. Peer-reviewed literature also protects one legally if an adverse event occurs.

A discussion of lasers for just a few of the procedures listed in Table 1 will help decide what the best laser is for your practice. A review of the peer-reviewed literature is an important part of the decision process. Following are a few True/False questions to gauge your familiarity with what lasers can do:

1. Lasers have shown the ability to obtain **clinical new attachment with bone fill** in previously diseased sites. This technique has shown **significantly better results** than those obtained through conventional osseous grafting alone.

   That statement is impressive; clinical new attachment with bone fill, with better results than conventional grafting; however, it is true as stated in the Compendium of Continuing Education in Dentistry.¹ What wavelength was used for this study? A Superpulsed CO₂ laser with a waveguide delivery system.

2. In a **human histological study** comparing laser assisted periodontal surgery vs. conventional surgery, connective tissue and repair cementum formed in laser treated sites. This compared to a long junctional epithelial adhesion in all of the control (non-laser treated) teeth.

   This statement also seems too good to be true. A periodontal surgical procedure using a laser, resulting in new connective tissue and new cementum? Sounds incredible -- yet also true. This is a study published in the Journal of Periodontology -- the official journal of the American Academy of Periodontology.² The laser used in this study was a Superpulsed CO₂ with a waveguide.

3. Laser treatment combined with mechanical instrumentation constitutes a useful tool to condition root surfaces and **increase fibroblast attachment to root surfaces**.

   Could this be true? Is it possible to shine a laser onto a root surface and increase fibroblast attachment to a root surface? The answer, according to a paper published in the Journal of Periodontology, is yes -- a Superpulsed 10.6 μm CO₂ laser with a waveguide.³ This study showed two important results: the quantity of fibroblasts attaching to the root surface was superior when a 10.6 μm CO₂ laser was used to treat root surfaces; and the quality of attachment of fibroblasts to the root surface was superior.

4. In a histological study using monkeys, lasers can be used to delay the apical downgrowth of epithelium and this technique is **less technically demanding and more time efficient** than other currently known methods of epithelial retardation.

   a. Why is it so critically important to delay the downgrowth of epithelium? Epithelium grows much more quickly than connective tissue. When you close a flap, you want new connective tissue to grow. You want a new connection between the bone and the root surface. You want new periodontal fibers.

   b. If you do not somehow prevent the epithelium from growing, you will not get a new fibroblast-mediated soft tissue connection. You will get a long junctional epithelium, which is essentially a failure.

   c. Is it possible to use a laser instead of membranes to prevent the downgrowth of epithelium in surgical sites during periodontal or implant surgery? Once again, the Journal of Periodontology says that you can -- using a Superpulsed 10.6 μm CO₂ laser with a waveguide.⁴

   A review of the literature shows many more papers from the Journal of Periodontology that advocate the use of lasers. Israel, Rossmann and Froum⁵ performed a human histological study of laser de-epithelialization. Patients were divided into 2 groups. One group had conventional periodontal surgery. The second group had laser de-epithelialization. Notches were placed in the teeth at the heights of the alveolar crests. At 90 days, block sections of tissue were removed from the patients for histological analysis. Their results showed that in the control teeth,
junctional epithelium extended the length of the root to the base of the notch. On the 10.6 μm CO₂ laser treated side, the notch was filled with connective tissue and repair cementum. This finding was not seen in any control teeth. In another human study, Centty took patients with bilateral periodontal defects, performed conventional (blade) surgery on one side, and laser de-epithelialization on the other side. This human, in-vivo study found that the 10.6 μm CO₂ laser eliminated sulcular and gingival epithelium without disturbing underlying connective tissue. Centty concluded that 10.6 μm CO₂ lasers have little to no effect on tissues beyond the target, and 10.6 μm CO₂ lasers appear to effectively remove epithelium more completely than conventional scalpels. Pick stated that using a 10.6 μm CO₂ laser to de-epithelialize flaps may lead to a more predictable and desirable bone and soft tissue result, and that the use of surgical membranes may be eliminated.

What does all this research mean? Do pockets actually shrink? Does the patient really benefit? According to a report issued by the Research, Science and Therapy Committee of the American Academy of Periodontology, the answer is Yes. They stated that the 10.6 μm CO₂ laser has been shown to enhance periodontal therapy through an epithelial exclusion technique in conjunction with traditional flap procedures, and when 10.6 μm CO₂ lasers are used to de-epithelialize the mucoperiosteal flap during surgery, it has enhanced reduction in periodontal probing depths. There is no laser wavelength that has as much peer-reviewed histological based literature using three animal models – monkeys, beagles, and humans – as 10.6 μm CO₂ lasers when treating periodontal disease.

Can these procedures be applied to peri-implantitis as easily as periodontitis? Deppe and his group published 3 papers on the use of the 10.6 μm CO₂ laser for treatment of peri-implantitis. The first paper involved placement of 60 implants in beagle dogs. Histologic sections of the jawbones 4 months after the laser treatment showed statistically significant evidence of new direct bone to implant contact. They concluded that peri-implant defects can be successfully treated via laser decontamination without damaging the surrounding tissue. Their second study also placed 60 implants in beagle dogs. Their results showed that 10.6 μm CO₂ laser treatment of failing implants does not result in excessive titanium concentration in body tissues, unlike other wavelengths. Their third study also placed 60 implants in beagle dogs. The implants were divided into three groups: air powder abrasion; 10.6 μm CO₂ laser irradiation; or a combination of both air abrasion and 10.6 μm CO₂ laser irradiation. Fluorescence microscopy showed that the laser treated groups showed significantly greater amounts of newly formed bone than the non-laser treated group. They concluded that 10.6 μm CO₂ laser irradiation renders significantly more new bone formation than conventional decontamination.

Romanos and Nentwig published a report of 15 patients with 19 deep peri-implant infrabony defects treated with 10.6 μm CO₂ laser in combination with osseous grafting and membrane placement. Ten sites were augmented with autogenous bone; nine were augmented with a commercially available bone grafting material. At 27 months postoperative, probing depth of the defect was significantly reduced. In all of the xenografted defects, complete bone fill was radiologically observed. In autogenous grafted defects, at least 2/3 of the defect was filled due to bone resorption of the graft over time. They concluded that decontamination of implant surfaces with 10.6 μm CO₂ laser in combination with augmentative techniques can be an effective treatment method for periimplantitis.

In the most definitive peer-reviewed paper on peri-implantitis published to date, Romanos, Ko, Froum and Tarnow performed a MEDLINE literature review of peer-reviewed English language journals published from January 1986 to December 2007. Keyword used were: CO₂ laser and implant; laser and peri-implantitis; and CO₂ laser decontamination. Seventy-one papers were summarized in this literature review. They concluded that 10.6 μm CO₂ laser treatment of peri-implantitis deserves consideration as an efficacious treatment. The paper also presented a surgical protocol for CO₂ laser treatment of peri-implantitis.

What kind of 10.6 μm CO₂ laser can perform these treatments? Just as there are 4 totally different types of diode lasers on the market, there are different types of CO₂ lasers on the market. They differ in the length of the laser pulse and in the type of delivery system. The length of the pulse is one of many critically important factors when evaluating 10.6 μm CO₂ lasers. One 10.6 μm CO₂ laser system on the market uses a type of pulse called a Superpulse. Other 10.6 μm CO₂ systems use what is called an UltraSpeed® or Micropulsed technology. The bulk of the literature regarding the use of 10.6 μm CO₂ lasers in dentistry used a SuperPulse system. Though it might be possible to replicate the results obtained with the Superpulse system when using a Micropulsed or Ultraspeed laser, the peer-reviewed literature does not appear to support the use of those types of lasers. Just as the literature justifying the use of one type of diode does not justify the use of all diode wavelengths for all procedures, the literature justifying the use of SuperPulse technology does not justify the use, or even guarantee similar results when Ultraspeed or Micropulse technology is used. Each of these pulse parameters delivers a totally different power density to the surgical site leading to very different clinical results.

The other significant difference between 10.6 μm CO₂ lasers is the delivery system. Some 10.6 μm CO₂ lasers use an articulated arm delivery system. Articulated arm systems are old technology that was developed in the 1970s. These systems have a set of hollow tubes connected with fixed mirrors that bounce the laser energy from one tube through the next one. Flexible fiber waveguide technology, the newer technol-
ogy, was developed in the 1990s. Rather than a bulky articulated arm that needs a counterweight for balance, the flexible fiber is much more lightweight. The overall weight and bulk of articulated arm systems can fatigue the user’s arm and hand, leading to potentially negative surgical outcomes. Figure 1 shows a typical articulated arm on a 10.6 μm CO₂ laser. Figure 2 shows a typical 10.6 μm CO₂ flexible fiber waveguide. Figure 3 is a close-up of the typical surgical handpiece of an articulated arm laser side by side with 10.6 μm CO₂ flexible fiber waveguide handpieces. Note the slim pen-like size and shape of the flexible fiber handpiece, compared to the bulkier handpiece of the articulated arm unit. Figure 4 is a close-up view of the thick hollow metal tube typical of an articulated arm delivery system. Note the thickness as illustrated by the periodontal probe against the tube. Figure 5 shows how thin a 10.6 μm CO₂ flexible fiber waveguide is, as illustrated by a periodontal probe against the waveguide.

Figure 1. Photo of a typical 10.6 μm CO₂ laser articulated arm delivery system.

Figure 2. Photo of a typical flexible fiber waveguide delivery system. Note the slim profile with no need for a counterweight.

Figure 3. Top to Bottom:
Top: Close-up photo of a surgical handpiece of a typical articulated arm delivery system. Note the length and bulk of the handpiece. Middle: Close-up of a contra-angle surgical handpiece typical of a flexible waveguide delivery system. Bottom: Close-up of a straight surgical handpiece typical of a 10.6 μm CO₂ flexible waveguide delivery system.

Figure 4. Close-up photo of a thick metal tube from an articulated arm delivery system. Note the size of the tube, as demonstrated by the periodontal probe.

Figure 5. Close-up of a thin flexible waveguide delivery system. Note how thin it is, as demonstrated by the periodontal probe.

Focal distance is also very different for typical articulated arm systems vs. flexible waveguide systems. For many surgical procedures, the articulated arm must be kept 12 mm or more away from the tissue surface. Flexible waveguide handpieces are kept just 1 mm away from the tissue surface. All lasers must be calibrated on a regular basis in order to ensure that the power shown on the screen is actually the power coming out of the handpiece. Calibration is critically important. A dentist needs to know that his surgical results are consistent and
repeatable. 10.6 μm CO₂ flexible fiber waveguides delivery systems have calibration ports built into the sides of the unit, so the dentist can calibrate his unit every single day, if he so chooses. Articulated arm devices can only be calibrated by shipping the laser back to the manufacturer, or by a field service technician making a service call to the office, usually at considerable expense.

How can a laser be a game-changer for a simple restorative practice that is not interested in implant placement or periodontal surgery? A review of the procedures listed in Table 1 should give a restorative dentist more than enough reason to purchase a laser. Simple creation of an ovate pontic site or gingivoplasty to create natural emergence profiles when performing restorative dentistry in the anterior esthetic zone can make a world of difference in the esthetics of the completed case. Laser residual ridge modifications before making a removable partial or full denture will result in a ridge better able to support the prosthesis and a happier patient with a better fitting prosthesis.

Figure 6 shows a patient with a congenitally missing upper left lateral incisor. The patient had no restorations and was not a candidate for an implant. Treatment plan was for a Maryland Bridge replacing the upper left lateral incisor. Note the height of the residual ridge. If the pontic were to be placed abutting the residual ridge, the resulting pontic would look too short and artificial. If the pontic were to be placed at the correct gingivo-incisal height, it would be placed anterior to the ridge, resulting in an unaesthetic pontic that could be a potential food trap. Some dental laboratories avoid this pitfall by gently scraping the model before baking the porcelain on the pontic. This results in a pontic that blanches the gingival tissue and potentially strangulates tissue beneath the pontic, resulting in an unaesthetic pontic. Figure 7 shows a 10.6 μm CO₂ laser-created ovate pontic site outline. Figure 8 shows the completed laser created ovate pontic site. Figure 9 shows the completed Maryland Bridge with a natural emergence profile of the pontic.

Figure 10 shows a lower right canine supererupted and lingually locked out. A 10.6 μm CO₂ laser was used to gently scribe a line from the distogingival margin of the lateral incisor to the mesiogingival margin of the first premolar. Figure 11 shows the lower right canine restored with a natural emergence profile and beautiful esthetic result.
Figure 10. Preoperative view of a lingually locked out super-erupted tooth # 27

Figure 11. Postoperative view of tooth # 27 after a 10.6 μm CO₂ gingivoplasty and restoration with a porcelain laminate veneer to bring the tooth into proper alignment in the arch. Note the natural looking emergence profile of the restored tooth.

There is so much more that laser dentists can do with the correct laser and the correct training. This CE course barely scratches the surface of what a laser can do in the right hands.

References


Author Profile

Dr. Convissar has 23 years of experience with CO₂, Diode, Erbium, and Nd.YAG wavelengths. The author of peer-reviewed papers and contributing editor of 4 laser dentistry textbooks, his textbook “Principles and Practice of Laser Dentistry” is the best selling laser dentistry textbook in the world. Dr. Convissar lectures internationally and practices laser dentistry in New York City. He can be reached at laserbobdds@gmail.com.

Author Disclosure

Dr. Convissar is Director of Full Spectrum Seminars, dedicated to training laser dentists.
Questions

1. Which of the following should be considered when purchasing new capital equipment?
   a. Ability to create a “buzz” that draws in new patients
   b. Ability to increase productivity of the dental team
   c. Ability to keep more procedures in house and refer fewer procedures out to specialists
   d. All of the above

2. Which of the following is most important when deciding on the purchase of a laser?
   a. Sticker price
   b. Relationship with dental equipment salesperson
   c. Training program for the laser
   d. Special discounts given at dental shows

3. The most productive use of a laser in an office would be:
   a. Using it only for routine procedures already performed in your office
   b. Using it solely as a marketing device to draw new patients into your office
   c. Having only your hygienist use it
   d. Learning how to perform new procedures

4. Which of the following should be considered in the selection of a laser?
   a. Cost of the unit
   b. Cost of service plan after warranty expires
   c. Type of training provided
   d. All of the above

5. Using a laser that does not have peer-reviewed literature and F.D.A. clearance to justify its use for certain procedures:
   a. Could lead to a lawsuit if an adverse event occurs
   b. Is never a problem as long as the dentist is licensed to practice
   c. Is acceptable to do as long as the laser company suggests it can be done
   d. None of the above

6. In states where hygienists are not permitted to use a laser, which office staff members should be trained in laser use?
   a. The dentist
   b. The hygienist
   c. The office manager
   d. All of the above

7. The advantages of disposable tips over 3 meter long fiberoptic cables are:
   a. Significantly less overhead
   b. Significantly less cross-contamination
   c. Saves a great deal of time during set-up
   d. None of the above

8. The number of laser wavelengths currently on the market is:
   a. 4
   b. 6
   c. 9
   d. 10

9. Diode lasers of different wavelengths:
   a. Are all absorbed equally well in soft tissue
   b. Have been in the dental market longer than any other wavelength used in dentistry
   c. Have peer reviewed literature that is interchangeable from one wavelength to another
   d. None of the above

10. Peer-reviewed literature for a specific wavelength:
    a. Is unnecessary if any other dental laser wavelength has literature to justify its use
    b. Is important only for researchers and academics
    c. Is critical for each wavelength to have in case an adverse event occurs
    d. Is of no clinical relevance to practicing dentists

11. Which of the following procedures can be provided with the use of a laser?
    a. Gingivectomy
    b. Prenectomy
    c. Troughing
    d. All of the above

12. Sending out a letter announcing Academy of Laser Dentistry Certification:
    a. Can reactivate patients that have strayed from the practice
    b. Is an unnecessary waste of time
    c. Is unethical
    d. None of the above

13. Which wavelength has peer-reviewed literature that shows it can create clinical new attachment with bone fill in previously diseased sites?
    a. Diode 980
    b. CO2
    c. Er:YAG
    d. All of the above

14. Among the histological results found in a study using 10.6 μm CO2 lasers for periodontal surgery were:
    a. Connective tissue formation
    b. Cementum formation
    c. Both
    d. Neither

15. When a 10.6 μm CO2 laser is used on root surfaces it can:
    a. Increase the number of fibroblasts attaching to the root surface
    b. Increase the quality of the fibroblast attachment to the root surface
    c. Both
    d. Neither

16. When using a 10.6 μm CO2 laser for de-epithelialization of flaps:
    a. It’s more effective than blade de-epithelialization
    b. It does not effect the underlying connective tissue
    c. It may eliminate the need for membranes
    d. All of the above

17. The American Academy of Periodontology stated regarding 10.6 μm CO2 lasers:
    a. They enhance periodontal therapy through epithelial exclusion
    b. They enhance reduction in periodontal probing depths
    c. Both
    d. Neither

18. The laser wavelength with peer-reviewed literature in three animal models for periodontal surgery: monkeys, beagles, and humans is:
    a. Er:YAG
    b. 10.6 μm CO2
    c. Diode 940
    d. Nd:YAG

19. 10.6 μm CO2 laser treatment of peri-implantitis showed:
    a. New bone to implant contact
    b. Successful treatment of the defects
    c. No deposition of titanium in the peri-implant site
    d. All of the above

20. When performing periodontal pocket disinfection, which of the following statements is false?
    a. Case selection is critical
    b. Technique is critical
    c. All patients see improvement
    d. Training is critical

21. Which of the following are important when comparing lasers?
    a. Cost of disposables
    b. Procedures to be performed that are F.D.A. cleared for that unit
    c. Both
    d. Neither

22. The advantages of a flexible fiber waveguide over an articulated arm delivery system for 10.6 μm CO2 lasers include:
    a. Lighter weight to delivery system
    b. Smaller, more ergonomic handpiece
    c. Simpler to calibrate
    d. All of the above

23. Lasers must be calibrated in order to:
    a. Maintain the manufacturer’s warranty
    b. Ensure consistent power output from the unit
    c. Evaluate the proper focal distance
    d. All of the above

24. Which of the following is not important when deciding on periodontal pocket therapy for a patient?
    a. Case selection
    b. Training
    c. Insurance coverage
    d. Technique

25. Who should receive a letter announcing your achieving Academy of Laser Dentistry Standard Proficiency Certification?
    a. Active patients
    b. Patients who are past due for their prophylaxis
    c. Patients who have not been in for an extended period of time
    d. All of the above

26. Which of the following is NOT true about the difference between Superpulse, Micropulse, and Ultraspeed 10.6 μm CO2 lasers?
    a. It’s of no clinical relevance
    b. It can be discussed in terms of power density
    c. Will result in different surgical outcomes
    d. Is importance only in research

27. Flexible waveguide fibers for 10.6 μm CO2 lasers:
    a. Are much newer technology than articulated arms
    b. Require a counterweight for balance
    c. Are used for surgical procedures 12 mm from the tissue surface
    d. All of the above

28. The uses for a laser in removable prosthetics include:
    a. Torus reduction
    b. Tuberosity reduction
    c. Epulis reduction
    d. All of the above

29. The uses for a laser in fixed prosthetics include:
    a. Ovate pontic site formation
    b. Emergence profile modification
    c. Crown lengthening
    d. All of the above

30. The specialty that has no peer-reviewed literature describing the use of lasers is:
    a. Orthodontics
    b. Prosthodontics
    c. Endodontics
    d. None of the above
How to Select the Best Laser For YOUR Practice

Name: ____________________________  Title: ____________________________  Specialty: ____________________________

Address: ____________________________  E-mail: ____________________________

City: ____________________________  State: ____________________________  ZIP: ____________________________

Telephone: Home (__)  Office (__)  Lic./Ref. Renewal Date: ____________________________  AGD Member ID: ____________________________

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EDUCATIONAL OBJECTIVES
1. Describe the criteria used for selecting the best laser for their practice/their needs
2. Understand the basics of laser science
3. Discuss the difference between operating costs and purchase price of lasers
4. Discuss the advantages of laser use for virtually every type of dental practice, both generalist and specialist
5. Discuss the advantages and disadvantages of a laser compared to a traditional surgical technique

COURSE EVALUATION

Objective #1: Yes No  Objective #3: Yes No  Objective #4: Yes No
1. Were the individual course objectives met?
2. To what extent were the course objectives accomplished overall?
3. Please rate your personal mastery of the course objectives.
4. How would you rate the objectives and educational methods?
5. How do you rate the author's grasp of the topic?
6. Please rate the instructor's effectiveness.
7. Was the overall administration of the course effective?
8. Please rate the usefulness and clinical applicability of the course.
9. Please rate the usefulness of the supplemental website.
10. Do you feel that the references were adequate?

Objective #2: Yes No
11. Would you participate in a similar program on a different topic?
12. If any of the continuing education questions were unclear or ambiguous, please list them.
13. Was there any subject matter you found confusing? Please describe.
14. How long did it take you to complete this course?
15. What additional continuing dental education topics would you like to see?

IF NOT TAKING ONLINE, MAIL COMPLETED ANSWER SHEET TO:

Academy of Dental Therapeutics and Stomatology,
A Division of PennWell Corp.
P.O. Box 116, Chesterland, OH 44026
or fax to: (440) 845-3447

FOR IMMEDIATE RESULTS, go to www.ineedce.com to take tests online.
Answer sheets can be faxed with credit card payment to:
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(Checks and credit cards are accepted.)

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1. Were the individual course objectives met?
   -Objective #1: Yes No
   -Objective #2: Yes No
   -Objective #3: Yes No
   -Objective #4: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

2. To what extent were the course objectives accomplished overall?
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

3. Please rate your personal mastery of the course objectives.
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

4. How would you rate the objectives and educational methods?
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

5. How do you rate the author’s grasp of the topic?
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

6. Please rate the instructor’s effectiveness.
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

7. Was the overall administration of the course effective?
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

8. Please rate the usefulness and clinical applicability of this course.
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

9. Please rate the usefulness of the supplemental webliography.
   __________ 5 __________ 4 __________ 3 __________ 2 __________ 1 __________ 0

10. Do you feel that the references were adequate?
    Yes No

11. Would you participate in a similar program on a different topic?
    Yes No

12. If any of the continuing education questions were unclear or ambiguous, please list them.

13. Was there any subject matter you found confusing? Please describe.

14. How long did it take you to complete this course?

15. What additional continuing dental education topics would you like to see?

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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