Concepts in Laser Periodontal Therapy Using the Er,Cr:YSGG Laser

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Objectives of This CE Course

It is the goal of this continuing education course to accomplish the following:

1. Review laser physics, tissue interaction, and current laser technology relevant to the treatment of periodontal disease.
2. Review treatment algorithms that allow general practioners to evaluate patients requiring periodontal therapies to determine how they can best serve their patients' needs or when they should refer them to a periodontist.
3. Introduce a concept for the successful treatment of "site-specific perio" using a laser-assisted, minimally invasive protocol that enables victory in "the cellular race."

Introduction

Is the profession of periodontics in a paradigm shift? According to Dr. Gordon Christensen, in a recent lecture delivered at the World Congress of Minimally Invasive Dentistry, the number of patients with periodontal disease that are actually being treated by periodontists each year could be declining.[1] If this is indeed the case, there may be a combination of the following contributing factors:

1) General practitioners have become empowered, via continuing education courses and new or developing technologies, to offer a wider range of periodontal therapies. This empowerment is the result of technologies which include, but are not limited to, soft-tissue and hard-tissue lasers, periodontal scopes and antimicrobial agents developed for placement in the sulcus to treat periodontal disease.

2) Periodontal patients are having "water-cooler" conversations with coworkers regarding their personal experiences and the pain associated with conventional periodontal therapy.

These trends beg a couple of questions: Have the best interests of periodontal patients been taken into consideration during this paradigm shift? While this shift holds many positives for the patient, can the benefits be multiplied with proper training and diagnostic/treatment planning skills that enhance the standard of periodontal care? Is there a risk that general practitioners, armed with new technologies and methods for treating periodontal disease, may overestimate their newfound capabilities in successfully treating the disease?

It is the author's belief that the aforementioned paradigm shift was inevitable and is, in fact, good for dentists and their patients. That said, for the benefit of patients, it is incumbent on periodontists, GPs, dental schools, and dental laser manufacturers to establish treatment parameters and protocols that facilitate the proper training of practitioners in the execution of this paradigm shift.

Review of Laser Physics and Tissue Interaction

LASER is an acronym for Light Amplification by Stimulated Emission of Radiation, which is based on theories and principles first put forth by Einstein in the early 1900s. The first actual laser system was introduced by Maiman in 1960.[2] Laser light is a manmade single-photon wavelength. The process of lasing occurs when an excited atom is stimulated to remit a photon before it occurs spontaneously; spontaneous emission of light results in unorganized light waves similar to light emitted by a light bulb. Stimulated emission of photons generates a very coherent, collimated, monochromatic ray of light that is found nowhere else in nature.[3] Because laser light is so concentrated and focused, it can have a decided effect on target tissue at a much lower energy level than natural light. The effect of laser light on target tissue is dependent on its wavelength, which is determined by the lasing medium inside the laser device.

When laser light comes into contact with the tissue, it can reflect, scatter, be absorbed, or be transmitted to the surrounding tissues. In biological tissue, absorption occurs because of the presence of free water molecules, proteins, pigments, and other organic matter. In the thermal interactions caused by laser devices, water molecules and their absorption coefficient play a strong role.[4] Laser light that is well absorbed by water (Er,Cr:YSGG, Er:YAG) is able to mechanically ablate enamel, dentin, and alveolar bone, while laser light not well absorbed by water (Diode, Nd:YAG, CO_2), results in strong thermal reactions, such as carbonization, charring, and melting of organic tissue.

Review of Modern Laser Technology Available in Periodontics

The first research of laser use in dentistry surrounded hard-tissue treatments, such as cavity preparation and caries removal, as a substitute for the conventional drill. The first laser that was the focus of this research was the ruby laser invented in 1960.[5]

In subsequent years, many researchers investigated the hard-tissue applications of lasers, such as argon, CO_2,

and Nd:YAG. However, these laser systems resulted in major thermal damage to enamel and dentin.[6,7] As such, researchers focused their attention instead on the soft-tissue applications of these early-generation high-powered lasers. It was discovered that the CO_2 and Nd:YAG lasers were capable of excellent soft tissue ablation and hemostasis, which enabled periodontists to use these lasers for the treatment of soft-tissue procedures, such as gingivectomies and frenectomies.[8,9,10,11] However, these early lasers had such a profound thermal effect on target tissues, including gingival tissue, periodontal ligament, cementum, and alveolar bone, that their use for periodontal hard-tissue applications was not promising.

In the 1990's, an Nd:YAG laser was introduced that had a flexible, fiber-optic delivery system, which made it appropriate for selective procedures in the periodontal pocket, including root surface debridement and pocket curettage.[12] Researchers (including Hibst, et al, Keller, and Kayano, et al) discovered that an Erbium:YAG laser, which is highly absorbed by water and hydroxyapatite, was effective in cutting enamel.[13] Finally, in the late 1990's, Eversole, Rizoiu, Kimura, and others published several notable studies on the Er,Cr:YSGG laser and its efficacy and safety in cutting soft tissues, enamel, dentin, and bone, which all play a significant role in periodontal therapy.[14,15,16] Because of this versatility, the Er,Cr:YSGG laser was the first all-in-one laser that made the economics of providing laser therapy more feasible for the periodontist and general practitioner.[17]

Over the years, the collective research of hundreds of individuals has resulted in laser systems that have real and beneficial applications for periodontal care. Current lasers, wavelengths and applications are listed in Table 1.

Table 1. Lasers, Wavelengths, and Current Dental Applications

Laser Type	Wavelength	Current Dental Applications
Excimer	193 nm to 308 nm	Hard tissue ablation, Removal of calculus, (not in use at this date)
Argon	488 nm to 514 nm	Curing of composite materials, Tooth whitening,
Carbon Dioxide	10,600 nm	Intraoral soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis)
Nd:YAG	1,064 nm	Intraoral soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis), Analgesia, Treatment of dentin hypersensitivity, Pulpotomy, Root canal disinfection, Aphthous ulcer treatment, Removal of gingival melanin pigmentation
Diode	655 nm to 980 nm	Caries and calculus detection, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis), Analgesia, Treatment of dentin hypersensitivity, Pulpotomy, Root canal disinfection, Aphthous ulcer treatment, Removal of gingival melanin pigmentation
Er,Cr:YSGG	2,780 nm	Caries removal and cavity preparation, Modification of enamel and dentin surfaces, Intraoral general and implant soft tissue surgery, Sulcular debridement (subgingival curettage in periodontitis and peri-implantitis), Scaling of root surfaces, Osseous surgery, Treatment of dentin hypersensitivity, Analgesia, Pulpotomy, Root canal treatment and disinfection, Aphthous ulcer treatment, Removal of gingival melanin/metal-tattoo pigmentation
Er:YAG	2,940 nm	Same as Er,Cr:YSGG, although coagulative capabilities are more limited and studies have shown inefficient delivery energy at the tissue surface.[18]

The American Academy of Periodontology has issued several position papers on the use of lasers.[8,9,11,19] There have also been several research projects evaluating the benefits and disadvantages of using lasers for periodontal treatment. It should be noted, however, that the findings have focused almost exclusively on the Nd:YAG wavelength.

The positive results currently emerging in the scientific literature about the Er,Cr:YSGG wavelength clearly indicates that periodontists and general practitioners may have a new technology to facilitate the treatment of periodontal disease while achieving results within the standard of care.[20,21,22] Among researchers, most of this emerging information would be considered "anecdotal." That said, however, multicenter studies are currently underway to prove the benefits and applications of the Er,Cr:YSGG laser in periodontal therapy as stated in the anecdotal reports.

More importantly, it has already been annotated in the literature that the Er,Cr:YSGG laser system provides a more comfortable patient experience with less trauma and post-operative complications, as well as a decreased healing time.[23,24] Periodontists—whose clinical protocols can be some of the most precise, invasive, and traumatic in dental healthcare—should take advantage of these benefits and be leading the research and implementation of lasers into modern periodontal therapy. This can be achieved by creating relationships with local GPs that result in a proactive and productive approach to periodontal patient care.

Review of Treatment Algorithms: When Should a GP Treat a Periodontal Condition, and When Should They Refer?

One way for the periodontist to assist the general dentist in choosing the procedures they should or shouldn't be attempting with a laser would be for the periodontist to actively train referring dentists, thereby empowering them to confidently add these treatment protocols to their practice. The benefits are twofold:

1) The GPs will be able to deliver laser-assisted periodontal therapy as the standard of care for their community.

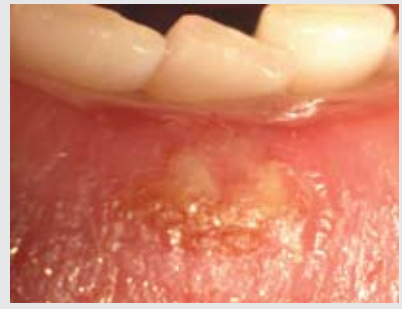
2) It allows the periodontist to focus on more complex cases that require a multidisciplinary team approach.

Properly implemented, this is a true "win-win-win" for the patient, GP, and periodontist.

The procedures discussed in Table 2 are based on the author's utilization of an Er,Cr:YSGG all-tissue laser (Waterlase MD™, BIOLASE Technology, Inc., San Clemente, California, USA).

Table 2. Essential Periodontal Procedures and Algorithms for Determining if a GP Should Treat or Refer

Procedure	CDT-4 Code	Description of the procedure and who should treat	Clinical Photograph
Soft-tissue biopsy (fibroma, mucoseal, etc.)	D7286	The surgical removal of a soft-tissue lesion. A simple procedure, especially with a laser, that can easily be treated by the GP and rarely requires sutures.[25] (Fig. 1)	 Fig. 1

Procedure	CDT-4 Code	Description of the procedure and who should treat	Clinical Photograph
Soft tissue band-aid for herpetic lesion, aphthous ulcer, split lip, etc.	D4999	Utilization of a laser to treat oral ulcerations for relief of pain A simple procedure, especially with a laser, that can easily be treated by the GP and rarely requires sutures.[14] (Fig. 2)	 Fig. 2
Frenectomy	D7960	The surgical removal or repositioning of a frenum; this procedure is performed to enhance the stability of a corrected disatema or to relieve a tongue tie A simple procedure, especially with a laser, that can easily be treated by the GP and rarely requires sutures.[14] (Fig. 3)	 Fig. 3
Circumrefential Supracrestal Fiberotomy	D7291	A surgical procedure designed to sever the gingival and/or transseptal periodontal fibers around a tooth, usually to reduce the tendency for relapse of corrected tooth rotations. A simple procedure, especially with a laser, that can easily be treated by the GP and rarely requires sutures.[14] (Fig. 4)	 Fig. 4
Gingivectomy	D4210, D4211	Involves the excision of the soft tissue when there is asymmetrical or unaesthetic gingival architecture. A simple procedure, especially with a laser, that can easily be treated by the GP and rarely requires sutures. Care must be taken to avoid violation of the biologic width. (See Laser-assisted crown lengthening below).[14] (Fig. 5)	 Fig. 5

Procedure	CDT-4 Code	Description of the procedure and who should treat	Clinical Photograph
Crown Lengthening-Functional/Cosmetic	D4249	*Functional:* This procedure is employed on a single tooth to allow a restorative procedure or crown when there is little or no tooth structure exposed to the oral cavity and the final restorative margins would violate the biologic width.[26,27] *Cosmetic:* This procedure is performed in the aesthetic zone to facilitate an ideal gingival architecture and may involve the recontouring of hard and soft tissue in order to prevent violation of biologic width.[26,27] (Fig. 6) Proper diagnosis and treatment planning are required to differentiate the complexity of the treatment required for both functional and cosmetic crown lengthening. Step 1. Sounding to bone to establish the height of the osseous crest in relationship to the planned gingival height. (Fig. 7) Step 2. The Er,Cr:YSGG laser is used to recontour the soft tissue and the osseous tissue, if needed, with a minimally invasive approach. In some cases, a flap is required to properly recontour the bone in which case the laser would assist in the completion of the procedure. Step 3. Re-sound down to the bone to make sure the biologic width has not been violated. (Fig. 8, Fig. 9) With training, GPs may choose to perform these procedures on a case-by-case basis or elect to refer more complex cases.	 Fig. 6.  Fig. 7.  Fig. 8.  Fig. 9

Er,Cr:YSGG Laser-Assisted, Site-Specific Perio and Cellular Kinetics

To better understand why the Er,Cr:YSGG laser is so effective in the treatment of site-specific perio, (Fig. 16) we need to first grasp the concept of cellular kinetics and the "cellular race." Unlike the Nd:YAG laser, which relies on significant penetration into the soft tissue[28] to achieve the desired results, the Er,Cr:YSGG laser ablates soft tissue by selectively removing a few cell layers at a time[29]. Because of this, the Er,Cr:YSGG laser allows a periodontist to achieve the successful results that had been previously achieved only by using more aggressive surgical techniques.

This paradigm shift in treatment is not based on the Er,Cr:YSGG replacing traditional periodontal therapies altogether; rather it is based simply on using a new instrument with proven results to manipulate the tissue interfaces and manage cellular kinetics.

What is 'Site-Specific Perio?'

As previously discussed, the empowerment of GPs to treat a significant portion of periodontal disease in their own practices is achieved with proper training and understanding of situational algorithms accomplishes two goals: 1) As a result of the information provided by the periodontist, the GPs enjoy a new source of revenue. This new revenue stream will ultimately result in a productive, loyal relationship between a GP and a periodontist; 2) It reduces the amount of generalized periodontal disease that is referred and instead allows GPs to refer only those sites, i.e. 'site-specific perio,' that have not responded to the treatments outlined in the algorithms.

Utilizing the Er,Cr:YSGG laser in conjunction with other emerging technologies and bone grafting material as required allows the periodontist to treat the 'site-specific perio' in a minimally invasive manner.

What is Cellular Kinetics?

Periodontal regeneration is defined as the replacement of lost connective tissue and supporting bony structure is characterized by the dynamic interaction of the three tissue types in the oral cavity: epithelium (Fig. 10a), connective tissue (Fig. 10b) and bone (Fig. 10c). It has been shown that the protective nature of epithelium causes it to travel much faster to repopulate a healing periodontal wound than the other two tissue types. Connective tissue cells come in second in "the race" with bone and periodontal ligament tissue cells being dead last. In this light, epithelium is clearly the "enemy" of a periodontal therapist as it relates to the healing that occurs following conventional treatment of periodontitis. If epithelium tissue is not properly managed, rapid growth may result in unpredictable periodontal regeneration, i.e. long-junctional epithelium[30] (Fig. 11).

Conventional site-specific perio treatment outcomes can be improved by creating a biologic advantage for connective tissue and bone. This can be facilitated by a surgically placed membrane that excludes epithelial cells from the healing process, which results in regeneration. "Guided tissue regeneration," as this technique is called, is a proven and widely used technique[31] (Fig. 12 and Fig. 15).

It may be possible to achieve the same process of cellular exclusion to enhance the biologic response using an laser-assisted, minimally invasive technique called "epithelial ablation" (Figs. 13-15).

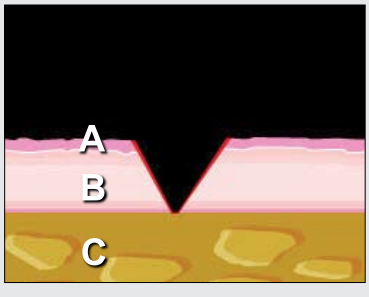


Figure 10. The "cellular race" involves three tissue types: epithelium (A), connective tissue (B), and bone/PDL (C). Pictured is an incision compatible with that associated with the treatment of periodontal disease.

Figure 11. When the three tissue types are not properly managed, scarring will occur. Pictured is a healed wound that is compatible with the formation of long-junctional epithelium.

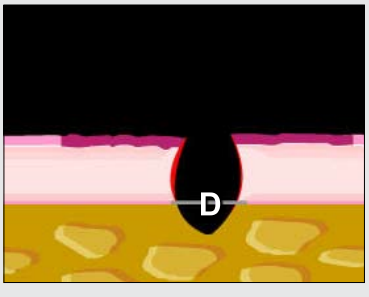


Figure 12. The periodontal defect with a membrane placed (D) to exclude epithelial cells during tissue regeneration.

First, the root surfaces of the teeth to be treated are thoroughly debrided of any calculus, plaque or bacteria. This is completed with a combination of hand instrumentation and use of the Er,Cr:YSGG laser (Fig. 17-19). The inside of the periodontal pocket is de-epithelialized using the laser (Fig. 20). This de-epithelialization is continued onto the buccal gingival tissue approximately 5mm beyond the free gingival margin. If a bony defect is present, the granulation tissue is removed using the laser. A bone grafting material or a tissue stimulant (ameliogens) may be applied to enhance the result.[32] The goals of a connective tissue re-attachment and resolution of the bony defect can be realized with minimal discomfort to the patient, no sutures and a reduced healing time (Fig. 21).

In the event a flap is required, the tissue on either side of the incision is de-epithelialized such that no scarring will occur following healing. The cellular race is won

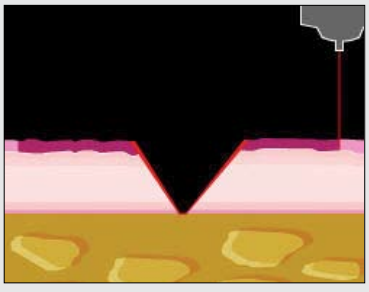


Figure 13. Ablation of the epithelial layer using the Er,Cr:YSGG laser to exclude epithelial cells during tissue regeneration.

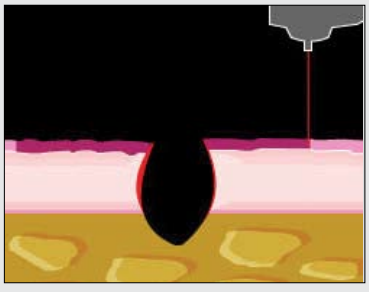


Figure 14. Ablation of the connective tissue using the Er,Cr:YSGG laser to exclude connective tissue cells during tissue regeneration.

Figure 15. Pictured is normal healing compatible with connective tissue reattachment and bone regeneration in the treatment of site-specific perio.

Figure 16. Site-specific periodontal disease.

Figure 17. Hand scaling.

Figure 18. Laser-assisted scaling using the Er,Cr:YSGG laser.

Figure 19. Thoroughly debrided root surface.

Figure 20. De-epithelialization using the Er,Cr:YSGG laser.

Figure 21. Normal healing has occurred with connective tissue reattachment and bone regeneration.

on behalf of the tooth when the three cell types repopulate the periodontal defect in the proper proportion along the root surfaces that existed in health (Fig. 21).

Conclusion

Although the state of periodontics is undergoing a paradigm shift, the advent of new laser technology provides periodontists and general practitioners with an instrument that allows minimally invasive, more comfortable treatment within the standard of care. The treatment capabilities involve the successful and effective treatment of traditional procedures, such as gingivectomies, frenectomies, soft tissue lesions; and advanced procedures, such as functional or cosmetic crown lengthening; and site-specific therapies for residual periodontal conditions. With laser technology more accessible than ever before, it is important that periodontists and general practitioners provide optimum periodontal therapy within the standard of care. This can be achieved with a clear understanding of basic laser periodontal procedures that can be performed at the GP level, and those that should be referred to a trained and informed laser periodontist.

If you are considering a purchase of a laser system, it is critical to consider laser manufacturers that heavily invest in training their endusers, whether through CE courses and seminars, larger-scale laser symposia, or a network of independent clinical trainers. That said, periodontists, dental schools, and dental-laser manufacturers should establish treatment parameters and protocols that facilitate the proper training of practitioners to successfully execute this paradigm shift for the benefit of patients.

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Author Profile

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Dr. Bradley Dean, who was recently voted one of the top periodontists in Texas, received his undergraduate education from Texas A&M University and his DDS from Baylor College of Dentistry, in Dallas, Tex. In Dallas, he also completed a fellowship in oral medicine and a Masters Degree from the department of periodontics. Dr. Dean lectures nationally and internationally and has written scientific articles on topics such as tissue regeneration, bone regeneration, and cosmetic implant dentistry. He is currently one of the pioneers in developing periodontal laser techniques that provide his patients a minimally invasive and virtually pain-free treatment of their periodontal conditions. He is a visiting lecturer at Baylor College of Dentistry and Collin County Community College Hygiene School. He is a Diplomate of the American Academy of Periodontology as well as an active member in the American Dental Association, the Texas Dental Association, the Dallas County Dental Society, and the North Texas Dental Society.

If you have any questions or comments for the author of this CE course, please send an e-mail to *authorquestions@ineedce.com*. Please reference the course title and author's name.

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Questions

1. The first laser used in dentistry in the 1960's was a _____ laser.
   a. Garnet
   b. Diamond
   c. Emerald
   d. Ruby

2. Thomas Edison introdcued the first theories on lasers.
   a. True
   b. False

3. LASER is an acronym for _____ .
   a. Light Amplification by Stimulated Emission of Radiation
   b. Light Assisted Stimulated Energy and Radiation
   c. Light Amplification by Stimulated Emission of Radar

4. The author believes that the current periodontal paradigm shift is bad for dentists and their patients.
   a. True
   b. False

5. Laser light is a man-made single-_____ wavelength.
   a. Atom
   b. Proton
   c. Neutron
   d. None of the above

6. Spontaneous emission of light results in unorganized light waves.
   a. True
   b. False

7. When laser light comes in contact with tissue, it can _____ .
   a. Reflect
   b. Scatter
   c. Be absorbed
   d. All of the above

8. Laser devices that are well absorbed by water include _____.
   a. Er,Cr:YSGG
   b. Nd:YAG
   c. Argon
   d. Diode
   e. Both b & c
   f. None of the above

9. Lasers not well absorbed by water result in:
   a. Carbonization
   b. Charring
   c. Melting of organic tissue
   d. Both b & c
   e. Both a & b
   f. All of the above

10. The Er,Cr:YSGG laser does NOT have FDA clearance for, and is not recommended for which one of the following ____?
   a. Soft Tissue Biopsy
   b. Periodontal Treatment
   c. Cavity Preparations
   d. Cutting Amalgam
   e. Cutting Bone

11. Early lasers had a profound thermal effect on target tissues.
   a. True
   b. False

12. Argon lasers were used to cure composite materials.
   a. True
   b. False

13. The Carbon Dioxide laser has a wavelength of _____ .
   a. 488 nm
   b. 2,100 nm
   c. 10,600 nm
   d. 337 nm

14. The Er,Cr:YSGG laser has a wavelength of _____ .
   a. 514 nm
   b. 2,780 nm
   c. 193 nm
   d. 2,940 nm

15. The Nd:YAG laser can be used for both hard and soft tissue.
   a. True
   b. False

16. The Er,Cr:YSGG laser can be used for both hard and soft tissue.
   a. True
   b. False

17. The early position papers published by the American Academy of Periodontology were primarily focused on the _____ laser.
   a. Er,Cr:YSGG
   b. Nd:YAG
   c. Er:YAG
   d. Diode

18. It has been demonstrated in the literature that the Er,Cr:YSGG laser has the following benefits for the patient:
   a. More comfort
   b. Less trauma
   c. Decreased healing time
   d. All of the above

19. The surgical procedure designed to sever the gingival and/or transseptal periodontal fibers around a tooth is called _____.
   a. Frenectomy
   b. Gingivectomy
   c. Circumferential Supracrestal Fiberotomy
   d. Soft-Tissue Biopsy

20. The procedure that involves the excision of soft tissue only when there is asymmetrical or unaesthetic gingival architecture is called _____.
   a. Gingivectomy
   b. Crown Lengthening-Cosmetic
   c. Frenectomy
   d. Soft-Tissue Biopsy

21. The CDT-4 code for a Frenectomy is ____.
   a. D7291
   b. D7286
   c. D4210
   d. D7960

22. The CDT-4 code for a Crown Lengthening is _____.
   a. D4249
   b. D7286
   c. D4210
   d. D4999

23. All crown lengthening procedures require the reflection of a flap.
   a. True
   b. False

24. The three tissues that are involved in the cellular race are:
   a. Epithelium, Connective Tissue, and PDL
   b. Connective Tissue, Bone, and PDL
   c. Epithelium, Connective Tissue, and Bone

25. In normally occurring cellular kinetics, _____ is the “enemy” of the periodontist.
   a. Bone
   b. Epithelium
   c. Connective Tissue
   d. Periodontal Ligament
   e. All of the above.

26. The goal of site-specific perio is to achieve a long-junctional epithelium attachment.
   a. True
   b. False

27. When the tissues are de-epithelialized to facilitate cellular kinetics, the recommended distance is _____.
   a. 3 mm
   b. 4 mm
   c. 5 mm
   d. 6 mm

28. When considering the purchase of a laser, training is not important for successful implementation in your practice.
   a. True
   b. False

29. The author believes that the initial root debridement can be accomplished with a combination of hand scaling and laser scaling.
   a. True
   b. False

30. In cellular kinetics, scarring occurs as a result of the invagination of the epithelium.
   a. True
   b. False

ANSWER SHEET

Concepts in Laser Periodontal Therapy Using the Er,Cr:YSGG Laser

This course is intended for dentists, dental hygienists, and dental assistants.

Name

Title

Address

City State Zip

Telephone Home ( ) Office ( )

After reading instructions: 1) Complete all information above. 2) Complete answer sheets with either a pen or a pencil. 3) Mark only one answer for each question. 4) When test is completed, enclose the completed answer sheet. Successful completion of this course will earn you 4 CEUs. 5) A blank duplicate answer sheet may be copied for additional course participants.

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1. Were the objectives and educational methods appropriate?
   5 4 3 2 1 0
2. Were the course objectives accomplished?
   5 4 3 2 1 0
3. Please rate the course content.
   5 4 3 2 1 0
4. Please rate the instructor's effectiveness.
   5 4 3 2 1 0
5. Was the overall administration of the course effective?
   5 4 3 2 1 0
6. How do you rate the author's grasp of the topic?
   5 4 3 2 1 0
7. Do you feel that the references were adequate? 1 Yes 2 No
8. Do you feel that the educational objectives were met? 1 Yes 2 No
9. If any of the continuing education questions were unclear or ambiguous, please list them:

   _____

10. Was there any subject matter that was unclear? Please describe.

    _____

11. Would you participate in a program similar to this one in the future on a different topic of interest? 1 Yes 2 No
12. What additional continuing dental-education topics would you like to see?

    _____

1.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	16.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
2.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	17.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	18.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	19.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ

AUTHOR
D. BRADLEY DEAN, DDS, MS

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The author of this course has no commercial ties with the sponsors or the providers of the unrestricted educational grant for this course.

EDUCATIONAL OBJECTIVES
After reading this course, the clinician will be able to do the following:

1. Review laser physics, tissue interaction, and current laser technology relevant to the treatment of periodontal disease.
2. Review treatment algorithms that allow general dentists to evaluate patients requiring periodontal therapies to determine how they can best serve their patients' needs or when they should refer them to a periodontist.
3. Introduce a concept for the successful treatment of site-specific perio using a laser-assisted, minimally invasive protocol that enables victory in "the cellular race."

INSTRUCTIONS
All questions should have only one answer. Grading of this examination is done manually. Participants will receive course results in the mail within two to three weeks after taking an examination.

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COURSE CREDITS/COST
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