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Dent Clin N Am 48 (2004) 923–936

THE DENTAL
CLINICS
OF NORTH AMERICA

Lasers for initial periodontal therapy

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The pathogenesis of periodontal disease and the methods of treating it have undergone radical changes in the past 30 years [1]. The current model for periodontal disease includes microbial components, host inflammatory responses, and host risk factors that contribute to the advancement of this disease [2,3]. The pathogenic bacterial plaque in the susceptible host triggers an immune response that results in inflammation and changes in the metabolism of the connective tissue and bone [4–6]. This disease can have periods of intense activity and periods of dormancy. Initial periodontal therapy now includes nonsurgical debridement of the tooth structure, local delivery of antimicrobials, host modulators, and laser reduction of sulcular bacteria with laser coagulation of the treatment site [7]. The dental hygienist generally is the provider of this initial nonsurgical periodontal therapy.

Scope of practice

According to the Dental Practice Act of California, "the practitioner must deliver competent care according to his or her education, training, clinical experience and scope of practice" [8]. Each practitioner must be familiar with the Dental Practice Act in the state in which he or she practices before delivering initial periodontal therapy. Understanding what treatment modalities are allowed by license determines who delivers the therapy. The language of each Dental Practice Act states who, by license, can scale and root plane, place antimicrobials, and use a laser for soft tissue therapy. For example, the use of a soft tissue laser by a dental hygienist is prohibited in the Dental Practice Act of four states: Alabama, Alaska, Florida, and Texas. In these four states, a licensed dentist must use the laser in the treatment sequence for initial periodontal therapy. Forty-six states do not specifically prohibit a dental hygienist to use a laser for bacterial reduction

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doi:10.1016/j.cden.2004.05.007

and coagulation in the treatment of periodontal disease under supervision of a licensed dentist.

Rationale for therapy

The US Surgeon General's recent report demonstrated potential consequences to an individual's general health by failing to treat dental disease [9]. The body of evidence that links the chronic infection of periodontal disease to serious medical conditions such as diabetes, low birth weight, premature birth, strokes, and lung and cardiac disease is growing [10–12]. The American Heart Association (www.americanheart.org) strongly recommends premedication for dental procedures as a standard regimen for some patients who are at risk from oral bacteria. Recent studies also show the risk factors that can affect the onset, progression, and severity of periodontal disease [13]. It now is accepted that periodontal disease is an infection and is opportunistic—the presence of virulent species of bacteria is as important as the host's response to them [14]. It becomes increasingly important to manage periodontal disease by addressing the microbes and the patient's health. Thorough treatment of periodontitis must be performed with the least amount of risk or side effects for the patient.

Soft tissue lasers are a good choice for bacterial reduction and coagulation in the treatment sequence [15]. The soft tissue lasers—argon (488 nm, 514 nm), diode (800–830 nm, 980 nm) and Nd:YAG (1064 nm)—are well absorbed by melanin and hemoglobin and other chormophores present in periodontally diseased tissues. The laser energy is transmitted through water and poorly absorbed in hydroxyapitite. These properties of the soft tissue lasers make them an excellent choice to use in a periodontally involved sulcus that has dark inflamed tissue and pigmented bacteria. The laser energy is delivered with a thin, flexible fiber optic system (300 to 400 μm in diameter) that allows the clinician to access the diseased tissue. The laser energy is transmitted through the fluid in the sulcus and is most attracted to and reactive with the inflamed tissue and pigmented bacteria.

One other laser, an erbium,chromium:yttrium-scandium-gallium-garnet laser (Er,Cr:YSGG, 2790 nm), also has an indication for use for soft tissue therapy. The laser energy of the erbium family of lasers is well absorbed by hydroxyapatite and highly absorbed by water. Ando and Aoki [16] showed that an erbium:yttrium-aluminum-garnet laser in vitro has a significant bactericidal effect on both *P gingivalis* and *A actinomycetescomitans*, which are primary components of periodontol infection. The clinician must be careful to keep the fiber in contact with the target tissue during soft tissue procedures with this wavelength to achieve a good result.

Various studies highlight the success of treatment of periodontal disease with soft tissue lasers. Neill and Mellonig [17] in 1997 performed a comparison study of scaling and root planing with laser bacterial reduction

using an Nd:YAG laser. The study used a measure of gingival index for inflammation and the presence of *P gingivalis* and *P intermedia* in the sulcus before and after treatment. The results demonstrated a significantly greater improvement in gingival index at 6 months with the laser-treated group. At 3 months, the laser-treated group maintained significant reduction in *P gingivalis* and *P intermedia*, whereas the scaling and root-planing group showed a measurable repopulation of these bacteria from initial treatment.

In 1998, Moritz et al [18] compared the use of a diode laser after scaling and root planing with scaling and root planing alone. Gingival index and bacterial populations were the parameters used for the study. At 3 and 6 months, the laser group showed significant lessening of bacterial populations and greater improvement in gingival index compared with the scaling-only group.

Liu et al [19] compared Nd:YAG laser treatment with scaling and root planing alone in 1999 in a randomized controlled clinical study. The study assayed for interleukin (IL)-1β, a known potent stimulator of bone resorption found in crevicular fluid and responsible for loss of periodontal structures in the disease process of periodontal disease. Four groups were used: control, scaling and root planing only, laser only, and scaling and root planing with laser. Three groups showed improvement in gingival index and reduction in IL-1β, with no improvement in the control group. The group with the laser combined with scaling and root planing showed further improvement over time in the reduction of IL-1β.

Three other retrospective studies showed pocket depth reduction. Using an argon laser, Finkbeiner [20] showed that pockets were reduced by a mean of over 1.5 to 3 mm, depending on the initial disease state. The soft tissue side of the pocket was coagulated with laser energy, and then the residual coagulum was removed during the subsequent root planing using hand instruments. Raffetto and Gutierrez [21] showed similar results using an Nd:YAG laser.

The reader should note that all of these studies show how the laser is used adjunctively in periodontal therapy. All patients must undergo scaling as the first step in the treatment protocol. Traditional periodontal therapy demands that the root surface be thoroughly debrided of pathogenic biofilms and calculus [22]; this is accomplished by conventional instrumentation. The laser can then continue to reduce the soft tissue inflammation.

Antibiotic therapy sometimes is used to control periodontal disease. Allergic reactions and compliance with taking prescribed medications can be a concern [23–25]. Soft tissue lasers reduce bacterial populations photothermally and eliminate those problems related to antimicrobial therapy. These lasers successfully and safely can be used on a wide range of the population, including children and pregnant women, unlike some prescribed or sulcularly delivered drugs. Unlike those medications, the patient will not experience allergic reactions, bacterial resistance, or untoward side effects when the laser is used.

Diagnosis

The purpose of initial nonsurgical periodontal therapy is to restore periodontal health. The first step in this process is the diagnosis of the level of disease present [26]. The licensed dentist is responsible for the diagnosis of health or level of disease. An examination of the hard and soft tissues to determine areas of disease can include visual examination of all tissues, full-mouth radiographs, occlusion and temporomandibular joint evaluation, probing, gingival index, and bacterial testing. The information from the examination is used to determine the level of disease, allowing a diagnosis to be made and the assignment of the proper case classification for periodontal disease. At the 1999 International Workshop for Classification of Periodontal Diseases and Conditions, a reclassification of the different forms of plaque-induced periodontal diseases was developed. The seven general types of plaque-induced periodontal diseases are: gingivitis, chronic periodontitis, aggressive periodontitis, periodontitis as a manifestation of systemic diseases, necrotizing periodontal diseases, abscesses of the periodontium, and periodontitis associated with endodontic lesions.

These classifications, along with the following American Dental Association case types, are used for diagnosis and third-party billing of insurance [27]:

- Healthy—pockets 3 mm or less and no bleeding or inflammation
- Type I: gingivitis—pockets 3 mm or less, bleeding on probing, inflammation, and possibly some debris present supragingivally
- Type II: mild periodontitis—pockets 4 to 6 mm with slight bone loss, bleeding on probing, inflammation, and debris present subgingivally
- Type III: moderate periodontitis—pockets 6 to 7 mm with bone loss, bleeding on probing, inflammation, and debris present subgingivally, with some mobility and possible furcation involvement
- Type IV: advanced periodontitis—pockets in the 7-mm or greater range, heavy bleeding on probing, inflammation and suppuration, and debris present supra- and subgingivally, with mobility and furcation involvement
- Type V: refractory periodontitis—inflammation and pocket depths of 4 mm or greater in a periodontium previously treated for periodontal disease

Treatment planning

After the diagnosis is complete, the treatment planning for the case begins. The dentist and dental hygienist, working as a team, divide the mouth into manageable treatment areas according to the amount of disease present and discuss the planned therapy with the patient.

A manageable treatment area is the number of sites that can be treated in a 1-hour therapeutic appointment. A site for treatment corresponds to the six-point periodontal probing done in the initial examination. The recorded six-point probed chart becomes the roadmap for the planned initial periodontal therapy (Figs. 1 and 2). The anatomy of the pocket can be different at each of the six probed areas of the sulcus. The changes in this architecture, along with amounts of debris and inflammation present, need to be taken into consideration in determining the time needed to adequately treat the site.

Initial therapy always should begin in the area with the deepest pocket depths and progress to less involved areas. Debridement of hard deposits on the tooth and root surfaces by ultrasonics and hand instrumentation is followed by laser bacterial reduction and laser coagulation of the soft tissue side of the sulcus [11,28]. Table 1 shows the author's recommended laser parameters. On subsequent appointments, the clinician should plan to relase the previously treated sites with a bacterial reduction setting, which reduces the bacterial load and enhances the healing process.

Appointment protocol

The appointment protocol for laser soft tissue therapy follows a simple formula for the 1-hour therapeutic appointment [7]. The hard side of the pocket (tooth and root surface) is debrided first, followed by laser bacterial reduction and coagulation of the soft side (epithelial tissue) of the sulcus.

For the initial appointment, the protocol includes the following:

- Anesthesia as needed (topical or injected)
- Ultrasonic scaler with antimicrobial irrigant
- Hand instrumentation
- Laser bacterial reduction

Fig. 1. Probe in periodontal pocket.

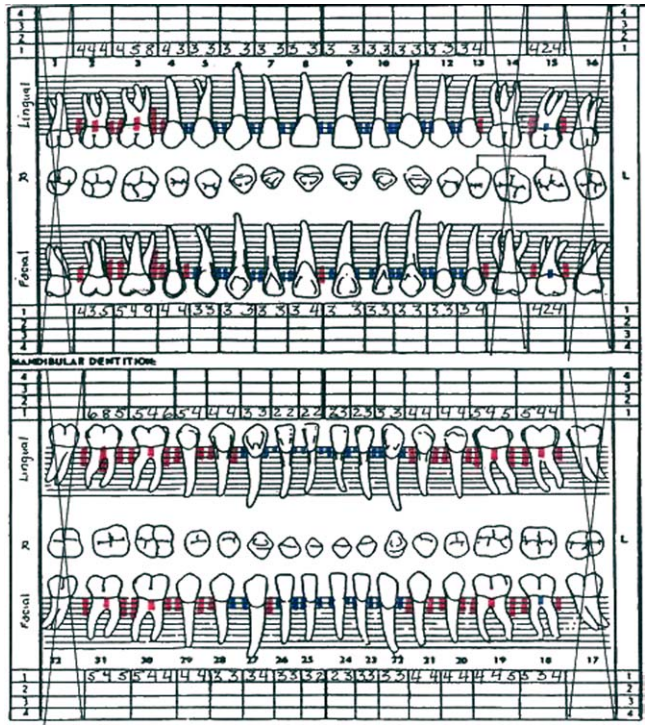

Fig. 2. Completed pretreatment periodontal chart with six-point pocket depths recorded.

- Laser coagulation of the treatment sites
- Postoperative instruction/home care instruction

An additional step is added to the appointment protocol in cases that require multiple visits. The laser is used with a bacterial reduction setting on previously treated sites, with the fiber calibrated to account for healing that has taken place since the previous appointment.

Table 1
Laser parameters for different laser instruments used in soft tissue therapy

Laser type	Fiber diameter	Bacterial reduction setting	Coagulation setting
Argon	300 μm	0.5 W, 0.05-sec pulse duration, 0.2 sec between pulses	0.75–0.85 W, 0.05-sec pulse duration, 0.2 sec between pulses
Diode	300 μm (initiated)	0.4 W, continuous wave, 20 sec per site	0.8 W, continuous wave, 10 sec per site
Nd:YAG	300 μm	30 mJ, 60 Hz, 1.8 W, 40 sec per site	100 mJ, 20 Hz, 2.0 W, 20 sec per site

Fiber calibration

Calibration of the laser fiber is critical for successful soft tissue treatment. The diagnostic, detailed six-point periodontal probing is used throughout the treatment to determine the fiber length to be inserted into the pocket. After debridement of the tooth structure is complete, the periodontal probe is used to recheck the architecture of the pocket and reconfirm the depth of the area to be treated with the laser. The probe is placed on the instrument tray, the laser fiber assembly is held next to the probe, and the fiber is adjusted in length to correspond to the periodontal probe charting (Fig. 3). The calibration for initial therapy is the depth of the treatment site minus 1 mm. This measurement allows for the laser energy to penetrate the tissue and reduce the bacterial load without the fiber touching the epithelial attachment at the bottom of the pocket. The optic fiber must be calibrated for each treatment site as therapy progresses.

Sites being retreated at subsequent therapy appointments are calibrated to take into account the healing that takes place after initial therapy. The sulcus heals from the bottom upward, and the fiber calibration is adjusted for this healing. At these appointments, the fiber is measured according to the initial periodontal charting minus 2 mm to allow for the area of fragile attachment healing at the floor of the pocket [29,30].

Laser fiber placement and therapy

The laser energy is transmitted through the flexible glass delivery system; the cladding surrounding the core of the quartz glass crystals ensures that the photons are emitted only at the tip, thus making the fiber "end cutting."

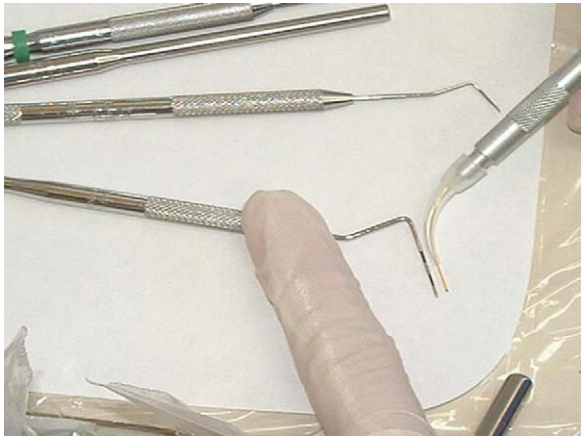

Fig. 3. Periodontal probe calibrates the bare laser fiber extrusion from the canula. The fiber length must be 1 mm shorter than the pocket depth.

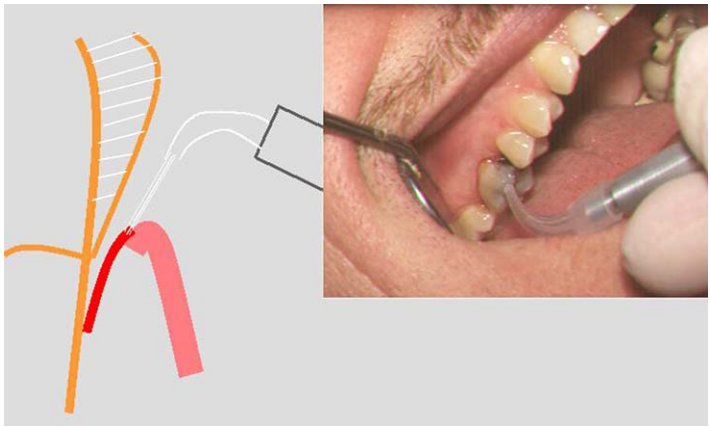

Fig. 4. Therapy is started with the laser fiber at the top of the sulcus. Start at the top of the sulcus and aim the fiber at the diseased tissue, not toward the tooth structure.

With this concept in mind, the laser clinician must maintain contact with the target tissue to achieve the treatment objective. In the case of soft tissue laser therapy, the target tissue is the inflamed epithelial lining of the pocket. The fiber is placed on the tissue at the top of the sulcus, directing the laser energy away from the tooth structure, and is moved toward the bottom (Figs. 4 and 5). The fiber is moved horizontally and vertically, and contact is maintained with the soft tissue down to the calibrated depth of the fiber (Figs. 6 and 7). The fiber must be inspected frequently, and any accumulated tissue and debris must be wiped off to avoid inefficiency. Bacterial reduction is complete when signs of fresh bleeding occur (Fig. 8). The laser energy is

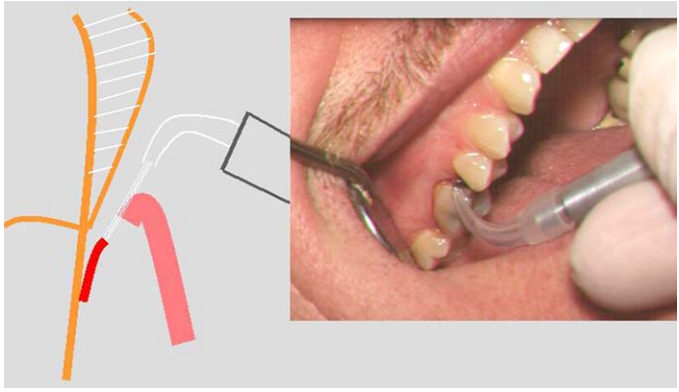

Fig. 5. The laser energy is activated and the fiber is kept in contact with the tissue. Begin to lase, keeping the fiber tip touching the surface of the epithelium.

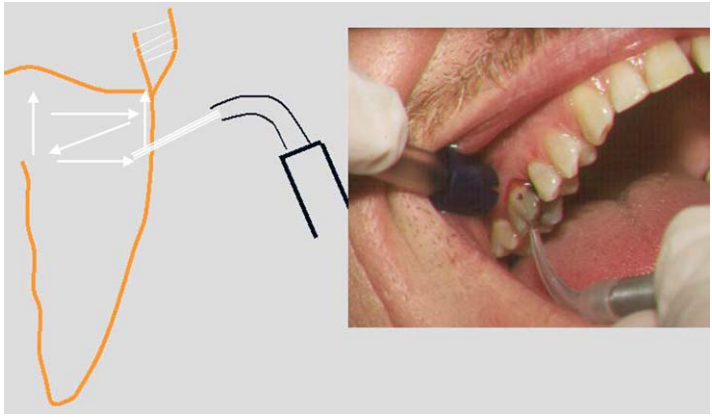

Fig. 6. The fiber is moved with a sweeping motion on the soft tissue side of the pocket. Move the fiber both horizontally and vertically, maintaining contact with the soft tissue at all times. Inspect the fiber frequently and wipe off accumulated tissue.

then changed to a coagulation setting and the fiber is held in contact with the tissue with the same motion—from the top of the sulcus to the bottom—until the bleeding stops. Laser therapy is now complete at the site.

Postoperative instructions

Postoperative instructions following laser soft tissue procedures may include analgesics as needed (eg, ibuprofen or acetaminophen); avoidance of foods that could cause irritation to healing tissue (eg, spicy food, poppy

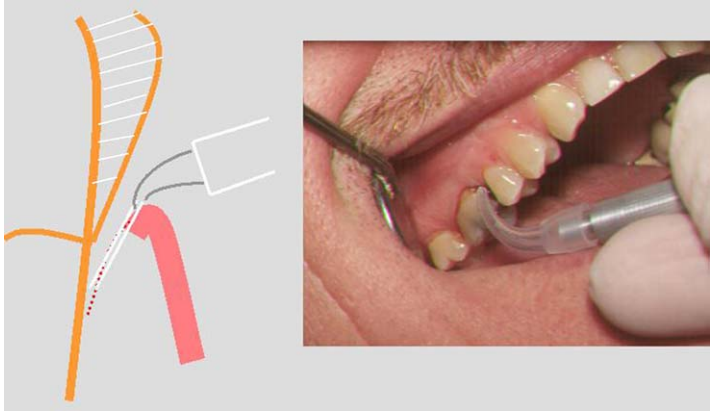

Fig. 7. Laser treatment continues until the calibrated depth is reached.

Fig. 8. Fresh bleeding occurs when the bacterial reduction is complete.

seeds, or popcorn) for 3 to 5 days; home care instruction tailored to the patient's needs, with instruction on how to use periodontal aides suggested by the clinician; and prescription or over-the-counter rinses.

Chart documentation

Recording the treatment parameters of the laser for laser soft tissue therapy is an important final step in the treatment sequence. Along with chart notes of the total procedure, the clinician should include the laser used for therapy, fiber size, operating parameters, total time the laser was used at each site, total energy delivered, and type of tissue treated. This information assures proper evaluation of patient response and healing assessment of the laser therapy. Good documentation allows the clinician to adjust laser parameters if necessary.

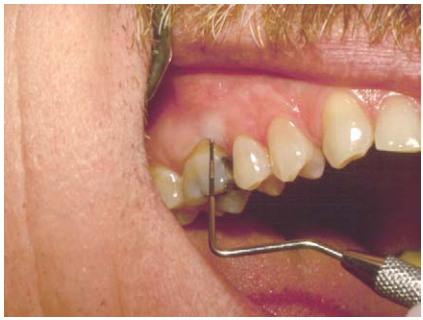

Fig. 9. Six-month probing of treated area. Note pocket reduction.

Probing intervals post therapy

Reprobing treatment sites and comparing probing depths with pretherapy recordings is critical to assess the healing response post laser therapy. The clinician is cautioned not to begin reprobing treated sites before 3 months post therapy because the healing in the sulcus begins at the bottom of the pocket. This tissue is fragile as it reattaches to the root surface and could be damaged with a probe, delaying the healing process [29,30]. Probing with a light touch is recommended at 3 months, and definitive six-point probing can be resumed at 6 months post therapy (Figs. 9 and 10).

Evaluation

The re-evaluation and diagnosis of the level of disease is an ongoing process that involves the doctor, the hygienist, and the patient at each follow-up appointment. When the diagnosis indicates areas of active disease, the first step is complete debridement of the area, followed by laser treatment at all inflamed sites. The bacterial reduction setting followed by the coagulation setting is used, and re-evaluation is done again at 3 months.

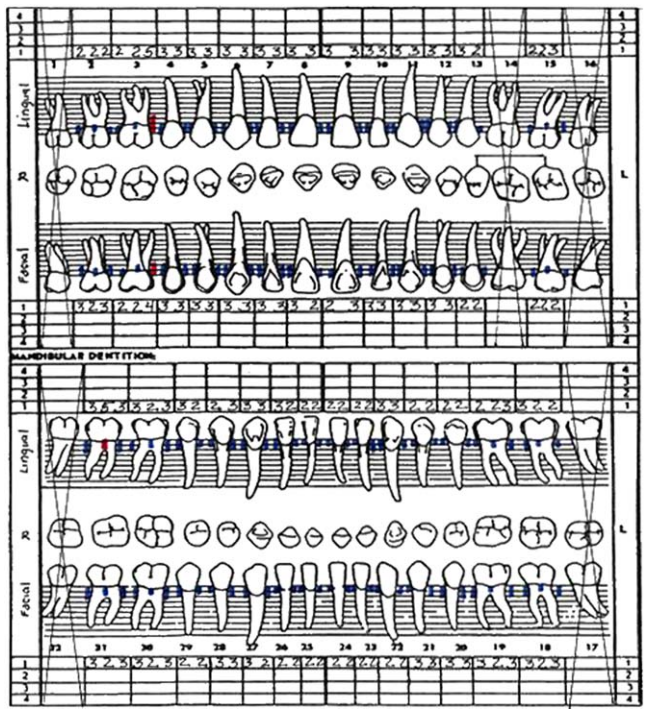

Fig. 10. Six-month probe chart with all pockets recorded.

At the 3-month follow-up appointment, the patient is gently probed and probe depths are compared with initial pretreatment probe depths. An assessment of the tissue tone, bleeding on probing, probe depths, and gingival index help the clinician to determine whether any areas need re-treatment (Figs. 11–13). The laser is used on a bacterial reduction setting for

Fig. 11. Continuing-care patient presents with gingival inflammation around cuspid.

Fig. 12. Laser therapy using bacterial reduction parameters.

Fig. 13. Six-month check of area shows healthy periodontium.

the sites that need care. Re-treatment of sites can reduce the bacterial load further and promote healing [17–19].

Referral

Re-evaluation of the patient every 3 months for a period of 1 year should follow initial laser therapy for periodontal disease. This timeline allows for the healing of the treated sites and re-treatment of deeper pockets. At 1 year, a decision can be made to refer the patient for surgical intervention, bone grafts, or other therapy by a specialist.

Summary

Understanding the components that initiate the host response into the downward spiral of periodontal disease and the systemic link to more serious conditions, the clinician must look for better treatment and therapy options. Clinical observations of patients treated with soft tissue lasers and studies of laser soft tissue therapy show good results and suggest that the incorporation of the laser into first-phase nonsurgical periodontal therapy is an excellent choice [21]. Laser-assisted therapy is a successful treatment option that can help the patient effectively maintain optimum periodontal health.

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