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Lasers For Initial Periodontal Therapy

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Synopsis

With a greater understanding of the components that initiate the host into the downward spiral of periodontal disease, the clinician must look for better treatment and therapy options. Clinical observations and studies are showing good results making incorporation of the laser into the first phase of non-surgical periodontal therapy an excellent choice.

Introduction

The pathogenesis of periodontal disease and the methods of treating it have undergone radical changes in the past thirty 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.(4,5,6) This disease can have periods of intense activity and periods of dormancy. Initial periodontal therapy now includes non-surgical debridement of the tooth structure, local delivery of anti-microbials, 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 non-surgical 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 where they practice 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 anti-microbials, 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 and coagulation in the treatment of periodontal disease under supervision of a licensed dentist.

Rationale for Therapy

The 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 linking 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. (10,11,12) 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 is now accepted that periodontal disease is an infection; and it 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 both the microbes and the patient's heatlh. Thorough treatment of periodontitis must be carried out 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 (488,514nm), diode (800-830,980nm) and Nd:YAG (1064nm) are well absorbed by melanin and hemoglobin and other chormophores present in periodontally diseased tissues. They are 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 microns 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 instrument, an Er,Cr:YSGG (2790nm) also has an indication for use for soft tissue therapy. The Erbium family of lasers is well absorbed by hydroxyapatite, and highly absorbed by water. Ando, Aoki, et al showed that an Er:YAG laser in vitro has a significant bactericidal effect on both P. Gingivalis and A. Actinomycetescomitans, which are primary components of periodontal infection.(16) 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 in 1997 performed a comparison study of scaling and root planing with laser bacterial reduction using a Nd:YAG laser.(17) 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 six months with the laser treated group. At three months the laser treated group maintained significant reduction in *P. gingivalis* and *P. intermedia* while the scaling and root planing group showed a measurable re-population of these bacteria from initial treatment.

In 1998 Moritz, et al did a comparison study using a diode laser after scaling and root planing with scaling and root planing alone.(18) Gingival index and bacterial

populations were the parameters used for the study. At three and six months the laser group showed significant lessening of bacterial populations and greater improvement in gingival index than the scaling only group.

Liu, et. al. compared Nd:YAG laser treatment with scaling and root planing alone in 1999 using a randomized controlled clinical study.(19) The study assayed for Interleukin-1 beta, 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: a 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 Interleukin-1 beta with no improvement in the control group. The laser combined with scaling and root-planing group showed further improvement over time in the reduction of Interleukin-1 beta.

Three other retrospective studies showed pocket depth reduction. Using an Argon laser, Finkbeiner showed pockets reduced by a mean of over 1.5 to 3mm, depending on the initial disease state.(20) 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 showed similar results using an Nd:YAG laser.(21)

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 is sometimes used to control periodontal disease. Allergic reactions and compliance with taking prescribed medications can be a concern. (23,24,25) Soft tissue lasers reduce bacterial populations photo-thermally and eliminate those problems related to antimicrobial therapy. These lasers can successfully and safely be used on a wide range of the population such as children and pregnant women unlike some prescribed and/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 non-surgical 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 and/or level of disease. An exam of the hard and soft tissues to determine areas of disease can include visual exam of all tissues, full mouth x-rays, occlusion and TMJ evaluation, probing, gingival index and bacterial testing. The information from the exam 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, absecesses 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 3mm or less and no bleeding or inflammation.
- Type I-Gingivitis; pockets 3mm or less with bleeding on probing and inflammation with some debris possibly present supra-gingivally.
- Type II-Mild Periodontitis; pockets 4-6mm with slight bone loss, bleeding on probing, inflammation and debris present sub-gingivally.
- Type III-Moderate Periodontitis; pockets 6-7mm with bone loss, bleeding on probing, inflammation and debris present sub-gingivally with some mobility and possible furcation involvement.
- Type IV-Advanced Periodontitis; pockets in the 7mm or greater range with heavy bleeding on probing, inflammation and suppuration, debris present supra and sub-gingivally with mobility and furcation involvement.
- Type V-Refractory Periodontitis; inflammation and pocket depths of 4mm or greater in a periodontium previously treated for periodontal disease.

Treatment Planning

Once the diagnosis is complete the treatment planning for the case begins. The dentist and dental hygienist working as a teamdivide 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 treated in a one-hour therapeutic appointment. A site for treatment corresponds to the six-point periodontal probing done in the initial exam. The recorded six-point probed chart becomes the roadmap for the planned initial periodontal therapy.(**figures 1,2**)

The anatomy of the pocket can be quite different at each of the six probed areas of the sulcus. The changes in this architecture need to be taken into consideration along with amounts of debris and inflammation present in determining the time needed to adequately treat the site.

Initial therapy should always 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) The following table shows the author's recommended laser parameters. On subsequent appointments, the clinician should plan to re-lase the previously treated sites with a bacterial reduction setting which reduces the bacterial load and enhances the healing process.

Figure 1

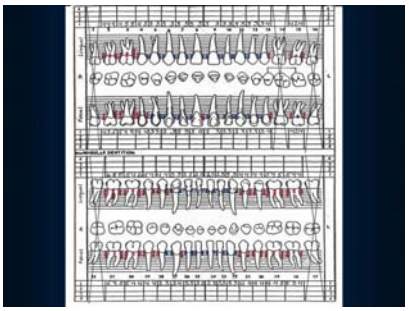

Figure 2

Laser	**Fiber**	**Bacterial reduction**	**Coagulation setting**

type	diameter	setting	
Argon	300 microns	0.5W, 0.05sec pulse duration, 0.2sec between pulses	0.75-0.85W, 0.05sec pulse duration, 0.2sec between pulses
Diode	300 microns (initiated)	0.4W, continuous wave, 20 sec per site	0.8W continuous wave, 10 sec per site
Nd:YAG	300 microns	30mj, 60hz, 1.8W 40 sec per site	100mj, 20 hz, 2.0W 20 sec per site

Table shows laser parameters for different laser instruments used in soft tissue therapy.

Appointment Protocol

The appointment protocol for laser soft tissue therapy follows a simple formula for the one-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:

- Anesthesia as needed (topical or injected)
- Ultrasonic scaler with antimicrobial irrigant
- Hand instrumentation
- Laser bacterial reduction
- Laser coagulation of the treatment sites
- Ultrasonic antimicrobial irrigation
- Post-op instruction/home care instruction

An additional step is added to the appointment protocol in cases requiring 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.

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 the debridement of the tooth structure is complete the periodontal probe is used to recheck the architecture of the pocket and to 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 (**figure 3**). The calibration for initial therapy is the depth of the treatment site *minus* 1mm. This measurement allows for the laser energy to penetrate the tissue and reduce the bacterial load without the fiber actually touching the epithelial attachment at the bottom of the pocket. The optic fiber must be calibrated for each treatment site as therapy progresses.

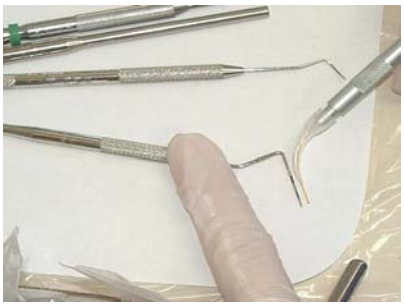

Figure 3

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 upwards and the fiber calibration is adjusted for this healing. At these appointments the fiber is measured according to the initial periodontal charting *minus* 2mm 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". 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 moved towards the bottom. (**figure 4,5**) The fiber is moved both horizontally and vertically, and contact is maintained with the soft tissue down to the calibrated depth of the fiber.(**figure 6, 7**) The fiber must be inspected frequently and any accumulated tissue and debris must be wiped off to avoid inefficiency. **(Figure 8)** Bacterial reduction is complete when signs of fresh bleeding occur. (**figure 9)** The laser energy is 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.

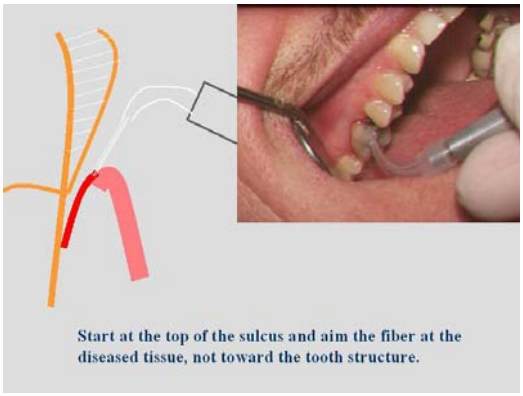

Figure 4

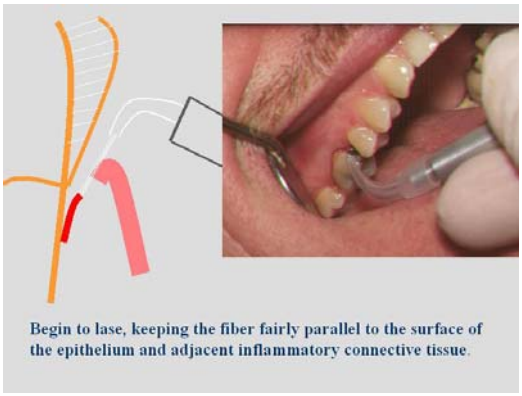

Figure 5

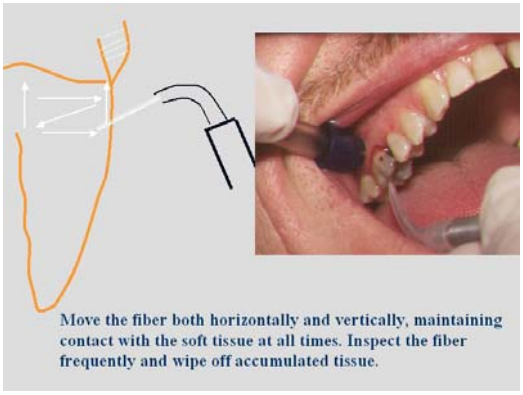

Figure 6

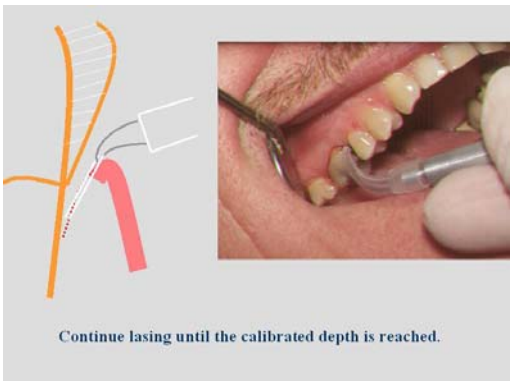

Figure 7

Figure 8

Figure 9

Post Operative Instructions

Post operative instructions following laser soft tissue procedures may include: analgesics as needed, such as ibuprofen or acetaminophen; avoidance of foods that could cause irritation to healing tissue, such as spicy food, poppy seeds, or popcorn, for three to five days; home care instruction tailored to the patients 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.

Probing Intervals Post Therapy

Re-probing treatment sites and comparing probing depths with pre-therapy recordings is critical to assess the healing response post laser therapy. The clinician is cautioned not to begin re-probing treated sites before three months post therapy because the healing in the sulcus begins at the bottom of the pocket. This tissue is fragile as it re-attaches 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 three months and definitive six-point probing can be resumed at six months post therapy.(**figures 10, 11**)

Figure 10

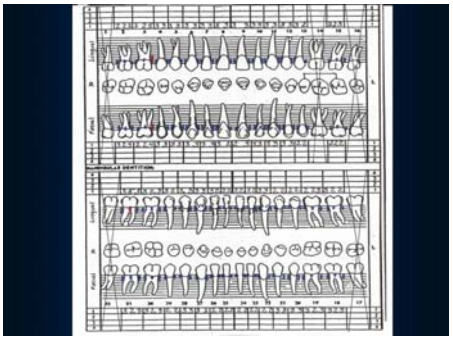

Figure 11

Evaluation

The re-evaluation and diagnosis of the level of disease is an ongoing process involving the doctor, the hygienist and the patient at each re-care 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 three months.

At the three-month re-care appointment the patient is gently probed and probe depths are compared to the initial pre-treatment probe depths. An assessment of the tissue tone, bleeding on probing, probe depths and gingival index help the clinician determine if any areas need re-treatment. (**figures 12, 13, 14)** The laser is used on a bacterial reduction setting for the sites needing care. Re-treatment of sites can further reduce the bacterial load and promote healing.(17,18,19)

Figure 12

Figure 13

Figure 14

Referral

Re-evaluation and re-care of the patient every three months for a period of one 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 one year a decision can be made to refer the patient for surgical intervention, bone grafts or other therapy by a specialist.

Conclusion

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 are showing good results and are suggesting that the incorporation of the laser into first phase non-surgical periodontal therapy is an excellent choice.(21) Laser-assisted therapy is a successful treatment option that can effectively help the patient maintain optimum periodontal health.

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LEGENDS for FIGURES

Figure 1 Probe in periodontal pocket

Figure 2 Completed periodontal chart with six point pocket depths recorded.

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

Figure 4 The therapy is started with the laser fiber at the top of the sulcus.

Figure 5 The laser energy is activated and the fiber is kept in contact with the tissue

Figure 6 The fiber is moved both horizontally and vertically on the soft tissue side of the pocket.

Figure 7 The laser treatment continues until the calibrated depth is reached.

Figure 8 Debris accumulates on the fiber tip and must be wiped off.

Figure 9 Fresh bleeding occurs when the bacterial reduction is complete.

Figure 10 Six month probing of treated area. Note pocket reduction.

Figure 11 Six month probe chart with all pockets recorded.

Figure 12 Continuing care patient presents with gingival inflammation around cuspid.

Figure 13 Laser therapy using bacterial reduction parameters.

Figure 14 Six month check of area shows healthy periodontium.