

Photodisinfection: The Future of Periodontal Therapy



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A number of innovative periodontal treatment options have been developed for use in the dental practice. These new modalities are often associated with novel technological approaches and functionally active chemistries that increase the predictability of treatment for the practitioner and the procedural comfort for the patient.

CLINICAL OPTIONS FOR TREATING PERIODONTAL DISEASE

Traditionally, the treatment of periodontal diseases is composed of 2 distinct phases. The *initial therapy*, or nonsurgical phase, consists of procedures that are specifically designed to eliminate or control the various risk factors, which may contribute to chronic periodontitis. In this phase, dentists and their team: provide oral hygiene instruction and periodic reinforcement; perform supragingival and subgingival scaling and root planing to remove microbial plaque and calculus; treat or remove local irritation factors such as decay, overhangs, ill-contoured crowns, and misaligned teeth; and recommend the use of various antimicrobial agents as adjuncts to the above treatments. If the initial therapy does not significantly improve the periodontal condition, periodontal surgery is considered in order to help resolve the disease process and/or assist in the correction of anatomic defects. A variety of surgical modalities may be appropriate in managing an individual patient.

In selecting periodontal treatment modalities, the dental professional should closely examine each treatment alternative as a potential tool, and then decide which of these tools are best suited for a specific problem. A patient may benefit most from a "conservative" or nonsurgical approach in one quadrant, and a more "invasive" or surgical approach in another. From a clinical perspective, the critical determining factor is the treatment (or treatments) that will ultimately serve the patient best.

NONSURGICAL VERSUS SURGICAL PERIODONTAL TREATMENT

As evidenced in the periodontal literature, the beneficial effects of scaling and root planing in the treatment of chronic periodontitis have been extensively studied and validated. The reduction of clinical inflammation, microbial shifts to a less pathogenic flora,



Figures 1a and 1b. Periowave treatment only. Note the absence of purulent exudate after just one week.

decreased probing depth of periodontal pockets, a gain in the clinical attachment, and a diminished progression of disease, are amongst these benefits.

Generally, clinical soft-tissue conditions improve following nonsurgical treatment. However, some intraoral sites do not respond to this initial therapy and may benefit from a surgical approach. Surgical access can facilitate mechanical instrumentation of the roots, reduce probing depths significantly, and even regenerate or reconstruct lost periodontal tissues. Clinical trials indicate that both surgical and nonsurgical therapy approaches can effectively stabilize clinical attachment levels.¹

Each of these therapeutic modes has various advantages and drawbacks. A nonsurgical mechanical approach may be deemed more conservative. However, it may have limited efficacy in advanced diseased sites since it does not fully eliminate pathogenic bacteria from all infected areas; in particular, bacteria in deeper pockets and furcation areas.² Flap reflection is considered more invasive, but can be more effective in increasing the clinician's ability to debride the roots in these difficult areas.² Osseous surgery has been shown to produce an even greater reduction of probing depths, but on the other hand, results in more extensive degrees of recession.³

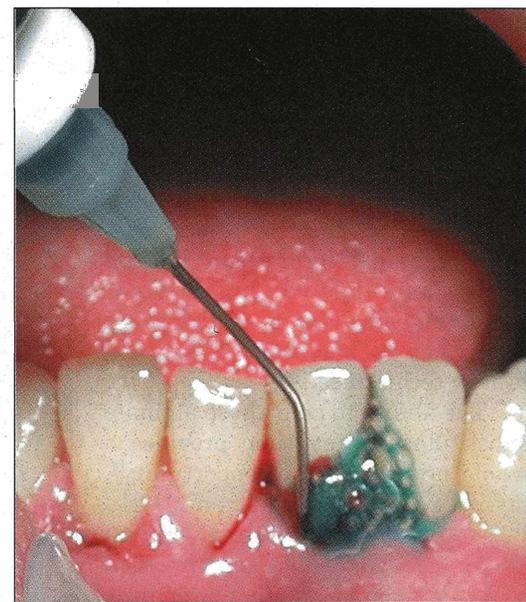


Figure 2. The periodontal pocket is treated with adequate photosensitizing solution.

BACTERIAL MANAGEMENT IN THE PERIODONTAL POCKET

The clinical manifestations that are identified as chronic periodontitis are the result of a complex chain of events that begins with the presence of pathogenic bacteria in the gingival sulcus, and in due course leads to a series of destructive host responses. The inflammatory response, which is elicited by the bacteria in the gingival tissue, is ultimately responsible for a progressive loss of the collagen attachment of the tooth to the underlying alveolar bone.⁴ If left unchecked, this process can cause the tooth to loosen, and to eventually be lost.

At any given time, depending on its depth and extent, the periodontal pocket can harbor from 10⁷ to almost 1,011 bacterial cells.⁵ The success of traditional debridement procedures and/or antimicrobial agents in improving periodontal health is generally associated with the reduction in the levels of these anaerobic bacteria in the dental plaque.⁶ Treatment has traditionally focused primarily on reducing the bacterial load in the periodontal tissues. This can be accomplished either through surgical or nonsurgical procedures, with the occasional adjunctive use of systemic and/or local antimicrobial agents in certain situations. Systemic

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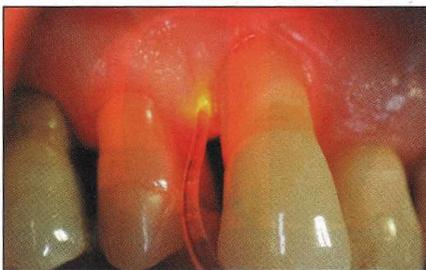


Figure 3. Minimum one-minute irradiation with the Periowave nonthermal diode laser.

antibiotics may be useful for those patients who fail to adequately respond to mechanical debridement procedures. Their use is limited, due to the emergence of resistant bacteria, the development of potential hypersensitivity reactions, and the occurrence of side effects.⁷ The development of localized delivery systems that deposit highly concentrated doses of antibiotic and/or antimicrobial agents directly at the site of infection (in the periodontal pocket) have been shown to improve treatment efficacy, while at the same time decreasing side effects and limiting resistance.

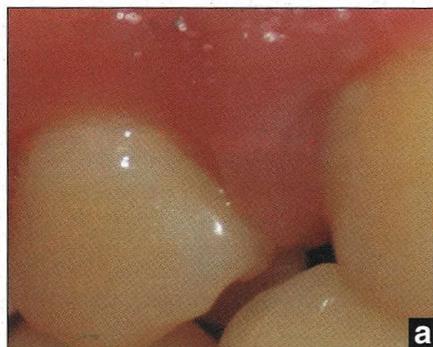
More recently, a pathogen-specific antimicrobial (Periowave [Ondine Biopharma Corporation]), that combines advanced nonthermal diode laser technology with a photosensitizing solution for the treatment of periodontal diseases, has been introduced. Periowave is a dual-action antimicrobial. This means that it not only kills gram-negative bacteria associated with periodontal disease, but also inactivates those endotoxins which are responsible for tissue destruction, thus greatly improving a patient's chances of healing.⁸ Periowave is also nonantibiotic, and a result, does not carry any risks of promoting antibiotic resistance.⁹ In clinical trials, those patients receiving Periowave treatment *in conjunction with scaling and root planing* (SRP) experienced significant improvements over patients treated with SRP *only*: these benefits included shallower pockets, increased clinical reattachment, and reduced bleeding.¹⁰

THE PERIOWAVE TREATMENT MODALITY

The process of photodisinfection is the topical adaptation of photodynamic therapy (PDT). While photodisinfection (Periowave) is new to dentistry, PDT has been used in various medical applications for more than 20 years. Photodynamic therapy is currently successfully being used for the treatment of some forms of cancer, macular degeneration (Visudyne—QLT), various dermatological applications, and plasma pooling disinfection. Photodisinfection was first adapted by professor Michael Wilson (Eastman



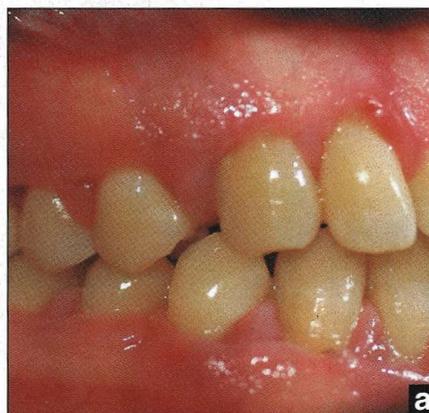
Figures 6a to 6d. Repeated photodynamic treatment (2006 to 2008).



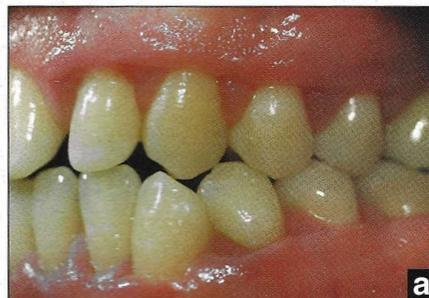
Figures 7a to 7c. Significant reduction of the clinical signs of inflammation and in the probing depths of pockets.



Figures 8a to 8c. Debridement and Periowave treatment (2-year follow-up photo). Minimal soft-tissue recession is observed.



Figures 9a and 9b. Debridement and periowave treatment, maxillary right quadrant (2 year follow-up photo).



Figures 9a and 9b. Debridement and periowave treatment, maxillary left quadrant (2 year follow-up photo).

Dental Institute at the University College of London, England) in 1989. Today, there are several hundred peer-reviewed, preclinical studies written by professor Wilson supporting this technology. Many of these focus on the effectiveness of photodynamic disinfection against various pathogens associated with periodontal diseases.

The underlying mechanism of photodisinfection is the targeting and the elimination of the bacteria most responsible for the progression of periodontal disease (Figures 1a and 1b). Methylene blue dye is gently injected (without the need for anesthetic) into the periodontal pocket (Figure 2). The dye binds to the lipopolysaccharides and lipids found on the cell walls of both gram-negative and gram-positive bacteria. Because of a difference in thickness of the peptidoglycan layer in their cell walls, gram-negative bacteria take up the methylene blue stain faster.

Meanwhile, the Periowave nonthermal diode laser produces photons whose frequency matches that of the molecule of the methylene blue dye (Figure 3). When the photons hit the dye molecules, they initiate the photodynamic chain of events. The oxygen molecules surrounding the dye are caused to lose an electron, and thus become free radicals. The free oxygen radicals are toxic to the bacterial cell walls and disrupt them, leading to the destruction of the bacteria.

Periowave is a broad-spectrum antimicrobial system that targets subgingival bacteria as well as their virulence factors. Bacterial proteases, collagenases, and lipopolysaccharides are inactivated, resulting in a reduced host inflammatory reaction and a diminished destruction of the local periodontal tissues.¹¹

Photodisinfection treatment is *not* meant to replace traditional mechanical SRP therapy but rather to *complement* it. A thorough debridement of the root is essential prior to the application of the photodisinfection process. In many cases, the combined therapies may result in a decreased need for surgical intervention, and can therefore be considered a less invasive approach.¹⁰ Photodisinfection may also be used during periodontal surgery to "disinfect" areas that may be difficult to instrument (such as furcations), particularly prior to regenerative procedures.^{12,13}

PERIOWAVE TREATMENT BRIEFLY DESCRIBED

Periowave treatment is relatively simple to administer. However, there are certain rules that must be respected for maximal efficacy. It is essential to flood the periodontal pocket to be treated with adequate photosensitizing solution. Too little solution will affect the results negatively. The re-



Figure 9. Periowave treatment kit.

quired irradiation time is one minute and must be respected. Too little time may compromise the photodynamic process. Each periodontal pocket must be treated individually. Results are better if the treated pocket is not bleeding profusely. Excessive bleeding can dilute the photosensitizing solution. If a patient is bleeding extensively after mechanical therapy, it is advisable to bring the patient back within one to 2 weeks for photodisinfection. Some tissue sites respond considerably better when treated photodynamically more than once (Figures 4a to 4d).

For patients who had not previously received periodontal therapy, the combined use of nonsurgical mechanical therapy and photodisinfection results in a significant reduction of the clinical signs of inflammation.^{10,14} This includes suppuration, bleeding on probing, edema, and in the probing depths of pockets (particularly evident) (Figures 5a to 5c). For these patients, it was noted that while the probing depths decreased considerably, soft-tissue recession was not significant (Figures 6a to 6c).

For patients who had previously received periodontal therapy (surgical and/or nonsurgical), but were still exhibiting signs of soft tissue deterioration, the combined use of nonsurgical mechanical therapy and photodisinfection displayed a lesser reduction of probing depths but a very significant reduction of bleeding on probing.¹⁰ Since the lack of bleeding on probing is one of the few reliable indicators of disease stability, a decrease in the percentage of bleeding sites is a desirable outcome even when the changes in probing depths remain minimal (Figures 7a to 8b).

CONCLUSION

Periowave (Figure 9) represents a novel and effective treatment system that can be used in conjunction with standard scaling and root planing procedures to improve treatment outcomes for patients with periodontal disease. Its nonsurgical profile improves the comfort of treatment and thus makes the process more attractive to patients. Its ease of use makes it suitable for both dentists and auxiliaries (when

Indications for the Use of Photodisinfection

- With debridement for aggressive cases (instead of antibiotics)
- With debridement (when purulence and generalized bleeding on probing are present)
- Refractory and recurrent cases of periodontitis
- Maintenance of difficult cases
- Disinfection of roots and furcation areas during regenerative surgery
- Disinfection of class II and III furcation involvement and deep vertical defects
- Peri-implantitis treatment

permitted). The role of photodisinfection in dental treatment is beginning to expand and should provide exciting new opportunities in oral healthcare. ♦

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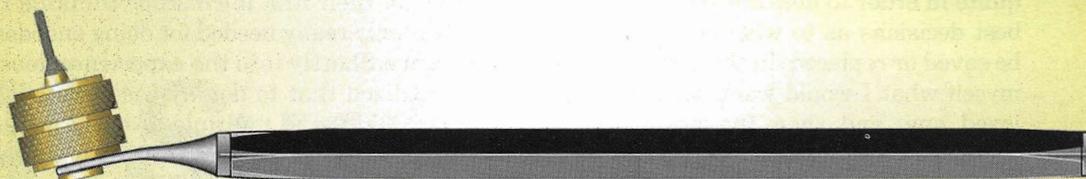
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Editor's Note: According to the manufacturer, the Periowave device has been approved for use in Canada, however, as of the time of this publication, is still awaiting FDA approval for sale and use in the United States.

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