Editor's Note: *The following 3 abstracts are offered as topics of current interest. Readers are invited to submit to the editor inquiries concerning laser-related scientific topics for possible inclusion in future issues. We'll scan the literature and present relevant abstracts.*

The 10,600-nm CO_2 Laser in Periodontitis Treatment: Its Effectiveness in De-Epithelialization and in Reduction of Periodontal Pathogens

In her clinical case "Nonsurgical Periodontal Infection Therapy with a 10,600-nm CO_2 Laser" (pages 18-37), Mary Lynn Smith relates a technique employing this laser to decontaminate surface tissue and dehydrate the gingival margin to inhibit epithelial growth into the pocket, without reflection of a flap. (Readers of the *Journal* will recall Smith described CO_2 laser decontamination in a previous issue: Smith ML. The pending zone: Managing the compromised periodontal patient. *J Laser Dent* 2009;17(2):94-99).

In 2017 Everett *et al.* described a similar technique, also without reflection of a gingival flap, using a continuous-wave CO_2 laser to decontaminate periodontal pockets and block epithelial down growth on the root surface. In their double-blind, randomized, clinical trial of split-mouth design involving 173 teeth in 14 patients with chronic periodontitis, they compared scaling and root planing only with scaling and root planing followed by carbon dioxide laser. The investigators used a 10,600-nm CO_2 laser equipped with an ablative prototype handpiece with an internal diameter of 0.762 mm. For the initial gingival margin decontamination and ablation procedure, the tip of the handpiece was kept parallel to the long axis of the tooth and "dragged along" the gingival sulcus. Power setting of 4 Watts in continuous mode (280 W/cm^2) was used. A second pass was then performed to decontaminate and ablate the periodontal pockets, at 8 Watts continuous mode (561 W/cm^2), with the tip placed into the pocket and "dragged" continuously along the depth of the pocket for a total irradiation time of 4 seconds per tooth. After the second pass, damp gauze was firmly placed on the gingiva to allow a clot to develop. Treatment was administered again every 10 days for three appointments. At 3 and 6 months, the laser-assisted nonsurgical procedure tended to show a greater decrease in probing depths and greater gains in clinical attachment levels, but the results were not statistically better than scaling and root planing alone.

Rossmann and Israel were among the first to describe the notion of using a carbon dioxide laser during gingival flap procedures to retard epithelial migration, first in an animal study and then in a pilot human study. Such controlled de-epithelialization is intended to increase the amount of connective tissue attachment through guided tissue regeneration wound healing.

In their 1992 study, Rossmann *et al.* performed open flap debridement on maxillary premolars and incisors of monkeys. On the experimental side, oral epithelium on the outer surfaces of re-adapted and sutured flaps was removed with a 10,600-nm CO_2 laser after exposure to impacts of 0.5-second duration at 10 Watts. The incident laser beam was held perpendicular to the tissue surface and focused to a 2-mm circular spot with a 400-mm focal length lens. Over 7 days, all specimens showed a trend toward less epithelium and more connective tissue attachment on the lased side, but no statistical analysis was possible for their histological study.

For the pilot histological human study by Israel *et al.* abstracted below, a 10,600-nm CO_2 laser was used to irradiate both the outer and inner aspects of reflected flaps. Laser parameters were 8 Watts in pulsed mode, 20 Hz, with an exposure of 20 msec, and 0.8-mm spot size in focus. As indicated below, their preliminary findings on laser de-epithelialization suggested that further controlled follow-up studies may be warranted.

Another related field of study involves the antimicrobial effect of 10,600-nm CO_2 laser irradiation in periodontal pockets. Reported results have been mixed.

In their examination of subgingival microbiologic effects of a CO_2 laser, Mullins *et al.* used DNA analysis of eight periodontal bacteria, prior to and immediately following treatment. Their laser technique involved use of a periodontal tip of 0.43-mm and 0.5-mm internal and external diameters, respectively, inserted into the periodontal pocket approximately 1 mm. Laser parameters were set at 2.2 W, 50 Hz, 80-millisecond pulse length, exposure rate of 1 mm per 5 seconds. The investigators reported that a one-time use of a 10,600-nm CO_2 laser in periodontal pockets did not substantially reduce subgingival bacterial populations compared to negative (untreated) controls.

The previously mentioned Everett group used bacterial sampling of 11 species and analysis via asymmetric multiplexed polymerase chain reaction to assess levels of periodontal pathogens. Results at baseline, 3 months, and 6 months after treatments showed a greater reduction is selected bacteria in sites treated with scaling and root planing in conjunction with laser irradiation, while scaling-and-root-planing-only sites showed a better result for other bacteria. However, no statistical significance was found between the groups.

For U.S. readers, certain carbon dioxide, Nd:YAG, argon, Ho:YAG, Er:YAG, Nd:YAP, Er,Cr:YSGG, diode, and frequency-doubled Nd:YAG lasers have been cleared by the U.S. Food and Drug Administration for intraoral soft tissue surgery.

As always, clinicians are advised to review the specific indications for use of their lasers and to review their operator manuals for guidance on operating parameters before attempting similar techniques on their patients.

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Use of the Carbon Dioxide Laser in Retarding Epithelial Migration: A Pilot Histological Human Study Utilizing Case Reports

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Predictable regeneration of tooth-supporting tissues lost to periodontal disease is the aim of periodontal therapy. Often the result of conventional treatment is healing with a long junctional epithelium along the root surface and little regeneration of the complete attachment apparatus. The purpose of this pilot study was to evaluate whether de-epithelialization with a CO_2 laser at the time of flap surgery and at 10-day intervals over the first 30 days of healing has the potential to enhance the formation of a connective tissue attachment. Six mandibular incisors in two patients were selected for the study. Each patient received oral hygiene instruction and initial therapy prior to surgery. The teeth were splinted together, open flap debridement was performed on all teeth, a notch was placed on the roots at the height of the crest of the alveolar bone, and the flaps were sutured in place. The test side received controlled de-epithelialization of the outer (oral) gingiva with the carbon dioxide laser, and the inner gingival flap. The de-epithelialization was repeated on the test side at 10, 20, and 30 days postsurgically. Controls received open debridement only. Block sections were taken at 90 days and processed for histologic analysis. The results showed that for both patients, junctional epithelium (JE) was formed on both test and control teeth. In all control teeth, the JE extended the entire length of the root to the base of the reference notch. On the test side (laser treated) in one patient, the notch was filled with connective tissue and limited repair cementum. This finding was not seen in any control teeth. This is the first reported observation of human histologic evaluation utilizing the CO_2 laser for de-epithelialization and may warrant further study.

Laser-Assisted Treatment of Patients with Type 2 Diabetes Mellitus and Periodontal Disease

In her clinical case “Laser-Assisted Periodontal Therapy with an 810-nm Diode Laser for a Diabetic Patient with Class III Periodontal Disease” (pages 38-54), Heather Gill describes a guarded long-term prognosis for a patient who had little interest in continuing his oral care.

Reports from the laser literature indicate varying degrees of success for laser-assisted periodontal therapy for patients with type 2 diabetes mellitus, compared to scaling and root planing treatment alone.

The Dengizek Eltas group studied 37 patients with chronic periodontitis and poorly controlled type 2 diabetes mellitus. Treatments consisted of scaling and root planing or scaling and root planing with laser. They used an 810-nm GaAlAs diode laser at 1 Watt power, in contact mode, along with a 400-µm fiber-optic tip. Laser treatment consisted of three sets of 15 seconds for each tooth if pocket depth was between 3 and 3.5 mm, and three sets of 20 seconds each per tooth if pocket depth was greater than 4 mm. The authors do not specify whether a continuous or pulsed emission mode was used. At 3 and 6 months post-treatment, laser-assisted treatment showed greater improvement in certain clinical parameters compared to scaling and root planing only; serum C-reactive protein levels and HbA1c levels were comparable for both groups. Their study is abstracted below.

Chandra and Shashikumar examined the effect of scaling and root planing alone vs. scaling and root planing following by diode laser irradiation in 40 patients with type 2 diabetes mellitus and chronic periodontitis. They utilized an 808-nm diode laser at power settings of 1.5 W-1.8 W in continuous, contact mode with a 320-micron fiber-optic cable. Duration of exposure in seconds corresponded to the depth of the periodontal pocket in millimeters. Results at 3 months showed a statistically significant greater improvement in clinical and microbiological parameters for the laser-treated group than scaling and root planing alone. Glycated hemoglobin level (HbA1c) levels decreased, but the intergroup difference was not significant.

In their investigation summarized below, Koçak *et al.* examined 60 patients with chronic periodontitis and type 2 diabetes mellitus. They compared scaling and root planing therapy to scaling and root planing followed by laser irradiation. They used a 940-nm indium-gallium-aluminum-phosphate diode laser equipped with a 300-µm fiber-optic delivery system at a setting of 1.5 W average power with a pulse interval of 20 ms and pulse length of 20 ms delivering 20 and 15 J/cm^2 of energy, respectively. The fiber was inserted into the periodontal pocket, oriented parallel with the root surface and slowly moved from apical to coronal in a sweeping motion, and the laser was activated for a total of 20 seconds for each tooth. After 3 months, clinical and glycemic outcomes were significantly better for the laser-assisted group than the scaling-and-root-planing-alone group.

Elavarasu *et al.* studied the effect of scaling and root planing alone compared to laser curettage as an adjunct to scaling and root planing on 10 patients with moderate chronic periodontitis and controlled type 2 diabetes mellitus. An 810-nm diode laser, set at 0.8 W in continuous mode, was used with an initiated fiber optic tip inserted into the periodontal pocket and