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- Gingival Depigmentation with an Er:YAG Laser
- Diode Laser Therapy for the Patient Who Smokes
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The Journal of Laser Dentistry
The mission of the Journal of Laser Dentistry is to provide a professional journal that helps to fulfill the goal of information dissemination by the Academy of Laser Dentistry. The purpose of the Journal of Laser Dentistry is to present information about the use of lasers in dentistry. All articles are peer-reviewed. Issues include manuscripts on current indications for uses of lasers for dental applications, clinical case studies, reviews of topics relevant to laser dentistry, research articles, clinical studies, research abstracts detailing the scientific basis for the safety and efficacy of the devices, and articles about future and experimental procedures. In addition, featured columnists offer clinical insights, and editorials describe personal viewpoints.
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- Randomized Clinical Trials
- Advances in Dental Products
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Onward and Upward

Donald J. Coluzzi, DDS
Portola Valley, California

I am honored to serve as your Editor for the Journal of Laser Dentistry. For those of you who don’t know me, I am a charter member of the Academy of Laser Dentistry (ALD); was president of the organization in 1998; and, along with Dr. Steven Parker, co-edited Wavelengths, the predecessor to the Journal. I have also served on various committees, especially Certification and Communications.

Together with my team of Associate Editors, I intend to continue with the Journal’s mission to provide you with the best and most useful information about dental lasers from clinical and research perspectives. I do need your help: please consider writing an article. Your submission can range from a clinical case to a scientific paper derived from a study; from a new technique to a review of common procedures; from a literature review to clinical problem solving; and from an insight into practice management to safety issues. All manuscripts will be peer-reviewed and the “Guidelines for Authors” are published in each issue to help you.

This year has been remarkable for the ALD. Celebrating its fifteenth anniversary, it has grown into a strong international organization. It has fostered relationships with the American Dental Association, Academy of General Dentistry, and the American Dental Education Association. The upcoming Annual Conference in Las Vegas has an outstanding preliminary program, and the Academy’s committees are involved in important tasks to help the leadership in its governance. I will persevere in my role to produce a worthy publication for you, the ALD membership.

A preview of this edition’s content appears on the next page. I hope you enjoy this issue.

SYNOPSIS

Donald J. Coluzzi, the new editor-in-chief, welcomes your articles and describes the contents of this issue.

AUTHOR BIOGRAPHY

Dr. Donald Coluzzi, a 1970 graduate of the University of Southern California School of Dentistry, is an associate clinical professor in the Department of Preventive and Restorative Dental Sciences at the University of California San Francisco School of Dentistry. A charter member and past President of the Academy of Laser Dentistry, he has used dental lasers since early 1991. He has Advanced Proficiency in Nd:YAG and Er:YAG laser wavelengths. He is the 1999 recipient of the Leon Goldman Award for Clinical Excellence and the 2006 Distinguished Service Award from the Academy of Laser Dentistry, and is a Fellow of the American College of Dentists. Dr. Coluzzi has presented about lasers worldwide, co-authored two books, and published several peer-reviewed articles.

Disclosure: Dr. Coluzzi is an occasional presenter and trainer for Hoya ConBio, and receives an honorarium for that service.
This edition of the Journal features a scientific review of the use of lasers for implant dentistry as well as four examples of soft tissue procedures using two laser wavelengths. Clearly, all available dental lasers can perform a variety of soft tissue procedures; however, the two highlighted here, diode and Er:YAG, possess fundamentally different tissue interactions, but both are effective. Your scrutiny of these articles will hopefully enhance your understanding of how these lasers can produce the results indicated. Supplemental reading materials and suggestions appear below and in the Research Abstracts section. In addition, the guest editorial sums up how we can think with our “lasermind.”

Readers are invited to examine the following additional references to enhance their understanding of the clinical cases. Previous issues of the Journal and its predecessor publications have featured similar applications.

Noncontact Venous Lake Treatment Using a 980-nm Diode Laser
David Burt, DDS
Center Valley, Pennsylvania

ADDITIONAL READING: VENOUS LAKES AND VASCULAR LESIONS


Gingival Depigmentation with an Er:YAG Laser: A Clinical Case with Three-Year Follow-Up
Grace Sun, DDS
Los Angeles, California

ADDITIONAL READING: GINGIVAL DEPIGMENTATION

“The Good, the Bad, and the Ugly”: 810-830-nm Diode Laser Therapy for the Periodontal Patient Who Smokes
Nora Raffetto, RDH
Los Altos Hills, California

ADDITIONAL READING: PERIODONTITIS AND SMOKING, SULCULAR DEBRIDEMENT
The Use of Laser Energy in Implantology

Steven P. A. Parker, BDS, LDS RCS, MFGDP
Harrogate, North Yorks, United Kingdom

J Laser Dent 2008;16(3):117-125

Introduction

The use of laser photonic energy has been shown to be effective in many aspects of clinical dentistry. The benefits of laser use include precision, hemostasis, pathogen reduction, and interaction with both hard and soft oral and dental tissue, depending on the laser wavelength employed.1 In consideration of the breadth of application of laser therapy with oral tissue and bacteria, the areas of implantology in clinical dental practice that might be applicable to the use of laser photonic energy are the possible preparation of osteotomy sites for placement, together with bone modification procedures, soft tissue manipulation in assisting the second-stage recovery of healed implants, and in the treatment of peri-implantitis.

Laser-Assisted Osteotomy Site Preparation

Bone is a connective tissue derived from hyaline cartilage whose matrix, under the influence of calciferol, has been hardened by the deposition of calcium and phosphate to form a carbonated hydroxyapatite-like mineral.2 Erbium:YAG (2940 nm) and erbium, chromium: YSGG (2780 nm) are the two lasers in current clinical practice that are used for osseous procedures. Erbium laser energy is absorbed by chromophores (naturally occurring substances) found in bone tissue — water and the hydroxyl groups of the hydroxyapatite mineral. Ablation occurs through vaporization of water and explosive dislocation of mineralized tissue.3-4 The nature of the ablative process achieved with commercially available microsecond pulse emission, together with the inherently low absorption of these wavelengths in pigmented blood proteins, offers limited opportunity for conductive thermal rise; consequently, there is minimal hemostasis with the use of these wavelengths and their emission parameters, which is a desired effect in bone surgery procedures (Figure 1).
With laser energy, it is possible to cut bone which allows graft harvesting and sinus-lift procedures to be carried out. The fundamental concern in any bone surgical procedure is to limit thermal rise to within 47 °C and for less than one minute, in order to avoid damage to cellular components of bone metabolism and delayed healing. With regard to this limit, studies have been carried out to investigate the physical and thermal effects of rotary instrumentation and CO₂ laser wavelengths on bone tissue. Conclusions have been drawn as to the benefits of the erbium laser wavelengths with water spray in limiting the thermal rise, and one study alluded to the possible promotion of osteogenic biochemical agents that might induce accelerated healing of the bone tissue.

The conventional protocol of osteotomy site preparation involves the use of burs, which may be internally irrigated and which are operated at an appropriate speed in order to minimize thermal rise in the hard tissue. Such preparation allows the implant to be either tapped into position or thread-driven using a torque wrench or low-ratio handpiece.

Although laser use is considered precise for many procedures, the mode of action of the emerging photonic beam is end-cutting and does not allow for a measured development of a fixed diameter three-dimensional preparation of the bone. In addition, the delivery of adequate water spray that is necessary when using erbium lasers may be difficult in deep preparations (Figure 2).

In a study of tissue healing by Kesler and colleagues, a 2-mm diameter osteotomy was performed and titanium implants were placed. The measured parameter of bone-implant contact demonstrated greater value in the sites prepared with an Er:YAG laser compared to the control. In practice, there are anecdotal reports of site preparation in bone prior to implant placement, where an Er:Cr:YSGG laser is used with specially designed, lengthened delivery tips to allow adequate water irrigation of the target site. Although success has been demonstrated, there remains concern as to the accuracy of the preparation when compared to conventional bone drilling.

Laser-Assisted Second-Stage Recovery of Implants
In some cases, the implant site may be subject to immediate loading, although the majority of sites are allowed to heal for at least a 3-month period, preferably with a closed soft tissue layer. The restorative phase requires the exposure of the implant cover screw and at this time a decision is made as to how much modification of the soft tissue is needed. In an ideal case, or where aesthetics is not a prime consideration, the simple exposure of the cover screw involves a mucoperiosteal flap, a soft tissue punch, or the use of a suitable laser to ablate the overlying epithelium. All laser wavelengths commercially available in dentistry are capable of positive interaction with target soft tissue, although the longer wavelengths (erbium family at 2780 and 2940 nm or CO₂ at 10,600 nm) preferentially react with the water content of that tissue. Where the tissue is pigmented or liable to bleeding, a shorter laser wavelength, such as the frequency-doubled Nd:YAG or KTP (potassium titanyl phosphate) (532 mm), diode (810 to 980 nm), or Nd:YAG (1064 nm), may be preferable. Each tissue element is capable of absorbing incident photonic energy, dependent on the laser wavelength. The consequent conversion of this laser energy into thermal energy will result in tissue change. The benefits of laser use include precision, hemostasis (which can vary depending on the wavelength), and immediate postoperative protection through a coagulum surface.

It is essential to accurately assess the position of the implant site relative to the edentulous ridge. This may be done through X-ray, model mapping, and using natural landmarks; exposure of the cover screw allows an impression to be taken from which the prosthetic superstructure can be made. Further assessment must be made of the soft tissue emergence profile, to establish whether augmentation is required to support the aesthetic appearance or whether modification is required to reduce the soft tissue peri-implant collar to allow

Figure 2: Light micrograph of demineralized, sectioned, and stained osteotomy preparations in animal specimen bone. Key: Left specimen shows preparation with conventional internally irrigated implant osteotomy bur. Right specimen shows similar preparation with an Er:YAG laser, with evidence of marginal irregularities and charred residues, indicative of poor water cooling. Laser parameters used: 400 mJ per pulse / 10 Hz / Average Power 4.0 Watts / Beam size 600 µm /
The use of lasers in the harvesting of distant connective tissue grafts has been reported through case reports and anecdotal accounts. Specifically, however, it is the subject of this review to examine the use of varying laser wavelengths to remove the tissue immediately overlying the implant site. Local anesthetic may or may not be used, depending on patient and operator preference. Some analysis of the form, thickness, and vascularity of the tissue should be made, which will define a choice of laser wavelength or, if not possible, the operating parameters. By use of a minimal power value commensurate with tissue ablation, a small cone of tissue is removed until near-contact with the screw is made. From this, the tissue opening is extended to a point within the diameter of the cover screw. Typical laser average power values should be in the range of 1 to 1.5 Watts to assess the ablation efficiency and increased slightly as required. However, care should be exercised to avoid the buildup of any carbonized material.

In the author's experience, at the stage of near-contact with the cover screw any remaining tissue tags should be removed with a sharp curette; the screw is removed and a suitable healing cap placed. The immediate post-surgery phase can be suitably managed through the topical application of a chlorhexidine mouthwash. With correct laser power settings, the choice of laser wavelength may be viewed as often irrelevant to the predictability of healing of the soft tissue collar (Figures 3-8).

The management of excessive soft tissue may be addressed in the same way as any laser-assisted debulking procedure – pedunculated overgrowths can be excised immediately above the base, and less-defined excess tissue can be incised under tension or, in the case of longer laser wavelengths, reduced by surface ablation. Where the objective is to reduce the thickness of the gingival collar around the transmucosal element, a technique similar to gingivoplasty / gingivectomy can be employed, using either a provisional crown or custom-made acrylic abutments to protect the metal surface of the transmucosal element (TME). In those cases where a more radical adjustment of overlying soft tissue...
is required, careful dissection of the tissue should be carried out using the laser with minimal power levels to avoid any heat buildup or pitting in the abutment (Figures 9-10).

Laser-Assisted Therapy in Peri-Implantitis

According to the 1st European Workshop on Periodontology, peri-implantitis is defined as the “term for inflammatory reactions with loss of supporting bone in the tissues surrounding a functioning implant.”28 Associated definitions exist to identify the nontissue nature of the metal fixture — the American Academy of Implant Dentistry has noted “implant histoclasis” or “peri-implantoclasis” as appropriate terms to denote conditions around the implant and these terms are published in the 1974 Current Clinical Dental Terminology’s glossary of terms.29 Nonetheless, the term peri-implantitis has persisted, and as a rapidly progressive failure of osseo-integration, the condition is due to bacterial toxins and yeasts disrupting the bone homeostasis.30

Figure 9: Use of a diode (810 nm) laser in gingival margin modification associated with three upper right quadrant implants. Key: Upper left – Preoperative view with acrylic temporary crowns in place to provide protection to the TME and allow accuracy of the gingivectomy. Lower left – Immediately post-laser use with crowns removed. Right – Healing at 3 months with final restorations in place. Laser parameters used: 1.4 Watts CW / Beam size 320 µm / Contact

The condition occurs irrespective of implant type,31-32 and is part of the etiology of implant loss, along with associated phenomena such as occlusal overloading and poor emergence profiles of the restoration.31-33 A review of 26 articles mapping the survivability of implant-supported single crowns showed that 9.7% of treatment sites had evidence of peri-implantitis and 6.3% showed greater than 2 mm of crestal bone loss over a 5-year observation period.35

Figure 10: Use of a CO2 (10,600 nm) laser to correct gingival contour. Original second-stage exposure of two implants, using scalpel and flap procedure has led to inappropriate gingival contour. Key: Upper left – Post-scalpel excision at three weeks. Lower left – Laser used to ablate excess soft tissue. Right – Healing cap exposure and healing at 10 days. Laser parameters used: 2.0 Watts pulsed / Beam size 600 µm / Noncontact mode

The distinction must be made as to whether the implant site exhibits essentially treatable peri-implantitis (the “ailing” implant), or whether the loss of the fixture is inevitable (the “failing” implant).36 The underlying bacterial involvement in cases of peri-implantitis — overt signs of infection and inflammation, marked infiltration of the peri-implant connective tissue by inflammatory cells, ulceration and proliferation of the junctional epithelium — has been demonstrated. However, microflora associated with infective failure are those that also cause periodontitis.37

Attempts to establish treatment protocols for the treatment of peri-implantitis include the application of an antimicrobial agent,38-40 local and systemic antibiotics,41 air- or abrasive-polishing,42 guided tissue regeneration,43-44 combination techniques using detoxification, tetracycline, citric acid, and guided bone regeneration.45 A review of published literature concluded that “most of the information accessible at this time derives from case reports ... Several uncertainties remain regarding the treatment of peri-implantitis.”46

Early investigations into the effects of Nd:YAG laser photonic energy on a range of pathogens showed significant results, but in the early 1990s two studies concluded that the thermal effects of an Nd:YAG laser resulted in damage to the titanium surface.47-48 The effects of such thermal rise may be seen in site defects (pitting,
melting craters), and local conductive effects into the bone. Furthermore a study using a CO2 laser showed possible distant transportation of metal substrates to organs such as the liver, spleen, and kidney. A comparative in vitro study undertaken by Kreisler of most commercially available laser wavelengths used without water cooling concluded that Nd:YAG and Ho:YAG lasers should not be used irrespective of the power output; CO2 and Er:YAG laser should be used at low powers; and only the 809-nm diode group appeared to not cause any surface alterations. Kreisler also showed the high bactericidal potential of the Er:YAG laser on the implant surface. Another study demonstrated that the Er:YAG laser at approximately 1 W (which is “low” power) with a water spray could effectively remove plaque and calculus from the implant surface without damage.

In consideration of the above studies, other factors will be discussed, such as reflectance from the implant fixture, power density, and thermal relaxation.

In analyses of the reflectance and absorption of titanium, two studies yielded different results. Rechmann showed the metal to be more reflective of long (CO2) wavelengths compared to visible (532-nm) light, but indicated no damage with the CO2 wavelengths. As previously stated, Kreisler’s investigation showed damage with Nd:YAG, Ho:YAG, Er:YAG, and CO2 lasers.

Power density effects relate to emission of photonic energy and the radiated beam (spot) size. The power density values of microsecond pulses may be several thousand Watts/cm², compared to few hundred found with continuous-wave emission. Power density may be viewed as the concentration of laser energy over an area, and (assuming some absorption occurs) this will lead to greater temperature rise with decreasing spot size. Boulnois and Niemz provide models that associate power density and exposure time in terms of tissue effects and allow deduction to be made that with lower power density values there is a longer exposure time before damaging effects may occur. Within such theoretical consideration, this supports the relatively safe use of a continuous-wave diode laser on titanium.

In their work with carbon dioxide lasers, Fried and colleagues explain that thermal relaxation is inversely related to the thermal diffusivity of the tissue (material) exposed to photonic energy, assuming that absorption of the energy occurs. One in vitro study with a continuous-wave 809-nm diode laser considered that the conditioning effect of local cooling measures (exposure of implants to laser energy within a body-temperature water bath) might approximate those found in vivo and concluded that this laser could be used on titanium implant surfaces, provided that exposure be limited in time and power to allow the implant and bone to cool to avoid tissue damage. On zirconia implants, one study using 810-nm diode, Er:YAG, and CO2 lasers, the Er:YAG wavelength was transmitted through the material and may cause damage to adjacent tissues, and CO2 altered the surface.

The author’s own clinical experience has shown a number of important factors to consider when...
selecting parameters for laser use in implant surgery:
- Power density
- Exposure duration
- Thermal relaxation potential, including the local cooling effect of circulating blood
- Use of coaxial water spray, if available
- Reflectance from the implant fixture
- Presence of energy-absorbing organic debris on the ailing implant surface
- Type of implant material.

The potential for all laser wavelengths to exert a bactericidal effect and the wish to define a more predictable protocol for treating peri-implantitis have prompted a number of studies into some of those wavelengths, but not all have shown to be positively conclusive. This has prompted concerns as to the effects of biofilm.

A biofilm is “a structured community of microorganisms encapsulated within a self-developed polymeric matrix and adherent to a living or inert surface. Biofilms are also often characterized by surface attachment, structural heterogeneity, genetic diversity, complex community interactions, and an extracellular matrix of polymeric substances.” Some studies have examined the effect of applying photonic energy to biofilm on implant surfaces. As such, low-level laser photoactivated disinfection (PAD) technique, used for endodontic canal disinfection as well as treatment of carious lesions, might allow inaccessible areas of infected implant surfaces to be adequately decontaminated. The author suggests the treatment protocol shown in the accompanying table.

### Conclusion

Modern implantology is based on strict protocols of pretreatment assessment, placement, and considering functional force dissipation. The success of integration of laser-assisted surgical therapy with hard and soft oral tissue manipulation has led to an understandable wish to bring such advantages within the placement and recovery stages of implant therapy. Apart from the evidence-based ability of erbium laser wavelengths to cut bone tissue, they are only in the developmental stage for use as the sole instrument to produce the osteotomy site. The second-stage recovery and any associated soft tissue manipulation can be usefully and predictably accomplished with any of the currently commercially available laser wavelengths used in dentistry. The extensive investigations into the possible use of laser photonic energy in the treatment of peri-implantitis have acknowledged the inherent dangers of such energy on metal and have been modified with greater understanding of the multifactorial aspects of laser use and the in vivo conditions that accompany the majority of peri-implantitis cases. A protocol that may address these factors and prompt greater research has been suggested. It remains the responsibility of the clinician to employ lasers within one's level of competence and understanding of laser-tissue interaction and the added respect for the demands of implant placement, function, and maintenance.

### Author Biography

Dr. Steven Parker is in private practice in Harrogate, UK. He has been involved in the use, investigation, education, and examination of all aspects of laser dentistry since 1990. He holds Advanced Proficiency in four laser wavelengths, is an Educator and Recognized Course Provider with the Academy, and a past editor of...
Wavelengths. He is the 1998 recipient of the Leon Goldman Award for Clinical Excellence in Laser Dentistry and the 2005 President of the Academy of Laser Dentistry. His publications include a chapter on laser use in fixed prosthodontics in Dental Clinics of North America, peer-reviewed papers on laser use with hard tissue in the Journal of Laser Dentistry and a nine-part (peer-reviewed) series “Lasers in Dentistry,” published in the British Dental Journal in 2007. Dr. Parker may be contacted by e-mail at thewholetooth@easynet.co.uk.

Disclosure: Dr. Parker has no company affiliation.

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Noncontact Venous Lake Treatment Using a 980-nm Diode Laser

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SYNOPSIS
This case report is one of treatment of a vascular lesion, a venous lake, that was performed using a diode laser in a noncontact mode, without a surgical incision.

INTRODUCTION
While a majority of the procedures performed using soft tissue lasers are surgical in nature, venous lakes and related angiomas represent a class of lesions which do not always respond well to traditional vascular surgery, and hence, are avoided. First described in 1956 by Walsh and Bean,1 venous lakes have been reported only in the adult population and on patients 50 years or older with the average age being approximately 65. While considered to be biologically harmless and asymptomatic, they can exhibit tenderness, pain, and excessive bleeding when traumatized. The negative cosmetic implications of these lesions are obvious.

The methods of treatment have ranged from electrosurgery, cryosurgery, and sclerotherapy to the use of argon, Nd:YAG, and carbon dioxide lasers. Although a laser can have some advantages, all of these modalities can achieve successful results. However, since they all involve surgical methods that are invasive in nature, prolonged healing and scarring can result. Those potential complications have kept many dental clinicians from attempting to treat a venous lake.

This clinical case study will examine the use of a 980-nm diode laser in a nonsurgical setting to achieve results considered acceptable to the patient as well as the clinician. It is hoped that the demonstrated beneficial outcome would allow dentists to feel more comfortable in providing this service to their patients.

PRETREATMENT
A. Outline of Case
Clinical Description
A 75-year-old male presented with a chief complaint of a blue-colored swelling on his lower lip. He had noticed it for quite some time, but reported that it recently had gotten larger and become a nuisance when eating. His medical history was noncontributory and his only medication is Eldepryl which is used to impede the onset of Parkinson’s disease. Dentally, he was presented with a good periodontal condition, and excellent general oral health. A clinical exam revealed a group of three ovoid-shaped, raised papules on his lower vermilion border measuring approximately 6 mm x 5 mm, 4 mm x 3 mm, and 6 mm x 3 mm, as shown in Figures 1 and 2. The areas were dark blue in color, raised approximately 2-3 mm, and felt soft and compressible to the touch. These areas were fairly well demarcated and had a smooth surface. All other soft tissue was within normal limits and no other tests were performed. He did state that his mother had had the same condition and that he remembered it being more extensive than his.

Figure 1: Preoperative view of three venous lake lesions on lower lip

Figure 2: Preoperative measurement of the lesions

B. Diagnosis and Treatment Plan
1. Provisional Diagnosis
A tentative diagnosis would include blue nevus, melanoma, basal cell carcinoma, and venous lake. The test used for differentiating venous lakes from other lesions is diascopy. This involves direct pressure on the lesion using a glass microscope slide. Since it is highly vascular, the site will blanch due to the emptying or shifting of the contents (Figures 3 and 4). In some occasions, the area will not completely empty of the blood but there will be a distinct color change noted.

2. Final Diagnosis
A final diagnosis of venous lake
was determined by diascopy and blanching.

3. Treatment Plan Outline
The treatment approach, because of the size of the area and the potential for excessive bleeding, was to use a 980-nm diode laser in a noncontact mode, allowing the laser energy to penetrate into the vascularized area. The lack of an incision reduces the risk of hemorrhage. Varied power settings would be used to determine the most effective treatment based on time, optimum visual results, and patient comfort.

4. Indications, Contraindications, and Precautions
Remediation of this lesion would have functional as well as cosmetic indications. The potential for trauma to the area was becoming more significant as per the patient’s original complaint. The contraindications to this procedure are excessive bleeding or frank hemorrhage, scarring, and inability to eat or speak due to pain. The patient’s age is significant but not a contraindication to the procedure due to his robust health.

The main precaution is to avoid the possibility of heat buildup in the surrounding tissue. The tissue will be cooled with ice between laser exposures.

5. Treatment Alternatives
Treatment alternatives include referral to a dermatologist or plastic surgeon to evaluate for surgical intervention or other therapy. No treatment is also an option.

6. Informed Consent
Written and verbal consents were obtained after a lengthy discussion of the treatment objectives and the realistic variability of the potential outcomes. The patient was enthusiastic about achieving success without having to be subjected to injections, sutures, and a lengthy healing phase.

TREATMENT

A. Treatment Objectives
Strategy
Use of a diode laser would potentially achieve the results desired due to its affinity for blood proteins. The lesion will be reduced in size by coagulation and sclerosing the vessels surrounding it. The laser energy will penetrate into the lesion but will be controlled to avoid damage to the underlying dermis. The noncontact mode of the laser fiber allows flexibility in controlling the amount of energy being transmitted to the target area by simply adjusting the distance from the tissue surface.

B. Laser Operating Parameters
A 980-nm diode laser (SIROLaser, Sirona Dental Systems, LLC, Charlotte, N.C.) was used for the treatments. The 320-micron fiber delivered the energy through a stock handpiece modified to accept a 19-gauge disposable tip (Ultradent Products, Inc., South Jordan, Utah) which was curved to approximately 60 degrees. The laser fiber was not initiated. The power settings for the first and second treatments were 2 W continuous wave (CW), followed by 1 W CW for the third. The fiber was used in noncontact mode, 1-2 mm away, with the tip being kept perpendicular to the tissue.

C. Treatment Delivery Sequence
The laser safety officer verified that protective eyewear was worn by the patient, the doctor, and attending staff. She also informed the remaining staff, via walkie-talkie, to not enter the treatment room. The local anesthetic was applied to the lip and allowed to remain for 15 minutes (Figure 5). EMLA cream, which is a eutectic mixture of lidocaine and prilocaine, was used initially but TAC 20% (lidocaine 20%, tetracaine 4%, phenylephrine 2%) was found to have a better and faster onset of anesthesia, requiring only five minutes of application. (These products are available from Professional Arts Pharmacy, Lafayette, La., or a local compounding pharmacy.) During this time, the patient was instructed to raise his hand to notify the doctor of any discomfort or sensation of warmth during the treatment. The laser settings were confirmed, then the laser was test-fired outside the mouth. The target area then had ice applied for one minute and the first “pass” was started by using a constant motion of the tip to create small overlapping circles until the target area had been covered.
Clinical Case

Distance of the tip to the surface was kept at approximately 1-2 mm. This was continued until the patient registered a warm feeling. The ice was reapplied for one minute and the second “pass” started with attention paid to the change in color of the lesion, particularly near the borders. After the patient again informed us of a warm sensation, ice was applied for the requisite time and a third “pass” was undertaken. A definite lightening of the dark blue color was noted after each pass and was verified when compared to the pretreatment pictures. The immediate postoperative view is shown in Figure 6.

A total of three treatments was performed over a period of eight weeks and a gradual resolution was achieved, even though a regression of the color was noted before the start of each treatment session and was most prominent before the second treatment. Figure 7 shows the view after the second treatment and Figure 8 shows the view after the third treatment.

D. Postoperative Instructions
Postoperatively, the patient was instructed to use over-the-counter nonsteroidal anti-inflammatory drugs (NSAIDs) for any discomfort he might have. He was also informed that there may be some transient swelling of the area for up to 24 hours and to be careful when eating so as not to traumatize the site. The patient was further instructed to monitor the color of the site and to call to report any untoward reactions.

E. Complications
No complications of any type were noted by the patient in the days following the treatments.

F. Prognosis
The short- and long-term prognosis for this type of lesion is good. Recurrence has not been noted at this point and the patient is happy with the results.

G. Treatment Records
All pertinent data along with the informed consent and intraoral photos have been recorded and retained.

Follow-up Care
Assessment of Treatment Outcome and Long-Term Results

The 3-month (Figure 9) and 6-month (Figure 10) checks of the site revealed a smaller total area of the lesion as well as reduced height. The lesion now measures approximately 3 mm x 2 mm and the dark blue color has also lightened significantly to the point where the patient stated that it is not nearly as visible to himself or another person. A clinical exam showed smooth tissue with no visible signs of scarring or traction. A very pale blue color is still present at the site and most likely will not resolve unless further treatments are undertaken.

Conclusion
Although vascular lesions make most clinicians nervous when considering remediation, lasers can accomplish lesion resolution through methods which allow the practitioner to safely treat such lesions via radiant energy in a noncontact mode. The resultant sclerosing and coagulation of the vessels of a venous lake, without damaging the surface of the tissue, showcases some of the exquisite abilities of lasers in dental care.

Reference

Author Biography
Dr. David Burt is a graduate of Temple University School of Dentistry and is currently co-owner of Castle Dental PC with his wife, Dr. Lorri Burt, as well as owner of the Lehigh Valley Dental Education
Center where he teaches advanced CEREC and laser technologies. He has been using both CO$_2$ and diode lasers for more than five years and has performed many soft tissue applications with the 810-, 980-, and 10,600-nm laser wavelengths. He is also a member of the International Society of Computerized Dentistry, the Academy of Laser Dentistry, and the International College of Dentists. Dr. Burt’s personal passion is the sport of skydiving which he has enjoyed for more than 18 years. He is a licensed freefall instructor and has logged more than 1700 skydives to his credit as well as participated in a world record. Dr. Burt may be contacted by e-mail at diveburt@aol.com.

Disclosure: Dr. Burt has previously worked as a trainer for Deka and is currently a post-purchase trainer for the 980 SIROLaser by Sirona Dental Systems as well as a basic and advanced trainer for CEREC CAD/CAM technology. He receives an honorarium for his services.
Gingival Depigmentation with an Er:YAG Laser: A Clinical Case with Three-Year Follow-Up
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SYNOPSIS
This clinical case study describes the removal of gingival hyperpigmentation using an Er:YAG laser. This benign condition was an aesthetic concern for the patient, and the laser procedure produced good results. While the prognosis is good, the patient’s smoking can stimulate melanin production and the coloration can reappear.

PRETREATMENT
A. Case Outline
A 43-year-old African American male presented with normal medical, oral, and dental health. The patient reported that his four upper incisors had a history of trauma, but he would not supply any details. A clinical examination revealed that those four teeth had received endodontic therapy and were then restored with porcelain-fused-to-metal crowns. A panoramic radiograph showed good dental health (Figure 1). The patient had been a cigarette smoker for 20 years, but had since quit smoking for 10 years. The patient had recently finished adult orthodontic therapy and was happy with the results; but he expressed concern about the darkened color of his gingival tissue on both arches, as seen in Figure 2. He was informed that pigmentation can be a normal benign condition, but he revealed that he was unhappy with the esthetics. Furthermore, he described the coloration to have had a negative psychological impact on him for the past 20 years.

B. Diagnosis
The diagnosis is hyperpigmentation due to excessive melanin in the basal layer of the epithelium. This condition exists among all races, but is more prevalent among the African and South Asian population. It can be exacerbated by smoking, since chemicals such as nicotine can activate melanocytes to produce melanin. In fact, this benign increase in melanin has been termed “smoker’s melanin.” The metal substrate of his crowns appeared to be a precious alloy, and this finding was important since some nonprecious metals can cause marginal gingival discoloration. It was then determined that the metal composition was not a factor in the soft tissue coloration on the maxilla and had no effect on the mandibular arch. Periodontal probing showed adequate biologic width around all teeth, with normal pocket depth and healthy tissue.

C. Treatment Options, Precautions, and Informed Consent
As per the patient’s request, removal of the excessively pigmented portion of the gingival tissue will be performed. The options for this elective treatment were discussed, including scalpel surgery, rotary abrasion, cryotherapy, electrosurgery, and laser ablation. The patient chose the laser option. Multiple wavelengths of dental lasers could be utilized to ablate the basal epithelial layer containing the melanin. Since prime absorption of melanin and other pigments occurs in the near-infrared portion of the electromagnetic spectrum, diode or Nd:YAG laser wavelengths would be good choices for efficiency. Erbium and carbon dioxide lasers could also be used, since they are also effective for soft tissue surgery.

The chief precaution is to control the energy delivered to the tissue to avoid potential collateral damage. Depending on which laser wavelength is chosen, underlying connective tissue, periosteum, and bone could suffer from the heat of ablation if it were to extend beyond the target tissue.

The second precaution is to preserve as much of the thin marginal tissue as possible, partic-
ularly on the mandibular arch.

The author chose a fiber-delivered Er:YAG laser because its free-running pulse emission mode provides some degree of thermal relaxation, and it has a relatively shallow depth of penetration. As with other lasers with flexible delivery systems, it permits accurate placement of the tip. The instrument can also be used with a water spray for soft tissue surgery to help cool the tissue and flush the site of debris. While the Er:YAG laser has limited hemostatic ability on soft tissue, especially when coincidental water spray is used, it was felt that whatever bleeding might occur in this moderately vascular area could be readily controlled via conventional means such as compression. Moreover, efficient high-volume evacuation and enhanced visualization with magnification will aid in the precision of the procedure.

The patient gave his consent for the procedure.

TREATMENT

A. Treatment Objective
The objective was de-epithelization to remove the melanin principally located in the basal layer of the epithelium.

B. Laser Operating Parameters
An Er:YAG laser (DELight, Hoya ConBio, Fremont, Calif.), 2940-nm wavelength with a fiber delivery system was used with a 600-micrometer 80-degree tip. The parameters were 30 Hz, 70 mJ, with a water spray. This is a low power setting (2.1 W), and some of the laser energy will be absorbed by the water spray. The total treatment time was 2 hours and the laser exposure was approximately 20 minutes.

C. Treatment
High-volume evacuation was in place, and all laser safety precautions were used. Visualization was enhanced with 3.5x magnification. Periodontal probing showed adequate attached gingival width. Only topical anesthetic (TAC 20% alternate gel – tetracaine 4%, phenylephrine 2%, lidocaine 20%) (Professional Arts Pharmacy, Lafayette, La.) was used. This topical cream is applied for 5 minutes onto an area of tissue. After that time, good anesthesia is obtained for 20-30 minutes.

The treatment area on the maxillary arch extended from the right first bicuspid to the left first bicuspid and consisted of a 5-mm-wide band of excessive pigmentation on thick gingival tissue. On the mandible, the area extended from cuspid to cuspid, and the pigmented width varied from 2 to 7 mm, within thin marginal tissue.

The first site selected was the tissue above the upper right cuspid, where the tissue thickness was greatest. The laser energy was directed at the tissue with very light contact of the tip. The epithelium was gradually ablated in very thin layers. Ultimately, the basal layer was exposed and carefully ablated, and the pigmentation was removed. When this area was completed, the same parameters and procedures continued toward the left cuspid area. Figure 3 shows an intraoperative photograph, and the ablation areas are apparent. The mandibular tissue was treated with the same parameters and protocol, once again moving from right to left.

Some bleeding occurred in various areas after the pigmentation was removed. Hemostasis was achieved by compression with wet gauze and no complications arose. The immediate postoperative view is shown in Figure 3.

Upon completion of the procedure in both arches, adequate free gingival marginal tissue remained, and bleeding was absent on the ablated surfaces.

D. Postoperative Assessment and Instructions
The patient did not experience any discomfort during or after the procedure, and there were no complications. The postoperative instructions were to eat a soft diet and take over-the-counter medications such as Motrin®, Advil®, or Tylenol® if necessary.

FOLLOW-UP CARE

A. Treatment Assessment, Prognosis, and Long-Term Results
The healing was uneventful and the early prognosis was good. The patient returned for follow-up visits at 1 week, 2 weeks, 6 weeks, 3 months, 6 months, 1 year, 2 years, and 3 years. Figures 4-9 show various postoperative periods. The gingival tissues have remained healthy, and the patient liked the absence of the darkened gingiva. At the 3-year-postoperative visit, some slight repigmentation appeared (Figure 9). Comparison of photographic records confirmed this reappearance. The patient reported that he started smoking cigars, and he was reminded that smoking can contribute to excessive pigmentation.

B. Long-Term Prognosis and Conclusion
The long-term prognosis is good. As noted above, it is partially
dependent on the patient’s smoking habits. Moreover, he has a genetic tendency to produce melanin.

The gingival depigmentation procedure using the Er:YAG laser was successful, with good patient comfort, predictable healing, and satisfaction.

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AUTHOR BIOGRAPHY
Dr. Grace Sun routinely utilizes multiple wavelengths of dental lasers. Her articles on dental lasers have been published in Dental Clinics of North America. Dr. Sun is also certified as Advanced Proficiency and was awarded Educator status by the Academy of Laser Dentistry where she was a member of the Board of Directors. She had lectured internationally on the subjects of laser and cosmetic dentistry. Dr. Sun is an accredited Fellow with the American Academy of Cosmetic Dentistry, a Fellow of the International Congress of Oral Implantologists, and is a Master of the Academy of General Dentistry. Dr. Sun may be contacted by e-mail at gracesun@sundds.com.

Disclosure: Dr. Sun has no commercial relationships relative to this article.
“The Good, the Bad, and the Ugly”: 810-830-nm Diode Laser Therapy for the Periodontal Patient Who Smokes

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INTRODUCTION
The pathogenesis of periodontal disease and the methods of treating it have undergone radical changes in the past 30 years. The contemporary model for periodontal disease includes microbial components, host-inflammatory responses, and host risk factors that contribute to the disease progression.1 The pathogenic bacterial plaque in the susceptible host triggers an immune response that results in inflammation and subsequent pathology of the connective tissue and bone.2-3 Periodontal 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 antimicrobial agents, host modulators, and laser reduction of sulcular bacteria with laser coagulation of the periodontally inflamed areas.4-6 The dental hygienist generally is the provider of this initial nonsurgical treatment. During treatment and post-therapy the most unpredictable element the clinician will face is the “human factor,” which refers to a patient’s compliance with home care and other treatment modulators such as smoking.1,6,7 Continued tobacco use can severely compromise the success of periodontal therapy.

CASE PRESENTATION
The patient is a 58-year-old Caucasian male with good general health. He was taking over-the-counter seasonal allergy medication (CLARITIN®, Schering-Plough Corporation, Kenilworth, N.J.) for seasonal allergies. The patient reported that he smoked two packs of cigarettes daily.

The periodontal examination included a full-mouth X-ray, complete periodontal probing, oral cancer screening, and an evaluation of occlusion. The results of this exam showed inflammation, supra- and subgingival calculus, recession from 1 to 6 mm due to occlusal trauma, bone loss in all quadrants, and a peri/endo abscess on tooth #13. Figure 1 is the radiograph of tooth #13. Figures 2 and 3 show pretreatment probing of the maxillary posterior areas. Figure 4 depicts the pretreatment periodontal probe chart.

The diagnosis was Chronic Moderate Periodontitis.

Short-Term Goals
- Initiate good plaque control with an oral hygiene program tailored to the patient’s needs.
- Treat the peri/endo abscess on tooth #13.
- Adjust occlusal interferences for more balanced contacts.
- Work with the patient on smoking cessation.
- Debride all hard tissue followed by laser treatment of the soft tissues.

Long-Term Goals
- Continue support with smoking cessation.
**Clinical Case**

- Improve periodontal condition with a gain in clinical attachment levels.
- Help patient maintain a high level of oral hygiene.

**Treatment Plan**
- Complete debridement of the hard tissues using ultrasonics followed by hand scaling.
- Perform laser bacterial reduction followed by laser coagulation of the site.
- The treatment laser is an 810-830-nm diode laser (DioDent, Hoya ConBio, Fremont, Calif.)
- The fiber for this treatment is a 400-micron fiber
- Bacterial reduction settings are 500 mW CW for 15-20 seconds per site
- Coagulation settings are 700 mW CW for 10 seconds per site
- Conduct oral hygiene instruction tailored for the patients needs.
- Start the patient on Fluoridex® (Discus Dental, Culver City, Calif.) 1.1% sodium fluoride daily topical application.

**Treatment Sequence**
The patient was treated in a split-mouth design, with the upper and lower left quadrants treated first, followed 8 days later by the upper and lower right quadrants.

Anesthesia used for treatment included Septocaine™ (Articaine hydrochloride 4% with epinephrine, 1:100,000, SmartPractice, Phoenix, Ariz.) injected and OraQix® 2.5% (lidocaine and prilocaine topical periodontal gel, DENTSPLY Pharmaceutical, York, Pa.).

After scaling, the laser was used in the pockets to a calibrated depth to achieve bacterial reduction and coagulation. Figures 5, 6, and 7 show the laser procedure, which has been described for diode and Nd:YAG lasers by a number of clinicians.4-5, 8-10

**Treatment Assessment**
Assessments of the treated areas were done at 1, 3, 6, 9, 12, 15, and 18 months post-treatment. During the initial treatment phase the patient stopped smoking. Figure 8 shows light pressure probing of the upper left area, with some pocket depth reduction.

At the 6-month follow-up appointment the patient reported that he was smoking again, but was making an effort to stop. The home care evaluation showed considerable plaque so time was spent adjusting the home care for the patient and retreatment of areas of bleeding and inflammation with the laser. Figure 9 shows probing of the upper left quadrant.

The 9- and 12-month appointments showed improved tissue health with some gain in clinical attachment levels. The patient reported that he had again stopped smoking. Figure 10 shows probing of the lower right, and Figure 11 depicts the 12-month post-treatment periodontal chart.

At the 15-month appointment after the initial therapy the patient was again smoking and home care techniques were not being employed. The clinician noted several areas of calculus and plaque with many areas of inflammation (Figure 12). These areas were debrided and treated with the laser and home care was stressed.

The patient reported at the 18-month appointment that he was still smoking and not very regular with his home care. Areas of inflammation were treated with the laser, home care instruction was again stressed, and the need for smoking cessation was discussed. Figure 13 shows the upper right area with accumulated plaque and inflammation, a result of the patient’s poor oral hygiene and continued smoking habit.
Prognosis
The long-term prognosis for this patient is guarded. The clinician notes that the patient must participate wholeheartedly in his treatment to have a good outcome. To date the patient has been unable to quit smoking cigarettes for longer than six months at a time. Regular removal of the dental plaque is a must for this patient, but removal has been irregular resulting in hard deposits and inflammation. An ongoing effort to help the patient quit smoking and be invested in his oral health through good home care is the goal of the clinician.

CONCLUSION
An excellent treatment plan executed flawlessly with the latest technology does not guarantee a good result unless the patient is ready to participate completely with the clinician. Sometimes it is the human factor of a case that is the most difficult to treat.

Good assessment intervals will be helpful to keep the patient involved in his treatment and allow the clinician to adjust the home care and laser therapy to achieve the best result.

REFERENCES

AUTHOR BIOGRAPHY
Nora Raffetto has Advanced Proficiency in Nd:YAG and diode laser wavelengths and has completed the Educators Course. She has written articles on lasers, has had a chapter published in Dental Clinics of North America, and taught courses on lasers for hygiene application. Ms. Raffetto is the recipient of ALD’s 2001 Leon Goldman Award for Clinical Excellence and has been active in the Academy of Laser Dentistry since 1992, having served two terms on the Board. She has been practicing for 33 years in a general practice setting in Redwood City, California. Ms. Raffetto may be contacted by e-mail at nraffetto@sbcglobal.net.

Disclosure: Ms. Raffetto has no commercial relationships relative to this article.
Gingivoplasty Using an 810-nm Diode Laser to Treat Drug-Induced Gingival Enlargement

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SYNOPSIS
This article describes a clinical technique for recontouring gingival tissue hypertrophy due to the patient’s medication. The author discusses how different wavelengths have been used, and highlights his protocol that employs a diode laser.

INTRODUCTION
Prescription drug-induced gingival hyperplasia is a form of periodontal disease affecting many patients. This condition can be chronic and can require repeated surgical interventions to remove the excessive tissue. Calcium channel blockers and anticonvulsant medications, as well as immunosuppressant drugs, are known to promote gingival hypertrophy. Today, the term “gingival enlargement” or “gingival overgrowth” has been adopted by the American Academy of Periodontology to describe medication-related gingival lesions previously termed “gingival hyperplasia” or “gingival overgrowth.”

Gingival overgrowth is first seen as localized papillary enlargement, as shown in Figure 1. However, its severity can range from minor variations to complete coverage of teeth, leading to functional and esthetic problems for the patient. Histological assessment suggests that the overgrowth is a combination of epithelial and connective tissue neoplasia, which often results in deepening of the normal sulcular depth. This is usually considered a “pseudo pocket” because the epithelial attachment typically has not migrated apically due to periodontal tissue breakdown.

As a result, some authors have advocated a multiphasic approach to treating gingival hyperplasia that includes mechanical and chemical plaque control, as well as removal of the hyperplastic tissue.

Traditional Removal Approaches
Traditional techniques for removing hyperplastic gingival tissue include thinning the underlying connective tissue using a sulcular surgical approach, or using the scalpel or similar knives to thin the tissue from the exterior side. These techniques leave the connective tissue exposed to the oral environment, cause hemorrhage, and expose nerve endings, all of which may result in delayed healing and postoperative pain.

With the latter surgical approach, it is usually necessary to cover denuded tissues with periodontal dressings. However, the author has found that applying periodontal dressings is time-consuming and is met with less-than-favorable acceptance by the patient. There is also a small possibility that bacterial pathogens can be entrapped against the denuded surgical site.

The Evolution of Laser Removal Techniques
Lasers have been employed for more than 20 years for the excision of hyperplastic oral tissues. Since at least 1985, the carbon dioxide laser has been used for various soft-tissue procedures in the oral cavity, including – but not limited to – gingivectomies, gingivoplasties, incisional and excisional biopsies, frenectomies, and removal of certain soft tissue lesions. The benefits of its use in such procedures include lack of hemorrhage that results in a dry working field, significant bacterial reduction in the surgical area, minimal postoperative discomfort, and reduced time to perform the procedure. Compared to the use of a scalpel, the laser gingivoplasty is easy to perform, although specific training with lasers is required.

As reported by some studies, the early CO₂ laser soft tissue surgery usually resulted in a charred or eschar layer on the surface of the wound, as shown in...
The first designed-for-dentistry laser was the Nd:YAG (neodymium:yttrium, aluminum, garnet) (dLase 300, American Dental Laser, Birmingham, Mich.). In contrast to the aforementioned older CO₂ laser concept, the removal of tissue with the Nd:YAG laser is accomplished by holding the laser tip perpendicular to and in contact with the tissue being ablated. Similarly, however, charring was a natural outcome of the technique, as shown in Figure 2b, especially if higher power settings, inordinately slow technique, or re-application of laser energy to the previously ablated / surgerized site were employed. The same outcome is evident when diode lasers are used under similar conditions.

There are currently available CO₂ and diode lasers with pulse durations as small as a few ten-thousandths of a second. That emission mode on those instruments should significantly reduce the potential for char on the soft tissue.

Although both the CO₂ and Nd:YAG lasers could be used successfully for a variety of soft-tissue procedures, the CO₂ laser was thought to be faster for most procedures. In time, however, many astute laser clinicians found that the charred layer that resulted from both devices led to increased postoperative pain and affected the predictability of the resultant tissue level.

In both Figures 2a and 2b, the charring results from reheating already coagulated tissue and/or from excessively high energy levels. This excess fluence also causes increased edema in the underlying connective tissue.

Users of the Nd:YAG laser learned that the optical fiber could be held in the same orientation relative to the tooth as a knife or scalpel. The same concept was applied when the 810-nm diode laser was introduced; that is, the energy was delivered parallel to the tissue instead of perpendicular. This orientation helped to reduce deep penetration of the laser beam into the underlying soft tissue, and continued heating and thermal damage would be decreased. In this way, the amount of charring could be held to a minimum. Additionally, these optical fiber-delivered lasers have been considered as an appropriate substitute for the scalpel for periodontal surgery because the clinician can work in a familiar setting, using a contact mode for tactile sensation and to facilitate the lasers’ insertion into the depth of the periodontal pocket.

Instead of a char layer, the resulting surface consists of denatured protein. This layer will usually remain in place for several days – protecting the underlying connective tissue, nerve endings, lymphatics, and blood vessels – before sloughing off. The author refers to this as the “laser bandage.” This covering is usually adequate and protects against possible postoperative pain and infection. After 3 days, the author has observed that normal masticatory function and tooth brushing will remove the “laser bandage,” leaving exposed connective tissue. During this time re-epithelialization begins, and the wound is covered. During the denuded phase, patients often report being sensitive to acidic foods (e.g., tomato products), abrasive foods (e.g., snacks), and oral hygiene techniques.

Diode Laser Gingivoplasty Technique

A 38-year-old female patient presented with gingival enlargement as a result of many years of Dilantin® (phenytoin) therapy for epilepsy. She desired a veneer restoration to reposition the labial surface of the upper right lateral incisor. The clinical finding was that of excessive labial gingival tissue including an enlarged papilla, and the treatment was a laser gingivoplasty. The protocol and results of that procedure are described below.

For the typical gingival surgery, attention to anesthesia is required. Many patients will benefit from only the application of topical agents. These include transdermal lidocaine patches; eutectic mixtures of local anesthetics (e.g., lidocaine 20%, prilocaine 20%, and phenylephrine 4%) that are custom-
formulated in local pharmacies or available commercially (e.g., Oraqix®, DENTSPLY Pharmaceutical, York, Pa.); or benzocaine 20%, which is applied subgingivally.

The depth of the pockets must be measured using the six-point probing scheme. The starting point for the beveled incision, as it relates to the end result, must be predetermined. To accomplish this, the clinician uses a periodontal probe, records the depth of the pocket to be treated, and notes and evaluates its condition (e.g., acute or chronically inflamed).

If there is no apparent exudate present, the probe is used to define the height of contour that should be established when reducing the pocket depth. The laser can be used to place a line or a series of small dots along the facial aspect of the gingiva to create a reference for the laser incision path.

The author uses an 810-nm diode laser (Odyssey® 3Watt, Ivoclar Vivadent Inc., Amherst, N.Y.) with an initiated 400-micron fiber, utilizing a power setting of between 1.0 and 1.4 Watts, in the continuous-wave mode. The fiber is angled slightly toward the occlusal or incisal aspect of the tooth and the excess tissue is removed down to the previously marked incision line, as shown in Figures 3 and 4.

Figure 3: Bare fiber tip of the diode laser in the recommended orientation

Figure 4: Laser surgery begins. The power setting in this excision was 1.0 W continuous wave. Care was taken to maintain papillary height while reducing the pocket depth to 2 mm. The blue arrow indicates the direction of laser fiber’s movement. The clinician needs to remove approximately 1 mm of additional tissue to allow for the regrowth of the epithelial layer

The majority of hyperplastic tissue has been removed, the remaining tissue should be contoured and blended into the surrounding area. This phase of the procedure is termed “laser festooning” by the author. The crestal gingiva is contoured as needed using powers of 1.5 Watts or less, then any excess epithelium remaining near the root is quickly removed (Figure 5). The operator should remember to move quickly, and to avoid touching the root with the laser fiber whenever possible. Immediate postoperative results, subsequent to wound cleansing, are shown in Figure 6.

Figure 5: Gingival tissue “festooned” for normal physiologic contour. The sulcus is then flushed with warm saline solution or hydrogen peroxide. The immediate postoperative result is not clearly understood. Moreover, the laser parameters mentioned by Karu16 are well below those used by the author. It is known, however, that the inflammatory responses are muted;13 and, in the author’s experience, healing appears at an accelerated rate and most patients report little to no postoperative pain. The appearance of normal tissue color with stippling has been observed to return within a 14-day period in most cases. Figures 7 and 8 depict postoperative healing at 7 and 21 days, respectively.

CONCLUSION
Soft-tissue lasers are increasingly being utilized, and newer, more efficient and effective methods of employing lasers for the benefit of
dental patients are being reported with greater frequency. This article has demonstrated one such technique for performing a gingivoplasty procedure more predictably and safely than conventional methods when treating a patient with medication-induced gingival enlargement. Moreover, the recurrence is lessened when a laser is used.17

**AUTHOR BIOGRAPHY**

Dr. John Graeber is a graduate of the University of Medicine and Dentistry of New Jersey, and maintains a private dental practice in East Hanover, New Jersey. He joined the Academy of Laser Dentistry (ALD) at its inaugural conference in 1993, and has taught laser courses since 1996. He has earned Advanced Proficiency, Educator status, and Mastership in the Academy, and is an ALD Recognized Course Provider. A current ALD Board Member, he serves on the Ethics and Education committees. This is his tenth published article. Dr. Graeber may be contacted by e-mail at hitekdr@mac.com.

**Disclosure:** Dr. Graeber is a current consultant and trainer for Ivoclar Vivadent, and receives honoraria for those services.

**REFERENCES**

Editor’s Note: The following four 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.

LASER TREATMENT OF GINGIVAL HYPERPLASIA

In his case study of laser treatment of drug-induced gingival enlargement, (136-139), Dr. John J. Graeber uses an 810-nm diode laser to perform gingivoplasty – removing the hypertrophic tissue and contouring the remaining tissue to optimize the esthetic and functional result.

Silverstein and colleagues1 outline the types of medications identified as possible causative agents. They include anticonvulsants (to control epileptic seizures), immunosuppressants (to prevent rejection in human organ transplants and to treat diseases of cell-mediated autoimmune origin such as Type I diabetes mellitus and rheumatoid arthritis), and calcium channel blocking agents (to manage certain cardiovascular conditions).

Enlargement of oral mucosal tissue may also occur during or as a result of hormonal changes (during pregnancy, at puberty, and with the use of oral contraceptives), orthodontia, localized sites of chronic irritation such as ill-fitting dentures, poor oral hygiene, system diseases such as leukemia, and other conditions. Esmeili and colleagues2 review the etiology of many of the common soft tissue masses, and emphasize the need for conducting a definitive diagnosis to determine treatment.

Lasers have been used to effect treatment of such conditions for more than two decades, as indicated in Dr. Graeber's article and a previous review of this subject in the Research Abstracts section of the Journal of the Academy of Laser Dentistry 2005;13(3):33-35. The additional abstracts below illustrate how a variety of lasers may be used to facilitate treatment.

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.

REFERENCES


For additional background on the use of lasers in the treatment of gingival hyperplasia, readers are referred to clinical cases and research abstracts in previous issues of the Journal of the Academy of Laser Dentistry and Wavelengths.

Aims: Based on our accumulated experience, the present study evaluates and discusses the indications, advantages, and inconveniences of oral cavity epulis resection using the carbon dioxide laser (CO2) versus the erbium:YAG laser (Er:YAG), diode laser, and surgical scalpel. Materials and Methods: A retrospective study has been made of 120 patients involving the removal of 128 epulis lesions with the CO2 laser, Er:YAG laser, diode laser, and surgical scalpel. Postoperative controls were carried out after 7, 15, and 30 days to evaluate healing and wound evolution, and after 3, 6, and 12 months to assess possible relapse. Results: Two groups were defined, based on the clinical and etiopathogenic characteristics of the excised lesions: gingival hyperplastic lesions (77 cases) and fibromatous hyperplasia (51 cases). The lower jaw was the most frequent location of gingival hyperplasia (51.9%). Fibrous hyperplasia was the most common histological diagnosis (49 cases; 63.6%). Percentage relapse following removal was 9.1%, of which 5 cases corresponded to fibrous hyperplasia. Only one malignancy was identified, corresponding to infiltrating squamous cell carcinoma. On the other hand, of the 51 treated cases of fibromatous hyperplasia, 58.8% were located in the upper jaw. These were histologically confirmed to be fibrous hyperplasia, with relapse in 19.6% of the cases. Conclusions: Although the different surgical techniques used for removal of epulis of the oral cavity are appropriate, we consider the CO2 laser to be the treatment of choice, since it offers a number of both intra- and postoperative advantages. On the other hand, all oral lesions require histological study to establish a firm diagnosis.

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Inflammatory papillary hyperplasia of the palate is a persistant non-neoplastic lesion that is normally caused by poorly fitting dentures and Candida infection. We describe a case that was managed primarily with topical miconazole, and complete removal of the old acrylic denture. A multidisciplinary approach between surgeon and prosthodontist was used that combined carbon dioxide laser followed by substitution of the old removable denture for a new implant-supported screw-retained prosthesis. This avoided direct support of the prosthesis by the palatal mucosa and made oral hygiene easier. The treatment has resulted in complete remission and there has been no recurrence during 3 years of follow-up.

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**USE OF THE CO$_2$ LASER ON ORTHODONTIC PATIENTS SUFFERING FROM GINGIVAL HYPERPLASIA**

_Sabrina K.C. Gama, DDS; Telma Martins de Araújo, PhD;
Daniel Humberto Pozza, PhD; Antonio Luíz B. Pinheiro, PhD_

_Dr. P. Infante-Cossio, 1 R. Martinez-de-Fuentes; 2 E. Torres-Carranza, J.L. Gutierrez-Perez_  

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**INFLAMMATORY PAPILLARY HYPERPLASIA OF THE PALATE: TREATMENT WITH CARBON DIOXIDE LASER, FOLLOWED BY RESTORATION WITH AN IMPLANT-SUPPORTED PROSTHESIS**

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**USE OF THE CO$_2$ LASER ON ORTHODONTIC PATIENTS SUFFERING FROM GINGIVAL HYPERPLASIA**

_Sabrina K.C. Gama, DDS; Telma Martins de Araújo, PhD; Daniel Humberto Pozza, PhD; Antonio Luíz B. Pinheiro, PhD_

Objetive: The present study aimed to assess the effect of the use of the CO$_2$ laser on the treatment of gingival hyperplasia in orthodontic patients wearing fixed appliances. Background Data: Gingival hyperplasia is a condition very frequent in patients undergoing fixed orthodontic treatment. Amongst the treatments available for this is the use of surgical lasers. Methods: Ten patients entered this study and signed an informed consent. Seventy-five anterior teeth with gingival hyperplasia were selected for laser surgery. Prior to surgery, the length of the crowns were measured using a digital caliper, and depth of the pocket was probed. The hyperplasic gingiva was removed with a CO$_2$ laser under local anesthesia. Immediately after surgery, measurement of the length of the crowns and probing were carried out and were repeated. Results: The results were statistically analyzed and significant differences were detected regarding the length of the crown (p = 0.000) and depth of the gingival sulcus (p = 0.000). Conclusion: It is concluded that the use of the CO$_2$ laser was effective in the treatment of gingival hyperplasia.

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Recently, the *Wall Street Journal* ran a piece on obesity control. Obesity, as I am sure you are aware, is one of the major public health challenges of our time. The Journal reported a unique and promising approach to the problem using the Buddhist concept of mindfulness and described the approach as *mindful* eating.

Mindfulness methodology is the brilliantly simple idea that says one can only do one thing at a time. How novel a concept during this era when multitasking is frighteningly held in such high esteem. The idea as it relates to eating, and borne out by research, revealed an unexpected finding. Overweight and obese people can barely remember what it is they ate just a few minutes after finishing a meal. This, of course, points up the distinction between eating food in a mindless manner and actually tasting and appreciating it. Think about the notion of placing one raisin in your mouth, chewing, then tasting, and then swallowing it. There will be an appreciation of that raisin that is often missed in our rushed lives.

But we miss far more than raisins when we laud the so-called benefits of multitasking and efficiency in the modern and often hysterical world. Maggie Jackson, author of a disturbing and important new book, *Distracted*, observes, as we move at warp speed from one task to another, from one conversation to another, or from one relationship to another: "Attention is the building block of intimacy, wisdom and cultural progress. If we squander our powers of attention, our technological age could ultimately slip into cultural decline." This was first discussed by William James, the American psychologist and philosopher, who wrote at length about the varieties of human attention in *The Principles of Psychology* (1890). He outlined the differences among "sensorial attention," "intellectual attention," "passive attention," and the like, and noted "gray chaotic indiscriminateness" of the minds of people who were incapable of paying attention.

As laser dentists we have a wonderful metaphor at our disposal. The idea of a *lasermind* is one that focuses absolutely and with full attention and awareness. A *lasermind* will provide us with a tool for both superb care for our patients and learning and growth for ourselves. Like many tools our lasers have learning curves. Learning about laser-tissue interactions, learning about the details of laser safety, and learning the requisite laser physics that distinguish these devices from most of the instruments in our operatories provide us with fertile ground for intellectual growth. All of these areas can be entered with the full focus of our *laserminds*.

If we sit with this concept of mindfulness we will see that it has the capacity to transform our professional and personal lives. Slowing down, we can pay attention not only to the broad array of details that require our careful attention, but perhaps more importantly, the myriad relationships that provide the human cement that make us a part of our community. And as we pay attention to these things our skills improve and our efficiency increases. Imagine, for a moment, suggesting to our patients that they brush and floss *mindfully*. At first they might look at you in a funny way, but when you explain that their tooth brushing and flossing activities could have *intention* attached to them so that when they were doing these chores they weren't daydreaming about this thing or that, but they were focused on where the bristles landed or where the floss was placed. Again the Buddhist and other Eastern teachings provide some guidance in these matters. The metaphor that they use to teach the concept of *intentionality* uses the activity of washing dishes, seemingly the most mindless of activities. "One should wash the dishes when one is washing the dishes," they suggest. This is different than thinking about something else while washing the dishes. What could be more beautiful, clear, or self-
evident? I can only add: as it goes with dishes, so it goes with teeth!

Only please trade the Cascade for some Crest…

AUTHOR BIOGRAPHY

Born and raised in the Bronx, Dr. Alan Goldstein graduated from the City College of New York before receiving his dental degree from the University of Pennsylvania School of Dental Medicine in 1968. He is a frequent contributor to the dental literature as well as a lecturer in a variety of venues. He was certified as a Professional Integral Coach in 2001 and has a coaching practice in New York City. He often addresses audiences on topics of personal effectiveness, fulfillment, and leadership as well as dental practice management and use of lasers. He is a past president of the Academy of Laser Dentistry and a former editor of Wavelengths. He serves on the Dental Advisory Board of Dentistry Today and the Journal of Laser Dentistry and is a Fellow in the American College of Dentists. Dr. Goldstein may be contacted by e-mail at allaama1@mindspring.com.

Disclosure: Dr. Goldstein has provided educational services for a number of laser manufacturers and received honoraria for these services. Presently, he has no commercial financial relationships.

REFERENCES

Educational Objectives

Upon successful completion of this module, you will be able to:

- Identify which laser types may be used safely for osseous surgery, and specify the chromophores that are absorbed by the laser’s energy.
- Describe the parameters under which a laser may be used for osseous surgery, and enumerate the laser’s advantages and limitations in such a procedure.
- Identify which laser types may be used safely for second-stage recovery of implants.
- Describe the procedure and precautions for using a laser for second-stage uncovering of an implant.

Test Questions

1. The currently available laser wavelength(s) that have clinical indications for use in performing osseous surgery is (are):
   a. all diodes
   b. Nd:YAG
   c. carbon dioxide
   d. Er,Cr:YSGG and Er:YAG

2. The wavelengths utilized for osseous surgery are absorbed by the chromophores in bone, including:
   a. hemoglobin and oxyhemoglobin
   b. water and the hydroxyl group of hydroxyapatite
   c. phosphate and nitrate groups
   d. melanin and xanthophyll

3. When an osteotomy for the placement of an implant fixture is performed with a laser, which of the following statements is true?
   a. the laser has an advantage because it can much more rapidly prepare the site than size-matched burs
   b. the water spray used for cooling the tissue is easily directed into even the deepest preparations with conventional tips
   c. the end-cutting laser beam does not allow for a measured development of a three-dimensional preparation
d. studies have shown significant disrupted healing of laser-prepared osteotomies compared to the control group.

4. To avoid damage to osseous tissue with a laser, the maximum temperature to which bone should be raised during osseous surgery is:
   a. 47 degrees Celsius
   b. 42 degrees Celsius
   c. 80 degrees Celsius
   d. 57 degrees Celsius

5. The application of laser energy on the metal implant should be accomplished under which of the following considerations:
   a. Use a laser with a power density of several thousand Watts per pulse
   b. Use a laser with a high peak power per pulse without a water spray
   c. Use a laser in continuous-wave mode with an average power of approximately 1.0 W
   d. Use a laser that causes detectable disruption of the coated implant surface

6. Which of the following statements applies to second-stage uncovering of an implant fixture? The procedure:
   a. should not be performed with a laser because of the laser’s potential to harm the fixture
   b. can be performed with any commercially available laser wavelength
   c. should not be performed with a laser because of the laser’s potential to damage the periodontium
   d. can be performed only with fiber-delivered lasers with water spray

7. According to the author, second-stage uncovering of the implant with a laser:
   a. can be performed without regard to the thickness and vascularity of the soft tissue
   b. should be performed at a starting average power of 4-5 Watts
   c. starts with removing a small cone of tissue until near-contact with the implant is made
   d. should produce rapid buildup of carbonized material on the soft tissue surface and the tip of the laser

8. Which of the following was demonstrated in the article’s accompanying clinical case examples of second-stage uncovering of the implant fixture?
   a. the choice of laser wavelength is irrelevant, as long as the proper parameters are utilized
   b. the laser clearly damaged the periodontium
   c. excessive soft tissue must not be removed with a laser
   d. a laser cannot be used to contour the gingival tissue after uncovering the implant

9. The generally accepted definition of the term peri-implantitis is:
   a. the acute inflammation of only the marginal gingival tissue adjacent to a functional implant
   b. inflammatory reactions with loss of supporting bone in tissues surrounding a functional implant
   c. the loosening of the implant abutment
   d. disintegration of the restorative material on the abutment crown

10. In the treatment of peri-implantitis, which of the following is true?
    a. the presence of biofilm on the implant surface causes no concern
    b. removal of granulation tissue is not recommended by the author
    c. occlusal loading is never analyzed
    d. pathogen reduction is a primary step
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The Use of Laser Energy in Implantology
Steven P. A. Parker, BDS, LDS RCS, MFGDP

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Place an X in the box corresponding to the answer you believe is most correct.

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