_earn C.E. credit
Low-level laser therapy-activated latent TGF-β1

_research
Diode laser surface decontamination in periodontitis therapy

_history
From theory to the first working laser
Experience the Soul of AMD LASERS
www.amdlasers.com/soul

Just Getting

The best-selling dental laser in the world

Best-in-class education and training included

Innovative, award-winning design and technology

Wireless foot control now available

Choose traditional fiber or convenient disposable tips

Since 2008, thousands of dentists around the world have put Picasso lasers to work in their practices. Now that we are a part of the DENTSPLY family, our mission is one step closer to reality: A laser in the hands of every dentist and hygienist, in every office, and every operatory around the world. We are just getting warmed up.

Call 866.999.2635
Pick Up a Picasso Today!

AMD LASERS®
A DENTSPLY International Company
Looking for Laser Education? We’ve got you covered!

Full Length DVD included
iPAD App
On-line training
Hands-on courses
Peer-to-Peer Learning

NEW!

MASTERS OF LASER DENTISTRY

We are proud to be the exclusive sponsor of the Masters of Laser Dentistry, the profession’s premier laser training series. Learn from wet-gloved laser dentists who use Picasso lasers everyday. Course material includes creating a productive laser soft-tissue program, FDA-approved procedures, laser-tissue interaction, safety, and much more.

UPCOMING MASTERS COURSES

SAN DIEGO, CA
August 5th

NEW ORLEANS, LA
August 19th

DETROIT, MI
September 16th

COLUMBUS, OH
September 23/24

KANSAS CITY, MO
August 12th

PORTLAND, OR
September 19th

HEWLETT, NY
September 23/24

BOSTON, MA
September 30th

Call 866.999.2635 to Enroll Today
Stay on the cutting edge with laser

There has never been a better time to practice dentistry. Rapidly advancing technology has given dentists the ability to treat patients in new and innovative ways. One of the most exciting advances, of course, is laser technology. And that is what makes the publication you are holding right now so valuable.

For this issue of laser, we’ve assembled a collection of articles from some of the most respected names in laser dentistry. These expert clinicians are sharing their knowledge and expertise with you.

Within these pages, you can read about research on diode laser surface decontamination in periodontitis therapy by Dr. Georg Bach of Germany, and temperature changes in subperiostal bone during laser frenectomies in sheep jaws by Dr. Anastasios Manos and Prof. Nicolaos Parissis of Greece. There are two articles on the use of lasers for periodontal treatment by Dr. Howard Golan of the United States, Dr. Fay Goldstep and Dr. George Freedman of Canada. Dr. Thorsten Kuypers of Germany offers a user report on the use of a minimal-invasive laser technique for surgical crown lengthening. The scientific portion of this issue concludes with a look back at the invention of laser technology by Dr. Ingmar Ingenegeren of Germany.

But there’s more.

Every issue of laser magazine also contains a C.E. component. By reading the articles on low-level laser therapy by Drs. Tristan Hunt, Eason Hahm and Praveen Arany of the United States, and implant exposure with Er:YAG laser by Dr. Gerd Volland of Germany, then taking a short online quiz about these articles at www.DTStudyClub.com, you will gain one ADA CERP-certified C.E. credit. Keep in mind that because laser is a quarterly magazine, you can actually chisel four C.E. credits per year out of your already busy life without any lost revenue or time away from your practice.

To learn more about how you can take advantage of this C.E. opportunity, visit www.DTStudyClub.com. Annual subscribers to the magazine ($50) need only register at the Dental Tribune Study Club website to access these C.E. materials free of charge. Non-subscribers may take the C.E. quiz after registering on the DT Study Club website and paying a nominal fee.

I know that taking time away from your practice to pursue C.E. credits is costly in terms of lost revenue and time, and that is another reason laser is such a valuable publication.

I hope you enjoy this issue and that you get the most out of it.

Sincerely,

Torsten Oemus
Publisher
LIGHTWALKER
Hard & Soft
All Tissue Laser

California Dental Association (CDA-SF)
September 22-24, 2011
San Francisco, CA

American Dental Association (ADA)
Booth #3142
October 10-12, 2011
Las Vegas, NV

Visit us & receive the New
Lightwalker Sling Backpack!

Pride Institute
Best In Class

949.276.6650
T4Med.com
C.E. articles
08 Low-level laser therapy-activated latent TGF-ß1
_Drs. Tristan Hunt, Eason Hahm and Praveen Arany
13 Implant exposure with Er:YAG laser
(= 2,940 nm)
_Dr. Gerd Volland

Protocol
16 Diode lasers for periodontal treatment:
The story so far
_Dr. Fay Goldstep and Dr. George Freedman

User reports
20 The use of lasers in periodontal treatment
_Dr. Howard Golan
40 The minimal-invasive laser for surgical crown lengthening
_Dr. Thorsten Kuypers

Research
26 Diode laser surface decontamination in periodontitis therapy
_Dr. Georg Bach
34 Temperature changes in subperiostal bone during frenectomies with the electrotome and Er:YAG laser in sheep jaws
_Dr. Anastasios Manos and Prof. Nicolaos Parissis

Feature
44 From theory to the first working laser
_Ingmar Ingenegeren

Industry
46 Dual-wavelength Waterlase iPlus

About the publisher
49 Submissions
50 Imprint

On the cover
Cover image provided by BIOLASE Technology.
The Dual Wavelength waterlase® iPlus™
Advancing Laser Technology to Its Ultimate

**iNCOMPARABLE ACCESS & FIELD OF VISION**
- No Pain, Therefore No Shot Necessary
- No Micro-fractures or Thermal Damage
- No Cross Contamination as with Burr
- Best Ergonomic & Smallest Design

**iNCREDLIBLE POWER**
- Cutting Speed that Surpasses the High Speed Handpiece and Any Other Dental Laser on the Market
- Cuts Faster and More Efficiently than Lasers with More Power Watts
- Combines 0.5-10 Watts Power with 100 Hz & Short Pulse for 600 mJ of Laser Energy
- Patented Laser Technology

**iNTUITIVE GRAPHICAL USER INTERFACE**
- Step 1: Application
- Step 2: Procedure
- Step 3: No Shot/No Drill

**iLASE 940nm DIODE LASER**
- 5 Watts of Power with ComfortPulse
- Handheld & Ergonomic
- Battery Operated with Finger Switch Activation
- Proprietary Multi-diameter/Length Bendable Tips
- Single Use for No Cross Contamination

Biolase

*waterlase® iPlus™ | Intuitive Power™ | www.Biolase.com | Toll-free 888-424-6527*
Low-level laser therapy-activated latent TGF-β1

Authors Tristan Hunt, Eason Hahm and Praveen Arany

A potential molecular pathway mediating the nexus between inflammation and wound healing in oral tissues

Low-level laser therapy in dentistry

For more than 30 years, lasers have been a part of dentistry and oral surgery predominantly as surgical tools. Surgical lasers currently used in dental practice include CO2 lasers, Nd:YAG lasers, Er:YAG lasers and diode lasers. CO2 lasers have been used to precisely remove superficial tissue layers while leaving underlying tissues relatively undamaged and are especially valued for their coagulation effects. Er:YAG lasers have been used for ablation of soft and hard tissues and to sterilize root canals and periodontal pockets while Nd:YAG lasers have been used for debridement of calculus and the reduction of endodontic microbes. The diode lasers have been used for variety of low-level applications from analgesia to stimulating healing.

Low-level laser therapy (LLLT) is considered a non-invasive and painless process that uses photonic energy to provide biological therapeutic advantages, including analgesic capabilities. While these types of lasers are still used surgically, clinicians have been increasingly using LLLT in the past 10 years. Rather than cut or ablate, low-level lasers take advantage of certain photobiological processes, the mechanistic molecular basis of which are yet to be fully characterized. These lasers function in the milliwatt range instead of the higher wattage (0.5 to over 1 W) used by the surgical lasers.

The clinical applications of a low-power laser for patient care in dentistry have been used to reduce inflammation, relieve pain and discomfort — including hypersensitive dentine — and promote wound healing. There are some clinical studies but few rigorously controlled trials to demonstrate the efficacy of LLLT definitively, as well as a paucity of basic science research to probe its mechanistic underpinnings in its various dental applications. This short review does not attempt to comprehensively overview the state of the field, but highlights some of the recent human clinical studies that have attempted to directly explore the efficacy of LLLT on inflammation and healing in oral tissues.

Inflammation

Inflammation is a complex reaction to injurious agents, such as microbes and damaged, usually
necrotic, cells that consist of vascular response, migration and activation of leukocytes and systemic reaction. Inflammation is usually a protective pathophysiological response of the body to help prevent noxious damage and return to a homeostatic physiological state. But in scenarios of persistent stimuli or uncontrolled inflammatory reactions, this mechanism can turn pathological and harm the host instead.

Wound healing and regeneration

Wound healing, on the other hand, is the resolution of inflammation that succeeds the inflammatory reaction. The ultimate goal of healing is to remove all traces of the damaged tissue and return tissues to their original structural and functional homeostatic state. The ideal outcome of wound healing is a complete restoration of the damaged tissue and is termed “regeneration.” There are two possible modes of regeneration, although these two processes are not sharply delineated and may coexist in certain scenarios. Firstly, the mode of regeneration involving proliferation of material preceding development of the new part is termed “epimorphosis,” while the other involves transformation directly into a new organism or part of an organism without proliferation at the cut surfaces, termed “morphallaxis.”

The nexus of inflammation and healing with timing of LLLT

While inflammation is critically important and precedes healing, a persistent inflammatory reaction will interfere with effective healing. The ability to modulate the inflammatory response by changing the initial milieu of factors can potentially direct the eventual healing process. The use of LLLT attempts to do just this by delivering photonic energy in this early inflammatory, post-injury scenario that could activate or inactivate specific molecular pathways, accelerating the resolution and the subsequent healing process. The early or repeated use of LLLT during the persistence of the inflammatory phase is therefore a central aspect in defining its clinical efficacy. The use of LLLT in a chronic inflammatory scenario will probably be inefficacious due to the recurrent, persistent noxious stimuli and the poor healing milieu. We believe LLLT does not create a novel in vivo scenario but aids in the re-establishment of homeostatic mechanisms, often accelerating its natural trajectory.

LLLT in gingivitis and periodontitis

Gingivitis generally is not associated with significant pain, and thus the LLLT studies have focused on its anti-inflammatory effects. In one study, 10 female subjects refrained from all oral hygiene for 28 days in an effort to induce gingivitis. On day 21 and day 24, the marginal gingival, buccal to the one of the lateral mandibular incisors, was irradiated for four minutes by LLLT. Results showed no statistical difference between the laser and control sites in regards to the level of plaque formation or gingival bleeding. In a more recent study, patients were subjected to 10 LLLT sessions with a 670 nm laser to treat gingival inflammation. Clinical parameters such as the gingival index, plaque index and probing index at one, three and six months after laser or conventional oral hygiene therapy were assessed. While both methods are successful at reducing gingivitis, the authors concluded that LLLT leads to better therapeutic results.

Periodontitis, due to pathogenic bacterial species, often presents with bleeding and swelling of the gums, halitosis, gingival recession, and if untreated can lead to tooth loss. Qadri et al. showed that treatment with LLLT along with routine oral hygiene measures reduced gingival inflammation. In a split mouth, double-blind study, patients with moderate chronic periodontitis were treated with a 635 nm InGaAlP diode laser at 4.5J/cm2 and a 820 nm GaAlAs diode laser at 8.75 J/cm2 following basic periodontal treatments of scaling, root planning and oral hygiene instructions. Following treatment, plaque and gingival indices as well as pocket depth were all reduced for the laser-treated side, indicating a reduction in inflammation. Additionally, analyses of gingival crevicular fluid showed decrease matrix metalloproteinase-8 (MMP-8) in the laser-treated side that has been linked directly to the severity of inflammation. Another study by the same group observed that the longer coherence length of an HeNe laser had a more pronounced biological effect than an InGaAlP diode laser on gingival inflammation.

In a study performed to evaluate LLLT as an initial treatment for periodontitis, 30 subjects ranging from ages 20 to 60 who had periodontal pockets...
of at least 5 mm deep in each quadrant underwent treatment in which half of their mouth was treated with traditional scalpel and root planning (SRP) procedures and the other half was treated with SRP and a Nd:YAP laser.

The Nd:YAP laser was used at 10 W with a 200 nm fiber, time and total fluences were not reported. Evaluations were done at day 0 and day 90 based on the quantity of plaque, gingival inflammation, bleeding on probing (BOP), pocket probing depth (PPD) and clinical attachment level (CAL). The analysis showed that although both methods were equally effective in treating periodontitis, there was no difference in postoperative pain as reported by the patients.10

Similarly, another study used a He-Ne laser at 0.2 mW for 10 minutes for eight days in the first three months to treat advanced chronic periodontitis (probing pocket depth more than 5 mm) in 16 patients and evaluated supragingival plaque (PL), BOP, PPD and probing attachment level (PAL) were recorded at baseline and at three, six, nine and 12 months. Their results also showed no additional clinical benefit with the He-Ne laser compared to conventional periodontal therapy.11

Other studies, however, using diode laser treatment as a therapeutic method for periodontitis proved to be more promising. In a study done in Greece, 30 patients diagnosed with aggressive periodontitis in all four quadrants were initially evaluated for plaque index, BOP, PPD and CAL at two weeks, 12 weeks and six months after treatment. Each quadrant was randomly assigned to either SRP alone, SRP with laser, laser alone or control. In this study, a 980 nm diode laser in continuous mode at 2 W was used. Plaque samples obtained six months after treatment showed a statistically significant reduction in total bacterial load, PPD and CAL in the SRP-plus-laser group compared to either treatment alone; however, there was no difference in plaque index and BOP.12

In a similar LLLT study using a diode laser (630–670 nm) in combination with SRP in 60 patients randomly sorted into three treatment groups, the first group received only SRP treatment for four days, the second group received SRP treatment for four days followed by five days of laser treatment and the third group received four days of SRP treatment followed by 10 days of laser treatment. The clinical parameters measured included the plaque index and gingival index, and BOP demonstrated a statistically significant improvement with both LLLT groups.13

While there appears to be some discrepancies in clinical outcomes of these studies, there appears to be a large variation in type and manner of lasers used to perform these LLLT studies. Another important aspect is the varying clinical scenario and the nature of underlying patho-physiological processes in each of these diseased states that might need a more tailored therapeutic LLLT regimen for its clinical efficacy.

**LLLT and oral wound healing**

A study by Amorim et al. used LLLT on gingivectomy wounds in 20 patients with periodontal disease using the split mouth design. They used a 685 nm, 50 mW laser at 4 J/cm².14 The authors observed a significant improvement in clinical parameters evaluated in the laser group at 21 and 28 days post surgery compared to the control sites. They postulated that the improvement likely derived from higher collagen production leading to a better remodeling of connective tissue and a reduction of the probing depth, the latter in turn aiding oral hygiene and synergistically contributing to limiting inflammation.

A similar split mouth study design by Ozcelik et al. also showed that LLLT could enhance epithelization and improve wound healing after gingivectomy and gingivoplasty procedures.15 Using a Mira-2-tone solution to visualize areas of epithelization, the investigators treated patients with a 588 nm diode laser at 120 mW and 4 J/cm² for seven days post surgery. They observed a significant decrease in the non-epithelialized surfaces following LLLT, suggesting that besides stimulating collagen production, LLLT might facilitate fibroblast and keratinocyte migration, angiogenesis and growth factor release contributing to decreased inflammation and improved wound healing.

Hypertrophic scars and Keloids can be considered aberrant wound-healing responses. Two recent studies have looked at the physiological mechanism implicating mast cell degranulation following LLLT. Sawasaki et al. and Silveira et al. used histological evaluation of hypertrophic gingival tissues (epulis fissuratum) irradiated with 670 nm AsGaAl laser at 8 J/cm². Both groups observed significantly increased degranulation indexes of mast cells in the irradiated samples than in the non-irradiated controls. This increase of degranulated mast cells and the resultant release of histamine would lead to increased inflammation. While this would seem counterintuitive to the anti-inflammatory effects of LLLT, it is suggested that hastening the inflammatory response by the degranulation of mast cells and, hence, heralding inflammatory resolution could in turn expedite the succeeding wound healing process. The intricate interplay following mast cell degranulation by LLLT on macrophage influx, fibroblast proliferation and collagen synthesis remains to be investigated.16,17

Our clinical study recruited 30 patients scheduled to undergo multiple extractions for complete dentures. Following institutional ethical approval and obtaining informed consent, two sites in each patient were used in our study, each patient acting as his or her own control. Following tooth extraction, one site was irradiated with a 10 mW, 904 nm GaAs laser in
contact for five minutes for a total dose of 3 J/cm². A small soft-tissue biopsy was obtained from the two sites and wound healing parameters, such as inflammatory infiltrate, vascularity, matrix synthesis-organization and TGF-β1 expression, were assessed using routine histopathology and immunostaining.

We observed a better organized healing response in laser-irradiated oral tissues compared to normal tissue. It is significant to note that the laser-accelerated healing did not preclude any normal wound healing phase, demonstrating all the usual phases but which seem to occur at a more rapid pace (Fig. 1). This accelerated laser healing correlated with an increased expression of TGF-β1 immediately post laser irradiation. A major regulatory step in defining the physiological role of TGF-β in vivo is its activation from its naturally secreted latent complex. Various physico-chemical modalities such as heat, extreme pH, proteases and reactive oxygen species (ROS) that all induce a change in the conformation of the latent complex-causing dissociation and, hence, activation of the TGF-β1 dimer. Therefore, the ability to activate the latent TGF-β (LTGF-β1) complex would provide a precise and natural manner of exploiting its role in various biological processes.

The histological analysis from our clinical study suggested that a potential source of LTGF-β1 could be the abundant degranulating platelets from the serum present in the early wound environment that are among a known potent source of in vivo LTGF-β1. We then used a cell-free system with serum and assessment by an isoform-specific ELISA and a reporter-based (p3TP) assay system demonstrated the ability of LLLT to activate the latent TGF-beta complexes in vitro at varying fluorences from 10 seconds (0.1 J/cm²) to 600 seconds (6 J/cm²). We conclude that activation of latent TGF-β1 by LLLT could contribute to the photobiomodulatory effects and promote oral wound healing.18

**Potential mechanisms of LLLT on inflammation and healing**

Despite the increased clinical popularity of LLLT due to its non-invasive, physiological mode of action, lack of information on the precise molecular mechanisms and well-controlled clinical trials have prevented LLLT from being more widely accepted as a routine treatment option. LLLT broadly utilizes wavelengths in the red and near-infrared spectrum to change intra-cellular photoreceptors such as endogenous growth factor complexes, porphyrins, flavins, surface transmembrane receptors and cytochrome c oxidase in the respiratory chain. To broadly categorize these intermediates, we outline a putative hierarchical level of interaction from the literature in the context of LLLT and cell-tissue compartments (Fig. 2).

Our work with a latent growth factor complex, Transforming Growth Factor-β (TGF-β), a multifaceted cytokine, and LLLT has unraveled one such molecular pathway providing an attractive molecular mechanism for photobiomodulation.18 TGF-β plays key roles in biological processes such as development, wound healing and malignancies and has a myriad range of effects based on its spatio-temporal expression on a wide range of cells from epithelial keratinocytes to fibroblasts, endothelial, neural and inflammatory cells. The intricate role of TGF-β on inflammatory cell subsets displays a fascinating dichotomy between its immune-suppresser versus immune surveillance functions and is an ongoing area of intense lab investigation.

Interestingly, although primarily identified as a pro-matrix, fibrosis-promoting wound cytokine, TGF-β transgenic mice have shown a startling variety of healing phenotypes, further indicating its diverse roles in epithelial migration and survival, chemotaxis of monocytes-macrophages and mechanical homeostasis of the matrix milieu.19 The activation of such a multifaceted growth factor by LLLT with its broad effects on various components of the inflammatory healing process could “short-circuit” or “kick-start” the complex cascade of biological events affecting the eventual healing and regenerative outcomes.

Clinically, one of the most attractive features of exploiting this mechanism is the activation of endogenous levels of TGF-β and thus, potentially only gently nudging the natural physiological process along, without a major perturbation of the biological system as seen with addition of exogenous factors.

We speculate that there might be more such latent molecular complexes amenable to low power laser modulation in the inflammatory and early wounding scenarios. Our present research has established that the photophysical and photochemical events can correlate with large magnitudes of laser fluences. In contrast, the photobiological events are tightly limited within a narrower range of laser fluences through an unknown biological regulatory mechanism.

This mechanism, along with potential chromophores, wavelength and fluence parameters affecting the latent TGF-β activation process by LLLT for oral wound healing and other biological applications, are among our present focus of research.

**Conclusions and future challenges**

It might be prudent to point out that irrespective of the precise molecular intermediate being activated, the high-energy laser densities have a deleterious effect in the realm of photodynamic therapy as has been well documented. Akin to the parallels
drawn to the biphasic mode of the Arndt-Schultz therapeutic dose curve, careful use of a therapeutic LLLT dose regimen will be key to its successful clinical use.20

Another significant aspect in this field of research is the attention to standardization. As evident from the studies listed here, we observe a wide variation in laser parameters such as delivery modes, energy density and wavelengths.

Questions about the significance of coherence, collimation, pulsing, optimal time and distance from target tissue remain to be elucidated and must be carefully documented in each study. Finally, the clinical scenario where LLLT is being attempted should be of prime consideration.

The quest for a universal “therapeutic window” (wavelength and fluence) for LLLT is probably a myth and treatment parameters will vary with its application and individual patient scenarios. We strongly feel the attention to these details in future research trials, especially clinical studies, would be the key to establishing stringent and precise therapeutic regimens.

A few of the parameters that we feel are most promising as evident from our own work and the published literature are wavelengths in the red and near-infra-red (800 to 980 nm) and fluences ranging from less than 10 J/cm² with a median at 3 J/cm² while the lower end of this range is yet unclear. The use of a split mouth design, acknowledging the limitation of systemic spillover effects, is probably the best clinical study design as it accounts for the local and regional factors affecting the wound healing process in each patient.

In summary, LLLT offers an attractive, painless and non-invasive therapeutic avenue to modulate inflammation for oral applications. Nevertheless, a great deal of research on the mechanism of LLLT action remains to be investigated in order to optimize it as a routine physician tool.

References

Implant exposure with Er:YAG laser (= 2,940 nm)

Author: Dr. Gerd Volland

Comparing lasers of different wavelengths

The use of lasers in oral surgery is known to have many advantages compared to conventional surgery. Zeredo et al.\(^1\) did prove in a study on incision in rats that the nociception is reduced with a factor of 3 compared to the conventional scalpel use. Surgical cuts with electrotome and scalpel cause a bacterial invasion in treated animals. Kaminer et al.\(^9\) did not find this problem using laser techniques.

Lasers of different wavelengths are proven to reduce bacteria efficiently in different fields of dentistry and medicine.\(^4,5,6,13\) After an initial lag in healing the application of superpulsed carbon dioxide laser light reduced the configuration of scars significantly compared to electrotome and scalpel (Romanos et al.)\(^15\).

Because of these reasons, the healing\(^14,16\) and the bloodless operation field lasers use is more and more common in all fields. Depending on the wavelength, laser light is absorbed, transmitted or scattered very differently depending on the irradiated tissue.\(^2\) Nd:YAG lasers are not proriate in second stage surgery because of the high absorption in metal, especially titanium. They are used for laser melting in dental labs by the technicians.

Whereas diode lasers with 810, 980 or 1,064 nm penetrate uncolored tissue up to 4 mm, carbon dioxide and erbium lasers are absorbed very superficially in a range between 3 (Er:YAG) and 17 µm (carbon dioxide).\(^3\) Chromophores of the skin are oxyhemoglobin, hemoglobin, melanine and carotene.\(^8\) Not only in different ethnical groups we find different coloration of the skin, even in people of central Europe we find different coloration of the oral mucosa and the palate.\(^8\)

Aside the ethnical aspects we find different coloration of the mucosa in different parts of the mouth in the same patient depending on pigmentation, vascularization and percent of fibrous tissue, such as palate or vestibulum. Watching the absorption curves, we find differences with a factor of 10 to 10,000 comparing the absorption coefficient of the different compartments.\(^7\) This causes the problem of

---

Fig. 1. Infrared camera.
Fig. 2. 980 nm 300 µm fiber 5 W cw.
Fig. 3. 980 nm 300 µm fiber 7 W spray.

---

This article qualifies for C.E. credit. To take the C.E. quiz, log on to www.dtstudyclub.com.
unpredictable absorption using diode or Argon lasers in oral surgery.

So the surgeon needs a lot of experience because he has no consistent protocol.

Neither power setting nor velocity of the cut are fixed parameters. Starting with low-power settings may cause long treatment time. High power enables fast cutting but uncontrolled heating because the alteration of the tissue leads to extreme development of temperature increase. Especially for surgeons who start with a laser, it would be perfect to have an instrument with which you can see what you do and does not have a high penetration, as well as a fixed protocol to reach best possible success.

Gutknecht described the way of cutting with fiber diode lasers and gave the name “hot tip” cutting. With this, however, the main danger is the overheating and uncontrolled necrosis especially in fibrous non-colored parts of the mouth, such as the palate or a fibrous frenulum.

Investigation in 2001 at LMTB in Berlin using a spray of distilled water (diode laser 980 nm Ceralas D15, 7 W cw, 300 mm fiber, 10 ml/min. 3 bar air pressure) showed that by water cooling a lot of the heating can be transported away from the “hot tip” by the water flow.

The picture of a thermo camera shows the cooling effect is very good. Nevertheless, we need the hot fiber end for the cut as seen in the picture.

The uncontrolled heating in fibrous tissue causes deep necrosis up to 400 µm cutting mucosa of a pig, which can disturb healing very much (Fig. 3).

In comparison, the cut with 7W and spray shows a clearly defined zone of necrosis of about 200 µm. Nd:YAG lasers (6 W 100 Hz 300 µm fiber) in unpigmented skin of a pig make very uncontrolled carbonization.

The only constant part in oral mucosa is water with about 85 percent.

Because of this, the only lasers that have always the same effect regarding the zone of periphery necrosis in the whole mouth soft tissue are carbon-dioxide and erbium lasers. Especially in Er:YAG lasers, the thermal damage goes down to zero using pulse width of 300 µs because the cut is not thermal but almost completely thermomechanical. Parts of the subsurface water are sublimated within 2 µs.

By this effect, there is almost no thermal damage in this pulse width.

Aside from cavity preparation, the Erbium can also be used for oral surgery. From theory using less power per pulse and using a higher frequency should lead to more thermal effect using the same pulse width.

For the in vitro experiment a laser with pulse width 300 µs, a fiber as light transmission system and special conical sapphire tip 300 µm (Hoya, Versawave) were used.

The exact energy output at the end of the tip could not be asked by the company. So the parameters shown on the display had to be used for definition of energy density and power density.
Material and method

Different frequencies enabling an effective cutting were compared.

Mandibula mucosa of fresh pig that were not cooled after the slaughtering for having always the same amount of water in the mucosa were put in Ringer Solution. After making smaller parts the mucosa on the tongue side including the periost was cut through in contact mode. The average thickness of the mucosa was 1.0 mm.

They were put in 10 percent formaline and examined in Ansbach pathology institute.

The pathologist made histologies using cuts over the length using hematoxyline-eosine colouring. The cuts were examined in a depth of 0.6 mm.

The evaluation was made by using a Zeiss microscope with magnification 5X to 40X with Discus software by Hilgers.

The necrosis with spray was between 17.72 µm at 15 Hz/420 mJ up to 47.54 µm using 40 Hz/125 mJ.

Without spray the lateral necrosis was between 18.9 µm at 15 Hz/420 mJ up to 102.18 µm at 50 Hz/40 mJ.

Discussion

Using a higher frequency in Er:YAG lasers with spray leads to coagulation of a maximum of 47.54 µm. Without using spray, the average necrosis goes up to 102.18 µm.

The higher frequency leads to an almost linear increase of the tissue alteration. This enables the surgeon to work with predictable coagulation results on the tissue.

Kreisler et al.11,12 proved that applying 11.2 J/cm², pulse width 300 µs the titanium surface of implants gets no harm. So damage of the implant/bone interface using available settings can be excluded. For effective laser work in implant exposure and in esthetically critical areas, Er:YAG lasers can be used. There is no risk for loss of tissue by uncontrolled heating with maintenance of reduction of bleeding or even no bleeding.

The bone below the cut is damaged up to 12 µm using the no spray parameters. So it is a safe way also when cutting fibrous tissue, i.e., a wisdom tooth cut eliminating risk of bacteriemoy or cuts on the palate.

More controlled increase of the coagulation area over the measured may be reached by using other parameters with less power per pulse, higher frequency or a higher pulse width.

Indications

Vestibuloplastics, frenectomies, hyperplasia, excisions in the lip red or implant recovery in fibrous regions will be the indications for the Erbium instead of a knife.

The limitation using the Erbium laser in incisions are the regions with vessels. Because of no light penetration bleedings cannot be stopped using this laser. Normally compression should help. This laser should not be used in vessel producing tumors such as hemangioma.

People with hemorrhage diathesis or anticoagulation will have no benefit.

In these people, diode lasers (810, 980, 1.064 nm), Argon (488/514 nm) or long pulsed Nd:YAG lasers are the first choice in treatment.

The aim for the future is to develop an appliance that combines easy and safe cutting of a scalpel with controlled coagulation and all the other benefits of laser like sterilisation of the cut or low-level effects.

Editorial note: The literature list can be requested from the publisher.
Diode lasers for periodontal treatment: The story so far

Authors: Dr. Fay Goldstep and Dr. George Freedman

The concept of using dental lasers for the treatment of periodontal disease elicits very strong reactions from all sides of the spectrum. Everyone has an opinion. Everyone is certain that their own opinion is correct. But the only certainty is confusion, and the lack of clear direction in the concept of laser-assisted periodontal therapy (LAPT).

Much of this uncertainty stems from not comparing "apples to apples," in terms of the type of lasers utilized and the way that studies are designed. Certain lasers are used specifically for soft-tissue treatment. These include the CO2, Nd:YAG and diode lasers. Others can be used for both soft- and hard-tissue applications. These are the Er:YAG and Er, Cr:YSGG lasers. They must be compared within their own category.

Many of these lasers have been shown to provide periodontal treatment benefits. In order to achieve an element of clarity and simplicity on this very complex topic, the following discussion exclusively addresses the use of the diode laser for periodontal treatment.

_A specific instrument_

The diode laser has become an important tool in the dental armamentarium due to its exceptional ease of use and affordability. It also has key advantages with regard to periodontal treatment. The diode laser is well absorbed by melanin, hemoglobin and other chromophores that are present in periodontal disease.

Hence, the diode specifically targets unhealthy gingival tissues. The laser energy is transmitted through a thin fiber that can easily penetrate into deep periodontal pockets to deliver its therapeutic effects.

The 2002 American Academy of Periodontology statement regarding gingival curettage proposes "gingival curettage, by whatever method performed, should be considered a procedure that has no additional benefit to SRP alone in the treatment of chronic periodontitis." Also stated is that all the methods devised for curettage "have the same goal, which is the complete removal of the epithelium" and "none of these alternative methods has a clinical or microbial advantage over the mechanical instrumentation with a curette."

This was the science in 2002. More recent studies have shown that instrumentation of the soft periodontal tissues with a diode laser leads to complete epithelial removal while instrumentation with conventional curettes leaves significant epithelial
I.COI World Congress X X VIII
6~9 October, 2011 | Coex, Seoul, Korea

- Congress Co-Chair: Dong-Seok Sohn (Korea), Carl E. Misch (USA)
- I.COI President: Hom-Lay Wang (USA)
- I.COI Korea President: Chong-Yeon Shin
- Program Chair: Su-Gwan Kim (Korea)
- I.COI Co-Chair: Kenneth W.M. Judy (USA), Carl E. Misch (USA)

Invited Speakers

- Carl Misch (USA)
- Chen Zhuofan (China)
- Douglas Deporter (Canada)
- Erika Benavides (USA)
- Giulio Rasperini (Italy)
- Hom-Lay Wang (USA)
- Hyun Jun Jeon (Korea)
- Jim Yuan Lai (Canada)
- Keith Doonan (Australia)
- Kunihiro Teranishi (Japan)
- Kyeong-An Joe (Korea)
- Kyoo-Sung Cho (Korea)
- Marius Steigmann (Germany)
- Maurice Salama (USA)
- Mitsuhiro Tsukiboshi (Japan)
- Mohammad Ketabi (Iran)
- Myron Nevins (USA)
- Myung-Jin Kim (Korea)
- Pablo Galindo-Moreno (Spain)
- Scott Ganz (USA)
- Shih-Chang Tweng (Taiwan)
- Shiotaka Makoto (Japan)
- Stephen Chu (USA)
- Tae-ju Oh (Korea)
- Trakol Mekayarajjananonth (Thailand)
- Tulio Valcanaia (Brazil)
- William Giannobile (USA)
- Yoshiharu Hayashi (Japan)

* partial list of speakers

GEOIN C&I
DENTIS
Bio-TIS
An effective instrument

Bactericidal

Periodontal disease is a chronic inflammatory disease caused by a bacterial infection. Hence the bactericidal and detoxifying effect of laser treatment is advantageous in periodontal therapy. The diode laser’s bactericidal effectiveness has been well-documented. Moreover, there is a significant suppression of A. Actinomyctecomitans, an invasive bacterium that is associated with aggressive forms of periodontal disease that are not readily treated with conventional scaling and root planing (SRP). A. Actinomyctecomitans is not only present on the diseased root surface, but it also invades the adjacent soft tissues, making it difficult to remove by mechanical periodontal instrumentation alone. This necessitates the use of adjunctive antibiotic therapy.

The diode laser provides a non-antibiotic solution. A. Actinomyctecomitans has also been found in atherosclerotic plaques, and there has been evidence to suggest that subgingival A. Actinomyctecomitans may be related to coronary heart disease. This makes it even more compelling to seek methods to control this aggressive pathogen.

Wound healing

Diode lasers are very effective for soft-tissue applications including incision, hemostasis and coagulation. Many advantages of the laser vs. the scalpel blade have been discussed in the literature. These include a bloodless operating field, minimal swelling and scarring, and much less or no postsurgical pain. When laser surgical procedures are carried out, the surface produced heals favorably as an open wound, without the need for sutures or surgical dressings. Studies have shown enhanced, faster and more comfortable wound healing when the diode laser is used in conjunction with scaling and root planing (SRP).

An adjunct to scaling and root planing (SRP)

There is very compelling evidence in the dental literature that the addition of diode laser treatment to SRP (the gold standard in non surgical periodontal treatment) will produce significantly improved results. After SRP, the diode laser is used on the soft tissue side of the periodontal pocket to remove the inflamed soft tissue and reduce the pathogens. Research has demonstrated better removal of the pocket epithelium compared with conventional techniques. Many studies have shown increased reduction of bacteria (especially specific periodopathogens) when diode lasers are utilized after SRP. Significant improvement in decontamination and effective treatment of peri-implantitis also occurs with the addition of diode laser therapy.

Gingival health parameters are significantly improved with the addition of the diode laser to SRP. Studies have shown decreased gingival bleeding, decreased inflammation and pocket depth, as well as decreased tooth mobility and decreased clinical attachment loss. This improvement in gingival health remains more stable than with conventional SRP treatment alone and tends to last longer. Moreover, patient comfort is significantly enhanced during the post operative healing phase, with the addition of diode laser therapy.

The research thus shows diode laser periodontal treatment to be an effective procedure. It is also a minimally invasive procedure. Patients are demanding less surgery and the diode laser provides the general dentist with an excellent means of keeping periodontal treatment in the general practice.

A safe instrument

Histological testing of roots where the diode laser was used after SRP demonstrated no detectable surface alteration to root or cementum. There were no signs of thermal side effects in any of the teeth treated. Many studies have specifically indicated no adverse tissue events, demonstrating the safety of the diode laser.

The diode laser’s very effective bactericidal action on periodontal pathogens makes the adjunctive use
of antibiotics unnecessary.\textsuperscript{10} This eliminates the problem of bacterial resistance and systemic side effects engendered by antibiotic use.\textsuperscript{6} The laser is a safer, more effective treatment.

The protocol so far

The above cited research has demonstrated that the use of the diode laser after conventional scaling and root planing (SRP) is superior to SRP alone. Various protocols have been developed by clinicians to incorporate this treatment into the busy dental practice.

These protocols may be performed by the dentist and/or the hygienist as determined by the regulating organization in the geographic location of the dental practice.

Individual parameters vary depending on the clinician and the particular diode laser that is being used. However, most protocols do follow a simple formula. The hard side of the pocket (tooth and root surface) is first debrided with ultrasonic scalers and hand instrumentation (Fig. 1).

This is followed by laser bacterial reduction and coagulation of the soft tissue (epithelial) side of the pocket\textsuperscript{1} (Figs. 2 and 3).

The laser fiber is measured to a distance of 1 mm short of the pocket depth. The fiber is used in light contact with a sweeping action that covers the entire epithelial lining, from the base of the pocket upward.\textsuperscript{24} The fiber tip is cleaned often with a damp gauze to prevent the build up of debris.

Re-probing of treated sites should not be attempted for three months post operatively (Fig. 4), because healing starts at the base of the pocket and the new tissue remains fragile for this period of time.\textsuperscript{1}

The power settings and time parameters are determined by the particular laser used. The diode laser clinician must take training on the specific laser in the practice to be fully able to implement LAPT. With experience, the user will feel comfortable enough to adapt the protocol to his or her particular practice.

In the future, protocols will be modified and fine-tuned by various laser user groups after discussion of their experiences and results. These results will be incorporated into new procedures which will bring LAPT to a newer, more effective level.

The time has come

The time has come to embrace the routine use of lasers for the treatment of periodontal disease. The diode laser has been shown to be effective and safe for this purpose. If not now, when?

Patients need treatment. LAPT is non-invasive. With the diode laser there is a reduced need for systemic or locally applied antimicrobials. This leads to fewer allergic reactions and antibiotic resistance.

There is significant proof that the addition of LAPT to conventional scaling and root planing improves outcomes. This is particularly compelling when considering the periodontal health/systemic health link. It is time to open our minds to laser technology and apply the treatment that is in the best interest of our patients.

Editorial note: The literature list can be requested from the publisher.

---

**About the Authors**

**Dr. Fay Goldstep** sits on the Oral Health Editorial Board (healing/preventive dentistry), has served on the teaching faculties of the post-graduate programs in esthetic dentistry at SUNY Buffalo, the University of Florida (Gainesville) and the University of Minnesota (Minneapolis), and is a former ADA Seminar Series featured speaker. Goldstep is a consultant to a number of dental companies, and she maintains a private practice in Markham, Ontario, Canada. She can be reached at goldstep@epdot.com.

**Dr. George Freedman** is a past president of the American Academy of Cosmetic Dentistry. He has authored or co-authored 11 textbooks, 400 dental articles, and numerous CDs, videos and audiotapes. He is a co-founder of the Canadian Academy for Esthetic Dentistry and a Diplomate of the American Board of Aesthetic Dentistry. He lectures internationally on dental aesthetics, dental technology and photography. A graduate of McGill University in Montreal, he maintains a private practice limited to esthetic dentistry in Toronto, Canada. He can be reached at epdot@rogers.com
The use of lasers in periodontal treatment

Author: Howard Golan, DDS, JD, MWCLI

There are some dentists who embrace technology. Technology can improve the delivery of dentistry and also help traditional dental philosophies evolve. For example, a patient presents with an emergency: a broken cusp on an upper bicuspid, below the free gingival margin. Technology, lasers and CAD/CAM specifically allows the clinician to provide endodontics, osseous crown lengthening, an adhesive core buildup and a definitive porcelain restoration all in a single appointment.

The advantages to this type of treatment are obvious. However, the dentist must be willing to alter his/her current dental philosophy and, many times, make an initial financial investment that is larger than what the clinician is used to. The traditional way to provide treatment such as endodontics is in one to two visits. A post and core, an elastomeric impression, provisional restoration, referral to a specialist, surgical healing time and then definitive cementation of the restoration currently is a valid and overwhelmingly used treatment sequence.

Sometimes, however, newer technology can perform these tasks just as well if not better than traditional methods, all the while improving the dental experience for the patient. Lasers have been used in dentistry for the removal of soft tissue for more than two decades. Carbon dioxide, Nd:YAG and diode lasers have been very predictable and successful for the removal of oral soft tissue. In the past decade, the erbium lasers have been used for soft tissue and for restorative, endodontic and surgical procedures.

Erbium lasers are efficient in removing enamel, dentin and bone. However, the past five years have seen a tremendous push by the laser manufacturers for the lowest cost and most portable diode lasers. Due to their more approachable price point, and an increasing number of U.S. jurisdictions allowing hygienists to use these tools, the diode lasers have had sort of a renaissance.

One of the most impacted areas of laser use in a general practice has been in the area of periodontal treatment. The treatment of periodontal disease is often a difficult arena for the general dentist to enter. As a chronic disease that so often relies on the host response for success, true treatment success is often never seen.

Often the general dentist chooses not to treat periodontal disease, referring patients to a specialist. As will be shown in subsequent paragraphs, this modality many times results in the patients never getting treated at all.

Lasers have allowed me to treat many different periodontal cases. It has introduced patients to periodontal treatment in a minimally invasive way, ensuring that almost all patients diagnosed with periodontal disease get treatment. Lasers have al-
AAID 60th Annual Meeting
REALITIES OF IMPLANT DENTISTRY
STACKING THE DECK IN YOUR FAVOR

AMERICAN ACADEMY OF IMPLANT DENTISTRY  
OCTOBER 19-22, 2011

LAS VEGAS

www.aaid.com
user report: periodontal treatment

followed me to increase the services that I provide in my practice by adding periodontal procedures that would have not been done before the integration of laser technology.

Finally, introducing more and more patients to periodontal treatment has increased my referrals to periodontal specialists.

_The controversy: Science vs. clinical results_

I have always been an advocate of evidenced-based dentistry. I rely on the results of science more than ever before. From endodontics to adhesive dentistry, scientific evidence is important in formulating my treatment decisions and protocols.

Periodontal disease has and continues to be researched heavily. The systemic impact of periodontal disease is being uncovered and understood each day. The periodontal community aims to base its treatment decisions on the science. However, there is no absolute cure for periodontal disease. It is a complicated, often chronic multi-factorial disease process. Bacteria are just one factor. However, one must also look at patient compliance, environmental factors including the patient’s restorative history, and systemic issues. Thus, it is essential that clinicians in evaluating and treatment planning a patient for periodontal disease look at a wide spectrum of factors, many of which might conflict with the scientific literature.

Lasers have been controversial because of the claims of the manufacturers that are not solidly backed up by science. There is no question that the lack of multi-center, double blind and randomized trials inhibits the ability of lasers to gain widespread acceptance in the periodontal community. However, many times each and every day practitioners, general and specialists alike, practice dentistry based on anecdotal evidence. Relying on their own successes and failures to treat their patients.

If we as clinicians only practice what and how science tells us to practice, then we are many times doing a disservice to the patient. Dentistry is both a science and an art, and the individual judgment of the clinician is often as important as a published research article. Thus, we can use lasers and the science that is available as just one battalion in a large army in the fight against periodontal disease.

Lasers provide advantages that traditional therapies do not. When used properly, laser therapy is a big weapon in this fight.

_What do lasers have to offer?_

Lasers (Light Amplification by Stimulated Emission of Radiation) use light energy to have a clinical effect of oral tissue. This light energy can be con-
I 23 laser
_2011

user report
periodontal treatment

verted to heat and that heat is used to remove tissue and destroy bacteria. However, heat can have negative effects on tissue. Hard tissue burning or melting and possible soft tissue necrosis must be avoided or at least minimized.

Other lasers use the potential energy of light and convert it to kinetic energy with another substance (e.g., water) to remove or ablate tissue. This allows the effective and efficient removal of infected epithelium and granulation tissue without the necrotic effects of heat. This provides less post-operative issues, such as swelling and pain.

Lasers are also effective in removing hard tissue, including bone and calculus. In fact, the U.S. Food and Drug Administration has approved a laser for calculus removal. Furthermore, because of the ability to collimate and bend light, lasers can access areas such as furcation and root anatomy that even surgical access with curettes and ultrasonics could not.

Thus, many procedures that were once absolute surgical cases can be treated non-surgically. The treatment of periodontal disease requires the proliferation of some cells while excluding other cells. To get re-attachment and regeneration, epithelial cells need to stay away from the healing site while fibroblasts and odontoblasts should be encouraged to enter. Lasers have the ability to assist in both areas.

For exclusion, lasers can de-epithelialize the area, by removing the epithelium to the connective tissue, both on the internal pocket wall and the external pocket wall. The fast-growing epithelium is retarded to allow the slower moving fibroblasts and osteoblasts to do their work.

For proliferation and migration, lasers, when introduced to the oral tissue at power levels too low to cut, have actually been shown to increase the proliferation and migration of the osteoblasts and fibroblasts. This is called photo-biomodulation or low-level laser therapy (LLLT). The use of LLLT is ever expanding in medicine and dentistry. In dentistry, LLLT is used for pain relief, such as TMD and wound healing and to control inflammation, which is essential for the successful treatment of periodontal disease.

Finally, the LLLT allows patients to heal from laser procedures faster and with fewer incidents by supporting the wound healing response and suppressing the inflammatory response.

Laser assisted periodontal therapy: Clinical situations

**Treat general/refer specific**

One of the biggest challenges in a general practice is getting patients to actually go to a periodontist once referred. Patients are consistently referred but many times never follow through. If their condition goes untreated, it affects their health, their mouth and does not allow me to go forward with other treatment, such as prosthetics.

Patients are more likely to follow through with treatment when it can be all accomplished within the general office. Often periodontal disease is not acutely painful, and thus patients will prolong the treatment until there is an acute problem. A less expressed but as significant of a reason for patient not to go to the specialist is fear. Periodontal surgery does not have a great reputation, irrespective of the ability of the clinician.

Patients hear stories of pain, swelling, bleeding and sensitivity. The last thing clinicians want are patients not having treatment because of fear. However, when sent to specialists for specific procedures on a finite number of periodontal sites, the patient is more likely to seek treatment.

Specifically, we have seen that a patient who is referred for the treatment of tooth #14 (maxillary left first molar) does not hesitate to go for treatment compared to a patient who is sent to that very same referral for the upper left quadrant.

Therefore, our philosophy is to treat as much of the disease process in the general practice non-surgically, then upon re-evaluation send only the non-responsive areas to the periodontal specialist for surgical intervention. Introducing a laser into the non-surgical equation provides the patient with a minimally invasive, non-surgical option. The laser
provides something different, something new that most patients are not familiar with.

Scaling, therefore, is not the primary therapy but an adjunct to laser therapy. Thus, the patient realizes that surgery will only be done after all non-surgical options are exhausted and that those treatments will not be painful and there is no reason to fear "gum" treatment.

When surgical intervention is recommended, the patient understands the efforts made and that surgery must be accomplished in a localized area, minimizing the potential uncomfortable post-operative consequences. With this philosophy, we have seen a three-fold increase in the number of patients referred to the periodontist who actually have the treatment completed within a reasonable time of referral. This is compared to referrals before lasers were introduced into the practice.

Site-specific treatment — the recall patient

When a minimally invasive procedure is available to patients, it takes much less effort to educate a patient and get the patient to accept treatment.

When a laser is placed inside the hygiene treatment room, a recall patient with an isolated periodontal pocket can be treated at the time of recall. In many jurisdictions in the United States, hygienists can use lasers for periodontal treatment.

This allows the dentist to diagnose the condition on examination, instruct the hygienist what to do and leave the room and return to treating his own patients. Thus, a patient can not only have his or her cleaning and checkup but also take care of a dental issue without having to return until the next recall. Even in those states that do not allow a hygienist to use a laser (such as the author's), the laser in the hygiene room still allows for this but the dentist does the treatment with the laser.

Moreover, site-specific treatment adds a new dimension to the treatment spectrum. Instead of just a scaling and root planing procedure, the dentist can perform, and thus bill, a profitable and more definitive treatment with a laser. Figs. 1 and 2 illustrate a patient on a recall visit who exhibited a 5 mm pocket on the mesial of maxillary left first molar. Laser assisted site specific treatment was performed in the hygiene room with a Er, Cr:YSGG laser (Waterlase MD, Biolase Technology, Irvine, Calif.) and a 940 diode laser (EZlase, Biolase Technology). The perio charting shows initial and three- and six-month recall probing depths.

Management of the hopeless periodontal patient

Many times a patient presents to the office with the following history: Patient has a history of periodontal disease with significant bone loss and periodontal pocketing.

The patient had four quadrants of periodontal surgery to treat this condition many years ago. Upon examination, the periodontal pocketing is still present or has returned and the clinician recommends periodontal surgery again. However, the patient tells you that he or she will "never go through that again." The patient had a bad experience with surgical intervention and will not entertain the idea of referral to a periodontist. Thus, the patient never has the treatment recommended.

Furthermore, there are patients where through everyone's best efforts the treatment is never successful. These patients are referred to as "refractory" cases. These patients are particularly difficult, since they have spent much money and time and do not see results. Many times they need significant extractions and implants, but at the present time refuse this treatment due to financial or emotional obstacles. Every dental practice has these patients.

Laser therapy provides an opportunity to manage, stabilize or treat these patients at reasonable cost and minimal intervention compared to surgical therapy or extractions.

Refractory cases will not be "cured" with laser therapy, but if we can stabilize the disease process then we provide an invaluable service to the patient. Laser treatment might occur every recall visit or with
increased frequency depending on the extent of the disease process.

Often we can maintain a patient with his or her own teeth longer than originally thought. This is an area of laser dentistry that was unexpected but has become one of the most rewarding. The images shown illustrate a typical hopeless case. Patient is 48 years old with a long history of periodontal treatment, including numerous SC/RP visits and surgery.

The patient’s hopeless maxillary anterior was restored with implants. The lower arch was treated with laser therapy and scaling. Though there is no evidence of regeneration, the change in the marginal bone is evident three years later. This patient is now five years post treatment with stable periodontal tissues (Figs. 3 and 4). Patient was compliant with three months recall.

Prosthetic replacement: Marriage of technologies

Patients with crown and bridge often present with periodontal pocketing and inflammation. Often, the prosthetics either invade biologic width or the crowns are under-contoured below the gingival margin.

Treatment of this situation would include replacement of the crowns and treatment of the soft tissue. If there is biologic width invasion, then a crown lengthening procedure is needed to adjust the height of the alveolar bone.

This condition is often caused by the fundamental need of mechanical retention of the crowns. Due to caries, fracture and short clinical crown heights, the crown preparation needs to be placed significantly under the free gingival margin in order for the crown to stay on.

Technological advances in ceramics and adhesion allow for posterior restorations to be adhesively bonded to the tooth allowing for equi- and supragingival restorations.

These restorations coupled with laser therapy can resolve a periodontal pocket within weeks without surgery and more trauma to the root surfaces. If biological with correction is needed, then the use of a laser to incise the attachment and remove the bone can often be accomplished without flap reflection.

This minimizes post-operative pain, swelling and leads to more patient acceptance and profitable treatment for the dental practice. Figs. 4–9 illustrate pocketing and inflammation associated with crowns on the maxillary left first and second molars.

The crowns were removed and laser assisted periodontal debridement and curettage was performed. Fig. 7 shows 14-day healing prior to cementation. Figs. 8a and 8b are the adhesively bonded ceramic crowns (eMAX, Ivoclar Vivadent, Amherst, N.Y.). Fig. 9 shows the initial and three-month recall periodontal charting.

This article is designed to introduce the dental community to lasers and their use in periodontal treatment in a general dental practice. The use of lasers does not eliminate the need for surgery, and especially the wonderful work of periodontal specialists.

However, when a philosophy of minimally invasive treatment is employed, then patient and dentist work together to help the patient accomplish his or her periodontal treatment goals. There will be an increase in periodontal treatment plan acceptance and an increase in periodontal referrals that actually result in treatment._

Howard Golan, DDS, JD, MWCLI

369 Old Courthouse Road
New Hyde Park, NY 11040
E-mail: hsgolan@optonline.net
Web: www.enamelrules.com
Diode laser surface decontamination in periodontitis therapy

Author: Dr. Georg Bach

15 years of incorporating _We don’t always have the opportunity to provide long-term dental treatment for patients with a profound marginal parodontopathy who have undergone resective surgical therapy, at times including reconstructive work. Correspondingly, there is only a limited amount of literature available due to the aforementioned fact. The number of published studies/other publications is even more limited as regards new therapy concepts or adjuvant treatments to complement a proven therapy regimen. In 1995, the first diode laser (wavelength 810 nm) was presented at IDS in Cologne. This device — initially as a prototype — had been used within the scope of a test phase since 1994. At the end of 1994 patients were treated with this “new” laser wavelength for the first time, which had not been used in dentistry up until that time. The Freiburg laser work group led by Krekeler and Bach, who were the first ones to deal with the integration of diode laser light in dentistry, noticed the considerable advantages of this new technology.

High-performance diode lasers emit monochromatic coherent light at a wavelength of 810 nm. This light is absorbed particularly well by dark surfaces. Thus the injection laser (diode laser) is ideally suited to perform cuts, as are common in dental surgery,

CASE 1

_Fig. 1_ Panoramic tomography (emergency service) dating back to 1995 — immediately prior to commencement of treatment.

_Figs. 2-4_ Baseline findings in 1995.

_Figs. 5a, 5b_ Tooth 37 was not conservable in spite of hemisection (August 1995), resulting in a large edentulous space in the third quadrant (November 1995).
as well as for the removal of benign tumors in the oral cavity, for exposing implants and for use in mucogingival surgery. This excellent cutting performance of the diode laser can be attributed to the exceptional absorption of the laser light by the hemoglobin in the tissue. Aside from an application in soft-tissue surgery, the diode laser is also used for decontaminating surfaces that are colonized by germs (on implants and teeth). It was proven in these applications that especially a gram-negative, anaerobic germ spectrum is sufficiently damaged by the laser light.

The following article describes — by means of three selected patient cases — our “Freiburg” experience of incorporating laser light decontamination in the therapy of marginal periodontopathies.

Material and methodology

We are presenting treatment results for three patients who received dental treatment over a period of 15 years (December 1994 to April 2010). Initially, these three patients suffered from a profound periodontopathy with inadequate degeneration of supportive tissue. The course of treatment for these three patients proceeded according to the following regimen:

1. Initial therapy (December 1994 through January 1995)
   - Motivation and instruction of the patient
   - Cleaning and polishing
   - Application of disinfecting agents

2. Resective phase (January and/or February 1995)
   - Creation of a mucoperiosteal flap
   - Removal of granulation tissue
   - Decontamination with diode laser light (p = 1.0 Watt; tmax = 20 sec)
   - Apical shifting of soft tissue

3. Reconstructive phase (January and/or February 1995)
   - Bone augmentation, if required
   - Mucogingival corrections, if required

4. Recall phase (May 1995 to present)
   - After four weeks, six months, one year and then annually: complete survey of clinical evidence, X-ray diagnosis, repeated decontamination with diode laser light of exposed root areas, if required.

Imaging procedures

As a general rule, the orthopantomogram (panoramic tomography) and in special cases as a supplementary measure dental film images as a parallel technique were the applied imaging procedures. A-scan and B-scan ultrasonography was also used in a few cases of exacerbated inflammations. An orthopantomogram was taken preoperatively and immediately post-operatively, and a panoramic tomography every three years thereafter.

The distinct advantage of an orthopantomogram is its panoramic view of all teeth, the osseous limbus alveolaris and important adjacent anatomic structures. By comparison, dental film images as a parallel technique provide information about the progression and stagnancy of the issue degeneration, because they enable statements about the behavior of the limbus alveolaris.

Microbial diagnostics

At the time of diagnostic radiology (see above),
germ extractions of the affected areas were also performed. This was not done by way of the conventional microbial examination technique (germ extraction — cultivation — pure cultures — microscopic specimen — gas chromatography — sensitivity to antibiotics and color test strips); instead, DNA-RNA hybridization tubes were used.

The advantage of these hybridization tubes was that no live material from the probed areas was required for cultivation, thus reducing work in the dental practice. In addition, the results were available much faster than with the classic microbial examination. The disadvantage of these rapid tests is a relatively high price and the fact that the employed product only detects special marker germs so that not all microbial organisms in the sulcus can be identified.

The area where a germ extraction was planned had to be carefully dried with a cotton swab. The paper tip was then put in place and, after an exposure time of 10 seconds, was immediately packaged in a sterile container and forwarded to the manufacturer for germ identification. The manufacturer identified the germs and evaluated the so-called marker germ values.

The result was considered negative if less than 0.1 percent was identified as a marker germ. The result was considered to be low if 0.1 to 0.99 percent was identified as a marker germ. The result was considered to be medium if 1.0 to 9.9 percent was identified as marker germ and high if more than 10 percent was identified as marker germ.

Laser light decontamination

Decontamination was an essential part of the overall therapy.

It was achieved with diode laser light of 810 nm wavelength, 1 watt of power and an application time of 20 seconds per tooth and implant under fiber contact in continuous wave mode. When adhering to these parameters (time limitation and power limitation) it can be guaranteed that the germ spectrum causing the disease can be sufficiently damaged and at the same time that pulpa and/or peri-implant or periodontal tissue structures do not suffer any thermal damage (Bach and Krekeler [1994]).

Three patient cases: 1995 to 2010

Three patients are presented from the original patient group of the "diode laser basic study" (25 patients) from 1995 (Krekeler/Bach, Department of Parodontal Surgery of the University Dental Clinic, Freiburg/Breisgau) who showed "typical progression patterns" and whose treatment illustrates the advantage of integrating diode laser light application into a proven therapy regimen for the treatment of marginal parodontopathies.

First Case (Figs. 1–14)

The holding therapy case

Female patient, born in 1954.

Medical history

The patient went to the Sunday emergency service at the Freiburg dental clinic because of pain in tooth 37. A profound parodontopathy was diagnosed there, and the patient came to our department on the following Monday requesting treatment. She had received a complete fixed restoration from her dentist six months prior, but without a preprosthetic X-ray diagnosis. Ms. D. is a healthy and very health-conscious physiotherapist.

Clinical baseline findings (1995)

Abutment tooth 17 showed a degree of loosening of 2, as did tooth 26 and tooth 45. Mesial probing resulted in profuse, hard-to-arrest bleeding. BOP and high probing depths were found in general. The interdental spaces had soft deposits, also under the pontics.

X-ray diagnosis (1995)

The panoramic tomography (orthopantomogram) shows severe horizontal and vertical bone lesions. Teeth 35 and 26 have dish-shaped defects. Trifurcation 34 is opened radiologically.
MONTRÉAL CANADA

CANADA’S LARGEST ANNUAL SCIENTIFIC AND DENTAL EXHIBITION

MAY 25TH to 29TH 2012
Palais des congrès de Montréal

FEATURING

- Over 95 scientific sessions in English and in French presented by top clinicians from around the world
- Over 240 exhibitors occupying more than 500 booths representing Canada’s largest dental trade event
- Hands-on workshops and seminars covering all aspects of dentistry
- All scientific sessions and access to the exhibit floor included in one low registration fee
- CERP approved continuing dental education credits for all sessions
- Dental Tribune Study Club C.E. Symposia featuring leading experts lecturing in various dental specialties

FOR MORE INFORMATION, PLEASE CONTACT:

Journées dentaires internationales du Québec
625, boul. René-Lévesque Ouest, 15e étage, Montréal, QC. H3B 1R2
Tel.: 514 875-8511 • Fax: 514 875-1561
E-mail: congres@odq.qc.ca • Website: www.odq.qc.ca

ANNUAL CONVENTION
ORDRE DES DENTISTES DU QUÉBEC
AN ADA CERP RECOGNIZED PROVIDER

PLEASE SEND ME MORE INFORMATION

Name ____________________________
Address ____________________________
City __________________ State ______
Zip Code, Country __________ Telephone ________ E-mail ________
CASE 2

Fig. 15. Panoramic tomography dating back to 1994 — prior to commencement of treatment.

Fig. 16. Initial X-ray image taken in 1995.


Fig. 20. Four-year follow-up 1999.

Fig. 21. Panoramic tomography taken in 2004; dental implants were inserted to increase the number of abutment teeth.

Diagnosis
Most severe form of adult marginal periodontitis having portions with a fast-course component.

Course of treatment: 1995 to 2010
Tooth 37 was extracted within the scope of initial pain treatment, as were teeth 26, 17 and 35. Removable immediate prostheses were incorporated because all three pontic reconstructions had to be destroyed during the extraction therapy. The pre-treatment phase proved to be unproblematic; the patient was very motivated and eager to learn the oral hygiene techniques as instructed.

From June to August 1995 the remaining teeth were treated with open curettage. She had no recurrence for a long time. She received implants in the third quadrant while the remaining maxillary side teeth received fixed prostheses. The edentulous space in the second quadrant remained at the patient’s request; in the first quadrant, the principle of a shortened row of teeth was realized (up to 5’ to 5th).

This condition was maintained from the end of 1996 to 2008. The patient conscientiously observed all recall appointments. Aside from the usual cleaning, motivation and instruction steps, a diode laser light application was always performed. Special emphasis was placed on the periodontally severely damaged premolars and the remaining molar 27.

First re-inflammations of the marginal periodontopathy were noticed in 2009; a curettage of teeth 14, 15 and 27 was performed once again. Due to subliminal but latent discomfort, teeth 15, 14 and 27 were removed at the beginning of 2010 and a new concept for treatment of the maxilla was developed.

A removable telescopic prosthesis (cusps are abutment teeth) was incorporated. The prosthesis on the mandible, which has been in place for 15 years, is still there, and there are no signs of a degeneration of the supportive tissue on the natural and artificial abutment teeth.

Epicrisis
Very remarkable in this patient was the considerable amount of trust she had — in spite of bad experiences in the past — in the new laser-assisted therapy concept, which was out of the ordinary at the time. Her compliance was exceptionally good for the entire 15 years. Because of her conscientious oral hygiene and strict adherence to the recall system, she remained recurrence-free for more than a decade. This still holds true for the mandible, while the antecedent massive degeneration of supportive tissue required the removal of three maxillary teeth. Thanks to the diode laser assisted periodontal therapy and the continuous recall, the patient was able to retain the majority of her teeth in the maxilla and the fixed prostheses for a longer period of time.
It was only recently that this concept in the maxilla had to be modified in favor of a removable one; however, this occurred 15 years after a similar suggestion (removable prosthesis) had been made by her attending dentist at the time.

**Second Case (Figs. 15–24)**

Success due to (laser-assisted) recall case

Male patient, born in 1938.

**Medical history**

This patient had been treated since childhood by a dentist who passed away in 1991. For some time the patient had been complaining of toothaches and bleeding of the gums, the latter also occurring spontaneously.

He consulted the successor of his former dentist at the dental practice. However, this dentist did not pay much attention to his descriptions (discomfort) and only remarked once that “there is nothing that can be done!” The patient had obtained the last OPG that had been taken and brought it to the initial examination at our clinic, but he refused (three months later at our clinic) a new X-ray diagnosis, stating that he was completely healthy.

**Clinical baseline findings in 1995**

Teeth 27 and 37, 38 showed a degree of loosening of I–II. The side teeth showed high probing depths, and a BOP was detected in general. The front mandible was found to be without irritation. The interdental spaces had soft deposits. There were edentulous spaces 16, 25, 26, 27, 45, 46, 35, 36.

**X-ray diagnosis (1995)**

The panoramic tomography (orthopantomogram) shows an adult dentition with general horizontal bone loss and profound vertical bone lesions on the following teeth: 17, 24, 27, 47 and 48. The patient had received primarily cast restorations. Tooth 24 shows two apical radiopaque structures on the root apex and a discrete periapical translucent zone.

**Diagnosis**

Adult marginal periodontitis.

**Course of treatment: 1995 to 2010**

The entire pre-treatment phase proved to be without complication due to the patient’s initially high compliance. The teeth of the maxilla and the mandible were treated with a mixed open (side-tooth area) and closed (front-tooth area) curettement in the subsequent surgical phase. The surgical part of the periodontal treatment was completed in April 1995. Since then the patient has been in the recall system, which he took very seriously initially and which helped him to remain recurrence-free for four years after the surgical treatment. From 1999 to 2003 the recall started to become difficult because the patient did not show up in spite of appointments or rescheduled appointments on short notice.

At the beginning of 2003 increased probing depth were found on 23, 24 and 27 and three additional teeth exhibited bleeding when probed. Another curettement with laser light decontamination resulted in a decrease of the inflammation; however, 27 could not be saved and had to be extracted, as did tooth 24 (condition after root apex resection), which fractured subgingivally. The resulting free-end situation starting with tooth 23 in the left half of the maxilla and the existing edentulous space in the right half of the maxilla, which had been there for a longer period of time, were treated with three implants that received crowns after a three-month osseointegration period. We arranged with the patient that he should participate in a quarterly recall and make a new appointment upon completion of the respective recall. He has been recurrence-free since then.

The X-ray images showed a marked tendency for reduction of the osseous supportive tissue on tooth 24. (Note: This tooth was also extracted.) None of the other teeth showed any substantial changes in the course of the osseous limbus alveolaris. The implants also did not show any changes of the perimplant osseous condition from insertion up to the present day.
Epicrisis

Our prognosis after removal of the non-conservable teeth and the systematic increase of abutment teeth is very favorable. The patient’s compliance — after variations in the medium observation period — is stable and good. The long recurrence-free interval is also very gratifying.

_3rd Case (Figs. 25–34)_

The “completely delightful long-term patient”
Male patient, born in 1952.

Medical history
This patient had been with the same dentist for many years, whom he consulted for checkups on a regular basis. The patient was surprised to find that his teeth 12 and 11 were “loose” and had to be extracted. He was then referred to our clinic. The patient was quite obviously unhappy with the loss of two teeth and the referral (“I feel pushed off”). He is a physical education teacher at a high school and stated that he was completely healthy.

Clinical baseline findings (1995)
Almost all teeth revealed increased probing depths, and probing on the gums in the side-tooth area resulted in bleeding. The smooth surface cleaning was very good; however, deposits were found in the interdental spaces. The dental necks of the maxillary premolars showed wedge-shaped defects. The patient had received primarily cast restorations.

X-ray diagnosis (1995)
In the maxilla, the osseous limbus alveolaris has a considerably reduced level. The alveolar ridge in the area of the tooth gap 12, 11 is severely atrophied. Bone mass in the mandible is also reduced, although not as extensively as in the maxilla. Tooth 45 had received a root canal treatment. The crown edges of the cast restorations do not align perfectly with the contour of the teeth and mostly have an overhanging design.

Diagnosis
Severe adult marginal periodontitis.

Course of treatment: 1995 to present
Our most difficult task initially was to appease the patient’s dissatisfaction because he felt he “had been taken for a ride.” After we had successfully done that, the patient eagerly followed our instructions and followed a frequent and sufficient oral hygiene regime. He grew especially fond of interdental cleaning, which had never been mentioned to him before. In May 1995 we started the corrective phase, which was completed in July. We carried out lobe surgery with apical soft tissue fixation in all quadrants. The patient received two implants in regions 12, 11 and, after their osseointegration, two blocked crowns.

Due to the severe bone degeneration and the patient’s wish to forego augmentation, we arrived far below the cement-enamel junction of the adjacent teeth in one oral implant; however, this did not pose a problem due to the patient’s extremely deep-set upper lip. The patient has been in our recall system for 15 years now; he has not missed one recall appointment and has been recurrence-free ever since. A successive prosthetic re-treatment of some single (component) crowns, which had become insufficient, was carried out over the course of several years.

Epicrisis
I feel that — on the “credit side” — we have the
Patient’s excellent cooperation, which has not diminished to this day, and the long recurrence-free period. In this context, one should not forget the extent of the previous periodontitis. These aspects leave a very satisfying impression.

Discussion

The diode laser decontamination study (Krekeler/Bach; University Dental Clinic, Freiburg/Breisgau) that started in 1994 and 1995 was made up of 25 patients, of which seven are still receiving treatment. The extremely long examination period (15 years) naturally limited the number of patients we could examine and treat. Some of the patients, who are no longer in our recall system, have unfortunately passed away in the meantime, while others have moved away or found a different dentist who is located closer to their new residence (usually a care home).

Over the years, three “patient types” have emerged — the “holding therapy” type, the “imperative recall type to avoid being the unsuccessful type” and the “successful type.” The purpose of this paper is to present these three types by way of individual examples. Diode laser light decontamination proved to be very helpful in all examined patients — I feel that, based on the current results, this assessment is justified because the incorporation of diode laser decontamination into the proven treatment regimen for periodontitis resulted in a considerable reduction of the recurrence rate and a considerable improvement of the prognosis of this disease.

An evaluation of the significance of the laser treatment, which has been established as an integral part of a proven therapy regimen in our treatment philosophy, is certainly worthy of discussion. Laser critics will want to argue that a close-meshed and consistent recall, possibly supported by other adjuvant measures, would have yielded similarly positive results. This may indisputably be the case; in fact, I am sure that this assessment is true.

However, if the key to treatment success is then rather the consistency and frequency of treatment, I consider laser-assisted treatment to be one of many options in the extensive field of periodontal therapy. Laser-assisted periodontal therapy thus makes no pretense of being a unique feature, but rather an adjuvant therapy with the claim to be efficient, gentle and ultimately successful.

I would like to dedicate this article to my academic instructor, Professor Dr. Gisbert Krekeler (†). We owe it to his initiative that the option of diode laser decontamination and the introduction of diode laser into dentistry in general were made possible!
Abstract

The aim of this study was to investigate the temperature changes in subperiostal bone and through that to show if there are risks for bone damage during frenectomies with the electrotome and Er:YAG laser.

Thirty sheep lower jaws with the frenulum preserved were used in the study. Electrodes from thermocouples were inserted in the subperiostal bone tissue in three places: coronal, middle and apical. A water bath at 37 degrees Celsius was used to stabilize the start temperature at 36.8–37.2 degrees. The sheep jaws were stabilized in gypsum inside the water bath with the frenulum extended out of the water. The sheep jaws were divided in three groups with 10 parts in every group. In these jaw parts, frenectomies were performed using the electrotome and Er:YAG laser with water spray and without water spray. The results of temperature changes, the maximum temperature, the irradiation time, the cooling time and the time the temperature stayed above 47 degrees Celsius were registered and statistically analyzed.

The results of the temperature changes have shown that the electrotome creates a much higher temperature elevation in subperiostal tissues (up to 80.3 degrees C) than the Er:YAG laser without the water spray (up to 40.3 degrees C) while the use of the water spray with an Er:YAG laser creates a maximum temperature drop to 34.1 degrees Celsius.

In conclusion, we can say that when doing frenectomies with the Er:YAG laser, there is less thermal change to the subperiostal bone tissues than with the electrotome and, therefore, the risk of thermal damage with the Er:YAG laser in subperiostial bone tissue compared to the electrotome is minimal.
_Introduction_

The temperature increase and its side effects are always a problem in surgical procedures when an electronic surgical instrument (e.g., electrotome, laser) is used instead of a scalpel. Electric or electromagnetic energy can spread in deeper tissues and create side effects that could influence the healing process of the tissues or the prognosis of our therapy.

Since the 1930s, the electrotome has been used in different surgical procedures, and 25 years ago, lasers were used in similar surgical procedures. Although different investigators have looked at the temperature increase in the surface of the treated tissues, little has been done to investigate the temperature fluctuations in the deeper parts of the tissues. This research project attempted to investigate the temperature changes in the subperiostal bone tissue during frenectomies in sheep jaws with an Er:YAG laser and an electrotome.

_Materials and methods_

An electrotome and an Er:YAG laser were used as surgical instruments in this study. These two electronic surgical instruments were used as a scalpel for performing frenectomies in sheep jaws. These frenectomies were performed in order to investigate the temperature fluctuations in the subperiostal bone under the frenulum.

The Er:YAG laser was used in the study due to its very good absorption by the water contained in the tissues (Fig. 1). This absorption of the erbium laser beam makes the erbium laser a very good cutting instrument for soft and hard tissues.

Thirty lower sheep jaw with preserved frenulums were used in the study.

Electrodes from thermocouples were inserted in the subperiostal bone tissue in three different places (coronal, middle, apical) 5 mm away from each other in the vertical dimension in order to register the temperature changes in the subperiostal bone during the frenectomy procedures. The sheep jaws were stabilized in a gypsum base in a water bath. The water bath was used in order to simulate the physiological temperature of the living tissues at 37 degrees Celsius. The preserved frenulum and the electrodes of the thermocouples were kept out of the water in order to avoid any interference during the frenectomy procedure from water in the water bath.

The 30 lower sheep jaw parts were divided in three groups of 10. In the first group, the electrotome was used to perform the frenectomies in the central frenulum; in the second group, the Er:YAG laser was used without water spray; and in the third group, the Er:YAG laser with water spray (5 ml/min).

_Parameters used in this study_

1) The power used in electrotome on the scale of 10 was 5. That means it was 50 percent of the maximum power of the electrotome (50 watts), which is 25 watts. The tip of the electrotome had a diameter of 0.40 mm.

2) The energy used in the Er:YAG laser was 150 mj, with the pulse frequency of 20 Hz and the pulse duration in 700 µsec (long pulses).

The incision was made 3 mm away from the attached gingival at a depth up to 15 mm from the surface of the frenulum.

_Results and statistical analysis_

The results show that the temperature increase was much higher in the frenectomies with the electrotome than with the Er:YAG laser without water spray. On the other hand, in the frenectomies with the Er:YAG with water spray, the temperature dropped under the physiological temperature of 37 degrees Celsius, thereby creating hypothermia in the tissues.

The statistical analysis was done with SPSS 13 statistical package and Bonferroni method. The results show that the temperature changes between the Er:YAG laser with water spray and without water spray are significant. While the frenectomies with the Er:YAG laser with water spray there was a drop in temperature below the physiological temperature of the living tissue to 34.1 degrees C, in the frenectomies with the Er:YAG laser without water spray, we saw a temperature increase in the subperiostal bone of up to 40.3 degrees C.

The mean of the maximum temperature increase/decrease had significant differences between the
Three different techniques were used for the frenectomies in this study. These differences can be seen in Figure 1 and Table 1.

The mean time of the temperature staying above the threshold time level of one minute gave significant differences between the electrotome and the Er:YAG laser without the water spray. In the frenectomies with the electrotome, the time the temperature stayed above 47 degrees C always exceeded the time threshold of one minute while in the frenectomies with the Er:YAG laser this time threshold was never exceeded. These results can be seen in the Figure 2 and Table 2.

The mean of the cooling time also showed significant differences with the longer cooling time in the apical part of the frenectomies with the electrotome and the shortest cooling time in the coronal part of the frenectomies with the Er:YAG laser.

These results can be better seen in Figure 3 and Table 3.

The mean irritation (or working) time was also registered and showed significant differences between the three frenectomy techniques used in this study. The longest working time was in the frenectomies with the electrotome and the shortest in the frenectomies with the Er:YAG laser without water spray. These differences can be seen in the Table 4 and Graph 4.

**Discussion**

There has been a lot of research about the temperature increase in living tissues in medicine, dentistry, and biophysics. Researchers are trying to investigate the temperature increase and its effects on living tissues after the use of mechanical instruments, lasers or electrotomes for different surgical procedures.

In 1983, Eriksson and Albrektsson defined the thermal threshold level for bone necrosis at 47 degrees Celsius for one minute. In 1989, Walsh et al. investigated the thermal effect of a q-switched Er:YAG laser on the skin, cornea, aorta and bone. They found that the thermal damage had a penetration of 5–10 µm.

In 1992, Prokova et al. investigated the thermal effects of the CO2 laser during surgical incisions on bone tissue. They found that when the power density was increasing, the temperature was also increasing. They also found that the temperature increase dropped at a logarithmic rate compared to the distance from the incision point. The temperature drop depended on the tissue’s thermal conductivity.

In our study, we also saw that thermal damage is influenced by the physical and optical properties of the tissues and of the power that is applied upon them. Looking at our results, one can see that the much stronger power of the electrotome did not speed up the incision on the tissues, but rather imparted a much higher temperature upon them. This is in agreement with the results found by Perry et al. in 1992.

There must be a threshold point in the applied power (electrical or electromagnetic) from which and after which the only given effect on the tissues is the temperature increase and the risk of thermal trauma.

One can also see in our study that the temperature dropped when we used the water spray cooling with the Er:YAG laser. This happens because part of the applied laser energy is absorbed by the water in the water spray.

The energy fluence on the tissues becomes much smaller, giving one a longer incision speed, and also produces a cooling effect upon them. This is in agreement with the results found by Miserendino et al. in 1993 and Frenzen et al. in 2003.

The temperature increase in our experiments depended on the power applied to the tissues. The time the temperature stayed above the threshold point for thermal damage (47 degrees Celsius) depends not only on the applied power, but also on the energy fluence, absorption, diffusion of that energy in the tissues and the tissue conductivity. The energy...
Pacific Dental Conference

March 8–10, 2012  Vancouver, BC

Join us in Vancouver for Canada’s premier dental conference!

- Earn up to 15 hours of CE credits during three days of lectures and hands-on courses
- Over 100 speakers and 150 open sessions and hands-on courses to choose from, as well as the Live Dentistry Stage in the Exhibit Hall
- Enjoy the largest two day dental tradeshow in Canada featuring all the newest equipment and products at over 500 exhibitor booths in the spacious PDC Exhibit Hall
- Lunches and Exhibit Hall Receptions included in the registration fee
- Online hotel reservations now available
- Shopping, hotels, restaurants and breath-taking Stanley Park are all within blocks of the spectacular Vancouver Convention Centre
- Scenic two hour drive to world famous Whistler Mountain for spring skiing and snowboarding

Easy online registration opens October 14th, 2011 at...

www.pdconf.com
fluence applied to the tissues gives the temperature increase while the energy diffusivity in the tissues and the tissue conductivity give the cooling time of the tissues. Because diffusivity and conductivity in the oral tissues of the same species (sheep) can be considered to have the same value, we can conclude that the higher the applied energy fluence, the longer the cooling time will be.

More research is needed in order to understand the way the temperature changes appear in living tissues and how these tissues respond to these changes. Alterations in the tissues can appear in different ways both macroscopically and microscopically when using a laser with different parameters. Additional research will allow us to find and understand the biochemical reactions that take place deeper in living tissues both during laser irradiation and the healing process. The direct result of all that will give clinicians more concrete guidelines to follow in order to choose the best parameters for each surgical or therapeutic procedure. Through such research, we can then create a protocol for every surgical and therapeutic laser procedure that can guarantee the best result with the minimal side effects.

**Conclusion**

As a conclusion we can say that:

1) The threshold point of 47 degrees Celsius for bone necrosis was exceeded in all the frenectomies with the electrotome (a rate of 100 percent) while this never occurred in the frenectomies with the Er:YAG laser (a rate of 0 percent).

2) The mean time the temperature stayed above 47 degrees Celsius is always more than 60 seconds with the electrotome, thus presenting a risk for thermal damage in the subperiostal bone tissue, while the mean time for the temperature stayed above 47 degrees Celsius with the Er:YAG laser was 0 seconds.

3) The cooling time was significantly longer with the electrotome.

4) The mean irradiation (or working) time was significantly longer with the electrotome.

5) It is safe to use the Er:YAG laser for frenectomies when using the parameters explained in this study.

6) One may expect less temperature increase in living tissues due to the blood microcirculation in the surrounding tissues.

**References**


11. Misuridino L. J., Abt E., Wdg H., Misuridino C.

---

Anastasios Manos, DDS, LSO, MSc, PhD
In private practice
K. Paleologou 2, 17121, Nea Smyrni
Athens, Greece
tandlaek@otenet.gr

Prof. Nicolaos Parissis
Aristotle University of Thessaloniki
Dental School
Department of Oral Surgery,
Implantology and Roentgenology
Thessaloniki, Greece
Surgical crown lengthening is a procedure that is probably not performed as often as it should be. There are multiple medical indications for this operation.

For example, not only do we need it to modify the red-white esthetics, but this operation should be done in many other cases. If a patient has clinical crowns that are too short, which would not give enough retention for restorations, we should prepare a more suitable situation by surgical intervention. Especially with ceramic restorations, which need adhesive attachments, we often have problems.

The preparation margin should be supra- or pargingival. This is often not the case, so it is more difficult to have a clean and dry operation area while attaching the restoration. If we would perform a surgical crown lengthening before preparation, things would be a lot easier afterward.

Last but not least, we often have to distort the biological width. This will result in chronically inflamed areas around the restoration. If we know that the defect of the tooth is going to force us to damage the biological width, we have to perform surgical crown lengthening before starting with the planned treatment.

So why is it that this operation is performed so rarely? The answer is an easy one. Conventional treatment with scalpel, bone milling cutter, needle and thread is not easy, is bloody and risky and often associated with pain for our patients.

In addition, we have to wait several weeks for the healing process to end, which retards the actual treatment. Therefore, it is obvious that many dentists and patients will look for a compromise and risk functional and/or esthetic degradation as a result.

To solve this problem, we would need the option to perform surgical crown lengthening so that it is fast, safe, painless and with a shorter healing time. This is where laser dentistry steps onto the field. The correct lasers, used in the correct way, are able to meet each of these requirements.

This article will show the correct treatment via a case presentation. The crown lengthening was done with a combination of an 810 nm diode laser and an Er,Cr:YSGG laser.

We intentionally wanted to show a case of the upper front jaw. In such cases, we need a high amount of predictability, which is a given in laser surgery. In addition, it readily lends itself to a quality case documentation.
Clinical procedure

The following case report illustrates the clinical guidelines related to how to use different wavelengths when performing this type of treatment. It would be possible, of course, to perform crown lengthening with just an erbium laser because it absorbs mostly in water and thus works on the gingiva and bone. However, under clinical aspects it is our opinion that the combination of a diode and erbium laser is very useful. Given the gingivectomy with a diode laser — in this case, the Q 810 laser by ARC lasers — the operation field is not awash in blood and shows good clarity. With good clarity, it is no problem to measure the new biological width by ablatting the bone with an erbium laser.

At first it must be ascertained how much tissue one has to remove and how much space exists from the limbus alveolaris to the top of the gingiva. This is carried out by means of measurement with a PA probe under anesthesia. Once the measurement is done, one is able to mark the tissue that is to be removed. This is helpful for the subsequent reshaping of the gingiva (Figs. 1–3). Then we can begin with the excision of the soft tissue. In this case, we used 2.8 watts in the CW mode. In this setting, the task is completed speedily and under excellent coagulation (Figs. 4, 5). Once modeling of the gingiva is concluded, one can begin ablation of the bone. If one removes 2–2.5 mm of bone, the basis for a new biological width is created.

Ablation with an erbium laser is completed without thermal damage under good visibility. In this case, the Waterlase MD Cr:YSGG laser (Biolase) with a 2,780 nm wavelength was used. Ablation of the bone is possible without a flap, which minimally invasive and causes no thermal damage. These were important factors for the patient to consider and choose this type of treatment. Bone ablation was checked during treatment by means of a PA probe (Fig. 6, 7).

‘... for laser dentists, opportunities arise that cannot be reached in a conventional way. A clinician’s level of therapy can be improved and expanded, and he or she is able to treat patients in a non-invasive manner that comes with good predictability of the results achieved. This is a classic win-win situation.’
In this case, after the surgical steps were carried out, we shaped the incisors. Veneers were planned for the best esthetic result. However, functional pre-treatment was necessary. The result after crown lengthening was nice and already improved the esthetics (Fig. 8) in the eyes of the patient. After one week, there was hardly anything to be seen (Fig. 9). The healing process had no complications: there were no scars, no swelling or pain. During the day of the treatment, the patient took a painkiller. This was purely prophylactic on our advice. Subsequently, no more medication was necessary.

The patient resumed normal oral hygiene after four days. Before that, the area of crown lengthening should be left out of the brushing procedure. Only oral rinse was used adjuvant in the first days after surgery.

After two to three weeks, the healing was complete. The patient was pleased with the results at this point, and we began construction of the canine guidance and veneers. This approach was undertaken only because we were working in the front tooth area. If we had been working on molars where the esthetics are not too important, we can proceed with the next stage of treatment after six to 10 days.

_Benefits_

The advantages for the dentist are obvious. By using a laser, the clinical can avoid: an increased amount of time to complete the procedure; a bleeding surgical approach with flaps; stitches and the risk of scars afterward. In addition, complete healing can be achieved in a very short time. This means that one can begin the next restorative treatments in a timely fashion.

In using such a non-invasive approach, the clinician can increase treatment acceptance, because no patient wants to treatment time to be any longer than it has to be. As a result, clinicians can expand their techniques in esthetic surgery, pre-prosthetic surgery and simplify their workload.

It goes without saying that the financial benefits associated with an increase in patients asking for such non-invasive treatment due to the recommendation of friends and relatives is also an unmistakable advantage. For our patients, the advantages are also evident. A bloody, surgical intervention of this kind is substantially more pleasant due to the application of laser light as compared to the conventional approach. Furthermore, post-surgical healing is generally without complications. The less time it takes for the surgery and the good healing results allow a patient to undergo this procedure without changing his normal everyday life.

In conclusion, one can say that for laser dentists, opportunities arise that cannot be reached in a conventional way. A clinician’s level of therapy can be improved and expanded, and he or she is able to treat patients in a non-invasive manner that comes with good predictability of the results achieved. This is a classic win-win situation.

_Summary_

There are many indications for surgical crown lengthening. Even though the indication list is long, this treatment is not completed very often. This is probably because it is difficult and demanding to perform and often painful for patients. To solve this problem, clinicians have the opportunity to use lasers instead of the conventional technique. Laser surgical crown lengthening can be completed quickly, without great difficulty and offers a great amount of safety and comfort to our patients._

_Name: Thorsten Kuypers, MSc_
In private practice
Neusser Straße 600
50737 Cologne, Germany
info@laserzahnarzt-koeln.de
We search for the best worldwide!

The GLOBAL DENTAL TRIBUNE AWARDS will celebrate excellence in dentistry. We will recognise outstanding individuals and teams that have made a unique and substantial contribution to improving dental care, whether in clinical practice, health policy, dental education, dental research or the dental industry.

Nominees will be chosen by a global audience of over 650,000 dental professionals, all readers of the Dental Tribune newspapers, which are published in more than 25 languages worldwide.

All dental professionals are invited to submit their applications, which will be taken to an online voting by their peers. Shortlisted candidates will be judged by a jury of the most renowned opinion leaders in their respective categories. The awards ceremony will be held in New York City at the end of this year, filled with all the glitz and glamour of a red carpet event.

For preregistrations and more information please go to:

awards.dental-tribune.com
From **theory** to the first **working laser**

**Laser history — part one**

*Author* Dr. Ingmar Ingenegeren

---

The principle of both maser (microwave amplification by stimulated emission of radiation) and laser (light amplification by stimulated emission of radiation) were first described in 1917 by Albert Einstein (Fig. 1) in "Zur Quantentheorie der Strahlung", as the so-called "stimulated emission," based on Niels Bohr’s quantum theory, postulated in 1913, which explains the actions of electrons inside atoms. Einstein (born in Germany, March 14, 1879–April 18, 1955) received the Nobel Prize for physics in 1921, and Bohr (born in Denmark, Oct. 7 1885 – Nov. 18, 1962) in 1922.

In 1947 Dennis Gábor (born in Hungary, June 5, 1900 – Feb. 8, 1972) developed the theory of holography, which requires laser light for its realization. In 1963 the first successful holographic trials were done by Emmet N. Leith (born in the United States, March 12, 1927 – Dec. 23, 2005, National Medal of Science Award, among others) and Juris Upatnieks (born in Lithuania, May 7, 1936, 19 U.S. patents) using a ruby laser. Both were nominated for the Nobel Prize. Gábor received the 1971 Nobel Prize in Physics for the invention and development of the holographic method. To a friend he wrote that he was ashamed to get this prize for such a simple invention. He was the owner of more than 100 patents.

In 1954 at Columbia University in New York, Charles Townes (born in the United States, July 28, 1915, Fig. 2) and Arthur Schawlow (born in the United States, May 5 1921 – April 28, 1999, Fig. 3) invented the maser, using ammonia gas and microwaves, which led to the granting of a patent on March 24, 1959. The maser was used to amplify radio signals and as an ultra sensitive detector for space research. The two scientists also theorized and published papers about a visible maser, an invention that would use infrared and/or visible spectrum light. However, they did not proceed with any further research at the time. Townes was awarded with the Nobel Prize in Physics in 1964 (together with Bassov and Prokhorov) and Schawlow in 1981 together with Nicolaas Bloembergen (born in the Netherlands, March 11, 1920) and Kai Siegbahn (born in Sweden, April 20, 1918 – July 20, 2007) for their contribution to the development of laser spectography.

---

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913</td>
<td>Niels Bohr (born in Denmark, 7 October 1885–18 November 1962) explains along his quantum theory how electrons could act in the atom model. Nobel Prize in 1922.</td>
</tr>
<tr>
<td>1954</td>
<td>Charles Townes (born in the USA, 28 July 1915—today) and Arthur Schawlow (born in the USA, 5 Mai 1921–28 April 1999) develop a device that stimulates the emission of microwaves. Nobel Prizes in 1964 and 1981.</td>
</tr>
<tr>
<td>1957</td>
<td>Gordon Gould (born in the USA, 17 July 1920–16 September 2005) is the first to use the acronym laser in his work “Some rough calculations on the feasibility of a LASER”.</td>
</tr>
</tbody>
</table>
In 1957 Gordon Gould (born in the United States, July 17, 1920 – Sept. 16, 2005), came up with important concepts, as well as the word "laser." He patented optically pumped and discharge excited laser amplifiers, laser uses and optic communications. He idolized Edison, and his ambition from childhood was to be an inventor.

In 1957 his first ideas for the laser came to him one night "in a flash" and he wrote, "some rough calculations on the feasibility of a LA SER." That was the first use of this acronym. Due to a misunderstanding with his attorney, he did not file for a patent until 1959, after other laser researchers already filed. Because his original patent application contained a number of different inventions, it was put through a series of five separate interferences by the Patent Office, resulting in issuing Gould’s first basic laser patents in 1977. In 1991, he was inducted into the National Inventors Hall of Fame.

Fifty years ago, on May 16, 1960, at Hughes Aircraft Co., Theodore H. Maiman (born in the United States, July 27, 1927 – May 5, 2007) let the world’s first monochromatic, collimated, coherent, pulsed (red) light beam shine with a wavelength of approximately 694 nanometres. He succeeded in building the first operable laser, small enough to fit in his hand, based on a synthetic ruby rod, which served as the active medium, which worked on the first try. The idea of using a photographic flash for illuminating the ruby crystal came from his assistant Charles Asawa.

Theodore H. Maiman was inspired by the article of Townes and Schawlow, which appeared in the Physics Review in 1958 with the title “Infrared and Optical Masers.” One year later, the race to build the first laser started and was won by Maiman, who said his favorable academic background, the quest for simplicity, a maverick spirit and unconventional thinking helped him achieving this goal.

Although several other scientists had already discounted its suitability for such a task, Maiman persisted that ruby would work as an active medium, along his calculations of the fluorescence quantum efficiency. His first paper was rejected by the Physical Review Letters, and a shorter version was published in the journal Nature in the United Kingdom in August 1960. In 2000 Maiman published the story of his discovery of the laser in "The Laser Odyssey" and described the laser as "a solution seeking a problem."

Maiman was nominated twice for the Nobel Prize. He received the Fannie and John Herz Science Award, the 1984 Wolf prize and the 1987 Japan Prize (equivalent to the Nobel Prize). After he was introduced into the National Inventors Hall of Fame in 1984, he met his second wife, Kathleen, on the flight home. Mrs. Kathleen Maiman attended the 16th Congress of the ALD in April 2008 in San Diego. She received the ALD T.H. Maiman Award as post hum honor for her late husband’s groundbreaking work and contribution to science. Mrs. Maiman brought along a model of the ruby laser for the congress delegates to see and to hold (Fig. 4).

_Sources_


_contact_

Ingmar Ingenegeren, MSc MSc
Private Dental Laser Clinic
Gladbecker Straße 223a.
46240 Bottrop, Germany
E-mail: Laser@praxis-ie.de
www.praxis-ingenegeren-ewert.de
The dual-wavelength Waterlase iPlus all-tissue laser system from BIOLASE Technology, the world’s leading dental laser manufacturer, is the first major breakthrough in all-tissue laser technology since the Waterlase MD was introduced in 2005.

The “Intuitive Power” of the iPlus addresses the key needs for the next generation of laser dentists, while delivering more power, control and versatility for experienced laser dentists.

The iPlus cuts all tissue types twice as fast as current laser systems, with no pain or discomfort and less risk of cross-contamination associated with conventional drills, while creating a much smoother surface than ever.

BIOLASE Chief Technology Officer Dmitri Bou-toussov, PhD, said, “The iPlus represents a major leap in the development of all-tissue dental lasers. Cutting teeth at the speed of the mechanical drill without sacrificing patient comfort has always been our goal at BIOLASE. It was a tremendous challenge for us that took several years to develop. New patent-pending ‘2R Powered’ technology allows us to build an Er:Cr:YSGG laser with the highest pulse energy at short pulses and highest pulse repetition rates of any Erbium-based, 3-micron lasers in the industry. The result is very fast removal of hard tooth tissue with no discomfort to the patient, and a smooth surface finish.”

“Any dentist with a smart phone will feel right at home with the iPlus, as its intuitive nature eliminates both the mystery and the fear factor of lasers.”
Southern California dentist Dr. Christina Do stated, "It is amazingly fast, as fast or faster than my high-speed drill — and the patient never flinched."

The iPlus features a revolutionary intuitive user interface with a large high-resolution touch screen programmed with over 50 factory-loaded procedure presets. You simply choose which procedure to perform — from "bread and butter" restorative cases to specialty cases like periodontal or endodontic — and the iPlus programs everything for you.

The iPlus is available in either a dual wavelength configuration featuring the proprietary 2,780 nm YSGG technology with an integrated iLase 940 nm wireless diode laser, or as a stand-alone unit. YSGG technology has been the industry standard for all tissue dental lasers since its introduction in 1997. The iLase diode laser system enhances the capabilities of the YSGG by providing a treatment option for unexpected soft-tissue cases in an adjacent treatment room, for example.

Other iPlus innovations include a near zero resistance fiber delivery system with little to no "pull-back" on the dentist’s hand that greatly reduces fatigue throughout the day, and handpiece illumination that is three times brighter than previous Waterlase systems, for excellent site visibility.

"I have been using lasers from BIOLASE and other manufacturers for 20 years in my practice, and also taught hundreds of other dentists how to use lasers," said Dr. Phil Hudson from Spokane, Wash. "Whenever I have asked what took them so long to buy a laser, two of the most common concerns were that it would slow them down, and it would be too difficult to learn. The iPlus solves all of that. It is blazingly fast in all classes of cavity preparation and is my first choice when I am confronted by soft tissue surgical challenges. Any dentist with a smart phone will feel right at home with the iPlus, as its intuitive nature eliminates both the mystery and the fear factor of lasers."
2011

FDI Annual World Dental Congress
Mexico City
September 14–17
www.fdiworlddental.org

CDA Presents the Art and Science of Dentistry
California Dental Association
September 22–24
San Francisco
www.cdapresents.com

American Academy of Periodontology
November 12–15
Miami Beach, Fla.
www.perio.org/meetings/

Greater New York Dental Meeting
New York City
November 25–30
www.gnydm.org

2012

American Dental Association
October 10–12
Las Vegas
www.ada.org

Annual Congress of DGL
Dusseldorf, Germany
October 28–29
www.startup-laser.de

LaserOptics Berlin
Berlin, Germany
March 19–21, 2012
www.laser-optics-berlin.de

IDEM International Dental Exhibition
Singapore
April 20–22, 2012
www.idem-singapore.com
submissions: formatting requirements

Please note that all the textual elements of your submission:
- the complete article,
- all the figure captions,
- the complete literature list and
- contact info (bio, mailing address, e-mail address, etc.)

must be combined into one text document. Please do not submit multiple files for each of these items.

In addition, images (tables, charts, photographs, etc.) must not be embedded in the text document. All images must be submitted separately, and details about how to do this appear below.

If you are interested in submitting a C.E. article, contact us for additional instructions before you make your submission.

_ Text length

Article lengths can vary greatly — from a mere 1,500 to 5,500 words — depending on the subject matter. Our approach is that if you need more or less words to do the topic justice then please make the article as long or as short as necessary.

We can run an extra long article in multiple parts, but this is usually discussing a subject matter where each part can stand alone because it contains so much information. In addition, we do run multi-part series on various topics.

In short, we do not want to limit you in terms of article length, so please use the word count above as a general guideline and if you have specific questions, please do not hesitate to contact us.

_ Text formatting

Please use single spacing and un-indented paragraphs for your text. Please do not put a blank line between paragraphs.

We also ask that you forego any special formatting beyond the use of italics and boldface, and make sure that all text is left justified.

If you would like to emphasize certain words within the text, please only use italics (do not use underlining or a larger font size). Boldface is reserved for article headers.

Please do not “center” text on the page, add special tab stops, or use underlining as all of this must be removed before layout. If you require a special layout, please let the word processing program you are using help you to do this formatting rather than doing it by hand on your own.

If you need to make a list or add footnotes or endnotes, please let the word processing program do it for you automatically. There are menus in every program that will help you to do this.

The fact is that no matter how careful one might be, errors have a way of creeping in when you try to hand number footnotes and literature lists.

_ Image requirements

Please number images consecutively throughout the article by using a new number for each image. If it is imperative that certain images are grouped together, then use lowercase letters to designate the images in a group (i.e., Fig. 2a, Fig. 2b, Fig. 2c).

Please put figure references in your article wherever they are appropriate, whether that is in the middle or end of a sentence but before the period.

If you are not directly mentioning the figure in the body of your article, when it appears at the end of the sentence the figure reference should be enclosed within parenthesis and appear before the final period.

In addition, please note:
- We require images in TIF or JPEG format.
- These images must be no smaller than 4 x 4 inches in size at 300 DPI.
- Images cannot be any smaller than 80 KB in size (or they will print the size of a postage stamp).

Larger images are always better, and something on the order of 1 MB is best. Thus, if you have an image that is greater than 1 MB, please do not bother “sizing it down” to meet our requirements, but send us the largest file size available.

The larger the starting image is in terms of bytes, the more leeway the designer has in terms of resizing the image to fill up more space should there be room available.

Also, please remember that you should not embed the images into the body of the text document you submit. Images must be submitted separately from the textual submission.

You may submit images through a zipped file via e-mail, unzipped individual files via e-mail or post a CD containing your images directly to us (please contact us for the mailing address as this will depend upon where in the world you will be mailing them from).

Please do not forget to send us a head shot photo of yourself that also fits the parameters above so that it can be printed along with your article.

_ Abstracts

An abstract of your article is not required. However, if you choose to provide us with one, we will print it in a separate box.

_ Contact info

At the end of every article is a contact info box with contact information along with a head shot of the author.

Please note at the end of your article the exact information you would like to appear in this box and format it according to the previously mentioned standards.

A short bio (60 words or less) may precede the contact info if you provide us with the necessary information.

_ Questions? Comments?

Please do not hesitate to contact us for our International C.E. Magazine Author Kit or if you have other questions/comments about the article submission process:

Group Editor Robin Goodman
r.goodman@dental-tribune.com

Managing Editor Fred Michmershuizen
f.michmershuizen@dental-tribune.com
Copyright Regulations

The international C.E. magazine of laser published by Dental Tribune America is printed quarterly. The magazine’s articles and illustrations are protected by copyright. Reprints of any kind, including digital mediums, without the prior consent of the publisher are inadmissible and liable to prosecution. This also applies to duplicate copies, translations, microfilms and storage and processing in electronic systems. Reproductions, including excerpts, may only be made with the permission of the publisher.

All submissions to the editorial department are understood to be the original work of the author, meaning that he or she is the sole copyright holder and no other individual(s) or publisher(s) holds the copyright to the material. The editorial department reserves the right to review all editorial submissions for factual errors and to make amendments if necessary.

Dental Tribune America does not accept the submission of unsolicited books and manuscripts in printed or electronic form and such items will be disposed of unread should they be received.

Dental Tribune strives to maintain the utmost accuracy in its clinical articles. If you find a factual error or content that requires clarification, please contact Group Editor Robin Goodman at r.goodman@dental-tribune.com. Opinions expressed by authors are their own and may not reflect those of Dental Tribune America and its employees.

Dental Tribune cannot assume responsibility for the validity of product claims or for typographical errors. The publisher also does not assume responsibility for product names or statements made by advertisers.

The responsibility for advertisements and other specially labeled items shall not be borne by the editorial department. Likewise, no responsibility shall be assumed for information published about associations, companies and commercial markets. All cases of consequential liability arising from inaccurate or faulty representation are excluded. General terms and conditions apply, and the legal venue is New York, New York.
ANNUAL DENTAL TRIBUNE STUDY CLUB
SYMPOSIA AT THE GNYDM
NOVEMBER 27TH – 30TH, 2011, STARTING AT 10:00 AM DAILY

For the fourth year in a row, Dental Tribune Study Club hosts its annual C.E. Symposia at the GNYDM, offering four days of focused lectures in various areas of dentistry. Find us on the exhibition floor in aisle 6000!

Each day will feature a variety of presentations on topics, which will be led by experts in that field. Participants will earn CE credits for each lecture they attend. DTSC is the official online education partner of GNYDM.

PLEASE SEE PROGRAM DETAILS UNDER WWW.DTSTUDYCLUB.COM/GNYDM

REGISTER NOW: WWW.GNYDM.COM

ATTENDEES MUST PRE-REGISTER AS GNYDM VISITORS FOR FREE.

SUNDAY, NOVEMBER 27
10:00 - 11:00 DR. HOWARD CLAZER // COURSE NO. 3780
GIOERS: NEW GIANTS OF MI DENTISTRY

11:15 - 12:15 DR. SHAMS-HUDIN KHERANI // COURSE NO. 3790
COMPREHENSIVE DENTISTRY USING DIGITAL IMPRESSION TECHNOLOGY

12:45 - 1:45 DR. R. KAMINER // COURSE NO. 3800
THE HOTTEST TOPICS IN DENTISTRY

2:00 - 3:00 DR. LOUIS MALCACHES // COURSE NO. 3810
MINIMALLY INVASIVE DENTISTRY: TIPS AND TRICKS TO MAXIMIZE SUCCESS

3:15 - 4:15 TBA // COURSE NO. 3820
TECHNOLOGY TO IMPROVE YOUR CARES MANAGEMENT

4:30 - 5:30 DR. GEORGE FREEDMAN // COURSE NO. 3830
EVOLVING CONSERVATIVE RESTORATIONS

MONDAY, NOVEMBER 28
10:00 - 11:00 DR. FAY GOLDSTEP // COURSE NO. 4670
WHAT PATIENTS WANT... WHAT DENTISTS WANT: EASY, HEALTHY DENTISTRY!

11:15 - 12:15 DR. SHAMS-HUDIN KHERANI // COURSE NO. 4680
LASER DENTISTRY OVERVIEW WITH AN UPDATE ON CLOSED FLAP DISEASES

12:45 - 1:45 DR. LARRY EMMOTT // COURSE NO. 4690
REMEMBER WHEN "F" WAS JUST A LETTER? USE E-SERVICES TO IMPROVE PATIENT CARE AND INCREASE PROFITABILITY

2:00 - 3:00 DR. GEORGE FREEDMAN AND DR. FAY GOLDSTEP // COURSE NO. 4700
DIODE LASERS AND RESTORATIVE DENTISTRY

3:15 - 4:15 DR. DAMIAN MIKAVICH // COURSE NO. 4710
WHY VIEW YOUR 3D PATIENTS WITH 2D IMAGES? A COMMON SENSE APPROACH TO 3D IMAGING IN THE GENERAL PRACTICE

4:30 - 5:30 DR. MARTY JABLON // COURSE NO. 4720
UNDERSTANDING THE ADVANCES IN SELF-ADHESIVE TECHNOLOGY AND HOW TO INTEGRATE THEM INTO YOUR RESTORATIVE PRACTICE

TUESDAY, NOVEMBER 29
10:00 - 11:00 DR. GEORGE FREEDMAN AND DR. FAY GOLDSTEP // COURSE NO. 5700
INNOVATIONS THAT WILL CHANGE YOUR PRACTICE FOREVER

11:15 - 12:15 TBA // COURSE NO. 5700
THE IMPORTANCE OF THE FLAP DESIGN IN RELATION TO THE TYPE OF THE UNDERLYING BONE DEFECT

12:45 - 1:45 DR. GEORGE FREEDMAN AND DR. FAY GOLDSTEP // COURSE NO. 5710
THE DIODE LASER: THE ESSENTIAL SOFT TISSUE HANDBOX

2:00 - 3:00 DR. SELMA CAMARGO // COURSE NO. 5720
LASERS IN ENDODONTICS: CLINICAL APPLICATION FOCUS ON DIFFICULT CASES

3:15 - 4:15 JULIA WEHKAMP // COURSE NO. 5730
ONLINE LEARNING: A NEW APPROACH TO CONTINUING DENTAL EDUCATION

4:30 - 5:30 DR. MARILYN STEIGMANN // COURSE NO. 5740
MY FIRST ESTHETIC IMPLANT CASE - WHY, HOW, & WHEN?

WEDNESDAY, NOVEMBER 30
10:00 - 11:00 DR. MARIUS STEIGMANN // COURSE NO. 6600
MY FIRST ESTHETIC IMPLANT CASE - WHY, HOW, & WHEN?

11:15 - 12:15 DR. GEORGE FREEDMAN AND DR. FAY RICETZER // COURSE NO. 6610
CEMENTING ALUMINA AND ZIRCONIA RESTORATIONS

12:45 - 5:00 DISCO SYMPOSIUM
DR. DAVID HOXTER, ALONG WITH VARIOUS IMPLANT EXPERTS // COURSE NO. 6620
THE 3RD ANNUAL OSSUE UNIVERSITY SUMMIT: REVOLUTIONARY IMPLANT DESIGN UNVEILED

For more information, please contact
Julia E. Wehkamp, C.E. Director, Dental Tribune Study Club
Phone: (416) 907-8386, Fax: (212) 244-7185
E-mail: Jwehkamp@DTStudyClub.com
Just Getting Warmed Up.

 PICASSO

$4,995
3-Year Warranty
Features:
7 watts of power
Color touch screen
8 customizable presets

 PICASSO Lite

$2,495
2-Year Warranty
Features:
2.5 watts of power
Icon membrane touch screen
3 customizable presets

AMD LASERS®
A DENTSPLY International Company

Call 866.999.2635
Pick Up a Picasso Today!

#1 Lasers In the World

#1 Lasers In the World

Call 866.999.2635
Pick Up a Picasso Today!

AMD LASERS®, LLC
7405 Westfield Blvd.
Indianapolis, IN 46240, USA
866.WWW.AMDL
866.999.2635
TEL: +1.317.202.6530
FAX: +1.678.866.4103
sales@amdlasers.com

A USA COMPANY

ISO 13485
TSA STLM: V1-07-2011