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Temperature Changes in Periodontal Tissues

_case report
The use of the Er:YAG (2,940 nm) in a Laser-Assisted Implant Therapy

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Prof Dr Norbert Gutknecht
WFLD President
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Dear readers, Dear colleagues, Dear friends,

with Issue no. 4, you are just holding in your hands, we are celebrating the first anniversary of our laser magazine. By launching it into our laser family, we could not expect such a high acceptance and joy having now a journal, which makes us a global laser community. My special thanks are directed to those colleagues who have supported us with the submissions of their scientific studies, case reports and congress and/or society reports. I am looking forward to receive even more contributions next year, because I have seen many colleagues, groups and universities being stimulated to participate.

For the upcoming Christmas Holidays I would like to wish all of you a peaceful and harmonious time—detached from the stress and burdens of our daily responsibilities. For the new year I wish you a successful start and for our society an outstanding WFLD Congress. This World Congress will be an extraordinary meeting, embedded in one of the biggest dental exhibitions and congresses of the world—the AEEDC 2010 Congress in Dubai. If you have not yet made your decision to participate in this congress it is high time to enrol now. I am sure you will not regret!

With my best wishes and greetings,

Yours Norbert Gutknecht
Editor-in Chief
WFLD President

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Modern Surgical Approaches to Long-term Success

Laser Application in the Implantologic Surgery

author_Ute Gleiss, Germany

_Abstract

In implantology and accompanying dental surgery the laser has many advantages in comparison to conventional methods. Presenting three patient cases the use of lasers is demonstrated in the preimplantologic indication (improvement of soft-tissue situation) and the postimplantologic indication (implant exposure, periimplantitis therapy).

_Introduction

Since the beginning of its application in the dental therapy laser has experienced an unprecedented rise. The main cause for this rise are undoubtedly the specific benefits of dental lasers: they allow the practitioner a gentle, effective, minimally invasive work with shortened duration of treatment and at the same time meet the patients desire for a smooth, rapid treatment rather painless with little postoperative discomfort.[7, 9, 10] Especially in the field of implantology the laser treatment is very useful by its high bactericidal effects and the possibility of cutting almost without bleeding.

_Preimplantologic Indications

A stable soft tissue support is essential for the longevity of implants. The main objective of preimplantologic indication is to improve the subsequent soft-tissue situation. In particular mentioned are the frenectomy, the vestibuloplasty and the mukogingival surgery.[4]

The advantages of laser application in this area are precise careful cuts, a bleeding-poor and therefore better overseen field of working, reduction of bacteria in the operated area, low post-operative swelling and less scarring by significantly less myofibroblasts.[7, 9, 10]

Due to the low postoperative complaints the laser also experiences a high patient acceptance.

_Postimplantologic Indications

Main indications of the postimplantologic use of lasers are uncovering the implant and periimplantitis therapy.[4] The advantage of the application of lasers in implant uncovering is the immediately possible impression of the situation due to the reduced bleeding area and a faster healing without the requirement of removal of seams. However, adequate soft tissue support with adequate supply of attached gingiva is necessary and in aesthetically relevant areas the indication is limited. Especially in the domain of periimplantitis therapy laser-assisted procedures complete the conventional therapy, often they are even considered as the treatment of choice.[1, 3, 4, 11] The largest share of periimplantologic problems are seen (beside the biomechanical factors) in the bacterious–infectious etiology—a problem which is frequently connected to inadequate oral hygiene and/or reduced capacity for oral hygiene.

_Case 1

Fig. 1a_Frenectomy in the lower jaw — situation before excision.
Fig. 1b_Frenectomy in the lower jaw—after excision with the Nd:YAG laser.
Fig. 1c_Frenectomy in the lower jaw—after 3 days.

_Case 2

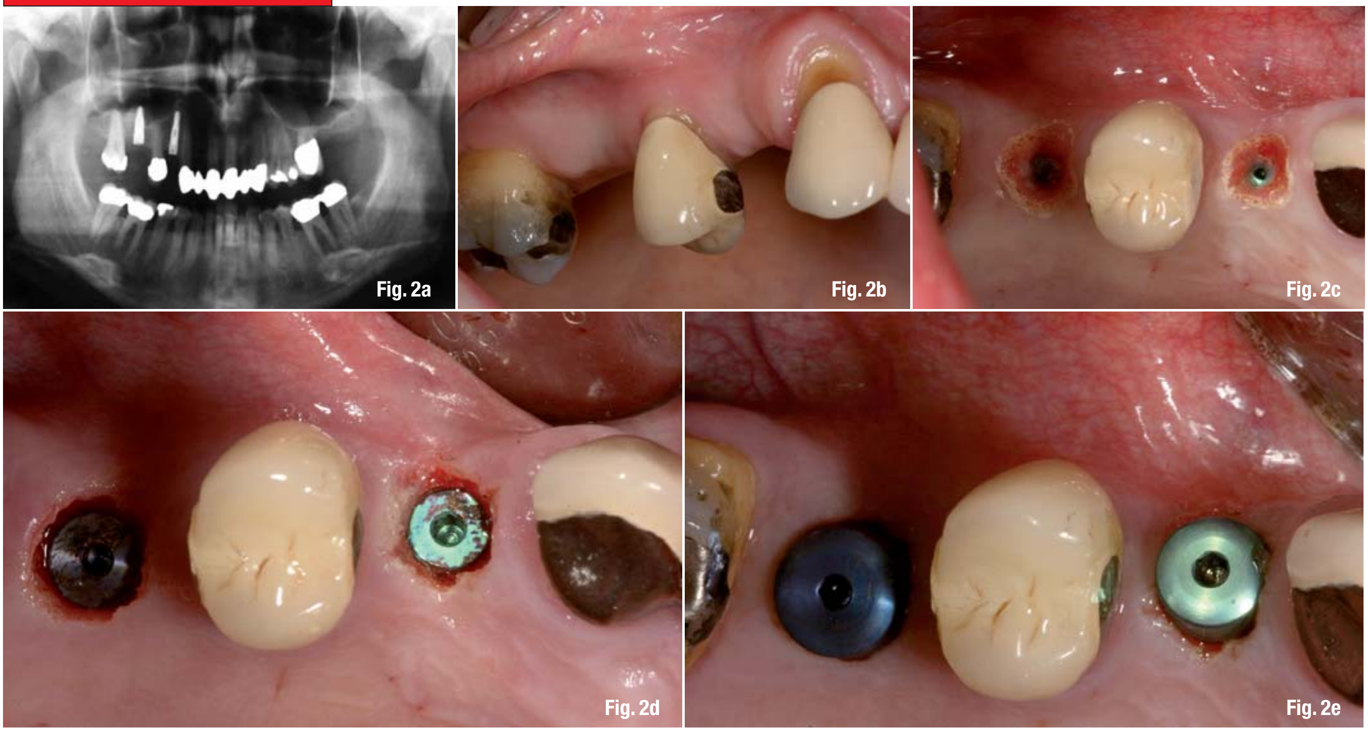

Fig. 2a Fig. 2b Fig. 2c Fig. 2d Fig. 2e

Decontamination in the gingival pocket plays a central role in the treatment of this plaque-induced disease. In this cases the use of the laser light is of great importance.

In literature there are described two basic procedures:

1. The first is the pure decontamination of implant surface and surrounding tissue preferably performed with diode lasers (810 nm and 980 nm) or the CO_2 laser (10,600 nm) after previous cleaning with hand instruments,
2. The second is an ablative procedure with decontamination (concerning granulation, concrements, infected bone and tissue), preferably performed with the Er:YAG laser (2,940 nm) or the Er,Cr:YSGG laser (2,780 nm).[1,2,3,5,6]

While there already exist excellent long-term results for the pure decontamination (reducing the relapse rate from 30 % to 11 %[1,2,3], the advantage of the ablative procedure is to be seen in the cleaning of the implant surface, removal of the biofilm and additional cleaning of the surrounding bone.[1,6,11] Depending on the progression of periimplantitis different accompanying measures such as augmentation and membrane application can follow.[6] The extent of the disease determines the progress and the therapeutic approach. The purpose is to stabilize the periimplantologic structures and avoid the loss of the implant and the bone defects often associated. Due to the increasing number of submitted implants, the development of the age structure of patients and thus possibly associated loss of manual skills, a progression of periimplantitis can be foreseen. The use of lasers represents a significant expansion of therapeutic range and opens new possibilities for preserving the implant. It also offers innovative enhancements in the treatment spectrum in form of possible implant bed preparations carried out only with the laser.

_Conclusion

Evidence-based clinical trials show that application of lasers has many advantages compared to conventional methods especially in the domain of implantology and accompagnying dental surgery. It is a highly effective, precise and gentle treatment instrument and the only instrument of a high patient acceptance. The dynamism in research and development and the change of age structure of patients will let expect large patient collectives. The application of lasers represents a significant expansion of therapeutic range and offers promising visions for the future.

_Case Presentations

Case 1: Frenectomy in the lower jaw

A 54-year-old female patient presented with problems with her prothesis in the lower jaw. Before placing implants in the posterior region a frenectomy regio 31 had to be performed. Using local anesthesia a Nd:YAG laser (Fotona/Fidelis Plus) with the setting: VSP (pulse duration about 100 microseconds), 2 W, 20 Hz, 300 micron fiber was applied. After excision there could be found

Fig. 2a_Implant exposure—radiography.
Fig. 2b_Implant exposure—situation before excision.
Fig. 2c_Implant exposure—uncovering screws using an Er:YAG laser.
Fig. 2d_Implant exposure—screws exposed.
Fig. 2e_Implant exposure—healing abutments placed.

_Case 3

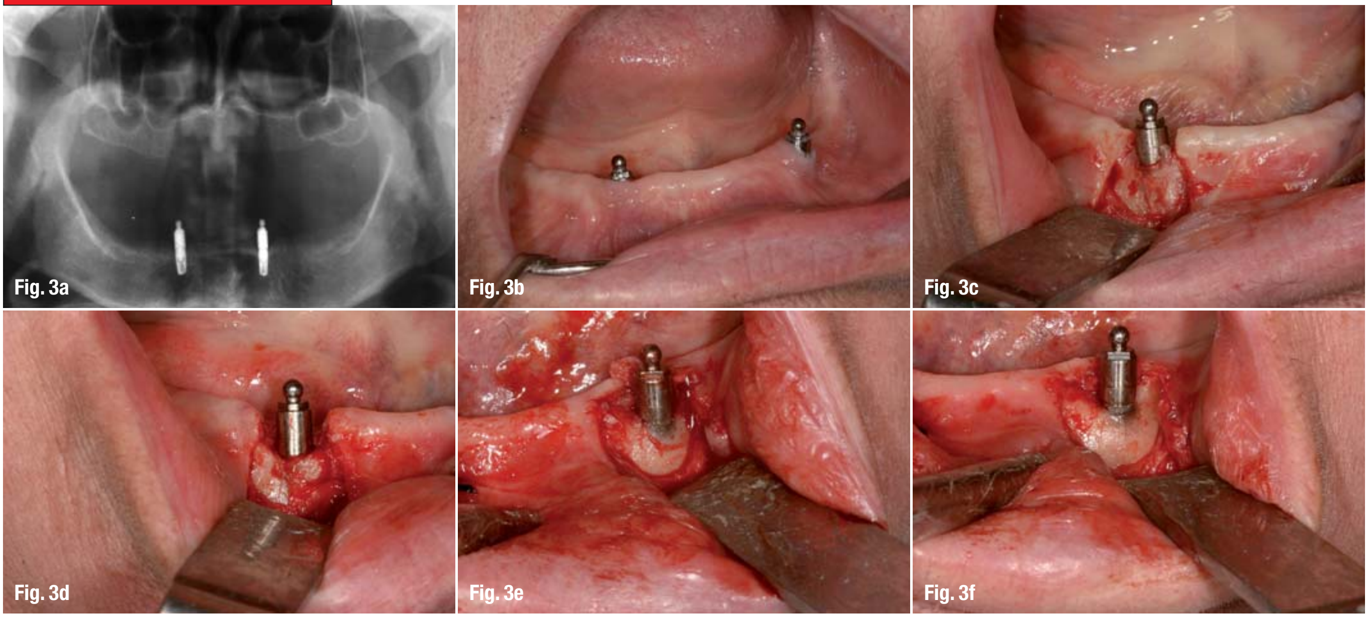

Fig. 3a_Periimplantitis therapy—radiography.
Fig. 3b_Periimplatitis therapy—situation before excision 43, 33.
Fig. 3c_Periimplantitis therapy—showing the granulation regio 43.
Fig. 3d_Periimplantitis therapy—after removal of granulation using an Er:YAG laser regio 43.
Fig. 3e_Periimplantitis therapy—showing the granulation regio 33.
Fig. 3f_Periimplantitis therapy—after removal of granulation using an Er:YAG laser regio 33.

neither post operative swelling nor complaints. The control after three days showed a significant improvement in the region of the gingiva regio 31.

Case 2: Implant exposure

A 51-year-old female patient wanted a quick, pain-free uncovering of the implants placed regio 14 and 16 after sinus elevation. Given sufficient attached gingiva the implant exposure was performed with an Er:YAG laser (Fotona/Fidelis Plus) setting: LP (pulse duration approximately 500 microseconds), 200 mJ, 20 Hz using local anesthesia. While uncovering the implants no bleeding could be noticed. An immediate impression of the situation after exposure of the implants was carried out. Neither swelling nor complaints could be noticed subsequently.

Case 3: Periimplantitis therapy

A 71-year-old female patient in good health presented with recurring pain in the region of the implants inserted alio loco regio 43 and 33. The radiography showed a generalized horizontal bone resorption with vertical drops regio 43 and 33. After preparation of a mucogingival flap the granulation regio 43 and 33 was removed using an Er:YAG laser (Fotona /Fidelis Plus) with the setting: SP (pulse duration approximately 275 microseconds), 15 mJ, 15 Hz. Local anaesthesia was used, an augmentation was not necessary.

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Use of the Erbium Laser to Treat Abnormal Frenum Attachments in Infants

author_Fred S. Margolis, USA

Fig. 1_Mark V., Age 3 months with severe ankyloglossia.
Fig. 2_Mark V., Age 3 months lingual frenectomy immediate post-surgery.
Fig. 3_Mark V., Age 3 ½ mos. 10 days post-surgery.
Fig. 4a_Mark V., Four years post lingual frenectomy exhibiting range of tongue.
Fig. 4b_Mark V., Four years post-frenectomy with normal lingual frenum.
Fig. 5a-b_Mark V., Seven years post-frenectomy.

_Case 1


Fig. 5b

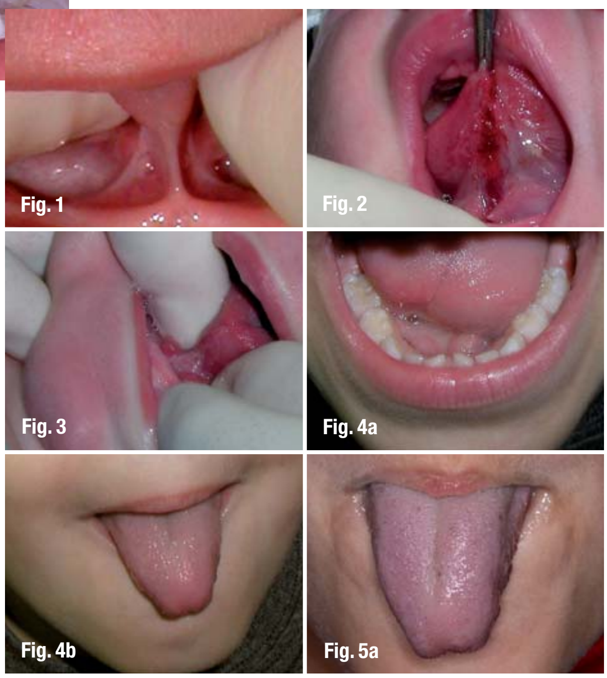
Fig. 1 Fig. 2 Fig. 3 Fig. 4a Fig. 4b Fig. 5a

_Abstract

Ankyloglossia (tongue-tie) is a relatively common condition in newborns. Affected infants have difficulty latching onto the breast nipple and thus have inadequate milk transfer, and subsequent maternal nipple pain, resulting in untimely weaning. An abnormal maxillary labial frenum may prevent proper latching onto the breast nipple, also preventing the infant to obtain adequate breast milk. The author will illustrate using case reports how the frenectomy procedure can be performed utilizing an Erbium laser.

_Introduction

Ankyloglossia is a developmental anomaly of the tongue characterized by a short, thick, lingual frenum resulting in limitation of tongue movement. The severity of the short frenum is variable and ranges from a light degree without clinical importance to a complete ankyloglossia with the tongue fixed to the floor of the mouth.[1] Ankyloglossia can lead to breast-feeding problems, atypical swallowing habit, speech problems, as well as preventing mouth cleaning of the buccal vestibule. The tongue-tie can also favor orthodontic and orthopedic anomalies.[1] Ankyloglossia can "be diagnosed when the length of the free-tongue (length of the tongue from the insertion of the lingual frenum into the base of the tongue to the tip of the tongue) is 16 mm or less."[1] Wallace and Clark concluded that the "benefits of breast feeding are well know and lactation consultants are becoming more aware of tongue-tie as a treatable cause of breast feeding difficulty."[2] Dollberg, et al., stated: "Ankyloglossia occurs in nearly 5 % of neonates..." They further state that there was a significant decrease in nipple pain after frenotomy in breast-fed infants with ankyloglossia.[3] They concluded that "frenotomy is an effective therapy for these difficulties."[3] Ballard et al., described the Hazelbaker assessment tool for lingual frenum function. They state: "in children older than four months, anesthesia is usually required because of the infant's strength and awareness. In early infancy, however, the procedure may be accomplished without anesthesia and with minimal discomfort to the infant."[1] Gontijo, et al., described a case of a labial frenum in an infant necessitating the frenectomy procedure.[4] The purpose of this article is to present two cases where infants exhibited frenums that were abnormal which resulted in difficult nursing. Surgical treatment with an Erbium laser was utilized to incise the frenum to release the tongue.

_Case 1

Mark V., age 3 months, a white healthy male, had difficulty in breastfeeding due to ankyloglossia (Fig. 1). Mark's twin sister had no difficulties in breastfeeding and was not tongue tied. The patient's mother reported that the baby was losing weight due to inability to obtain adequate breast milk. Informed consent was obtained. The patient's and parent's eyes were protected in addition to the operator and assistant. The patient was placed on the mother's lap with the patient's head on the mother's shoulder. A topical anesthetic (20 % benzocaine) was applied for 30 seconds prior to the injection of 0.6 cc. of 2 % lidocaine 1:100,000 Epinephrine which was placed on the floor of the mouth and the tip of the tongue. Utilizing an Erbium:YAG laser at 50 mJ, 30 Hz, no water and no air, high speed evacuation, and a hemostat to elevate the tongue, the lingual frenum was excised (Fig. 2). The remaining tissue was coagulated utilizing the Erbium laser at 10 mJ, 30 Hz, 0 % air, 0 % water. The procedure took five minutes. The patient returned in ten days for post-surgical examination (Fig. 3). Mother reported patient was feeding better and had gained weight. The patient returned in one month and every six months for recall examination. The patients' photos at four years and seven years post-surgery are shown in Figures 4a, 4b, 5a, 5b .

_Case 2

Hannah's mother informed the author that her infant was two weeks old and could not latch onto the breast nor bottle nipple due to an abnormally heavy frenum. Hannah was losing weight and the pediatrician had referred the patient to an otorhinolaryngologist (ENT) for a frenectomy procedure. The mother informed me that the ENT suggested a treatment plan involving a general anesthetic, scalpel and sutures to excise the frenum. A pacifier was used to illustrate the problem the infant had in latching onto the nipple (Fig. 6). After informed consent was obtained, a topical anesthetic (20 % benzocaine) was placed on the maxillary labial frenum (Fig. 7). Appropriate laser specific eye patches were placed over the infants' eyes. The mother's, operator's and assistant's eyes were also protected with appropriate wavelength safety glasses. An Er,Cr:YSGG laser (2,980 nm) (Biolase Technology™) was utilized with a MZ-6 tip at 2.0 W, 35 Hz, 0 % air, 0 % water. Excision of the frenum was performed. The procedure took 5 minutes. The tissue was coagulated to stop the bleeding with the laser at 0.5 W, 35 Hz, 0 % air, 0 % water. The patient's mother called me four days after surgery to report the infant had gained four ounces in the previous four days. The patient was seen for follow-up examination in one week (Fig. 8). The patient was seen again at one month with normal healing observed. _

_Case 2

Fig. 6

Fig. 7

Fig. 8

Fig. 6_Hannah N., Two weeks showing poor sucking ability due to heavy labial frenum.

Fig. 7_Hannah N., Two weeks exhibiting heavy labial frenum.

Fig. 8_Hannah N., One week post-surgery.

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Temperature Changes in Periodontal Tissues

Root canal treatment under irradiation with Diode Laser of 980 nm in sheep teeth

authors_Anastasios Manos,Greece, Norbert Gutknecht, Germany

_Abstract

The aim of this study is to examine if two different modes (CW-Chopped) with different power settings and irradiation time can rise the temperature of the periodontal tissues above 47 °C under root canal irradiation with diode laser of 980 nm and also see if the temperature rising has any correlation to the root length.

40 single root sheep teeth (the two lower central incisors) were endodontically treated with the step back technique. The root canal length was controlled with Schick 2.6 digital intraoral X-ray system. The 40 teeth were divided in two groups with 20 teeth in each group; one was irradiated with CW (Continuous wave) and the other one with chopped mode. The irradiation of the root canal was done with a 200 µm optical fiber. The power and irradiation time was different in both emission modes. In order the start temperature to be the same as the normal living tissue temperature, a warm bath was used with temperature in 37 °C checked with an inbuilt quicksilver thermometer. The temperature in the periodontal tissues was registered by a thermocouple in three different areas of the root length (1/3 coronal, 1/3 middle, 1/3 apical). The results were statistically analyzed with SPSS 13 statistical package.

The results have shown that the temperature never went above the 47 °C, temperature threshold for bone necrosis. There was a very strong correlation between the root length, the total irradiation time and the temperature rising in the CW mode and a weak correlation in the chopped mode. As a conclusion we can say that the diode laser 980 nm can be used for endodontic treatment without any risk for periodontal tissue damage with the power and irradiation time settings used above.

Table 1_Descriptive statistics of the temperature results.

VARIABLES	MISSING	VALID	MEAN	MEDIAN	STD. DEV	MIN.	MAX.
CW. APICAL	0	20	41.66	41.10	1.61	40.00	46.70
CHOPPED. APICAL	0	20	38.99	38.90	0.43	38.30	39.90
CW. MIDDLE	0	20	41.34	40.85	1.65	39.70	46.30
CHOPPED. MIDDLE	0	20	38.78	38.70	0.40	38.30	39.70
CW. CORONAL	0	20	41.13	40.60	1.69	39.60	45.90
CHOPPED. CORONAL	0	20	38.67	38.65	0.39	38.00	39.50
ROOT CANAL LENGTH -- CW	0	20	17.49	16.05	3.20	14.00	28.00
ROOT CANAL LENGTH -- CHOPPED	0	20	17.49	16.05	3.20	14.00	28.00

_Introduction

The history of observations on the pulp biology and the dental procedures to relieve the patient from the pulp pain is going back to ancient times. The relation between caries and pulp pain from the inflamed pulp is recognized in very old writings.

Since these old days reports have been found that ancient Greeks were trying to performed root canal treatments in order to relieve the patient from the pulp pain by hermetically sealing the root canal system of the tooth after disinfecting it with cauterization, by putting small trephines of very hot iron in to it.

In the modern days root canal treatment is achieved by removing the pulp from the root canal with different files (K-files, H-files) and different techniques. At the same time disinfection of the root canal and the dental tubuli can be achieved with a lot of different solutions such as NaOCl, Chlorhexidin, H_2O_2, Iodine, EDTA, or pastes such as $Ca(OH)_2$ with some times good and some other times not so good results.[1, 2, 6, 11, 12, 16] It seems that some of the bacteria are penetrating deeper in the dental tubuli making more difficult for the chemical solutions or pastes to penetrate that deep to kill them or that the bacteria itself is resistant to these solutions and pastes such as the bacteria *Enterococcus Faecalis* is, presenting a reservoir for future infections and risk for failure of our treatment.[1, 2, 5, 6, 8, 11, 12, 14, 16, 17]

An answer to this problem could be the different Laser systems which have given good results in disinfecting the deeper layers of the dentin.[5, 8, 13, 14, 17]

One of the ways that the Laser works on the tissues and on the bacteria is by being absorbed by them. The photons of the laser beam are absorbed from the bacteria or the tissues, giving their high kinetic energy to them which is transformed to thermal energy. In this way, temperature in the tissues and/or in the bacteria rises and kills the bacteria. The question which always comes up is if this temperature rising in the tissues is big enough to be transmitted to nearby tissues and create thermal damage to them.

During the recent years research was done with different types of Lasers (Nd:YAG, KTP, Diode 810 nm, Er:YAG, Ho:YAG, Er,Cr:YSGG) in order to answer this question. These research projects have shown no damaging thermal effect in the periodontium when different types of Lasers are used for disinfection of the root canal during the root treatment.[4, 7, 9, 10, 13, 14, 15]

The aim of this study is to investigate in vitro if the temperature changes in the periodontal tissues of sheep teeth exceed the thermal bone necrosis threshold[3] of 47 °C or not when we use a Diode 980 nm Laser for the disinfection of the root canal.

_Materials and Methods

Forty sheep teeth, the central incisors of the lower jaw, were drilled and endodontic treated with H-files up to nr. 50. The teeth were rinsed with NaOCl solution following the root treatment procedure for the human teeth in order to remove the smear layer as much as possible[11], and dried out with paper points. X- rays were taken from all the teeth involved with the Schick 2.6 digital X-ray system in order to control and measure the root canal length and also to control the placement of the electrodes from the thermocouples which were used to measure the temperature rising inside the periodontium. The electrodes of the thermocouples were placed in three different places in the periodontium in the vertical dimension (1/3 apical, 1/3 medial, 1/3 coronal). The front section of the sheep jaw with the treated teeth involved in the study was stabilized in a gyps base. The forty teeth were divided in two groups of twenty teeth in each group. The two central incisors in each jaw were used in the study. The first group (the right one) was irradiated with a power of 2 Watt in continuous wave (CW) and the second group (the left one) with a power of 3 Watts in Chopped mode with 10 ms the Laser radiation on and 10 ms the Laser irradiation off. Before the irradiation the section of the sheep jaw with the root treated teeth was put in a warm bath in order to simulate the normal tissue temperature of 37 °C as a start temperature for our experiments. The temperature was double checked with the thermocouples and an inbuilt quicksilver thermometer in the warm bath. In order to have a dry root canal even inside in the warm bath a rubber dam cover was used to insulate the opening of the root canal from the water. A diode 980 nm laser was used in the study with an optical fiber of 200 µm in diameter. Before every irradiation a calibration of the output power was done with an inbuilt calibration device in the Laser instrument.

The optical fiber was inserted into the root canal until the root apex was reached. Then the optical fiber was moved 1 mm back from the apical contact and the irradiation started with circular movements in contact to the root canal wall from the apical to the coronal area. The irradiation time was for CW mode 2 mm/sec while for the Chopped mode was 5 sec.

_Results and statistical analysis

The results of the temperature measurements during the experiments were registered in tables and a statistical analysis was done with the use of SPSS 13 statistical package. The differences in temperature between results of the irradiations in the two emis-

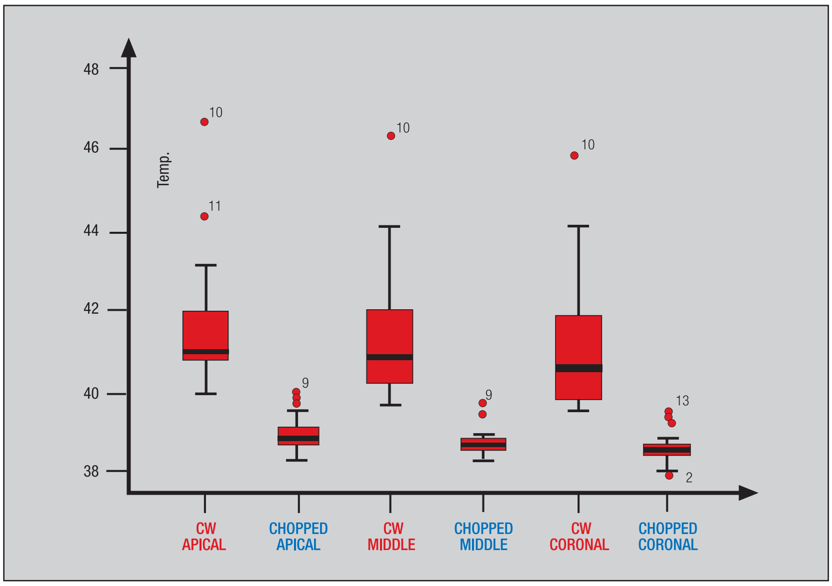

Diagram 1_The temperature rising in all the measurement places in CW and Chopped mode

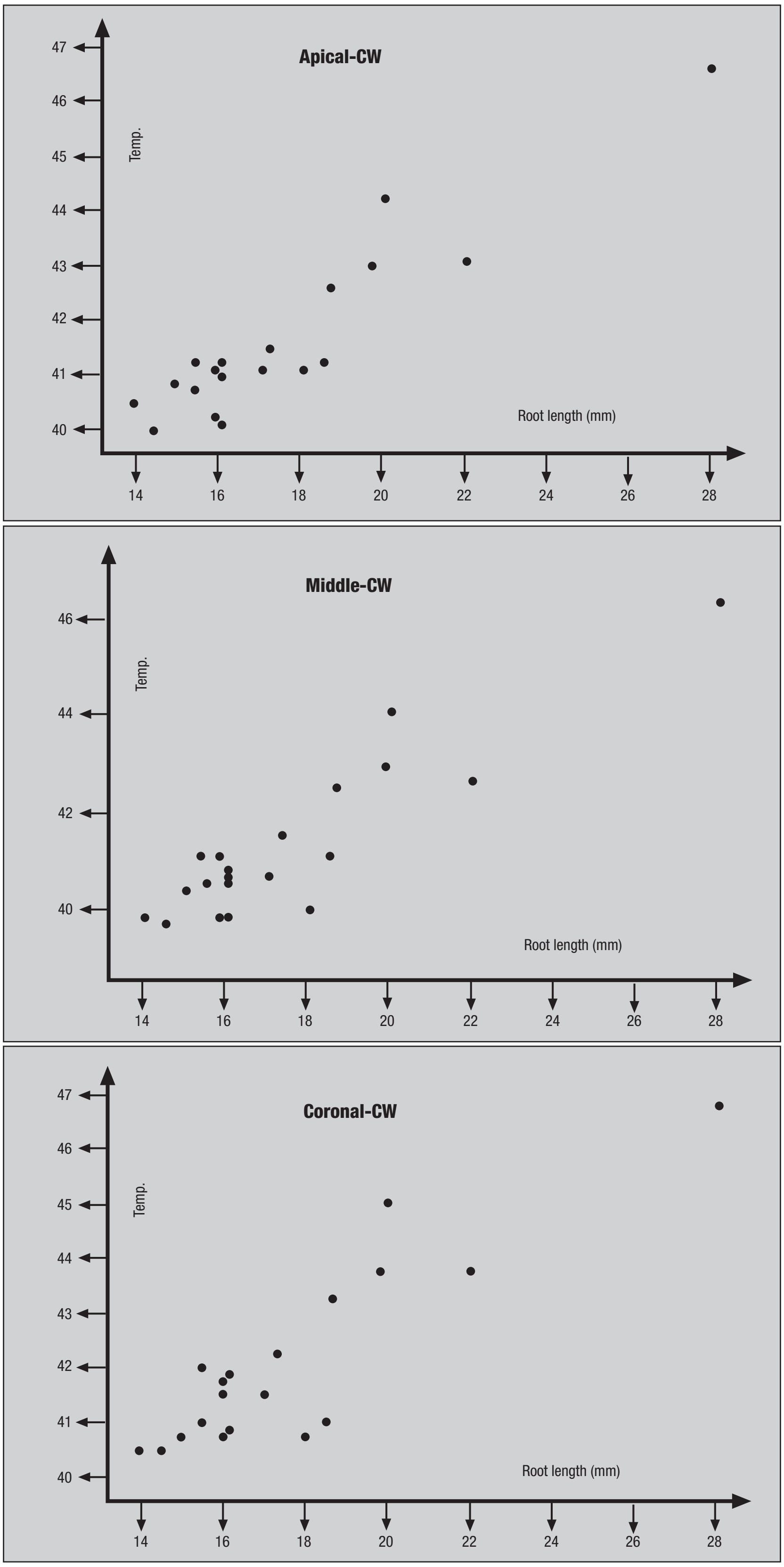

Diagram 2_The correlation between the root length and the temperature rising in CW mode in all the measurement places in periodontium.

sion modes and the three measurement places in the periodontium were tested with the Wilcoxon test. The relation between the total root length and the temperature was controlled with the Pearson's correlation coefficient.

The descriptive results for the temperature found in all the measurement places in the periodontium in both emission modes (CW, Chopped) are given in table 1.

It is obvious, from table 1 that in all the places in the periodontium in both emission modes the temperature rising does not exceed the temperature threshold point of 47 °C. The distribution is better seen in the box plot in the diagram 1 where it becomes obvious that the temperature rising is much higher for the CW-mode than for the Chopped mode. We can also see that the highest temperature is present in the apical area for both the CW and Chopped mode and the lowest in the coronal area.

The formal analysis shows that the value of 47 °C is not possible for the temperature rising in all the measurement places in the periodontium in both the emission modes.

The temperature, three times the typical divergence for the mean value of every measurement place in the periodontium for both the CW and Chopped mode was calculated and found to be:

- _For the CW mode: 46.5 °C in the apical 1/3, 46.3 °C for the middle 1/3, 42.2 °C for the coronal 1/3.
- _For the chopped mode: 40.3 °C in the apical 1/3, 40.0 °C in the middle 1/3, 39.8 °C in the coronal 1/3.

These temperatures can be considered the logical upper limit of the distribution of the temperature and the possibility to find, in such experiments, temperature values above these limits are 0.13 %.

Especially for the temperature value of 47 °C the possibility to have such a temperature rising is:

- _For CW mode: 0.046 % in the apical 1/3, 0.030 % in the middle 1/3, 0.026 % in the coronal 1/3.
- _For the Chopped mode is 0 % in all the three measurement places.

The differences between the CW and Chopped mode in the temperature rising was found to be statistically significant for all the measurement places.

The mean differences were:

- _For the apical 1/3: 2.67 (sd = 1.562, t = 7.651, $p < 0.001$)
- _For the middle 1/3: 2,57 (sd = 1.707, t = 6.719, $p < 0.001$)
- _For the coronal 1/3: 2.46 (sd = 1.777, t = 6.191, $p < 0.001$)

There was a very strong correlation between the root length and the temperature rising in all the three measurement places in the periodontium for CW mode. For the Chopped mode the correlation was weak.

The Pearson's correlation coefficient between the root length and the temperature rising for the CW mode was:

- _For the apical 1/3: 0.932 ($p < 0.001$)
- _For the middle 1/3: 0.907 ($p < 0.001$)

_For the coronal 1/3: 0.886 ($p < 0.001$)

The Pearson's correlation coefficient between the root length and the temperature rising for the Chopped mode was:

_For the apical 1/3: 0.393 ($p = 0.086$)
_For the middle 1/3: 0.211 ($p = 0.371$)
_For the coronal 1/3: 0.113 ($p = 0.634$)

The correlation between the root length and the temperature rising in all the three measurement places in the periodontium are better visualized in the graphs in diagram 2.

The graphs in diagram 2 make obvious that the longer the root length is the higher the temperature rising. This happens because the longer the root length is, the longer is the irradiation time in the CW mode.

The correlation between the root length and the total irradiation time in CW mode was also very strong. This correlation was:

_For the apical 1/3: 0.930 ($p < 0.001$)
_For the middle 1/3: 0.910 ($p < 0.001$)
_For the coronal 1/3: 0.895 ($p < 0.001$)

That is the reason why it is expected to find a very strong correlation between the temperature and the total irradiation time in CW mode.

_Discussion

Based on the established practice, it could be easier or more difficult to disinfect the root canal, depending on the type of the bacteria and their location in the root canal and the dentinal tubule.[1, 2, 5, 6, 11, 12, 16]

During the years different methods were tried in disinfecting the root canal and the deeper layers of the root canal walls with $Ca(OH)_2$ pastes, or NaOCl, H_2O_2, EDTA, Iodine solutions with different success rate.[1, 2, 6, 11, 12, 16] Some bacteria, e.g *Enterococcus Faecalis*, can not be killed or are imbedded far away from the reach of the disinfecting solutions deep inside the dentinal tubuli. An answer to the problem of reaching out and killing these bacteria is to use different Laser systems.[5, 8, 13, 14, 17]

In this study we tried to find out if the temperature in the periodontium rises in such a high temperature that exceeds the threshold point of bone thermal damage while using a diode 980 nm Laser with different power settings in the two modes (CW and Chopped) for disinfecting the root canal.

In 1983 Eriksson and Albrektsson reported in their article in the Journal of Prosthetic Dentistry that the temperature threshold for bone necrosis is 47 °C for 1 min.[3]

Researchers were trying to find the answer to this question using different types of Lasers such as diode 810 nm Lasers, Nd:YAG Lasers, Er,Cr:YSGG Lasers, Er:YAG Lasers and 2ΩNd:YAG (KTP) Lasers. All of these different research projects gave different results not only because of the different Laser types which have different absorption in the root canal walls but also because of the different power settings used in these projects. In all of these projects the temperature rising was ≤ 10 °C. That means ≤ 47 °C which is the temperature threshold for bone necrosis.[4, 7, 9, 10, 13, 15]

Looking at these projects separately we can see that in 1997 Klinke, Klimm, and Gutknecht, reported that during irradiation of the root canal with an Nd:YAG Laser, the temperature rising was kept locally in the root canal wall and was not transmitted into the deeper layers of the dentin.

At the same year, (1997) Moritz, Gutknecht, Gorharkhay, Shoop, Wernish, and Sperr, had irradiated root canals with diode 810 nm Laser with power of 4 watts in Chopped mode 10 ms on and 10 ms off, with irradiation time in 5 seconds. They found out that the maximum temperature rising on the root surface was 6 °C when the fiber was used with circular movements in the root canal. In 1999 Wan-Hong Lan had irradiated root canals with Nd:YAG laser in order to see the temperature elevation on the root surface. He found that the temperature never exceeded the 10 °C if the energy was 100 mJ/pulse, the pulse rate 20 pulses/ sec and the irradiation time of 15 sec. The increase of irradiation time resulted in increased temperature elevation which is in agreement with our results and conclusions. In 2004 Ishizaki, Matsumoto, et al., have shown that the average temperature rising on the root surface during root canal irradiation with Er,Cr:YSGG Laser was less than 10 °C.

In 2004 Shium Lee et al., have shown that the temperature rising on the root surface, was not only depended on the shape of the tip (flat or conical) but also to the dentine's conductivity, diffusivity and heat capacity. During the same year (2004) Namour, Kowaly, Van Reck, Rocca, were measuring the thermal elevation on the root surface during root canal irradiation with a 2ΩNd:YAG (KTP) Laser and found that the temperature rising never exceeded the 7 °C. In 2005 Gutknecht, Franzen, Meister, Vanweersch, Mir were investigating the temperature rising on the root surface during the root canal irradiation with a diode 810 nm Laser. They found out that with the power of 4 Watts and irradiation time of 5 sec., the thermal elevation in the apical 1/3 was 7 °C.

During our study we investigated the thermal elevation in the periodontium in sheep teeth in vitro during root canal irradiation with diode 980 nm Laser. The results of temperature rising can be correlated with the root length and the irradiation time.

The measurements and the statistical analysis have shown that no elevation of the temperature in the periodontium exceeded the threshold level of 47 °C a result that is in agreement with earlier studies with different types of Lasers. Looking at table 1 of our experiments it becomes obvious that the temperature elevation in the periodontium has always been less than 10 °C in all the measurements places, both for the CW and Chopped mode, even if the maximum temperature registered in the CW mode was very near to that point. The statistical analysis has shown that it is very unlikely to have temperature elevation above the temperature threshold point of 47° C in the Chopped mode with the possibility being 0, while for the CW mode this possibility is very small.

The differences between the measurement places in CW and Chopped mode separately, were also significant with the highest temperature being in the apical 1/3 and the lowest in the coronal 1/3.

The total root length had a very strong correlation with the temperature elevation in CW mode. The total irradiation time had also very strong correlation with the temperature rising in CW mode which was in agreement with an earlier study.[9] The same correlation for the Chopped mode was very weak because the total irradiation time had a standard value of 5 sec. The study has shown that the longer the irradiation time or the longer the root length, the higher the thermal elevation is in the periodontium in CW mode.

_Conclusions

As it is mentioned in earlier studies, also in our study, the temperature elevation in the periodontal tissues during the root canal irradiation with 980 nm Laser was never greater than the thermal bone necrosis threshold point of 47 °C. It is expected to have lower temperature elevation in living tissues due to the blood circulation in the periodontal tissues.

More research has to be done concerning the effect of dentine's conductivity, diffusivity, and heat capacity in order to understand better the temperature transportation between the dental and oral tissues.

Finally as a conclusion we can report that there is no risk for thermal bone damage in the periodontium under irradiation of the root canal with diode 980 nm Laser, as long as we do not exceed the working parameters of this study.

The literature list can be requested from the editorial office.

_contact laser

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Summery of a Microbiological In Vivo Comparison of Conventional Periodontal Treatment and Periodontal Treatment Assisted by KTP Laser

author_Peter Steen Hansen, Denmark

_Abstract

The study aim was to compare the results of a KTP laser therapy used in adjunct to scaling and root planning (SRP), and of SRP alone, in a small group of patients with early to moderate periodontitis.

Ten adult patients with periodontitis were treated according to split-mouth design, using Protocol A (KTP laser therapy combined with SRP) or, Protocol B (SRP alone). At baseline, and three months after the treatment four different periodontal pocket pathogenic populations growth pattern was evaluated.

The statistical analysis of the collected date has been achieved using Wilcoxon test (paried sample at chosen significant level of 0.05).

The Results revealed that there was statistically significant difference in the bactericidal efficiency of both treatment protocols noted before and after the treatment between the treated quadrants on the stage of 3 months post-operative investigation, while the differences was not significant at the immediate investigating stage. Moreover, the results showed a significant difference in the efficiency of KTP laser therapy combined with SRP in suppressing the isolated pathogenic germs re-growth compared to SRP alone therapy.

On conclusions, Non-surgical periodontal therapy using a KTP laser + SRP lead to significant improvements in all the investigated clinical parameters. The combined treatment using laser as an adjunct to scaling and root planning seemed to be advantageous when compared to SRP alone, due to more efficient bactericidal efficiency.

_Aim of the Study

The aim of our clinical study was to investigate a closed curettage therapy assisted by KTP-laser

Fig. 1_SmartLite KTP laser machine, DEKA, Italy.
Fig. 2_KTP laser system display screen demonstrating laser treatment parameters.

Fig. 1

Fig. 2


Fig. 3


Fig. 4

Fig. 3_Representative photographs.
Fig. 4_Representative Photographs demonstrating the sample collection.

system in comparison with conventional therapy. Our purpose was to answer the following questions:

1. Investigate the bactericidal effect of KTP laser assisted periodontal treatment on different bacterial species including *Aggregatibacter actinomycetemcomitans*, *Tannerella forsythia*, *Porphyromonas gingivalis*, and *Prevotella intermedia*.
2. Would KTP laser assisted treatment enhance periodontal healing after debridement?
3. Would KTP laser assisted treatment facilitate instrumentation and root planning?
4. Would KTP laser assisted treatment provide sufficient analgesia during the application?

_KTP Laser system

If a Nd:YAG laser is combined with a non-linear crystal (such as KDP, KTP etc.) light can be emitted at other wavelengths.

One of the newest laser wavelengths which have been established in dentistry is KTP laser system.

It is a combination of Nd:YAG laser (1,064 nm) and a KTP crystal. The system emitting at 532 nm, representing a frequency-doubled Nd:YAG device (green-light laser). The abbreviation "KTP" stands for "Kalium-Titanyl-Phosphat" meaning Potassium-Titanyl-Phosphate.

The systems has been introduced mainly for tooth-bleaching procedures but still studies showed that this specific wavelength have a promising antibacterial

Fig. 5a

Fig. 5b

Figs. 5a–b_Representative photographs demonstrating the control group SRP treatment.

capability and it is suitable for the disinfection of even the deeper layers of dentin and equal the results achieved by established wavelengths in state-of-the-art endodontics.

Its way of action/ working is the same as other diode lasers. There is no real pulsing. Real pulsing means, the shorter the pulse at a certain pulse energy, the higher the peak power, so the average power output stays the same. In diode lasers, the laser beam is not pulsed but just interrupted, gated with a shutter, which means that the pulse power has no peaks and the average power output at the end of the fibre decreases.

The use of KTP laser beams in dentistry and especially as a root planning complement may be of some interest because, after conventional scaling, it might be ideal to sterilise the root surface without pulpal damage, especially in the case of chronic infection with bone defects and pocket formation.

Before any eventually clinical use, it is wise to define the safety parameters and harmless irradiation conditions for the use of KTP laser beam in order to avoid any overheating of vital tissue.

_Study design

The study was performed according to a split-mouth design. A total of 15 maxillary and 5 mandibular pairs of teeth, of contra-lateral single- and multi-rooted teeth were included. The mouth quadrants have been divided to receive certain treatment protocol as follow:

1. Quadrant 1 & 4: received conventional scaling and root planning (SRP) using periodontal hand instruments. In this current study this group will be referred to as "Control group".
2. Quadrant 2 & 3: received conventional scaling and root planning (SRP) + laser treatment with KTP laser system. In this current study this group will be referred to as "KTP laser group".

Each tooth of each contra-lateral pair had to exhibit gingival inflammation with a positive BOP, subgingival calculus and a PD of 4–7mm on at least one aspect of the tooth. In each contra-lateral pair one tooth was randomly treated with the combination of a KTP laser and subgingival scaling and root planning using hand instruments, while the other tooth was treated conventionally using hand instrument alone. The distribution of the two treatment modalities was equally divided between the right and left sides. All patients were treated by a highly experienced operator.

_Oral hygiene program (pre-treatment sessions)

For 4 weeks before treatment all patients were enrolled in a hygiene program and received oral hygiene instructions on 2.4 appointments, as well as professional tooth cleaning according to individual needs.

All patients individually have received a care-plan and was informed and showed how to clean their teeth & mouth emphasizing on the teeth quadrants included the test with help of inter-dental-brushes (Curadent). Moreover, pocket depth measurement by our clinic dental-hygienist in the chosen teeth has been obtained.

Finally, all participants have been informed to NOT use chlorhexadine for mouth-wash. as well NO intake of antibiotic and NO anti-depressive medicine.

Figs. 6a-c_Representative photographs demonstrating the KTP laser treatment protocol.

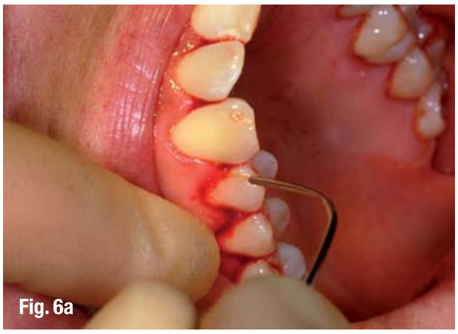

Fig. 6a

Fig. 6b

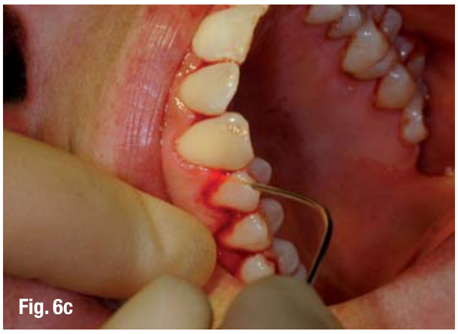

Fig. 6c

_Treatments protocols

SmartLite KTP laser (SmartLite, DEKA, Galenzano, Italy); frequency-doubled Nd:YAG laser, emitting at wavelength of 532 nm (visible green) (Fig. 1) was selected for laser treatment. The machine was used in pulse wave mode with an energy level of 150 mJ/pulse, 0.6 W , 50 ms pulse duration and a repetition rate of 10 Hz according to the instructions given by the manufacturer (Fig. 2).

The fiber tips of 300 mμ (DEKA) were chosen by the operator for periodontal pocket lasing. The treatment was performed from coronal to apical in parallel paths with a movement speed of approximately 1 sec. per each mm of measured pocket depth and with inclination of the fiber tip of 15.20 to the root surface.

The control group received conventional periodontic treatment procedure: SPR, scaling and root planning. The mechanical subgingival instrumentation was performed using Columbia LM curettes (LM-DENTAL, Rydontie 12A, Turku, Finland).

_Clinical flow chart

A. Treatment day

In each specific treatment day, the treatment was started by professional cleaning (to assure removing of all the plaque) and polishing, following that three pieces of sterile paper points (size 40) were introduced through the pocket sulcus of each individual selected teeth as far apically as possible and kept still for 15 seconds. On withdrawal of the paper point from the periodontal pocket, each piece was placed in a sterilized special laboratory plastic container in order to be used later on for the determination of the pre-treatment bacterial population (Figs. 3, 4).

Following that the full mouth treatment and the instrumentation for both test and control teeth was performed until the operator felt that the root surfaces were adequately debrided and planed (Fig. 5).

Only for the testing group this step was followed by insertion of the 300 μm periodontal laser tip/fiber inside the pocket and the device was activated and the whole root surface and the pocket area has been irradiated according to the parameter and protocol explained previously (Fig. 6). Each selected root surface was irradiated approximately for 15 sec. pro site (2 sec./mm pocket-depth) the procedure was applied twice; once before SRP and the other after SRP.

The time needed for treatment in the test groups, on average, was 6 min. for the SRP+ Laser group per each root. For the control group an average of 5 min. for each root was recorded.

The treatment procedure has been done completely free of anesthesia except for one patient.

Finally, for each treatment teeth for both group in all four quadrants, pockets were probed again by three pieces of sterile paper points for 15 second inside the deepest pocket, then were withdrawn slowly and placed in the laboratory plastic container in order to be used later on for the determination of the post treatment bacterial population indicating the immediate action feature for both treatment protocols.

B. Fourteen days recall session

In this session measurement of periodontal pocket-depth has been obtained for all treated teeth. Re-instruction has been done.

C. Three months recall session

In this session and depending on our previous experiences, instead of conventional cleaning of the relevant teeth, the teeth were just gently dried with a cotton pellet to remove the attached dental plaque and saliva in order to prevent any contamination that may lead to the alteration of the normal bacterial population, caused by pocket and gingival bleeding.

_Microbiological evaluation

The collected bacterial samples were divided according to the previously mentioned groups and subgroups. Then they were posted to LCL, Aachen Uniklinikum, Aachen, Germany.

For determination of the bacterial population and bacterial growth, each inoculated paper point cone removed carefully from the sterilized plastic box and analyzed using DNA probes & hybridization assay technique.

The DNA probes used (LCL Biokey GmbH, Aachen) were developed in a computerized comparison against 12,000 bacterial 16S rRNA/DNA sequences and then tested empirically against many bacterial species as well as against the human genome.

They proved to be (>99.99%) specific for *Aggregatibacter (*formerly *Actinobacillus) actinomycetemcomitans, Tannerella forsythia (*formely *Bacteroides forythus), Porphyromonas gingivalis,* and *Prevotella intermedia* respectively.

Nucleic acids were isolated by the aid of a QIAamp Blood & Tissue kit (QIAGEN, Hilden, Germany).

The dot blot hybridisation for (semi-)quantifying was performed according to the manufacturer (LCL biokey GmbH, Aachen) and standard procedures for the four following periodontal pocket pathogens:

1. *Actinobacillus actinomycetemcomitans*, gram-negative facultative anaerobe bacterial species.
2. *Bacterocides forsythus*, fastidious anaerobic gram-negative rod bacterial species.
3. *Porphyromonas gingivalis*, gram-negative oral anaerobic bacterial species.
4. *Prevotella intermedia*, a gram-negative, black-pigmented, obligate anaerobic rod bacterial species.

_Statistical analysis

After completing the final examination, the statistical evaluations were conducted by the statistical programs MedCal version 9.2.1.0 and Origin version 6.0. For all groups and as well subgroups the mean values and the standard deviation for different bacterial populations were calculated.

Furthermore; different inferential statistical functions at a chosen significance level of a = 0.05 was applied to identify the statistical differences between the main investigation groups as well as the subgroups.

Paired sample Wilcoxon test was used to determine significant differences between and within the groups. The level of statistical significance was set at P = 0.05.

_Discussion

The principal objective of periodontal therapy is to eliminate calcified deposits from periodontally diseased root surfaces and to minimize or reduce colonization of the subgingival compartment by periodontal pathogenic bacteria.

A variety of surgical and non-surgical modalities are available for the treatment of inflammatory periodontal diseases. Subgingival scaling and root planning are the most important procedures and clinical efficacy has been demonstrated in numerous clinical studies. This is in particular true for periodontal pockets with a probing depth of below 6 mm. With rising pocket depth, however, calculus removal and plaque control is often difficult and surgical flap procedures are recommended, allowing a better access and visual control of the root surface. Beside conventional scalers and curettes, ultrasonic systems are commonly used for the removal of subgingival calculus and bacterial plaque. Bactericidal chemicals as Chlorhexidine digluconate are useful adjuncts in the treatment of periodontitis.

On the other hand, laser applications in the field of periodontology have been of enormous scientific interest throughout the last decade and a variety of laser systems have been investigated in numerous in vitro and in vivo studies. In the treatment of inflammatory periodontal diseases, lasers may contribute to the bacterial reduction in periodontal pockets as well as to the removal of calculus and granulation tissue and can be used for contouring hyperplastic gingiva.

In this context, the laser mode of antisepsis has several potential advantages over traditional biochemical antibiotics in root disinfection, i.e. no side effect could be encountered, no evidence for development of bacterial resistance, no critical negative reactions; the local delivery mode is through light diffusion with spectrum of activity which covers a wide range of bacteria specially the dark pigmented pathogens.

The favorable mode of action of laser is contributed to the following points:

(1) A therapeutic dose can be delivered to a greater depth immediately and leaves no residual concentration.
(2) Laser radiation affects equally extracellular and intracellular pigmented pathogens and can access other privileged sites such as calculus and dentinal tubules.
(3) Laser antisepsis has no known systemic side-effects, resistances, or negative interactions with other modes of therapy.
(4) Laser energy has the potential to breach the protective mechanisms of biofilms.

However, in spite of many published articles concerning the effect of different laser systems in the periodontal therapy, our literature review of scientific and peer-reviewed literature revealed that no systematic comparative investigation has been performed to investigate the effect of 532 nm-visible green light laser wavelength in the field of periodontology. So it was the aim of our current in vivo clinical study to evaluate the effectiveness of the KTP laser as an adjunct therapeutic mean in combination with conventional SRP during periodontal closed curettage therapy and to investigate the bactericidal efficiency of this new laser system on the dominate pathogens present in the periodontal pockets.

Furthermore, according to Professor, Dr Conrads, LCL Biokey, the laser does not kill all the bacteria. It can be observed that the number of bacteria sampled from some sites is even higher immediately after treatment, especially when a laser has been used in the treatment procedure. This may be due to an increased sulcus fluid rate or by the release of more bacteria, that have been killed and thereby looses the ability to adhere to the sulcus or gingival since the used bacterial detection DNA-based method detects dead cells also.

Among all tested groups the only recorded statistical difference was found in *Porphyromonas gingivalis* species at three months post therapy stage.

_Conclusions

Under the circumstances of this clinical study and investigation, time limitations and the specification of the treatment protocol that have been used, it is our groups belief that the result of the study strongly indicate, that it is recommended to use a KTP-laser as a supplement in the treatment of periodontitis to assure an effective reduction of the periodontal pocket pathogens, and also in order to prevent a quick re-colonization of those pathogens in the pockets. In this way one can reduce the amount of antibacterial detergents and medical treatment.

Moreover, our clinical observations indicate that laser treatment reduced the need for conventional anaesthetics, resulted in diminished bleeding and enhanced visual control at debridement. The calculus deposits were very easy to remove after lasing._

_contact laser

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Comparative Evaluation of the Effect of Nd:YAG Laser and Chlorhexidine Gel

A Randomized Clinical Study

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_Abstract

Many studies have shown the inability of conventional periodontal treatments when used alone to completely eliminate pathogens existing in periodontal pockets. These studies have pointed out that adjunctive treatments such as laser or antimicrobial therapies may be effective in the complete elimination of such agents. The objective of the present study is to investigate the effects of SRP assisted by the two clinical treatment methods of laser or chlorine hexedine applications in comparison with SRP alone.

Materials and Methods: Six patients with average to severe chronic periodontitis were selected for this study. Each of the subjects had at least three pockets 4–7 mm deep. 28 randomly selected pockets were subjected to treatment by SRP, 40 pockets to Nd:YAG laser (100 mJ/Pulse 2Hz) 2W min, and 40 pockets were treated by chlorhexidine gel with a xathan base. The clinical indices (PI, BoP, CAL, and PPD) before and three months after treatment were measured and evaluated.

Results: The results revealed that SRP assisted by chlorhexidine gel and Nd:YAG laser therapies exhibits better results than SRP alone in reducing the probing pocket depth (PPD), in improving clinical attachment level (CAL), and in reducing bleeding on probing (BoP) ($P \leq 0.05$); no significant differences, however, were observed between the two laser and gel treatment methods ($P \geq 0.05$).

Results and Conclusion: The results from the present study revealed that in the treatment of periodontal pockets, SRP assisted by Nd:YAG laser and chlorhexidine gel has better effects on improving clinical indices than SRP alone. This can be due to the bactericidal effects of these two methods compared with the mechanical therapy.

_Introduction

An essential measure in the treatment of periodontal diseases is the complete elimination of the pathogenic agents, which is typically achieved by mechanical debridement of the microbial plaque.[1] However, the limitations of the application and effectiveness of this method warrants a set of adjunctive methods to be employed along with the more conventional treatment methods in order to maximize therapeutic effects. A number of antimicrobial agents and certain types of lasers have nowadays been proposed as Adjunctive methods in periodontal pocket therapies. The antimicrobial agents have a siecal deliverymenthods found wider applications since they create higher concentrations of the effective agent within the pocket and also because they are associated with fewer side effects compared with antibiotics. From among these, chlorhexidine has become the more common antiseptic agent used in combating microbial plaques and with a long history of utilization as mouthwash.[2] It has more recently come to be used in small chips and in gel form for the treatment of periodontal pockets, which owes its therapeutic effect in improving periodontal indices to its sustained release inside the pockets.[3-7] Vinholis et al[3] studied the effect of Chlorhexidine gel 1 % in periodontal therapy. They reported that the gel could be used as an Adjunctive material and that it is of value not only in the maintenance phase but even during treatment phase of periodontal therapy. Stratual et al.[4], Dinca et al.[5]

compared a Novel type of chlorhexidine—xanthan based called Chlosite combined with the Plakout chlorhexidine which lacks the xanthan base in the non-surgical therapy of periodontal pockets. They reported the sub-gingival application of Chlosite gel to be effective in improving periodontal indices, leading to reduced probing pocket depth (PPD) and increasing clinical attachment level (CAL).[4,5]

Numerous studies have also reported on the success rate of laser applications such as CO_2, Diode laser, Nd:YAG, and Er:YAG in the treatment of periodontal pockets.[8-14] Among these, Nd:YAG has been found to be one of the most desirable lasers as an adjunctive therapy to the conventional mechanical debridement due to its associated ease of energy transfer via a flexible optical fiber into the pocket and its disinfection and detoxication effects within the periodontal pocket.[15]

Horrton and Line[16] reported that Nd:YAG laser irradiation into the periodontal pockets was more effective that SRP in reducing specific bacteria and in controlling their recolonization Neil & Melloning[17] and Gutknecht et al[18] reported that Nd:NAG laser as an adjunctive method to SRP could play a significant role in reducing microorganisms inside pockets and in improving clinical parameters. However, Radvar et al[19] reported no advantage for Nd:YAG laser over SRP alone in improving microbiological and clinical parameters.

The objective of the present study was to investigate the effects of the two Nd:YAG and chlorhexidine gel-xanthan based on the clinical parameters of periodontal diseases in comparison with those of the SRP alone.

_Methods

Six patients of moderate to severe chronic periodontitis, each with at least three pockets 4–7mm deep were selected for the purposes of this study. Over 112 pockets were studied and 28 pockets (control) were randomly selected for treatment with SRP alone, 40 with SRP assisted by Nd:YAG laser therapy, and 44 pockets were subjected to SRP assisted by gel therapy. Single root teeth were used in this study. The criteria used to reject patients from this study included suffering from systemic diseases, taking such drugs as antibiotics over the three months prior to the study period, failing to cooperate appropriately, smoking, or having received periodontal treatments in the three months prior to the study period.

A record file was set up for each subject in which measurements of the clinical indices CAL, PPD, BOP, and PI were recorded. Following the measurements, scaling and root planing were accomplished using the ultrasonic dental unit (Mectron, Carasco, GE, Italy). Using curettes (Hu-Friedy, Chicago, IL, USA), root planing was also performed in zones where pocket depth was less than 5 mm. Then, scalers were used to detect the presence of any residual calculus. After the first SRP session, all patients received special training on brushing their teeth every night for two minutes using the modified Bass technique, flossing, and using chlorhexidine 0.2% to be applied twice daily. A week later, patients would be checked again for any remaining calculus to undergo another SRP session if necessary. In a following session a week later, the patients would then be subjected to Nd:YAG laser therapy (Fidelis Plus, Fotona; Ljubljana, Slovenia, 300 fiber; 2 W/100, 20 Hz, 2 min) as well as gel therapy. In this way, some pockets would be randomly selected for laser therapy and some for gel Chlosite (GHIMAS, s.p.a Bologna, Italy) therapy while leaving some pockets without either of the adjunctive therapies to be used as control. In teeth with pockets at several levels around, efforts were made to avoid the combined application laser and gel in order to prevent confused and interfering effects. Health care instructions would be given again after this round of treatment but

PPD reduction	After treatment	Before treatment	Group
3.2 ± 1.4	2.3 ± 1	5.4 ± 1.2	Laser
2.7 ± 1	2.3 ± 1	5 ± 1	Gel
1.4 ± 1	3.3 ± 0.7	4.7 ± 1	Control

Table 1_Mean & standard deviation of PPD before and after treatment.

PPD reduction	After treatment	Before treatment	Group
2.2 ± 1.6	2.3 ± 1.7	4.5 ± 1.9	Laser
2.8 ± 1.8	2.4 ± 1.5	5.3 ± 2.1	Gel
0.6 ± 1.2	3.7 ± 1.4	4.3 ± 1.8	Control

Table 2_Mean & standard deviation of CAL before and after treatment.

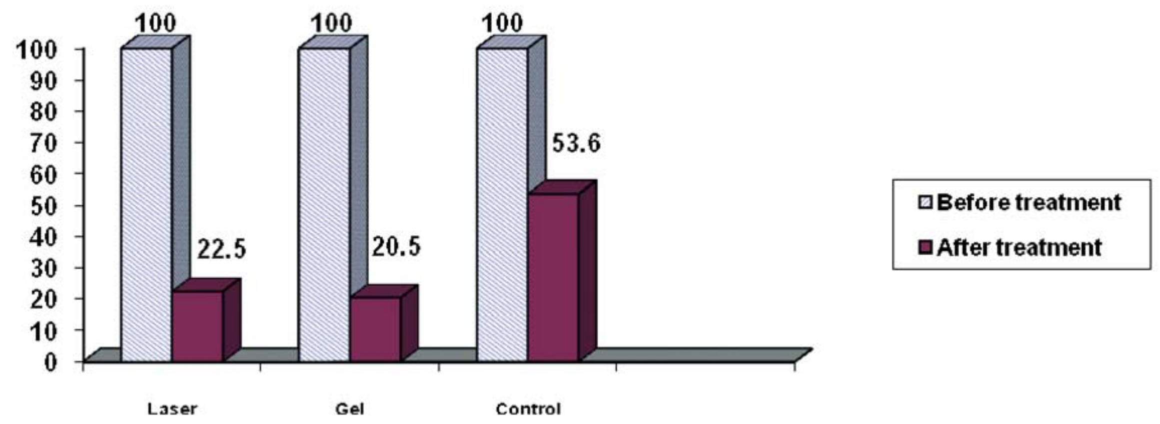

Fig. 1

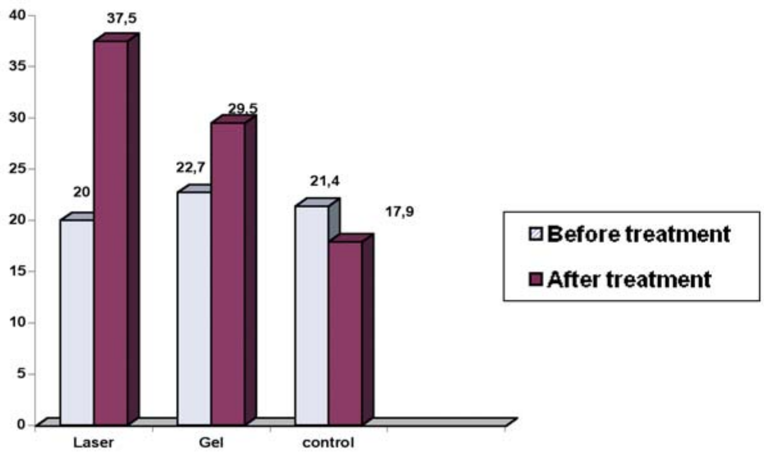

Fig. 2

Figure 1_Prevalence of BoP before and after treatment.

Figure 2_Prevalence of plaque-free zones before and after treatment.

chlorhexidine washmouth would be stopped. A week later again, laser therapy would be repeated. In the following and last session, laser or gel therapy would be administered for each of the experimental groups according to their treatment plan. This resulted in two gel therapies and three laser therapies for each patient. Patients were called back again three months after the first treatment session for clinical measurements. The data thus obtained were finally subjected to paired T-test, one-way ANOVA, Tukey's HSD Test, Kruskal-Wallis test, and Chi-square test, the results of which were then analyzed using the SPSS software ($P < 0.05$).

_Results

In this study, 112 cases were studied of which 40 cases (35.7 %) were included in the laser therapy group, 44 cases (39.3 %) in the gel therapy group, and 28 cases (25 %) in the control group.

Average values (expressed in mm) of probing pocket depth (PPD) and clinical attachment level (CAL) before and after treatments in the three groups of laser therapy, gel therapy, and control are reported in Tables 1 and 2.

Paired T-test revealed that treatment in all three groups significantly improved PPD and CAL compared to pretreatment conditions ($P > 0.001$). The One-way ANOVA showed that improvements in PPD and CAL in the three groups had significant differences ($P > 0.001$). Tukey's test also showed that PPD reduction ($P = 0.168$) and enhanced CAL ($P = 0.198$) in the two gel and laser therapy groups had no significant differences after treatment. However, these changes in the control were significantly less than those in the experimental groups ($P > 0.001$). Figure 1 below shows the distribution of prevailing BoP zones before and after treatment in the three laser, gel, and control groups.

The Chi-square test revealed that the percentage of BoP regions in the gel therapy and laser therapy groups was significantly less than that in the control ($P < 0.5$), while the two experimental groups did not show significant differences in this respect ($P = 0.820$).

Kruskal-Wallis test showed no significant differences between plaque-free zones in both groups before treatment ($P = 0.482$) and after treatment ($P = 0.186$). Figure 2 shows the distribution of plaque-free zones in the three groups.

_Discussion

Pathogenesis and treatment of periodontal diseases have undergone essential changes over the past three decades.[20] For instance, the initial non-surgical treatment of periodontal diseases which plays an important role in removing pathogenic bacterial plaque and, thus, in curing it no longer depends solely on the conventional mechanical debridement (SRP). Rather, local delivery of antimicrobials, host modulators, and laser application are used nowadays for reducing gingival sulcus bacteria and coagulation in the treatment zone.[2] However, no definitive answers can yet be given as to the effectiveness and application method of each of these agents in treating periodontal pockets.[15] In this study, therefore, efforts were made to compare the efficiency and effectiveness of two adjunctive methods including therapies using Nd:YAG laser and chlorhexidine gel with a xathan base following a conventional SRP treatment. The results revealed that Nd:YAG laser irradiation inside periodontal pockets with average depths of 4 to 7 mm following SRP had better therapeutic effects than the SRP alone, giving rise to higher PPD and BoP reductions and enhanced CAL (Tables 1 & 2, and Fig. 1).

Our findings are in agreement with those obtained by Neil and Melloning,[17] Gutknecht et al.[18], and Miyazaki et al.[8] despite slight differences in the application of Nd:YAG laser and the parameters used in the present study and those cited. In Miyazaki et al, Nd:YAG laser was used alone and compared with SRP while CO_2 laser was administered in three independent experimental groups, not as an adjunctive technique. Although in their study, Nd:YAG laser improved clinical parameters and the subgingival microflora after treatment, no significant differences were reported between the three groups. In our study, however, like those of Gutknecht et al. and Neil and Melloning, Nd:YAG laser was used as an adjunctive treatment to SRP, which showed enhanced improvements in clinical parameters compared to the SRP alone. The use of Nd:YAG laser in Gutknecht et al additionally led to a higher reduction of periopathogenic microorganisms. In contrast, the findings of our study do not match those of Radvar et al.[19] and those of Liu et al.[22] Liu et al. reported that the secondary application of Nd:YAg laser after SRP was associated with no advantages over SRP alone.

The parameters used for Nd:YAG laser beam were also different. Various combinations of the laser beam clinically used[24] for the treatment of periodontal pockets have been reported in different studies. Whit[23] and Coluzzi used it for different purposes such as coagulation and curettage of the pocket soft wall, bacterial reduction, and reduced hemostasis after mechanical debridement. This is while Gutknecht et al.[25] suggested Nd:YAG laser application with similar parameters (100 mJ/Pulse 2 Hz (2W)) for curettage before mechanical debridement in an attempt to reduce bacterium risks associated with SRP. Generally speaking, no consensus exists as to the application of Nd:YAG laser in the treatment of periodontal pockets. However, previous In vitro and In vivo studies have emphasized that Nd:YAg laser which is a soft tissue laser must only be used as an adjunctive method to conventional mechanical treatment methods rather than as a primary treatment of periodontal pockets.[15] The findings from our study also indicate that application of Chlorhexidine gel with a xathan base to periodontal pockets leads to significantly improved clinical parameters such as BoP, PPD, and CAL compared to the control ($P < 0.001$) (Table 1 & 2 and Fig. 1). These findings match those of Vinholis et al., Rusu et al., Cheng et al.[26], and Coysn et al.[27]

Comparison of the effects of Nd:YAG laser and chlorhexidine gel therapies on clinical parameters in the present study shows that the values of pocket reduction ($P = 0.168$) and CAL enhancement ($P = 0.198$) after treatment in the two experimental groups exhibit no significant differences. The same findings also show that percentage of bleeding zones (BoP) in the two gel and laser therapy groups is significantly lower than that in the control group ($P < 0.5$), but with no significant differences between the experimental groups in this parameter ($P = 0.820$).

It was also found that chlorhexidine gel with a xathan base and Nd:YAG laser as adjunctive therapies to SRP had similar effects, which may be due to their antimicrobial effects. Due to its mucoadhesive property and long retention time within the pocket, Xathan gel causes a delayed release of chlorhexidine, retaining it over two weeks and, thus, inhibiting bacterial recolonization.[4,5]

_Conclusion

Based on our findings, it may be concluded that application of Nd:YAG laser or chlorhexidine gel as adjunctive therapies to SRP may improve periodontal clinical indices to a far greater extent than would conventional periodontal mechanical treatments (SRP alone).

The Literature list can be requested from the editorial office.

_contact laser

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Lasers for Caries Detection: Does this Method Perform well on Occlusal and Proximal Surfaces?

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_Abstract

Caries diagnosis has become a major challenge in dentistry due to recent modifications in lesion characteristics and patient behaviour. Novel methods have been developed in order to aid visual and radiographic examinations for caries detection. This review focuses on the performance of laser-induced fluorescence devices (DIAGNOdent and the DIAGNOdent pen) that have been studied in the past decade. Both devices are based on the measurement of back-scattered fluorescence from bacterial metabolites present in the caries lesion. Occlusal and proximal surfaces can be assessed and lesion severity can be quantified using these methods. Based on the literature, both devices can be considered auxiliary methods for caries diagnosis, i.e., as a "second opinion" in the treatment decision-making process.

_Introduction

Dental caries is an important global public health problem. Its detection is a key element in the prevention and treatment of lesions, and is a difficult task in dentistry.[3] Therefore, early diagnosis is fundamental for the establishment of a treatment plan that is effective but as conservative as possible, in order to reduce the involvement of tooth structures in restorative procedures when indicated.

Due to the widespread use of fluorides, which promote superficial remineralisation that seems to delay cavitation, incipient occlusal lesions have become difficult to detect. The difficulty of precise detection is also related to other factors, such as the complex anatomy of pits and fissures[25] and the superposition of structures in radiographic evaluations. Additionally, the changes in lesion morphology could lead to the presence of occlusal dentine caries under a fissure which seems intact to the naked eye.

In general, an early caries lesion in enamel is clinically observed as a white spot lesion caused by acids from dental plaque. This incipient lesion progresses slowly and may be remineralised without requiring operative intervention.[22, 26] White spots are opaque because their crystals have altered physical and chemical properties, and the spatial configuration of the crystals is different from that of normal enamel. The presence of water means that light is reflected off the enamel surface differently for an initial carious lesion than for a sound surface. The early detection of smooth surface caries lesions is important for appropriate management of caries, i.e., to avoid premature tooth restoration treatment but allow the

Fig. 1a_DIAGNOdent 2095.
Fig. 1b_Tip A for occlusal surfaces.
Fig. 1c_Tip B for smooth surfaces.

caries to be monitored over time.

Caries lesions on proximal surfaces are difficult to detect with visual-tactile examination unless the lesion is relatively advanced and considerable loss of tooth structure has occurred.[5, 6] Bitewing radiographs have been recommended to aid and improve the diagnosis of proximal caries lesions. However, this method is of limited value during diagnosis and might lead to an underestimation of lesion size. An alternative system that permits better detection and monitoring of such lesions would be of great use to clinicians and researchers.

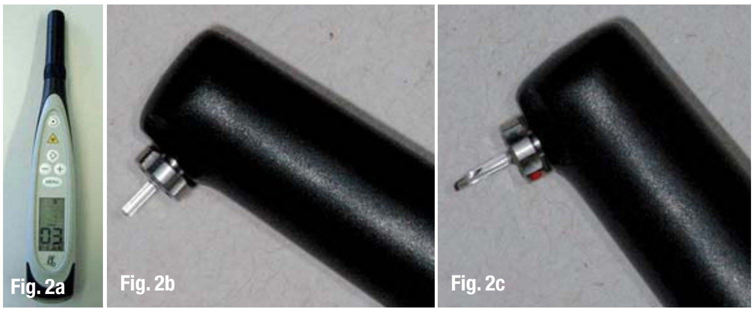


Fig. 2a_DIAGNOdent 2190 (DIAGNOdent pen).
Fig. 2b_Cylindrical tip for occlusal surfaces.
Fig. 2c_Wedge-shaped tip for proximal surfaces.

The difficulty in detecting caries has led to an increase in the research and development of new diagnostic methods. In recent years, a number of novel techniques such as electrical conductance measurements and fluorescence-based methods have become available to accompany traditional methods of caries detection.[12] In the present review, a brief explanation of laser-induced fluorescence devices and their performance in evaluating occlusal and proximal surfaces will be given.

_Laser-induced fluorescence methods

The first laser fluorescence device (DIAGNOdent, KaVo, Biberach, Germany) was developed in 1998. It is a laser-based instrument that emits light at 655 nm from a fibre optic bundle and is able to capture the fluorescence emitted by oral bacterial metabolites present in the caries lesions; this yields a quantitative measurement of caries development. This device is based on the principle that carious tissue fluoresces more strongly than sound tissue. A photodetector quantifies the emitted fluorescence that passes through the filter and displays a real-time (moment) and a maximum (peak) value. Changes in emitted fluorescence register as an increase in the digital number displayed on a monitor. This new method allows quantifiable, non-invasive examination of the tooth surface, therefore favouring early detection of lesions so that preventive measures may be adopted to prevent caries progression.[25]

More recently, a new laser fluorescence device (DIAGNOdent 2190, KaVo, Biberach, Germany) has been tested for the detection of both occlusal and proximal caries. This system functions on the same principle described above.[17, 18] In the LFpen device, the excitation and the emission of fluorescence follow the same solid fibre tip, but in opposite directions.[17] This is the main difference from the first device, which uses different fibres for excitation and emission.[19] To enable the user to place the probe on mesial and distal surfaces at the facial and oral sides of front and posterior teeth, the tip must be able to rotate about its long axis. A knob allows turning around the tip and a red point on it indicates the light direction.

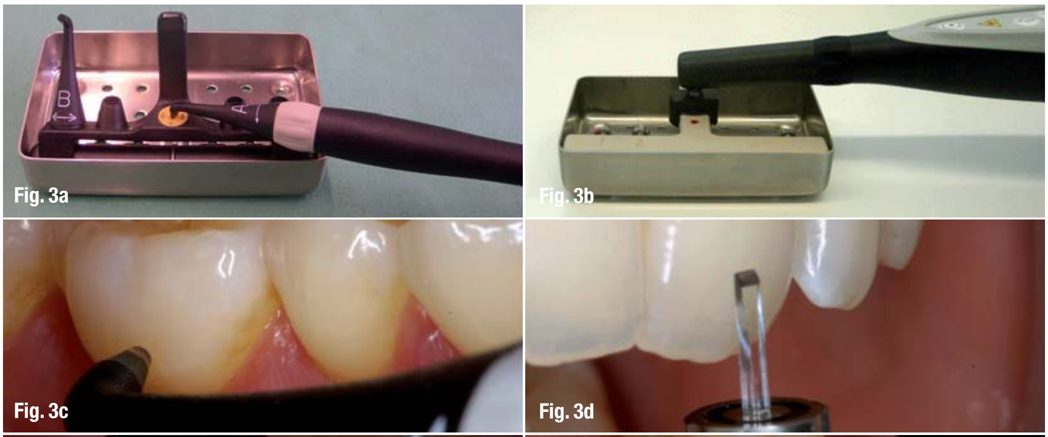
For both devices, the manufacturer's instructions indicate that it is necessary to perform a standard calibration on a porcelain object with known fluorescence (standard calibration). An additional calibration against a sound spot on the buccal surface should also be performed, allowing the automatic subtraction of the zero value from the site of interest (individual calibration).[7, 8, 11] However, some authors[13, 14, 16, 18] have chosen to measure a sound spot on buccal surface to obtain the zero value of fluorescence and perform the subtraction manually (zero value subtraction) after lesion assessment.

The studies that evaluated individual calibration are controversial. While Braun et al.[8] suggested that the individual calibration should be performed because a difference of 6 units was found in the LF assessments, Braga et al.[7] did not find any influence of the calibration procedure on the performance of the device in primary teeth. Recently, Rodrigues et al.[24] observed a decrease in sensitivity of DIAGNOdent performance when zero value subtraction was used. The authors concluded that the DIAGNOdent readings may be performed without zero value subtraction without cut-off's adjustment. For the DIAGNOdent pen, however, the absence of the zero value subtraction changed both the sensitivity and specificity and should not be eliminated.

_Performance on occlusal surfaces

Rodrigues et al.[25] compared different methods for caries detection in occlusal surfaces. DIAGNOdent showed higher specificity and lower sensitivity than the values found by Lussi and Hellwig[18], while the DIAGNOdent pen showed lower specificity and practically the same sensitivity when compared to these values. Another comparison of the DIAGNOdent device, visual examination and radiographic examination was recently performed in vivo. The authors concluded that the DIAGNOdent device may be a useful supplement to visual examination, and its diagnostic performance seems to be well-suited for occlusal caries detection.[2] Another in vivo study demonstrated that the DIAGNOdent device performs well in detecting dentine caries lesions.[10]

Additionally, a high value of fluorescence may indicate caries or changes in the physical properties of the



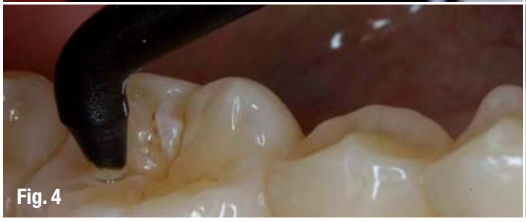


Fig. 3a-d_Calibration procedure: (a) and (b) standard calibration; and (c) and (d): individual calibration with DIAGNOdent (occlusal tip) and DIAGNOdent pen (proximal wedge-shaped tip), respectively.
Fig. 4_Assessment of an occlusal surface using DIAGNOdent.
Fig. 5_Assessment of a proximal surface using the DIAGNOdent pen (image reproduced from Neuhaus et al.).[20]

tooth structure, such as the presence of calculus, disturbed tooth development or mineralisation. Neither device performs well on stained surfaces, which can generate false-positive results.

A systematic review[3] showed that the DIAGNOdent device tended to be more sensitive than the visual method in detecting occlusal dentinal caries. This means that a larger proportion of true lesions were detected. However, the method was less specific in that the DIAGNOdent also identified a larger proportion of sound sites as being carious (false-positive results) than did the visual method. Furthermore, the device was less sensitive and more specific in detecting enamel lesions than in detecting dentinal caries; i.e., the performance of this device in enamel is worse than in dentin. For this reason, this device may be best used as an auxiliary method for occlusal caries detection.

Other limitations of both devices are that the clinician must move the tip around the test site until the highest value is obtained in order to avoid false assessments. This ensures that the tip picks up the highest value present in the fissure wall, where the carious process often begins. The calibration procedure using a ceramic standard should also be performed, as described above.

_Performance on proximal surfaces

Data concerning the performance of the DIAGNOdent devices on proximal surfaces are limited. The first device identifies proximal caries with high sensitivity but low specificity. In addition, the readings on proximal surfaces are not as reproducible as readings taken on occlusal surfaces.[26,27] This could be due to the fact that the tip made for the first device does not penetrate the proximal surface well, if at all.

Therefore, a special tip for the DIAGNOdent pen was developed for use on proximal surfaces. Its small width (0.4 mm) and unique shape, which allows better penetration into the proximal space and accurate light reflection, enable better assessment of these areas.[4] Lussi et al.[17] showed that this device accurately assesses proximal surfaces in vitro, indicating that this new system might be a useful tool in detecting proximal caries. Because of the reproducibility of readings taken with this device, it could be used to monitor caries regression or progression on proximal surfaces.

Novaes et al.[21] assessed primary teeth in vivo and also found that both the DIAGNOdent pen and radiographic methods presented similar performance in detecting the presence of cavitations on proximal surfaces.

_Other applications

DIAGNOdent devices have been also studied in other clinical situations, e.g., for the detection of recurrent caries[4,5], residual caries during excavation[15], caries around orthodontic brackets[1], root caries[28] and caries under sealants.[9,23]

_Conclusions

Based on the literature, DIAGNOdent devices perform well on occlusal and proximal surfaces. However, they cannot be considered as standalone diagnostic tools, but instead should be used as a second opinion during the caries diagnosis process. Finally, while using the laser-induced fluorescence devices, clinicians should understand the concepts of caries risk, activity, detection, diagnosis and assessment to determine the best treatment for each individual patient._

The Literature list can be requested from the author.

_contact laser

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The use of the Er:YAG (2,940 nm) in a Laser-Assisted Implant Therapy

How far we can push the envelope?

author_Dr Avi Reyhanian, Israel

_Abstract

The array of available clinical applications for laser assisted dentistry is growing rapidly, with the greater number of applications being for oral surgery. Er:YAG laser wavelength is considered to be extremely safe, and is the dominant wavelength in dentistry today . Er:YAG is one of the most suitable wavelengths for bone applications. The presentation will demonstrate the use of the Er:YAG laser in the world of implantology, and the advantages vs. conventional treatment methods. The purpose in this paper is to put some order into the chaotic information surrounding the subject and to provide some answers to the most common and frequent questions we often meet: How far we can go with this technology? Is it just a marketing tool or proven therapy? Where is the line between reality and fantasy? Does the new technology completely replace the conventional methods and if not, at which point do we lay the laser's hand piece down and re-employ the "old" tools and conventional ways?

The article will exhibit, beyond any doubts, that Er:YAG laser is very valuable tools and shows promise and safe as an effective new technical modality for implant therapy.

_Introduction

Osseo-integration dental implants have become a routinely recommended procedure in the clinical practice of dentistry,[1–4] and have been utilized as a successful treatment modality over three decades, with a reported success rate of greater than 90 %.[5–8]

Fig. 1_Intrasulcular incision.
Fig. 2_Midcrestal incision.
Fig. 3_Vertical incision for realese.
Fig. 4_Semi lunar incision.
Fig. 5_Granulation tissue.
Fig. 6_The erbium to ablate the granulation tissue.


Fig. 1


Fig. 2

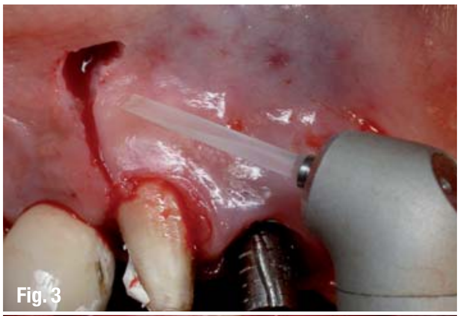


Fig. 3


Fig. 4


Fig. 5


Fig. 6

Fig. 7

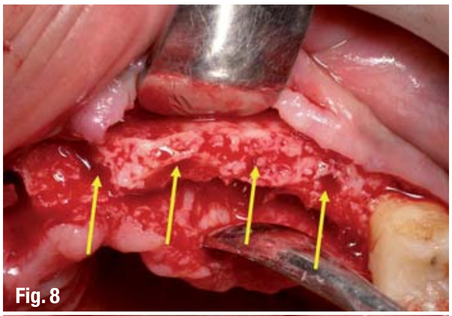


Fig. 8

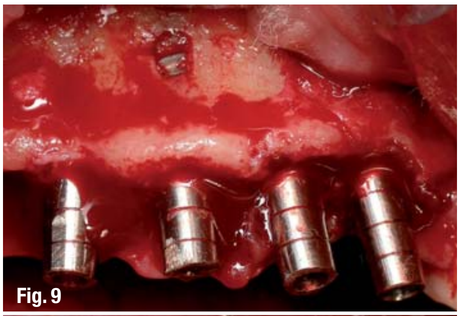


Fig. 9

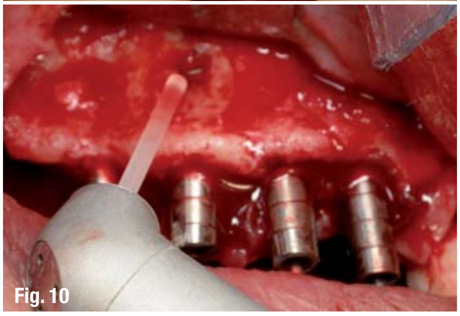


Fig. 10

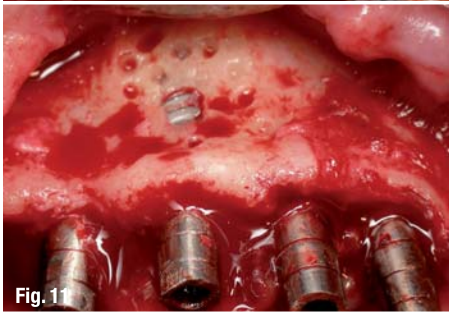


Fig. 11

Fig. 12

Fig. 7_The site image immediate post-op.
Fig. 8_Marking the location of the implant.
Fig. 9_Fenestration.
Fig. 10_The erbium for decortication.
Fig. 11_Decotrication.
Fig. 12_Recontouring of the soft tissue around the implants.

The predictability and success of dental implants has secured their place as a standard treatment modality. This technique using the Er:YAG laser presents several advantages vs. conventional treatment methods, and there are minimal post-operative complications coupled with a high rate of success. The Erbium:YAG is one of the most suitable wavelength for bone applications. The Erbium's energy is highly absorbed in the water component of dental tissue and provides efficient ablation without the risk of significant thermal damage.[13] The Er:YAG laser is a thermal laser wavelength which is located in the infrared zone of the electromagnetic spectrum, considered to be extremely safe. Most of the procedures performed at my practice are in the realm of surgery and they are all performed with the Er:YAG laser: Today we can observe an inordinate lack clarity concerning the clinical uses of the laser in the field of implantology, and with many doctors in the field reality does indeed mix with fantasy.

_What do we know about the Er:YAG laser 2,940 nm

The Erbium Yttrium Aluminium Garnet laser has a wavelength of 2,940 nanometres' and emits as a free-running pulsed train of photons in the mid infra-red portion of the electromagnetic spectrum. Got FDA approval for hard tissue in 1997. This laser is a thermal laser: interaction between the laser beam and the target tissue create heat. Successive laser pulses are 100–200 microseconds in width. The prime chromophore of this laser wavelength is water, which makes it appropriate for ablating both hard and soft oral target tissue. Incident laser energy is absorbed by the chromophore, converted into thermal energy which results in expansive vaporisation by micro explosions. Such action causes a dislocation of the tissue structure and ablation; often this is accompanied by an audible "popping" sound. Established high safety in clinical use. The erbium laser presents availability of water cooling: Extremely low thermal damage to surrounding tissue. Can be used in contact or noncontact mode, efficient ablation effect for both soft and hard tissue. Delivery system—articulated arm (Fotona), hollow wave guide (Lumenis) , fiber optic (Biolase, Doctor smile, Hoya combio), or no delivery system (Lite-Touch, Syneron medical ltd)

_What can we actually do today, 2009, with the Er:YAG Laser, in the world of implantology

1) Incsion—Midcrestal, Vertical, Intrasulcular (Figs. 1, 2, 3, 4).
2) Removal of granulation tissue (Figs. 5, 6, 7).
3) Marking the location and direction of the implant—Only lase at the cortical bone (Fig. 8).
4) Decortication and GBR technique (Figs. 9, 10, 11).
5) Reshaping of the soft tissue (flap) around the implants (Figs. 12, 13, 14).
6) Uncovering of submerged implants (Figs. 15, 16).
7) Flapless implants (Figs. 17, 18, 19, 20).
8) Open sinus lift—Opening the window (Figs. 21, 22).
9) Periimplantitis treatment (Figs. 23, 24, 25).
10) Implant failure treatment (Figs. 26, 27).
11) Immediate implants in infected sites (Figs. 28, 29, 30).

1) The Erbium laser can make an incision for flap lifting[9–13], such as a crestal incision, or an intrasulcular or vertical release incision. The laser produces

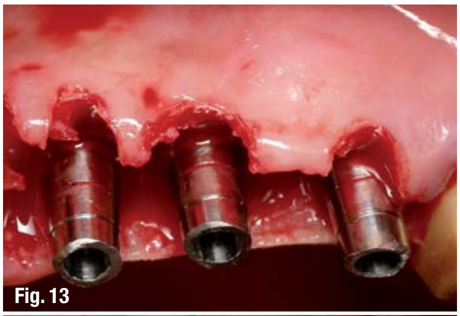


Fig. 13_Immediate post op.
Fig. 14_Final result.
Fig. 15_The erbium to uncover the submerged implant.
Fig. 16_The uncovered implant.
Fig. 17_The erbium to lase the soft tissue.
Fig. 18_The soft tissue after lasing with the erbium.

a wet incision (some bleeding) as opposed to the dry incision (no bleeding) that is produced by the CO_2 laser. The tip of choice is chisel tip or 200 micron tip, contact mode, set power 300 mJ/25 pps (7.5 watt). When performing the vertical incision, not to push the end of the sapphire tip into the soft tissue but rather to gently stroke the tissue with the tip. The doctor should lase the soft tissue until he feels the contact with the bone.

2) Vaporization of granulation tissue[13,15] (if any exists) after raising a flap is efficient with the Erbium laser, with a lower risk of overheating the bone[13,16,17] than those posed by the current diode or CO_2 lasers. Chosen laser is Er:YAG (LiteTouch, Syneron Medical Ltd). Tip of choice is 1,300 micron, noncontact mode (Distance between end of the tip and target tissue = 1.5 mm) set power 400 mJ/ 17 pps = (6.8 watt). It is important to vaporize the granulation tissue before drilling for the implant because one of the reasons for IPL (implant peri-apical lesion) is insertion of soft tissue into the site preparation for the implant.

3) Using the Erbium laser in non-contact mode (1.5-2 mm from the target tissue), the future location and angle of the implant is outlined; and the laser is used only on the cortical bone. Set power: 300 mJ/20 pps (6 watt). As an important point of clarification, the laser does not replace the pilot drill; it is used to create a "pilot hole" for the drill. The entire length of the implant is not lased with the laser. This technology doesn't give, yet, the answer to the question how to lase all the entire length for the implant with out the use of rotary instruments. Although there are some dental lasers users with a lot of experience who claim that they lase all the entire length of the implant with the erbium. This statement raze two main concerns: The first one is how to control the depth and the second one. Which is the the fundamental concern in any bone surgical procedure, is how to limit thermal rise to within 47 °C[18] in order to avoid damage to cellular components of bone metabolism and delayed healing.[19] Further clinical and basic investigations are require to establish the clinical effectiveness and safety of the Er:YAG laser in implant site preparation. We are not there yet although Er:YAG laser can promote the growth of new bone around placed titanium implants and better osseointegration compared to the conventional osteotomies, and results of a study 20 indicated that in the rat model the lased bone prepared implant sites vs. conventional bone preparation sites developed a statistically higher percentage of bone-to-implant contact.

4) One of the golden rules for GBR—Guided Bone Regeneration is to Provide a good blood supply—Cortical stimulation: To perforate the cortical bone to get bleeding which bring with him mesenchimal cells, they transform to osteoblasts, they transform to osteocits which are responsible for bone formation. Decortication is performed with the erbium laser (LiteTouch, Syneron Medical Ltd). The tip of choice is 1,300 micron, Set power 300 mJ/25 pps (6 watt). Noncontact mode. No rotary tool vibrations: reducing patient discomfort and enhancing the surgical site. Less stressful oral therapy with enhanced outcomes.[21,15]

5) Dental implant must form and maintain integration not only with bone but also with connective tissue and epithelium—The Junctional epithelial attachment is an important component of the protective permucosal soft tissue seal and may even limit the apical spread of marginal inflammatory that can lead to bone loss or implant failure. If there is enough keratinized tissue, before closing the flap it is recommended to reshaping the soft tissue (flap)



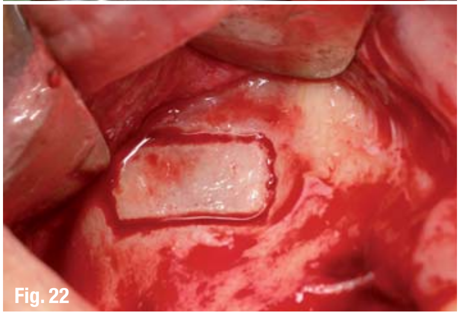
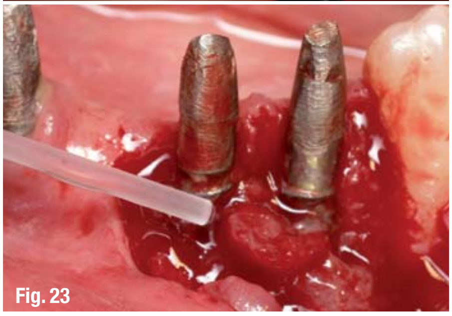
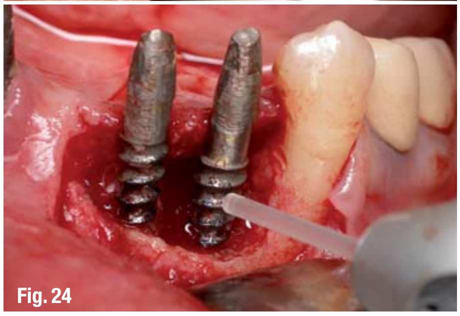





Fig. 19_Drilling for the implant.
Fig. 20_Insertion of the implant.
Fig. 21_The erbium to open the lateral window.
Fig. 22_The lateral window performed with the erbium.
Fig. 23_The erbium to ablate the granulation tissue.
Fig. 24_Detoxification of the infected implant screw.

around the implants in order to get a better sealing. Tip of choice 200 micron, contact mode, Set power 250 mJ/30 pps (7.5 watt).

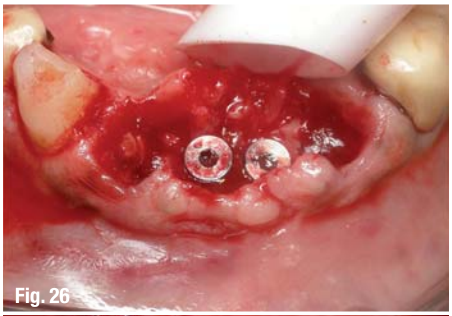
6) Implant exposure can be done with the Er:YAG, with the Diode and with the CO_2 laser or other wavelengths. The big advantage of the erbium in this procedure versus the others is less zone of thermal necrosis because of the water spray cooling. The benefits of laser use over scalpel include precision, incisional hemostasis and immediate post-operative protection through a tenacious coagulum surface.[22, 23] Local anesthetic may or may not be used, depending on patient and operator preference. A small cone of tissue is removed until near-contact with the screw is made. Tip of choice can be the 200 or 400 or 600 or 800 or 1,000 micron. The set power is around 6 watt.

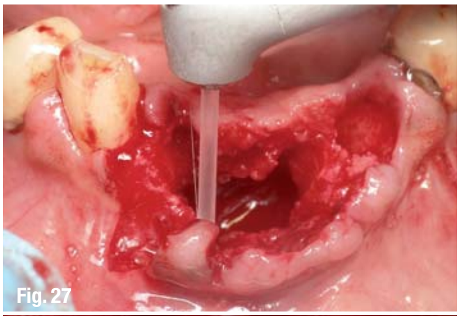
7) In those crests in which the width is more than 7 mm, it is possible to insert the implant without razing a flap. With the erbium laser a small cone of tissue is removed with the diameter of 6 mm. (Tip sapphire 800 micron, contact mode, set power 300/25 pps = 7.5 watt). With the 1,300 micron sapphire tip, in non-contact mode (1.5–2 mm from the target tissue), the future location and angle of the implant is outlined; and the laser is used only on the cortical bone. Set power 300 mJ/25 pps (7.5 watt). In the moment the location of the implant is marked it is recommended to reemploy the rotary instrument.

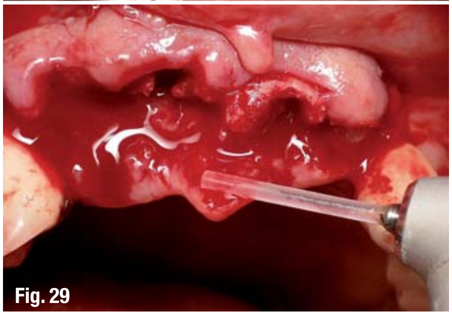
8) An Er:YAG laser has been determined as the most suitable platform for this procedure. The Erbium family of lasers is the only one which delivers a tissue-cooling water spray together with the laser beam, an extremely important feature when lasing bone tissue.[10, 24, 25] The tip of choice was a 1,300 micron sapphire, using non-contact mode. The distance between the end of the tip and the target tissue should be 9 mm. The energy used for this procedure was 200 mJ/15 pps, (3 watt average power). The headpiece should be always in constant motion very close attention paid, because the bone of the lateral window is usually very thin. The Er:YAG laser does not provide good hemostasis, both because of its short interaction time and its shallow depth of penetration. The moment a little bleeding appears, or the Schneiderian membrane is seen, the laser beam should be moved forward. The closer the beam comes to the Schneiderian membrane, the greater the distance should be between the tip and the target tissue (the energy is controlled by the distance between the end of the tip and target tissue). Pressurized air in the water spray was directed away from the attachment of the flap to minimize the risk of an air embolism. Antrostomy was performed with the Erbium laser to create a rectangular shape.[26] The height of this window should not exceed the width of the sinus. After lasing all four flanks of the window, the bone was gently removed or pushed inside the sinus, taking care not to damage the Schneiderian membrane.[27] The sinus membrane was then lifted gently from the bony floor. A space was created after the sinus membrane has been elevated, which was then grafted with different material.

Experience has shown that the laser is safer to surrounding tissue than rotating instruments[27, 28, 29] particularly when it comes to the risk of perforating the Schneiderian membrane. When adhering to the recommended operating parameters and tools (energy, tips, hand piece configuration and mode of beam application—contact/non-contact).

9) Periimplantitis is an inflammatory reaction that is associated with the presence of a sub-mar-







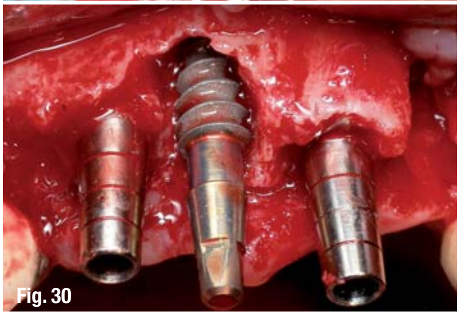


Fig. 25_The exposed screw after detoxification.
Fig. 26_Two mobile implants engage each other.
Fig. 27_The erbium to ablate and decontaminate the site.
Fig. 28_At presentation.
Fig. 29_The erbium to ablate granulation tissue and decontamination.
Fig. 30_Immediate implants.

ginal biofilm, with advanced breakdown of soft and hard tissue surrounding the endosseous implant: loss of the bony support of the implant. [30]

Therapeutic objectives focus on correcting technical defects by means of surgery and decontamination techniques: REJUVENATING. Removing mobile implants is recommended.

Therapeutic and surgical approaches in the conventional system include:

1. Systemic administration of antibiotics
2. Removal of supra-gingival bacterial plaque
3. Removal of granulation tissue with plastic curettes
4. Detoxification of the exposed surface[31]
_Mechanical brushing
_Air powder abrasive
_Citric acid[41]
_Chlorhexidine
_Delmopinol
_Topical tetracycline application
_Low intensity UV-radiation
5. Removal of peri-implant pocket
6. Regeneration of peri-implant hard tissue (GBR)
7. Plaque control

In addition to conventional treatment modalities, the use of the Er:YAG laser has been increasingly promoted for the treatment of peri-implantitis:

_The Erbium laser can make an incision for flap lifting,
_Vaporization of granulation tissue
_Detoxification of the implant surface[32] by lasing directly on the implant's exposed screws, using a low-energy setting, the target tissue is disinfected together with the implant surface[15] without injuring their surfaces.[33-35]
_The laser is bactericidal.[36, 37] The significant bacterial reduction in the implant surface and the periimplant tissues during irradiation are the main reasons for the erbium laser application in the treatment of periimplant lesions.
_Ablating the bone with the Er:YAG laser: remodeling, shaping and ablating necrosis Bone.[38–41]

10) In implants failure sites treatment the Er:YAG lase assist the doctor by the mean of incision to open the flap, ablation of granulation tissue, ablation of necrotic bone and decontamination of the site for GBR technique.

11) Insertion of implants in infected sites presents a lot of problems and some times require two stages of surgery. In conventional methods there is no tool in which in the same time provides decontamination of the target tissue: By lasing with the erbium it is possible to gain decontamination of the infected site, which enables the doctor to save chair time and, in some of the cases, to avoid the second stage of implant surgery.

_Summary

Er:YAG laser is an essential and indispensable tool for implant surgery today.

This wavelength shows promise and safe as an effective new technical modality for implant therapy when adhering to the recommended operating parameters and tools (Energy, tips, hand piece configuration and mode of beam application—contact/non-contact). However, further clinical and basic investigations are requiring for establishing the clinical effectiveness and safety of the Er:YAG laser in implant site preparation._

The Literature list can be requested from the editorial office.

_contact laser

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Laser Dentistry—Past to Present

author_Terry D. Myers, USA

_Abstract

The first laser in the world designed specially for general clinical dentistry debuted in Germany in 1989. Over the past twenty years many different laser wavelengths and units have been marketed worldwide. The author's long-time involvement in the dental laser industry gives him a unique perspective. In this two part series the author will first discuss the historical development of laser dentistry. The second part of the series will focus on the worldwide dental laser marketplace and the important research that helped obtain the first U.S. Food and Drug clearances for various laser wavelengths.

Today's dental lasers have their roots founded in the field of quantum mechanics formulated during the early 1900's. That is when Albert Einstein mathematically demonstrated the possibility that portions of the electromagnetic field could be stimulated to emit amplified light. However, it took over forty years for that principle to become a reality. American physicist Charles H. Townes in the early 1950's, amplified microwave frequencies by the stimulated emission process (maser). Then Schawlow and Townes (1958), wrote a paper in which they discussed extending the maser principle to the optical portion of the electromagnetic field. Finally Maiman (1960) inserted a ruby rod into a photographic flash lamp turned the switch and light amplification by stimulated emission of radiation (LASER) became a reality.

Shortly after Maiman's scientific break-through researchers began studying the feasibility of using this new technology for dental procedures. We will examine in a two part series, the present worldwide dental laser marketplace and the more significant efforts of dental researchers that not only helped to bring the various lasers to the dental market but also developed the basic laser safety parameters for all the hard and soft tissue clinical applications used today, but first let us look at the historical aspects of the first dental laser brought to market.

My brother and I submitted our first application to the United States Patent and Trademark Office (USPTO) in 1983 and two years later the USPTO granted our patent for a method of using a specific laser to remove surface tooth decay and in 1986, we started a small company (American Dental Laser [ADL] Birmingham, MI, USA) and sold our first laser in 1989. Over the next two years, ADL introduced our dental laser, the dLase 300, a pulsed 3 Watt Nd:YAG (Neodymium:Yttrium Aluminum Garet) laser with an emission wavelength of 1,064 nanometers, throughout North America, Germany and Japan.

From this small start-up company the dental laser market has continued to prosper and grow and today both local and international dental manufacturers and distributors offer a variety of dental laser wavelengths to their customers with market penetration of the units closely approaching double digits in several countries.

It sounds so simple: Obtain a patent, start a company and an industry will soon follow. However, it was anything but simple.

My brother, William D. Myers, M.D. was one of the first US ophthalmologists to use a laser in his private practice for posterior capsulotomy procedures and six years my senior had his M.D. degree before I graduated from dental school. After my graduation in 1973 he continued to ask me about the use of lasers in dentistry and would invite me to his office to observe laser procedures. His patients would go home shortly after a three minute laser treatment and resume normal activities. The conventional surgical procedures would require an overnight stay at the hospital. Needless to say I was very impressed and "hooked"! How can we use lasers in dentistry?

During the late 1970's, I gathered all the data on dental laser research that was available and found that from the mid 1960's through the mid 1970's, Stern and Sognnaes, Lobene and Fine, Kinersly, Gordon, Taylor and Adrian were very active researchers and all these groups experimented with the only laser available at the time—the Ruby laser. Their results were not favorable for clinical dental laser applications due to irreversible pulpal necrosis caused by the lasers thermal properties. However, in this same time period, other lasing mediums were being developed. Adrian et. al. (1971) used a Ruby laser to measure threshold response in dogs' incisor teeth and found that energy densities great enough to cause enamel cratering, cause total pulpal necrosis. He (1977) repeated this threshold experiment using a Neodymium laser and found that even at energy densities great enough to cause enamel cavitation no pulpal necrosis occurred.

Adrian's work was very exciting for me because my brother's ophthalmic laser was a mode-locked Nd:YAG and for the next two years beginning in 1979, my brother and I experimented with freshly extracted human teeth. I had an ophthalmic Nd:YAG in my dental office for over a year experimenting whenever possible since we both had full time practices. We were looking for surface modification changes on lased teeth and after obtaining SEM samples we would have a dental histologist review various samples of control, acid etch and lased teeth and with all of the collected historical data plus our own data by 1981 we began collecting comparison data utilizing different laser wavelengths, courtesy of several local hospitals.

By 1983 we were convinced we had collected enough sound invitro data to submit an article to the Journal of Prosthetic Dentistry and file for a patent with the USPTO which was published (1985) and patent granted (1985) two years later.

The following two years were spent locating a manufacturing company that was willing and able to transform what we had on paper into a working unit. We literally met and had discussions with laser manufacturing companies throughout the world. In the end we contracted with another small startup company, Sunrise Technologies (Fremont, CA, USA).

We had three other critical issues; form a company, obtain funding and most importantly get a clearance from the Food and Drug Administration (FDA). The company, American Dental Laser (ADL) was formed in 1986, and we hired a person to run the company and obtain private funding.

The first prototype was built in 1987(Fig. 1) and more testing and experimentation were conducted to obtain critical data for our FDA submission. In 1988 ADL and Sunrise submitted both a hard and soft tissue application to the FDA and in 1990 the FDA granted us a general oral soft tissue clearance for the dLase 300. Over the next several years ADL was granted several more patents and marketing clearances all of which were based on evidenced based research, thanks to numerous dental researchers and clinicians from around the world.

The first international showing of the dLase 300 occurred in 1989 at the International Dental Show (IDS) held in Stuttgart, Germany. Our exhibit was a success with both German dentists and distributors showing great interest in this new dental technology. Thus the beginning of the German dental laser market.

ADL helped form a German dental laser study club in 1991 to better train and educated the dentists who had purchased the dLase 300. This group formed the Deutsche Gesellschaft fur Laserzahnheilkunde e.V. (DGL) which held its 18th Annual Congress this year in Cologne, Germany. My congratulations to DGL!

American Dental Laser helped numerous other dental laser study clubs get started in Europe, Asia and North America in the early 1990's. Some of whom, like DGL, formed their own academies that are still in existence today. These academies have incorporated all laser wavelengths in their scientific sessions and have supplied important research data throughout the last twenty years.

In conclusion it is difficult to believe thirty years have past since lasing that first extracted tooth. It has been my good fortune to witness the birth and growth of a new dental technology and had the opportunity to meet many outstanding dental researchers, academicians and clinicians across the globe. It has been an exciting and fulfilling personal journey with many enduring memories.

_Worldwide Dental Laser Market and Research

The Food and Drug Administration granted market clearance for the first dental laser in May, 1989. It was a pulsed Nd:YAG (Neodymium:Yttrium Aluminum Garnet) laser. During the next eighteen months the FDA cleared two other Nd:YAG's, a Carbon Dioxide (CO_2) and an Argon Ion laser for general intraoral soft tissue surgery.

During the past twenty years the FDA has cleared hundreds of laser devices for dental use for over fifty different laser manufacturers for curing of composite materials, tooth whitening, sulcular debridment, caries removal and cavity preparation, aphthous ulcer, herpetic lesion treatment, diagnosis of dental caries and calculus as well as endodontic procedures and cutting and recontouring of osseous tissue.

FDA clearances are important for three entirely different reasons:

1. Demonstrates the device is safe and effective.
2. Allows the distributor/manufacturer to advertise and market the cleared device.
3. Most dentists from outside the United States are more willing to purchase a laser if it has FDA clearance.

Fig 1_The first working prototype of the first dental laser.

Because of these factors the FDA has had a major influence in the worldwide growth of the dental laser market.

Throughout the 1990's two US dental laser manufacturers were very instrumental in growing the worldwide dental laser market. In the early 1990's ADL changed its name to American Dental Technologies (ADT) to reflect its growth of new dental products and was the worldwide leader in dental laser marketing. Starting in the middle 1990's Biolase Technology (Irvine, CA, USA) became the leader in worldwide dental laser marketing and due to their combined marketing efforts, dentists became more aware of the advantages of laser dentistry. Both small startup companies and established medical laser manufacturers took note of the growth and entered the dental marketplace. By the year 2,000, most dentists in the world could go online, talk to their local dental distributor or attend a lecture to learn more about dental lasers or visit the International Dental Show (IDS) and see no fewer than 30 different lasers on display. The world wide dental laser market continued with slow but steady growth in the early 2000's, however, the market was missing one last key factor—a large international dental manufacturer willing to put their stamp of approval on laser technology. That changed when not one but three such companies obtained FDA marketing clearances. The companies were Ivoclar Vivadent (Schaan, Principality of Liechtenstein) Sirona Dental System GmbH (Bensheim, Germany) and KaVo Dental GmbH (Biberach, Germany).

These three companies supplied the necessary marketing power to place awareness of dental lasers at the same level of most other dental equipment. They also helped to solidify dental lasers in four major markets.

Table I shows the market penetration of dental lasers in the four major markets of the world. While dentists in all countries have purchased this technology, their market penetrations are below 5%. It is interesting to note the differences in laser wavelengths that are popular in the four major markets. Japanese dentists are not very interested in diode lasers or Erbium hard tissue lasers and during the last five years the CO_2 laser has out sold the Nd:YAG laser. In the United Sates both diode and Erbium lasers are very popular. Diode technology is also popular in Germany and Italy, while for the most part only German dentists are buying hard tissue Erbium lasers.

Table 1_ Market Penetration of dental lasers in the four largest markets of the world (from the Institute for Advanced Dental Technologies with permission).

Country	# Dentists	% Market Penetration
Japan	140,000	16–18%
USA	60,000	36–38%
Germany	60,000	8–10%
Italy	55,000	6–8%

_Dental Laser Research

Every year since the early 1990's hundreds of dental laser research abstracts and articles are published as well as oral and poster presentations given. Their topics have covered every aspect of clinical dentistry and have assisted clinicians and manufacturers to refine their techniques and instruments. This section will concentrate on key research that helped bring laser technology to the dental marketplace.

_Nd:YAG Lasers

White et.al (1991) was the principle reason the FDA cleared to market the first dental laser in May, 1990. Their initial work involved comparing laser to scalpel gingivectomies. Their results indicated that the Nd:YAG could be used successfully for general intraoral soft tissue surgeries and were well tolerated without local anesthesia and with minimal bleeding compared to scalpel surgery. White's group also provided laser safety guidelines regarding instrument settings and clinical procedural techniques to assure safe and effective treatment outcomes.

Research provided by Gutknecht et al. (1997) and Neill and Mellonig (1997) was instrumental in obtaining the first FDA periodontal laser therapy market clearance. Both groups compared root planing and scaling to laser therapy (curettage) plus root planing and scaling in adults with moderate to severe periodontitis. While both studies examined bacterial and recolonization reductions, Neill also recorded changes in Gingival Index (GI), Gingival Bleeding Index (GBI), Probing Dept (PD), Clinical Attachment Level (CAL), and Tooth Mobility (TM). Both groups found greater bacterial reduction and slower recolonization in site receiving laser therapy. Neill also found greater improvements in lased sites for GI and GBI. Both groups concluded that the adjunctive use of the Nd:YAG may have clinical advantages over scaling and rooting alone as a mechanical approach to non surgical periodontal therapy.

_Erbium Lasers

The Centauri Er:YAG (2.94 microns) dental laser from Premier Laser Systems (Irvine, CA, USA) was granted the FDA's first marketing clearance (May, 1997) for hard tissue procedures including caries removal, cavity preparation and surface modification of enamel and dentin. In part, the FDA relied on research supplied by Cozean et. al (1997). Their work consisted of two phases at five clinical sites. In Phase I the clinicians prepared teeth that were scheduled for extraction. The teeth were prepped and filled then extracted at various time intervals for histological examination of pulpal changes. Phase II involved prepping and filling teeth and following patients' responses over an eighteen month period. In both phases the patients were randomly divided into receiving either laser or high-speed air turbine treatment. The collected data showed that compared to the high-speed drill the Er:YAG was safe and effective for the indicated hard tissue procedures.

Eversole and Rizoiu (1995, 1997) conducted various invitro animal and in vivo human studies that were instrumental in obtaining FDA hard tissue marketing clearance (Oct. 1998) for the Erbium Chromium: Yttrium Scandium Gallium Garnet laser (Er.Cr:YSGG) from Biolase (Irvine, CA, USA).

To date the FDA has cleared to market fourteen other Erbium lasers for various hard and soft tissue dental procedures. The vast majority of these clearances and US Patents have cited the research of two individuals—Raimund Hibst and Ulrich Keller from the Institute for Laser Technology in Medicine (Ulm, Germany) and the dental school at the University of Ulm (Ulm, Germany) respectively. Their initial experiments (1989, 1991, 1993) laid the foundation for all other Erbium research over the past twenty years. And it was their research that directly helped develop the Keylase Erbium laser (KaVo Dental GmbH, Biberach, Germany). Any dentist that utilizes an Erbium laser in their practice owes a debt of gratitude to Hibst and Keller's ongoing dedication to dental laser research.

_Carbon Dioxide (CO_2) Lasers

Luxar Corp. (Seattle, WA, USA) received the FDA's first CO_2 soft tissue clearance in May 1991. Presently over twenty different units from various companies have been cleared by the FDA.

While sales were brisk in the early 1990's their popularity has decreased over the last decade (except in Japan). However a new generation of Ultra pulsed CO_2 lasers may reserve that trend.

CO_2 lasers have been used successfully for decades in medicine for various soft tissue surgeries so medical laser manufacturers had an easier time obtaining FDA clearances for soft tissue dental procedures. While there was no key research required for the clearances there were dental researchers that increased the awareness of this wavelength (10.6 microns) in dentistry. Fisher et. al (1983) Frame (1984) Pick (1985) and Miserendino (1988) all demonstrated the laser's advantages over conventional surgical techniques.

_Argon Lasers

In 1991, HGM Medical Laser Systems (St. Lake City, UT, USA) obtained FDA clearance for soft tissue procedures and curing composites. Soon other Argon manufacturers were cleared to market for curing composites and tooth whitening. Soon after LED curing lights became available and argon laser sales drastically decreased. Presently no Argon Ion laser is being marketed for dentists.

However key research was conducted for over the years to determine proper curing times and curing depths for the various systems by Blankenau and Powell (1989, 1999). Their research allowed various manufacturers to refine their units to maximize the efficiency and safety for curing composites.

_Diode Lasers

By the time Diode lasers (.810.980 microns) were cleared to market (Dec. 1995) the FDA was more willing to allow manufacturers to show that their devices were substantially equivalent to previously market cleared devices. The key research supplied to the FDA for the Nd:YAG, Erbium and CO_2 lasers indicated to the FDA that diode lasers were equivalent and thus granted FDA market clearance.

_Conclusion

This two part series attempted to familiarize the reader with historical data that helped develop today's worldwide dental laser industry. Today, laser manufacturers and researchers are examining new wavelengths and accessories that will allow dentists continued ability to deliver state of the art care to their patients. As dental laser sales continue to increase, even more revenues can be applied to future research and development of new laser technologies. In the last twenty years dentistry has witnessed more technological advancements than the previous one hundred years. The next twenty years promised to be even more bountiful and dental lasers will continue to be part of that excitement.

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The whole Literature list can be requested from the editorial office.

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Start of the new Master of Science course "Lasers in Dentistry"

author_Dajana Klöckner, Germany

_**Already the eleventh master course** "Lasers in Dentistry" started on 14 September 2009 in Aachen, Germany. This postgraduate Master of Science programme has been offered since 2004 at the RWTH Aachen University.

The Rector of RWTH Aachen University, Prof. Dr. Schmachtenberg, welcomed the 16 curious dentists who will get a taste of student's life again. He introduced the University of Excellence where they will study extra-occupational for the next two years.

The participants come from Germany, the European countries, Turkey, Iran and Iraq but also from Hong Kong and Canada. Some of them have already been working for decades as successful dentists in their countries. They have come to Aachen because they are persuaded that laser dentistry is the future in dental medicine. After the official enrolment at the RWTH Aachen University the students got to know their new study place by a bus tour. Already in the afternoon, the serious students life started with the first lecture.

All important theories and application options pertaining to laser use in dentistry are taught. Participants obtain sound theoretical knowledge in lectures and seminars led by renowned, competent and experienced international scientists and practitioners. Skill training sessions, exercises, practical applications, live operations and workshops with intensive assistance from scientific associates with doctorates guide participants towards using lasers successfully and professionally in their own surgeries. During the ten modules, students remain in steady contact with the RWTH Aachen University and the lecturers between attendance days via the e-learning system. This kind of segmentation allows established dentists to remain active in their surgeries while getting their Master degree.

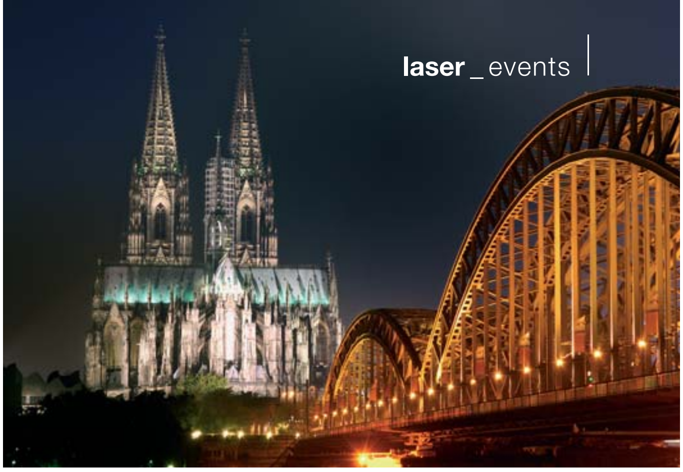
During the last five years more than 100 dentists could take their Master of Science degrees.

In addition to these documents awarded by the RWTH Aachen the graduates receive the degree "European Masters Degree for Oral Laser Applications" (EMDOLA) of the European ERASMUS Program for Postgraduate Studies.

Dr. Peter Fahlstedt, MSc, graduate from 2008, reports: "I will start the first Institute for Laser-supported Dentistry in the Nordic Countries with the aim to offer the highest achievable level of education in this field to dentists in Sweden and other neighbour countries. This is only possible with the extraordinary support and professionalism." The conclusion from Dr. Dimitris Strakas, MSc, who started his studies in 2004: "The quality of the program and its elaborate structure will certainly give you the boost that you need while using and successfully treating with lasers. I am grateful for all the things I gained and for the security I feel having a great team of colleagues beside me, as we all walk with confident steps towards the new era of dentistry."

The Master course "Lasers in Dentistry" is the first accredited dentistry laser Master program in Germany and indeed the world, recognized in the EU and all countries of the Washington Accord (USA and Anglo-American nations) and of the Bologna Reform as an internationally valid academic degree.

The master programme is taught in German and English in Aachen. The next course starts on 8 September 2010. The programme is also offered in Dubai (United Arab Emirates, next start in November 2009)._



Selected Events 2010/2011

MARCH 2010

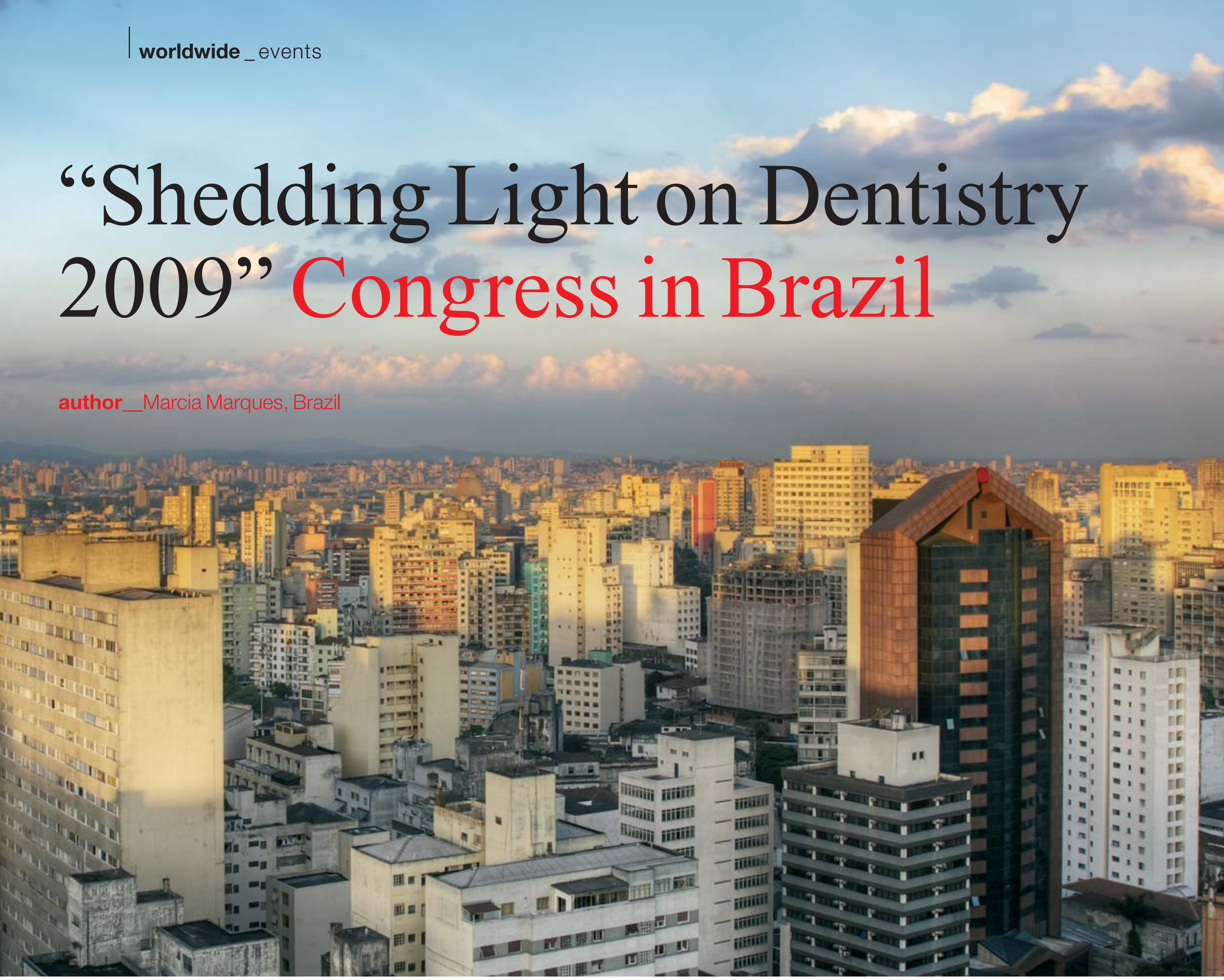
March, 09–11	*Biannual WFLD World Congress in Conjunction with UAE International Dental Conference &*	Dubai, UAE	Web: www.aeedc.com www.wfld-dubai2010.com

OCTOBER 2010

October, 29–30	*Annual Congress of DGL*	Berlin, Germany	Phone: +49-3 41/4 84 74-3 08 Fax: +49-3 41/4 84 74-2 90 Web: www.dgl-jahrestagung.de
	LASER START UP 2010/ 14th Starters Congress in Lasers in Dentistry	Berlin, Germany	Phone: +49-3 41/4 84 74-3 08 Fax: +49-3 41/4 84 74-2 90 Web: www.startup-laser.de

JUNE 2011

June, 10–11	*3rd European Congress World Federation for Laser Dentistry*	Rome, Italy	Web: www.wfld-org.info



"Shedding Light on Dentistry 2009" Congress in Brazil

author_Marcia Marques, Brazil

_The 1st Meeting of the South America Division (SAD) of the World Federation for Lasers in Dentistry (WFLD) was held jointly with the 5th Congress of the Brazilian Society for Lasers in Dentistry (ABLO). The „Shedding Light on Dentistry 2009" Congress occurred in São Paulo, Brazil, from October 22–24, 2009. The meeting was supported by Brazilian governmental research foundations, such as FAPESP, CNPq and CAPES; and two exhibitors (MMO and Oral-B).

The congress has succeeded to bring together leading clinicians and researchers in laser in dentistry from six countries for exchange and dissemination of scientific knowledge to promote excellence in patient care by advancing lasers and other related technologies. Thirteen keynote speakers presented the use of lasers in different fields of dentistry. More than 200 academics and clinicians attended the congress. There were 79 papers presented on scientific research and clinical techniques in laser dentistry (Fig. 1).

In the opening ceremony the meeting was officially opened by the president of ABLO, Professor Abílio Moura-Netto, followed by the Organizing Chairman, Professor Walter Niccoli, the President of the Scientific Committee, Professor Denise Zezell, the President of the WFLD-SAD, Professor Carlos de Paula Eduardo, and finally by Professor Gutknecht, the President of the WFLD. Professors Eduardo and Gutknecht expressed their satisfaction for the Congress organization, wished success for the event and most of all talked about the importance of the dissemination of the lasers in Dentistry accomplishments not only in congresses but also in scientific publications. They have emphasized that we are living a new era in the lasers applications especially in the health field. Moreover, professor Gutknecht congratulated the Brazilian researchers for the huge amount and quality of the scientific publications in international journals. Since the opening ceremony these professors enforced the importance in participating in the Dubai 2010 WFLD Congress (Fig. 2).

The honor invited speaker, Professor Norbert Gutknecht, kindly came from Germany, even in the middle of a very busy period, for participating in the meeting. He granted us with an opening lecture pre-


Fig. 1


Fig. 2


Fig. 3

senting his results on „A new approach to laser assisted bleaching". His bright presentation was followed by a series of oral and poster presentations. In the beginning of the afternoon, Professor Rafael Gutierrez, from Argentina, presented a lecture on „Surgical indications for laser use in lesions caused by HPV". Professor Martha Simões Ribeiro, from the Nuclear Energy Research Institute (IPEN-Brazil), spoke about „Strategies to optimize photodynamic antimicrobial therapy". Both presentations were very appreciated by all participants, who demonstrated depth interest on these discussed issues. In fact, throughout the meeting several studies were presented focusing in the PDT applications in dentistry and oral medicine.

The first day of the meeting was closed with two more important lectures given by the Professor Aldo Brugnera, the General Secretary of the WFLD and Vice-President of the WFLD-SAD, who talked about „Clinical use of photography in oral cavity". Finally, Professor Vanderlei Bagnato, from the Physics Institute of the University of São Paulo (IFSC-USP—Brazil) showed impressive results of „Photodynamic therapy in the treatment of oral cavity". This important researcher and professor has shown not only clinical cases, but also the development of new equipments for application in oral health.

In between the scientific presentations the coffee breaks were periods of joy, when the participants could get together for eating delicious treats and commenting the new knowledge presented in the meeting.

Additionally, there was time to announce the „LASER-International magazine of the laser dentistry". The new journal was received with enthusiasm by many participants who expressed interest in buying Journal subscriptions (Figs. 3–4).

The second day of the meeting started with the lecture of other honor invited speaker, the Director of „Hadassa" Dental College of Hebrew University in Israel, Professor Adam Stabholz. He presented the „New side-firing fiber effects in endodontics" developed by him with collaborators, showing the interesting effects of this fiber along with EDTA for cleaning the root canal walls. His interesting presentation was followed by two other lectures. First of all the one in „The use of Er:YAG, CO_2 and Diode lasers in treatment of head and neck cancer patients" presented by Professor Moti Sela, also from the Hadassa University, who showed his experience in treating oncologic patients with lasers, especially in the last 15 years. Then, Professor Antonio Pinheiro, other Brazil Representative in the WFLD presented the experience of his research group on „Laser surgery on the dental practice".

The afternoon started with a new welcome from Professor Carlos de Paula Eduardo, the President of the South America Division of the WFLD and Chairman of the Special Laboratory of Lasers in Dentistry (LELO) of the School of Dentistry of the University of São Paulo (USP). Based on his vast experience of more than 18 years militating in the field of lasers in dentistry, not only as clinician, but also as a hard work researcher, presented the lecture „New technologies—Laser in contemporary clinical dentistry". In this special occasion he invited everybody to get together in Dubai for having the opportunity to learn from important researchers from all over the world. Professor Eduardo devoted himself to the event not only following all the presentations, but also by giving support and attention to all participants and those who also worked hard for the success of the Congress.

Professor Eduardo presentation was followed for two more lectures, as follows: „Evidences of the effects of CO_2 laser in caries prevention" by Professor Marinês Nobre from the University of Campinas, Brazil; and „Optical coherence tomography in dentsitry" by Professor Anderson Gomes from the Department of Physics of the Federal University of Pernambuco, in a northeast state of Brazil.

Before the coffee break there were six oral presentations and then, the last two lectures were presented. Firstly, Professor Valdir Golveia from the São Paulo State University, Brazil, spoke about „Comparative study of PDT on periodontal treatment in different systemic alterations". Then, the closing lecture was given by Professor Gerdal Sousa, from the Periodontics Department of Federal University of Minas Gerais , Brazil, on „From photobiomodulation to photodynamic therapy: Clinical applications in dentistry". This leading researcher presented with enthusiasm a compilation of his group positive findings on the use of PDT in Periodontics.

Fig. 4

Seventy participants attended the six sections of „Lunch and Learning" where the invited speakers along with a section coordinator have discussed in a welcoming environment important issues of the use of lasers in different dentistry fields as: „Lasers in Periodontics" given by Professor Gutknecht and coordinated by Dr Iliria Feist; „Lasers in Endodontics" by Professor Adam Stahboltz and Dr. Sheila Gouw-Soares; „Lasers for treating oncologic patients" by Dr Fernanda de Paula Eduardo and Professor Márcia Marques, with the collaboration of Professor Moti Sela, „Laser for treating mouth diseases" by Dr Luciane Azevedo and Dr. Vivian Galleta; „Photo dynamic therapy (PDT)" by Dr. Aguinaldo Garcia and Professor Alyne Simões and last but not least „Treatment of dentine hypersensivity with low and high power lasers" given by Dr. Thereza Christinna Ladalardo and Professor Ana Cecília Aranha. All participants were pleased with the results of such opportunity of exchange experiences with knowledgeable clinicians and researchers of different Dentistry fields.

There were 35 oral presentations of studies developed mostly in several states of Brazil. The study „Comparison between laser therapy and non-surgical therapy for periodontitis in diabetic animal", presented by Professor Letícia Theodoro received the oral presentation first award. This professor showed a state-of-art study evidencing the improvement in periodontal healing when conventional periodontal treatment was associated to laser phototherapy.

Simultaneously with the coffee breaks there were four sections of poster presentations. Forty-four posters were presented and the graduate student from the Restorative Dentistry Program of the School of Dentistry of USP was awarded with the first prize. The student presented her master thesis „Er:YAG and Er,Cr:YSGG lasers irradiation on dentin" relating the dentin ultrastructure to the quality of dentin bond strength to composite resin.

The Congress dinner was very well participated and everyone felt very much at home. In fact, the overall feeling of participants was festive; everyone was satisfied with the presentations and also for the opportunity to meet friends and colleagues in a friendly atmosphere. This dinner was also celebrated ten years of the Professional Master of Laser in Dentistry. This post graduation program, offered by IPEN and FOUSP, has already formed more than one hundred dentists in the past 10 years. The students were very pleased by the reunion, excited about the new products presented at the conference and in particular for meeting personally with renowned researches of the laser dentistry field, as Professor Gutknecht, Adam Stahboltz, among others.

The congress certainly exceeded the expectation of all organizers and participants. Professor Denise Zezell, the President of „Shedding Light on Dentistry 2009" Congress Scientific Committee and her students have worked hardly for getting grants from research foundations to support all meeting activities. Everybody congratulated her for the successful meeting.

The staff of the „Special laboratory for Lasers in Dentistry (LELO)"of the school of dentistry –USP, coordinated by Professor Carlos de Paula Eduardo was in charge of the secretary work. The professors Ana Cecilia Aranha and Patricia de Freitas chaired a very organized and dedicated team (listed below) in order to have everything ready for the meeting before and during the event. Dr. Zilson Magalhães, from the company DiFatto, had an important contribution for the meeting success, being in charge of the contacts with oral care companies and their financial support for the Congress. Thank to them all activities occurred softly throughout the two-day congress.

In the closing ceremony, Professor Gutknecht (President of the WFLD) and honor speaker along with Professor Carlos de Paula Eduardo (President of the WFLD-SAD) announced the top six poster and oral presentations. The presenters were awarded with a certificate of achievement. Then, Professor Gutknecht expressed his gratitude in participating in the meeting. He again highlighted the importance of Brazil in the Scientific Scenario of Lasers in Dentistry with the large amount and quality of the publications in indexed journals. Moreover, he was very happy with the friendly atmosphere that was hallmark of the meeting. This friendship prevailed amongst participants of the teams of Laser in dentistry researchers of South America. Then, Professor Eduardo closed the meeting with the invitation to the 2010 Dubai WFLD meeting followed by a long section of photos and hugs of all participants.

The main goals of the first Meeting of the WFLD-SAD were fully achieved. The Congress was very successful in disseminating new knowledge in the field of lasers in dentistry, but mostly offered support to meet Dubai. The executive committee of WFLD-SAD chaired by Professor Carlos Eduardo de Paula made disseminating this important scientific event. Certainly, the 2010 Dubai WFLD meeting can count on the South America Division with a significant representation in Dubai._

3rd International Conference on Lasers in Medicine Timisoara

New Highlights in Clinical Practice

author_Cosmin Balabuc, Romania

_The third edition of the International Conference on Lasers in Medicine Timisoara, Romania, "New Highlights in Clinical Practice" took place in Timisoara (Romania) from 24th to 26th September 2009 under the presidency of Prof Carmen Todea (Secretary of WFLD-ED), Prof Norbert Gutknecht (President of WFLD), and Prof Jean Paul Rocca (President of WFLD-ED).

The third edition of the conference integrated many important topics and new developments in this non-conventional field of medicine and dentistry, thus offering to the participants the opportunity of enlarging their basic knowledge gathered after experiencing the last editions. As a novelty, for this edition, the Basic science section was integrated in the conference topics for the first time and dedicated to the physicists.

The scientific program comprised 14 plenary lectures, 17 oral presentations and 10 poster presentations, and had great impact, with many international personalities bringing their scientific contribution (Norbert Gutknecht, Steven Parker, Adrian Podoleanu, Jean Paul Rocca, Gianfranco Semez, Victor Nimigean, Giovanni Olivi, Dan Siposan, Carmen Todea, Mark Whiteley, Lajos Gaspar, Carlo Fornaini). Romanian participants brought also their contribution to the scientific program by oral and poster presentation, thus pointing out their increasing interest for the application of laser technology in dentistry and oral surgery. The poster session granted 3 prizes for presentation, as follows: "Laser Doppler flowmetry evaluation of pulp microcirculation in laser-assisted pulp capping treatment" having as authors C. Todea, C. Kerezsi, M. Calniceanu, C. Balabuc, L. M. Filip; "Class V cavities diagnostic by en face optical coherence tomography. The necessity of increasing the scattering for adhesive layer media" having as authors M. Rominu, C. Sinescu, M. Negrutiu, D. Pop, A. Bradu, E. Petrescu, R. Rominu, G. Dobre, A. Gh. Podoleanu; "Time domain OCT in galvano-ceramic fixed partial prostheses investigations" having as authors C. Clonda, C. Sinescu, M. Negrutiu, M. Rominu, A. Bradu, G. Dobre, A. Gh. Podoleanu.

The exhibition gathered various laser equipments from different manufacturers, such as Biolitec, Fotona, KaVo and Orotig, of various powers and wavelengths, for biomodulation as well as for hard and soft tissue surgical applications and last but not least, for applications in dental laboratory. We would like to thank to the major sponsor of our event, Fotona (Medical Partner—local representative) for the support in organizing this event and for organizing an hands-on workshop, providing lot of useful information about the use of diode, Nd:YAG and Er:YAG lasers, thus giving the participants the chance to test the laser equipments themselves.

Furthermore, during this edition general and vascular surgeons had the chance to listen two lectures of Dr. Mark Whiteley about novel laser-assisted treatment solutions: "Laser Sweat Ablation (LSA) for Axillary Hyperhidrosis" and "Endovenous Laser Ablation (EVLA) of Varicose Veins".

The social program started in the evening of the first day with an organ concert and continued with a speech of Prof Todea at the Opening Cocktail and a fantastic artistical program. The second evening was highlighted by the Gala Dinner, which delighted the invited speakers and participants with Romanian folklore and dance customs from the Banat region of Romania.

The social program ended after the conference with a special afternoon with wine tasting at the Recas Winery, one of the most famous in Romania.

We cordially invite you to share your laser experience to our future events!_

Laser Down Under

author_Ingmar Ingenegeren

Fig. 1_Presenting the poster to Dr David Cox, President of the AALD.
Fig. 2_At the gala, sitting from the right: Prof Laurence Walsh, Dr Graeme Milicich, Dr Andrew Brostek.
Fig. 3_All participants of the pre conference laser certification course received a certificate from the School of Dentistry of the Queensland University after passing the test.

_**The inaugural conference** of the Australian Association for Laser Dentistry took place on the 24th to 26th of July 2009 near Brisbane at the Gold Coast. The AALD has been formed to provide an education platform and a forum for laser users in general to meet, discuss and provide direction to regulators and professional associations regarding laser use, tapping into the wealth of knowledge the members have already at their disposal. The AALD in its short life has successfully lobbied the ADAQ, the Dental Board of Queensland, and Radiation Health Queensland to bring about a change in the Radiation Safety Act to allow hygienists and therapists to use class four lasers for procedures limited to the scope of their training under the direction of a dentist. With the moves to national registration from 1 July 2010, this could provide a template which can be adopted at the national level.

Fig. 1

Fig. 2


Dr Ingmar Ingenegeren

LASER APPLICATIONS IN DENTISTRY

By Professor Laurence J. Walsh

including: laser physics and laser safety
Er:YAG hard tissue procedures
laser soft tissue procedures
laser-enhanced tooth whitening
wet laboratory sessions
clinical demonstrations of laser hard & soft tissue procedures

31 July 2009

Associate Professor N.W. Savage
Director
Continuing Education

Professor L.J. Walsh
Head
School of Dentistry

RECOGNITION OF NON-AWARD PROGRAM

Completion of this program does not provide credit towards the official academic courses and awards of the University

Radiation Health Course Approval No. ED105

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AUSTRALIA

Fig. 3

The motto is: "A dentist must voluntarily embark upon a substantial level of education, not only to become proficient using the laser, but to make an informed decision about the best type of laser for the practice. For example, just because a particular laser is FDA-approved for a particular procedure doesn't necessarily mean that it is the best laser for that procedure. The dentist needs to be educated about laser physics and laser tissue interaction in addition to mastering the procedural skills. An informed purchaser will definitely reap the proven clinical and financial benefits of laser dentistry."

Among the invited speakers were Prof. Laurence Walsh, Professor of Dental Science and Head of the University of Queensland School of Dentistry since 2004. He leads an energetic research group working in advanced technologies, and he has been research program leader in laser applications in health sciences for the UQ Centre for Biophotonics and Laser Science since 1998. He is a registered dental specialist in special needs dentistry, and has been treating patients in clinical practice using laser technology since 1991. He wrote numerous articles and answers any question from any direction in Laser Dentistry. As a main speaker, he explained in multiple lectures, the state of the art of Laser in Dentistry including low level laser therapy.

Dr David Cox is the Founding President of the Australian Society for Laser Dentistry and holds clinical academic titles at both the University of Sydney and at the University of Queensland. He runs a large dental practice in Brisbane, where he has been treating patients with lasers since 1999. He has been at the forefront of laser dentistry ed-

ucation in Australia, having served as a clinical preceptor for many general practitioners during their introduction to lasers, both in Australia and overseas.

Dr Andrew Brostek has a private dental practice in Perth, Western Australia and is Clinical Senior Lecturer in Operative Dentistry at the University of Western Australia Dental School. He has given many national and international presentations concerning Minimal Invasive Dentistry and in the uses of Er:YAG dental lasers. On these topics, he has published in various dental journals and he has ongoing interest in further diagnostic uses of laser fluorescence.

Dr Graeme Milicich graduated from Otago in 1976 and has since been in private group practice. His fields of interest include cosmetic dentistry, occlusal rehabilitation, implant prosthetics, minimal intervention and lasers. He is a Fellow, Diplomate and founding board member of the World Congress of Minimally Invasive Dentistry. He is also a founding board member of the NZ Institute of Minimal Intervention Dentistry. He is currently conducting research on minimal intervention restorative techniques, laser ablation physics and clinical applications of the Er,Cr:YSGG laser. He showed how he determinded the optimal angle for most effective hard tissue ablation.

Dr Hisham Abdalla is the first multiple laser dentist and instructor in New Zealand. He is an international speaker, author and educator in the fields of Laser dentistry, Minimally Invasive, high-tech and CEREC CAD/CAM dentistry. He is an invited Associate Professor at the University of Cagliari in Italy. He is the NZ course provider and examiner for The Queensland University Laser Certification program, by Professor L. Walsh. He is a Fellow & Diplomate of the World Congress of Minimally Invasive Dentistry and had served as a directors board member of the organization in the USA. He is a Founding member of the NZ Academy of Cosmetic Dentistry, Founding member & VP of the NZ Institute of Minimal Intervention Dentistry & Fellow of the World Clinical Laser Institute. He practices dentistry and runs live courses for dental professionals from all over the world, at his Professional Development Centre at the Laser LifeCare Institute in Auckland. He graduated with honors from Charles University in Prague in 1998 as a Doctor of Dental Medicine.

Dr Peter Verheyen is a founding member and secretary of the European Laser users and Research Association and a founding member and treasurer of the European Society for Oral Laser Applications. He was also an Organisation Representative of the International Society for Lasers in Dentistry. He has had numerous articles published in dental journals and magazines. He also lectures on laser applications in dentistry and conducts workshops and training for practitioners. He and his son Jeroen presented the newest developments in laser assisted bleaching.

Dr Ingmar Ingenegeren is laser user since 1995 and a pioneer of implicating laser in implant surgery using more than 10 different wavelengths. He has a Master in Implantology (Danube University of Krems, Austria) and a Master in Laser Dentistry (University of Aachen, Germany), is a member of multiple international laser and implant societies and codirector of the laser module program of the Indian Academy for Laser Dentistry. In 2007 he became scientific co worker of the Dental Laser Department of the Aachen University (Germany) and has performed more than 25 laser workshops and more than 45 presentations at international congresses in the last four years. He was the only one to present a poster at this inaugural conference.

"The quality of speakers assembled at the AALD meeting is a testament to their belief in the establishment of this society. All speakers generously donated their time and efforts with minimal or no assistance, and I am sure you would agree their contributions made the meeting an enormous success", thus Dr David Cox. He also thanked the companies who supported the meeting. There were several booths with more than a handful of laser brands. All attendees of this inaugural conference automatically received a one years membership to the AALD. Prof. Laurence Walsh announced at the end of the meeting, that there are plans for 2010 to cooperate with the WFLD._

_contact laser

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Manufacturer News

KaVo

KaVo GENTLEray 980 diode laser: efficient, convenient, expandable

The GENTLEray 980 is a diode laser for soft tissue surgery, decontamination procedures in periodontics and endodontics, as well as for laser-assisted bleaching. The laser is available in two versions – Classic and Premium. The laser light with a wavelength of 980 nm demonstrates minimum absorption in water and high absorption in haemoglobin and melanin. The GENTLEray 980 Classic provides a performance of 6 Watt cw, and can be optionally upgraded to the Premium variation. By contrast, the GENTLEray 980 Premium diode laser is equipped with higher performance (7 Watt cw, 12 Watt peak), and the possibility of micropulsation at a frequency of up to 20,000 Hz. The increased treatment efficiency allows for faster procedures and shortened exposure times. Furthermore, the Premium variation is equipped with a water cooling system (peristaltic pump) which reduces thermal damage, thereby enabling less painful treatment with a reduction in post-operative discomfort. With the aid of the water supply, blood particles remaining after the SRP are rinsed from the pocket, so that in addition to laser-assisted sulcus sterilisation, disepithialization in the pockets can take place more efficiently. In comparison to conventional therapy, treatment with the GENTLEray 980 ensures only light bleeding, reduced swellings and in the course of time, just minor post-operative discomfort.

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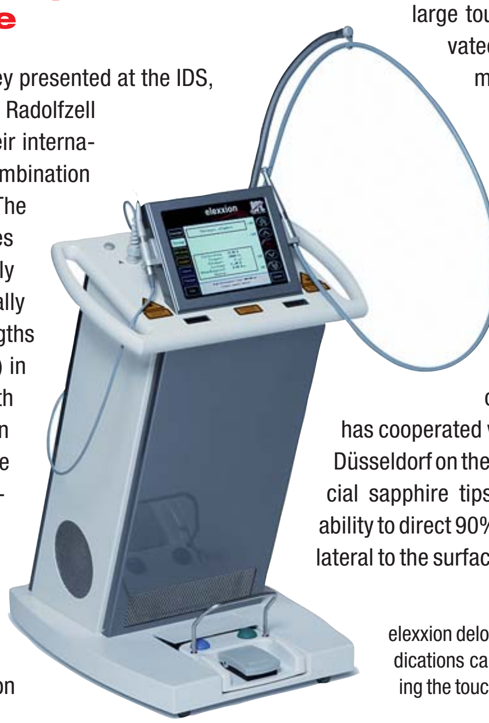
elexxion

Two wavelengths and 50 W pulse output in one machine

Among the products they presented at the IDS, elexxion AG, based in Radolfzell (Germany), included their internationally-patented combination laser elexxion delos. The elexxion delos combines two of the most frequently studied and scientifically recognised wavelengths (810 nm and 2,940 nm) in one machine so that both hard and soft tissue can be treated with one single machine. At present, according to elexxion, most applications can be reasonably treated with this combination system. For example, the elexxion delos can be used for the removal of concrements, decontamination, cavity preparation, root resection and bone ablation. Over 100 digitally stored indications can be accessed on a large touch screen and activated at a "touch". Output modifications can be easily and individually fine-tuned. The practitioner saves time, the dosage accuracy is guaranteed.

Especially for periimplantitis therapy and the treatment of biofilm, elexxion has cooperated with the University of Düsseldorf on the development of special sapphire tips. These feature the ability to direct 90% of the laser's power lateral to the surface of the implant. Further advantages of the elexxion delos for soft-tissue applications are: Together with the ultrashort pulse durations of as little as 9 µs, the modern diode technology with its 50 W pulse output enables a gentle, efficient soft-tissue surgery at a speed which, according to elexxion, was previously unattainable. A flexible fibre guide is an additional relief for the dentist during treatment. At the same time, the newly developed fibre increases the output density thanks to an optimized beam profile. This means higher removal speed, for example in the tooth enamel. The machine can be connected comfortably to the internal compressed-air supply or to an external compressed-air supply. The external connection permits the water spray to be precisely adjusted and, thus, improves the removal performance. The elexxion delos combination laser can be purchased in Germany from the specialized distributor Pluradent.



elexxion delos: 100 digitally stored indications can be easily activated using the touch screen

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Omicron

Omicron wins a new Partner for its worldwide Sales Network

The company Omicron-Laserage Laserprodukte GmbH from Rodgau, Germany further expands its worldwide sales network. As from now Omicron products will also be distributed in Singapore and Malaysia in cooperation with the photonic specialist Photonitech. As from now the laser specialist Omicron from Rodgau, Germany will be represented in Singapore and Malaysia by Photonitech Pte Ltd. The Asian sales representative includes the whole Omicron range of products in its portfolio. Founded in 2002 Photonitech is a well-established sales representative in the field of NanoTech, BioTech and SemiCon in Asia. Based in Singapore the specialist distributes customized, high quality products for the fast growing photonic industry in the whole Asia-Pacific region. Besides product distribution the PhotoniTech team also provides consultancy, technical support and product training for Omicron in Singapore and Malaysia. Further information about the distributor is available at www.photonitech.com.
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laser
international magazine of laser dentistry

WFLD World Federation for Laser Dentistry
Formerly ISLD, founded 1988

oemus

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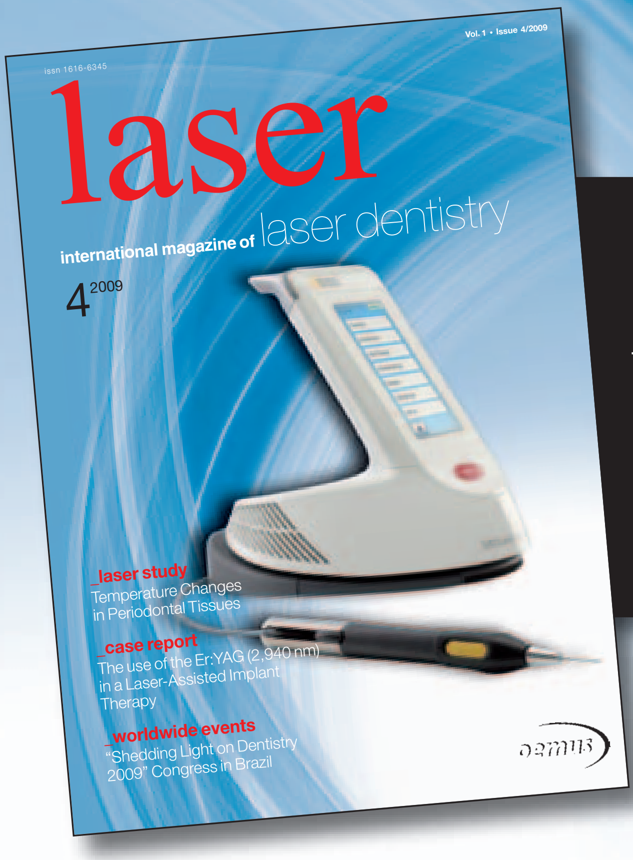

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