

laser

international magazine of laser dentistry

1 2009

_laser study

Conventional diode laser versus high-power pulse technology


_interview

The Right Wavelength—Areas of application and indications for different kinds of laser

_worldwide events

Laser-assisted Dentistry—
A report from the Nordic Dental Laser Society
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Prof Dr Norbert Gutknecht
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Welcome...

...to the new world laser community journal of the World Federation for Lasers in Dentistry (WFLD)

The WFLD is the membership organisation representing the specialty of laser-applied dentistry worldwide. The WFLD is structured into five major divisions, which are the North American, South American, European, Middle East and African, and the Asian Pacific division. Within these five divisions a number of national societies and individual members are incorporated.

The mission of our society is to stimulate the research in the different fields of laser-applied dentistry, to coordinate long-term clinical studies using lasers as main instrument during the treatment, and to establish an educational foundation for dentists who are intending to use or are already using lasers in their daily treatments. One of my main targets for this presidential period is to promote laser safety regulations worldwide, especially in those countries not having yet laser safety regulations in their national health programs. Furthermore it is my intention to support the integration of national dental laser societies in their national dental associations, in order to promote the beneficial use of lasers in the different dental disciplines.

The scientific strength of the WFLD is the huge worldwide network of universities, institutes and specialists working in the different research areas of laser dentistry. The strength of private practitioners, being member of the WFLD, is to be supported by evidence based treatment concepts, which have been developed by a team of WFLD specialists.

Being the responsible editor-in-chief of this new journal, it is my wish and desire to fulfil the expectations of our members and readers to establish this journal as the most important communication tool in the world community of laser dentistry.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'N. Gutknecht', written over a light blue horizontal line.

Prof Dr Norbert Gutknecht
WFLD President
Editor-in-Chief

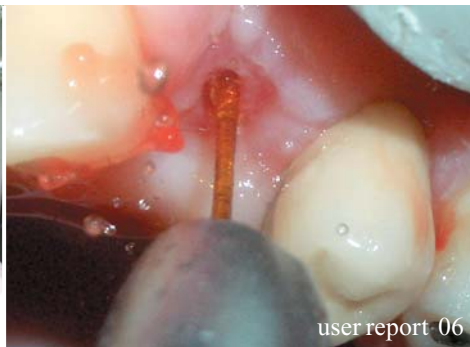
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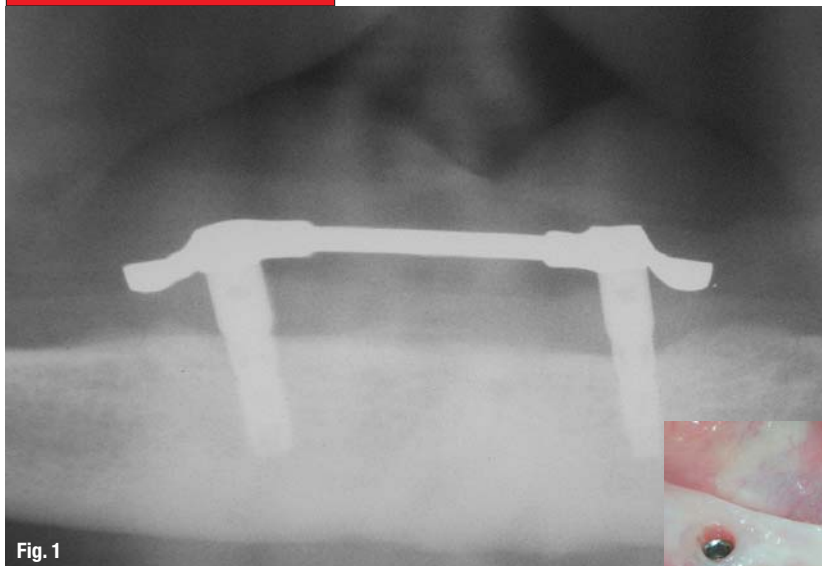
- 50 Imprint

Full-laser implant bed preparation: case studies using different implant systems

author_Ingmar Ingenegeren, Germany

The ability to treat a wide range of tissues with a laser has been a fact of life for a long time. What is new are the potential applications (new indications) and the refinement of techniques. The favorable absorption in water and hydroxyl apatite, and the interaction of water and laser light that substantially enhance the laser's effectiveness make the Er,Cr:YSGG laser (wavelength 2,780 nm, frequency 20 Hz, pulse length 140 μ , average output 6 W) an ideal tool for the gentle treatment of soft tissue and bone.

_Case 1



teeth 42 and 32 to counteract the tipping of the prosthesis.

Clinical procedure

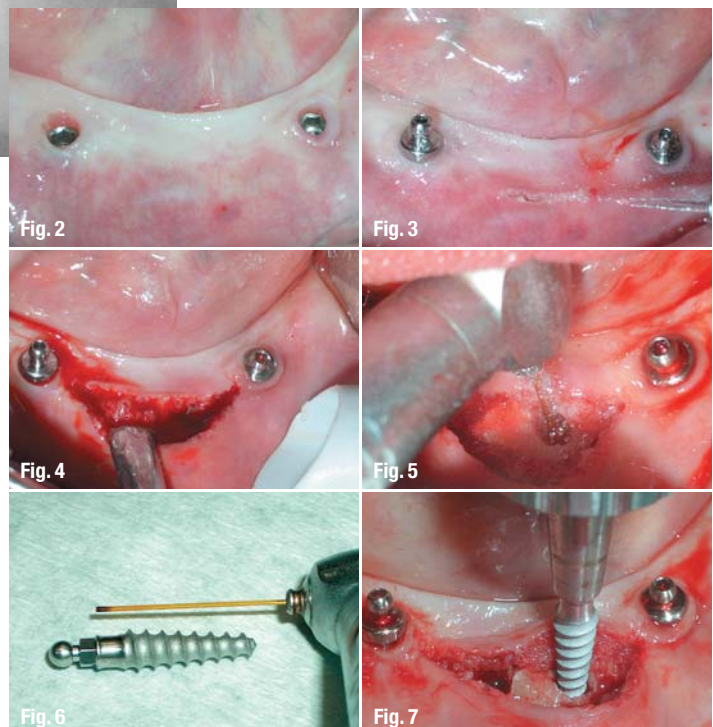
First, the old bar construction was removed (Fig. 2) and the new, shorter abutments were inserted for orientation. After infiltration anesthesia, the opening incision (Fig. 3) was made using the Er,Cr:YSGG laser with 2 W, 100 mJ, 40 % water, 40 % air*, tip S4, to the bone. A small zone was left to the mesial side of 43 and 33. After exposing the bone, an insignificantly bleeding surgical area was revealed (Fig. 4)

_Case 1: Improving prosthesis stabilization with two additional implants

Findings

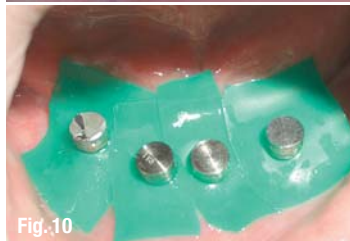
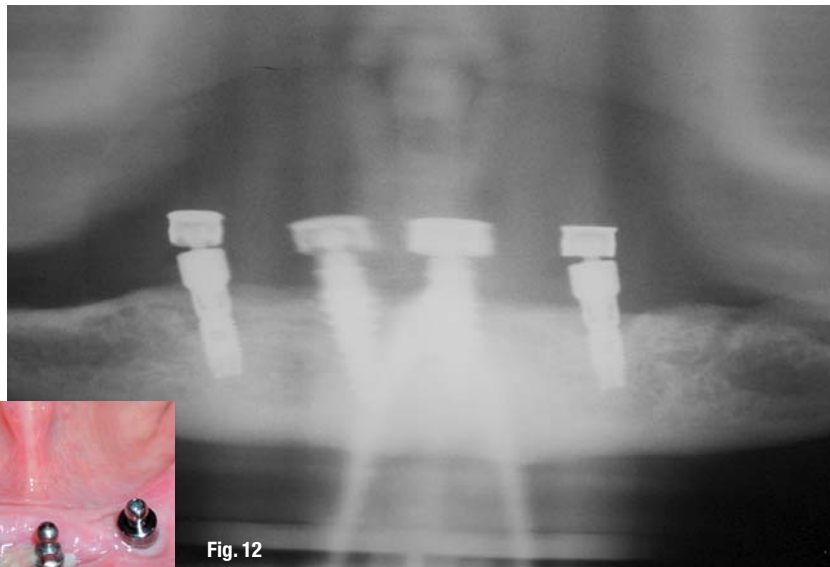
A 72-year-old male patient complained of the increasing instability of his mandibular prosthesis that was stabilized 10 years ago with a bar construction and two implants (Screw Vent) at 43 and 33 (Fig. 1).

We resolved to exchange the abutments with shorter ones possessing a pushbutton, and two additional implants with a pushbutton (Bauer screws) at



where the locations for implantation could be lightly marked using the same laser setting.

In order to work with cortical bone, more energy and less water and air are required because bone contains less water. We therefore used 3.5 W, 175 mJ and a sapphire tip (S6/10) to create a circumscribed opening the size of the implant neck using 65 % water and 50 % air*. We subsequently prepared the spongiosa with a 14 mm tip (Z4/14) and 3 W, 150 mJ with 55 % water and 50 % air* (Fig. 5) with an angled and a straight handpiece. Due to the large amount



of available space, the 12.5 mm implant length was easily achieved with the 14 mm tip (Fig. 6).

Both implants were inserted with maximum primary stability (the patient was almost pulled out of the chair) (Fig. 7), and the wound was closed with 4.0 sutures (Fig. 8). Three weeks after surgery (Fig. 9), the matrices in the prosthesis were fixed and subjected to a load (Figs. 10, 11).

Results

The wound healed without irritation or pain. The favorable primary stability enabled early loading. The envisioned goal was achieved (Fig. 12) since the patient was very satisfied with the new seat of the prosthesis.

Discussion

In preparing implant beds, there are certain matters that need to be addressed. First, the laser tip needs to be longer than the implants. In this case, 12.5 mm implants were used, and the tip length was 14 mm (Fig. 7).

Second, there must be congruence between the bone preparation and the shape of the implant. This, however, is less critical with the utilized conical, self-tapping implants than with cylindrical implants. A more precise fit is required in the mandible in contrast to the maxilla because of the denser bone. (When screwing in the implant, bro-

ken off bone parts can be moved to other locations to balance the shape of the cavity.) Third, the bone must be sufficiently cooled during the entire operation, which is achieved by the ingenious water spray system of the Er,Cr:YSGG laser. Carbonized sites can arise when a tip

comes too close to the bone, but these can be removed by additional irradiation from a greater distance. In addition to its many advantages, laser treatment has one disadvantage—it takes more time, up to 20 minutes with very dense bone.

The advantages are:

1. Slight bleeding, clean and hence visible preparation.
2. No smear layer that accelerates osseointegration.
3. The laser works on the surface and is thus not associated with the harmful penetration of heat.
4. Biostimulation accelerates wound healing.
5. Sterilization of the surface obviates the necessity for antibiotics.
6. Fewer instruments are required (no scalpel, drill or physiodispenser), which simplifies logistics.
7. Working without contact substantially increases patient comfort.
8. There is almost no pain, tumors, heat or inflammation after surgery.

Case 2: Minimally invasive, delayed immediate implantation of a single tooth with direct loading

Findings

A 32-year-old female patient lost tooth 24 from a root fracture (Fig. 1) and wore a removable interim

_Case 2

Fig. 1

prosthesis for six weeks (Fig. 2). Since she had a new boyfriend and her interim prosthesis was annoying while kissing and made her embarrassed, she immediately wanted a permanent tooth. A bridge was not considered because tooth 23 had not been brightened, and tooth 25 had an unclear root filling with apical brightening and revealed a crown and pin and hence could not reliably serve as a bridge abutment. The patient rejected extracting tooth 25 and extending the bridge to tooth 26. The amount of bone for implantation was sufficient in a palato-vestibular and mesiodistal direction, and the extraction wound was primarily closed.

Clinical procedure

The measurement using the implant template on the OPG revealed a safe depth of 12 mm (Fig. 3). After infiltration anesthesia, the straight handpiece and tip Z4/14 were used to penetrate the middle of the still relatively fresh extraction wound with 3 W, 150 mJ, 50 % water, 50 % air* (Fig. 4). The direction was determined by the neighboring teeth and the path of the bone in the alveole.

After achieving the desired length (Figs. 5, 6) and extending in a horizontal direction, the implant (Reuter One Day 4.2/12) was first inserted manually

(Figs. 7, 8) and then using a torque wrench (Fig. 9) with the maximum torque advised by the manufacturer for a direct load (50 Ncm) and with primary stability (Fig. 10).

At the palatal side, a small gingivectomy was created with 2 W, 100 mJ, 20 % water, 20 % air* (Fig. 11), which was necessary to correctly place the special impression post (Fig. 12). The area surrounding the implant was slightly de-epithelized with 1 W, 50 mJ, 10 % water, 10 % air*.

The master dental technician worked with a gingiva mask (Fig. 13) on the model to support the healing and shaping of the gingiva around the crown. On the next day, the finished crown



Fig. 2

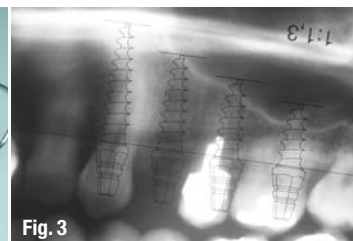


Fig. 3



Fig. 4



Fig. 5



Fig. 6



Fig. 7



Fig. 8



Fig. 9



Fig. 10



Fig. 11

was inserted (Fig. 14). The patient commented, that from the beginning the new tooth felt like one of her own. At the check-up after 14 months the gingiva was nicely adapted (Fig. 15).

Small but amazing.

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Results

The preparation of the implant bed and the impression took no longer than 15 minutes. The implant had maximum primary stability (a requirement for immediate loading), and the definitive restoration was finished on the next day. As a precaution, it was kept free of occlusion. The patient was extremely satisfied (as was her boyfriend).

Discussion

In (delayed) immediate implantation, the not-yet ossified alveole serves as a reference and yardstick. Lasers cannot slide or slip off as is the case with drills. Flap surgery is not required, which would create an unnecessary wound. Preparation beyond the apical margin of alveole requires careful prior measurement and sensitivity. When the sinus floor wall is reached, it is more difficult to proceed through hard cortical bone, hence indicating where to stop (a minor internal sinus lift can be created with an osteotome if necessary).

The horizontal extension of the bone cavity in the apical area is made easier by continuously probing with the inactive laser tip, proceeding cautiously so as not to break the tip. The indications for such an operation are limited by the available handpieces and tips (manufacturers should respond to this need).

Due to their large, flat thread, conical implants are specially designed for direct loading, which is essential for primary stability to compress the bone when screwed in. The congruence of the bone cavity with the shape of the implant is not as critical in the spongy maxillary bone.

With minimally invasive laser surgery, wound healing is fast, free of complications, and with no postoperative complaints. To avoid undesired lateral loads in the osseointegration phase from

articulation, it is recommended to be particularly careful with the occlusal fit of the crown.

Case 3: Prosthesis fixation on two implants in the mandible and exposure with the laser

Findings

A 78-year-old patient presented with a very loose mandibular prosthesis that caused him daily problems with speaking and eating. He was no longer able to bear adhesives. In the past, he underwent an invasive bone resection of the sharp bony edges on the alveolar process of the entire mandible by a maxillofacial surgeon. He suffered postoperative symptoms for many months, and consequently developed a phobia of oral surgery. He was accordingly afraid of implant surgery, but agreed to it after an extensive explanation of the laser procedure.

Clinical procedure

Under infiltration anesthesia, the transgingival areas at teeth 43 and 33 were marked with the laser with a flat tip, 2.5 W, 125 mJ, 50% water and 50% air* (Fig. 1). The mucosa was sectioned to expose the surgical area using the same setting (Fig. 2). At the marked locations on the cortical bone, 3.5 W, 175 mJ, 65% water and 60% air* were used to make circular recesses the diameter of the implant neck (Fig. 3). Then the spongiosa was prepared with 3 W, 150 mJ and various tips. A standard drill was used during surgery to measure if the desired diameter and the length had been reached. Then 13 mm tapered Screw Vent implants were used with a diameter of 3.7 mm (Figs. 4–6).

The wound was primarily closed with 4.0 sutures (Fig. 7). After three months of closed healing (Fig. 8), the implants were exposed with tip Z4/14, 2 W, 100 mJ, 50% water and 50% air* under slight anesthesia (Fig. 9). The connection with the prosthesis was created (Figs. 10–12) and loaded.

Results

The implants were inserted with maximum primary stability in a slightly long operation. There were absolutely no complications or pain post OP, the patient's trust in oral surgery was restored, and he was very thankful.

Discussion

In an edentulous jaw, the desired implant position is preferably defined before flap surgery. The laser can be used for transgingival marking at those locations after exposing the tooth and bone, which is very helpful when determining the correct position. The preparation of bone cavities for (nearly) cylindrical implants requires a calm

patient, a confident hand, and a good ability to estimate. Given a maximum laser tip depth of 14 mm, a maximum of 13 mm implants can be inserted assuming that the laser handpiece can contact the bone. Mobility must remain unrestricted, which is generally only the case in edentulous areas.

The success of laser surgery can be easily monitored with a standard drill (a 3.2 mm drill for 3.7 mm implants) where the drill is manually inserted into the preparation without force. Wherever it stops, additional bone has to be removed.

_Case 3



Fig. 12



Fig. 1

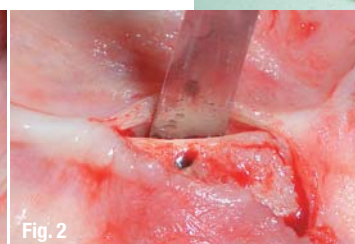


Fig. 2



Fig. 3



Fig. 4

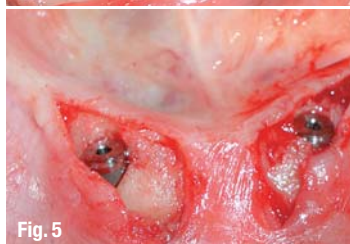


Fig. 5



Fig. 6



Fig. 7



Fig. 8

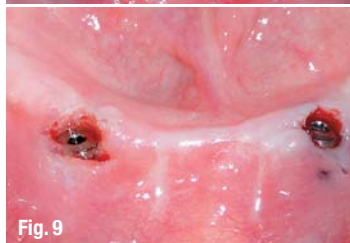


Fig. 9



Fig. 10



Fig. 11

Only the opening in the cortical bone must have the exact diameter of the implant neck to prevent fracturing during insertion. This can be achieved relatively quickly with a bit of practice. The extra time is justified by the patient's comfort (no vibration and easy, fast and painless wound healing).

**The cited settings are guideline values and depend on the tissue, sensitivity, utilized tip and care provider.*

_author

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Laser Supported Treatment of Periimplantitis on a Strategically Important Individual Tooth Implant in the Superior Maxilla

author_Georg Bach, Germany

Due to improved operating technique, finer surgical instruments, modified implant surfaces, oral implantations are safe and have become standard therapy. Early complications that were feared in the initial phase of oral implantology have become rare thanks to sophisticated operating techniques and improved implant surfaces.

_However, since the number of incorporated implants has strongly increased in the meantime, late sequelae that generally result in the loss of the artificial abutment have also become more numerous.

These late sequelae are mainly of an inflammatory nature and increase due to a lack of recall and a patient's poor oral hygiene. This paper presents such a case of periimplantitis and describes the therapy.

_The Patient

In 1991, the 43-year-old female patient had an ITI implant incorporated alio loco regio 13 (Fig. 1). Except for the remaining tooth 23, the superior maxilla is edentulous. After the healing-in process of the implant, a telescopic crown was placed onto the implant and the remaining tooth 23, onto which a telescopic prosthesis is fastened (Figs. 3, 4). After completion of the prosthetic phase, no recall took place because the patient moved away. Upon the recommendation of an acquaintance, the patient came back to our office in

1994 when she detected that brushing implant abutment 13 resulted in profuse bleeding. The clinical findings verified this observation. Probing with a pressure-calibrated plastic PA probe, BOP could be found and also there was a circular probing depth of 6 mm.

_Periimplantitis Therapy

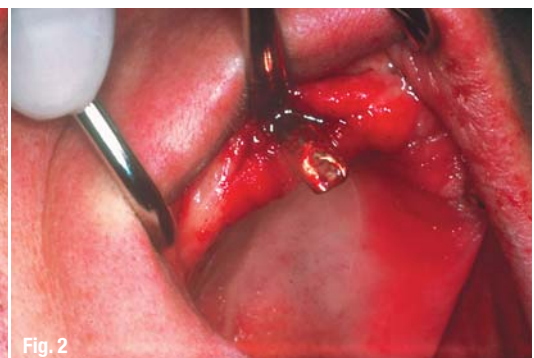
After extensive information from the patient and application of local anesthesia, a mucoperiosteal flap was opened up at the implant (Fig. 2). The granulation tissue was thoroughly removed by means of plastic curettes, and the edges of the flap were thinned out. The overall extent of bone loss attachment then became evident as the bone crater typical for periimplantitis was found.

_Decontamination with Diode Laser Light

The now exposed parts of the implant surface were treated with laser light with an output of 1.0 watts

Fig. 1 Regio 13, an ITI implant has been incorporated onto which a primary crown was mounted. A mucositis manifested itself that could already be clinically diagnosed.

Fig. 2 Formation of a mucoperiosteal flap at the implant.



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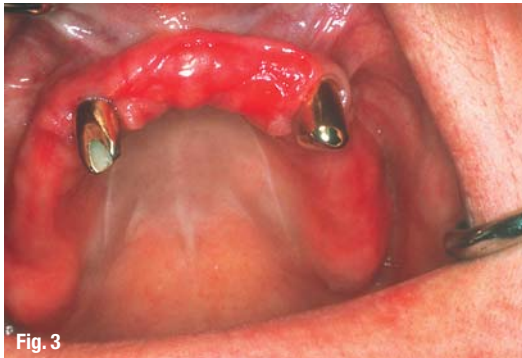
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Fig. 3_Six-months postoperative check; please note the irritation-free wound condition.

Fig. 4_Thanks to the laser supported periimplantitis treatment, the baseless designed superior maxilla prosthesis could be left in situ.

Fig. 5_More than ten years after the completion of the surgical resective phase, both abutments are still in the superior maxilla.

Fig. 6_The individual implant regio 13 is in an irritation-free environment.



over a period of 20 seconds. These parameters were sufficient to damage the gram negative anaerobe germ spectrum of the germs causing the periimplantitis while at the same time thermal or mechanical damages of the implant surface and the periimplantary tissue (bones, mucous membranes) could be ruled out (see Krekeler, G., Bach, G.: Our first experiences with a diode laser—A study; Universität Freiburg i. Br. [1994] and Bach, G., Krekeler, G.: Laser supported therapy of periimplantitis—A 5-year study, Philip-Journal [2000]). The laser light decontamination was repeated after healing of the soft tissue after 6 and 12 weeks.

Additional Therapeutical Steps

After completion of the decontamination, the lost bone capacities were reconstructed by means of periimplantary augmentative measures with bone material from the patient's chin. By means of intra-oral sutures the wound flaps were approached to

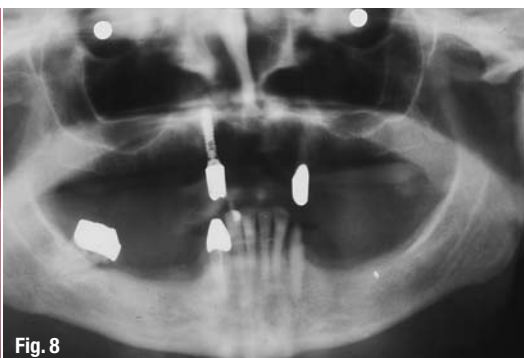
each other in a flushing manner to ensure healing per primam intentionem. The suture material was removed after one week. Further recall sittings took place after 6 weeks and 3 months. At the final inspection of the surgical resective phase after 6 months, the former surgical area was without irritation (Fig. 5). No probing depth could be measured. The telescopic superior maxilla prosthesis is in situ without irritation (Fig. 6).

Since that time, the patient takes part in a 6-month recall program and thoroughly follows this schedule.

Now, more than ten years after the surgical treatment of the periimplantary lesion, the prosthetic situation in the superior maxilla is unchanged. The telescopic bridge is still in place on 13 (supported by the implant) and 23 (natural tooth) (Fig. 5). The ITI implant regio 13 is located in a healthy environment without irritation, and, even after removal of the secondary crown, healthy periimplantary conditions are found (Fig. 7).

Fig. 7_Even after removal of the secondary crown, healthy periimplantary conditions are found.

Fig. 8_X-ray (OPT) 1994.



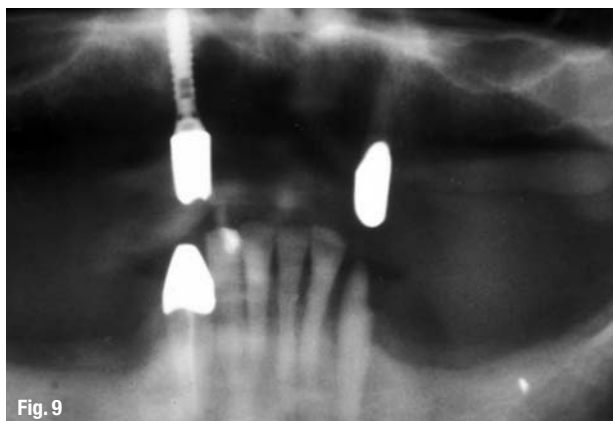


Fig. 9

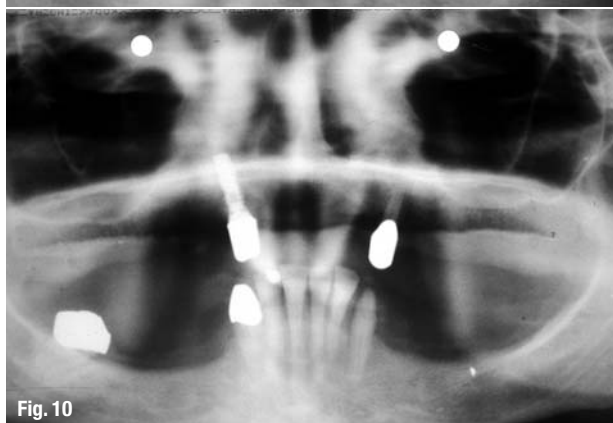


Fig. 10

Fig. 9_Detail from X-ray 1994: Typical bone lesion, cause by periimplantitis.

Fig. 10_No progressive bone loss at the implant (regio 13) can be seen.

Conclusion

Without treatment, the periimplantary inflammation would have resulted in the loss of the implant. Without any doubt, this loss of artificial abutment would have had serious consequences for the patient. The patient wanted a baseless solution that did not cover the gum. This would not have been possible after modification of the prosthesis, and the prognosis for the remaining tooth 23 as unique supporting abutment would also have been unfavorable. Thanks to laser supported periimplantitis treatment, not only could the inflammation be stopped, but also a restitution ad integrum could be achieved. The original philosophy of rehabilitation of the maxilla, the value of which is not being judged here, can now be continued.

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The Effect of Antimicrobial Photodynamic Therapy in the Treatment of Chronic Periodontitis: First Results of a Long-Term In Vivo Study

authors Tilman Eberhard, Jörg Neugebauer, Joachim Zöller, Freimut Vizethum, Germany

Periodontitis is characterised by the presence of inflammatory processes in the oral cavity, which can sometimes attack the whole periodontium. Inflammation itself of the periodontium manifest in increased probing depth or bleeding diathesis on light irritation of the gum. If left untreated, periodontitis can lead to bone resorption, which can be documented by X-ray, or even to the loss of the tooth. The primary cause of periodontitis is bacterial tooth deposits (microbial plaque).^{1,2} Marker bacteria, eg, *Actinobacillus actinomycetemcomitans* (A.a.), *Porphyromonas gingivalis* (P.g.) and *Prevotella intermedia* (P.i.) are among the highly pathogenic bacterial spectrum of these deposits.

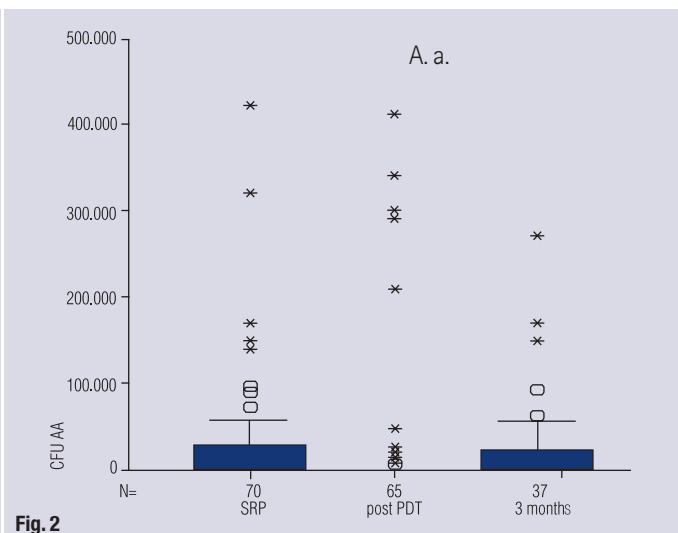
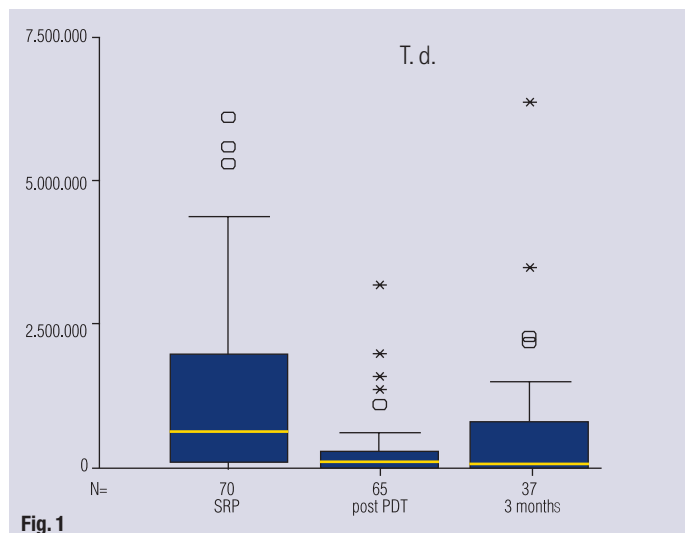
Chronic periodontitis is an infectious disease, which involves the inflammation of the periodontium and leads to progressive attachment and bone

loss. It is also characterised by the formation of periodontal pockets and/or gingival recessions, and is the most commonly occurring form of periodontitis.³ Different methods of treating chronic periodontitis are used in practice and are being discussed in scientific publications. The aim of the particular method of treatment is to reduce bacteria and regenerate any lost periodontal tissue.

A conventional procedure is the mechanical removal of supra- and subgingival plaque using the corresponding hand instruments. In this procedure the plaque and concretum attached to the exposed tooth necks and root surfaces are first removed with a curette (scaling), and then the tooth surfaces are smoothed (root planing). Alternatively, the mechanical removal of plaque can also be carried out using ultrasound devices.

Fig. 1 CFU of *Treponema denticola* at different treatment times.

Fig. 2 ... of *Actinobacillus actinomycetemcomitans* ...



In the case of probing depths over 5 mm or bone pockets, and in the case of furcation involvement, tooth scaling and/or root planing using SRP is only possibly under certain circumstances due to the complicated anatomical situation.⁴⁻⁶ The additional use of an antibiotic as part of mechanical therapy for chronic periodontitis should be questioned.

Indeed, several authors, eg, Slots⁸, currently doubt the rationale of using systemic antibiotic therapy. Ramberg et al.³⁵ also examine the long-term effect of systemic antibiotics after 3.5 years. No difference from the initial situation could be determined. Feres et al.³⁷ also reached this conclusion. Further disadvantages of antibiotic therapy include bacterial resistance and the occurrence of side effects after systemic use.⁸

A modern type of treatment for periodontitis is therapy using a high-energy laser device. This "hard laser" will use its thermal effect to reduce the periodontal pathogenic bacteria in the periodontal pockets, or even to eliminate them completely, to remove pocket epithelium and to support tissue regeneration. The use of lasers in periodontitis therapy has been researched in a number of clinical studies, using various study formats and different lasers.⁹⁻¹⁵

Different results were achieved from the studies in which a group of patients were treated solely with conventional methods and were compared with a group treated with a laser. Whilst some studies showed that conventional treatment achieved better^{9,10,16} or equally good¹¹ results, Schwarz et al.¹² determined significantly better results in the clinical parameters when using a hard laser. Other studies show that evidence of a significant reduction in periodontal pathogenic bacteria can always be provided, irrespective of the wavelength of the laser.^{17,18}

Clinical studies, which use a laser device in combination with a conventional procedure, show that

the additional use of the laser produces promising results in the treatment of periodontal diseases.^{17,19-23}

In their investigation, El Yazami et al.²⁰ reached the result of a significant improvement in all important clinical parameters, such as the plaque index, pocket depth and clinical attachment level, through the combined use of the SRP procedure and laser treatment in comparison to conventional treatment alone. In another in vivo study, evidence of a 25–30% bacteria reduction was produced with a Nd:YAG laser through the use of combined treatment with hand instruments and lasers.¹⁷

Some, eg, Liu⁹, saw problems in the fact that these results could not be systematically reproduced in practice. Antimicrobial photodynamic therapy (aPDT) is an innovative treatment concept in the area of periodontitis therapy, in which a low-energy laser is used in combination with a light-sensitive dye solution. Biofilm and bacteria are selectively dyed by the photosensitizer. When illuminated with light of a suitable wavelength, energy density and energy distribution, the stimulation of the photosensitizer in the triplet state will result in singlet oxygen formation on the bacteria membrane. The reaction of the high-energy oxygen molecule with the membrane lipid chain will lead to direct bacteria destruction. So far, various studies have confirmed the positive effect of aPDT on the successful treatment of periodontal and also peri-implant diseases.²⁶⁻²⁹

In a clinical study carried out by Dörtbudak-Kneissl et al.²⁶, a significant reduction in the number of pathogenic bacteria such as *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis* and *Prevotella intermedia* could be determined in the treatment of periodontal inflammations with the aPDT procedure. The aim of the current prospective long-term study is to examine the effect of

Fig. 3 ... of *Tannerella forsythensis* ...

Fig. 4 ... of *Porphyromonas gingivalis* ...

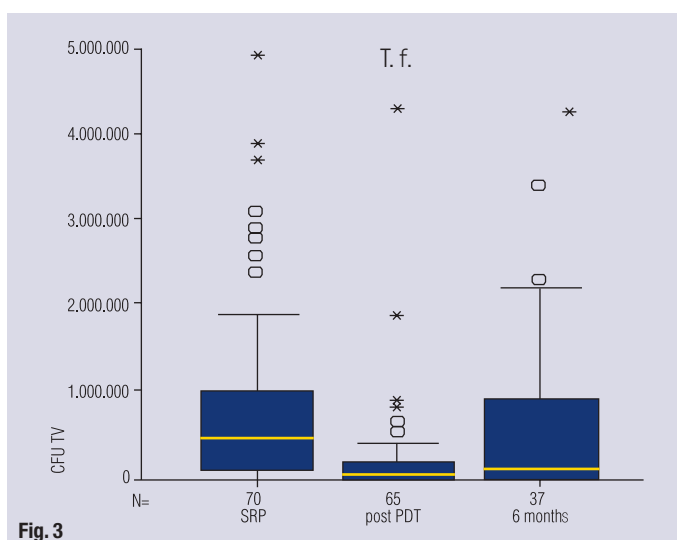


Fig. 3

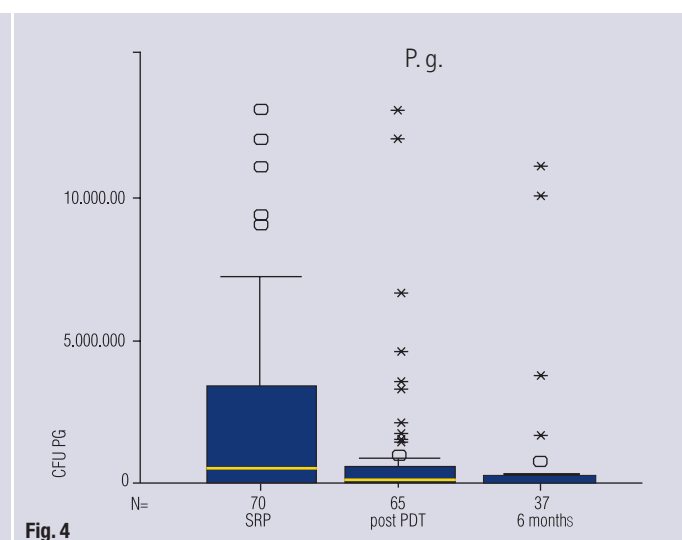


Fig. 4

antimicrobial photodynamic therapy (aPDT) in the area of conventional treatment of patients with chronic periodontitis.

Material & methods

Fifty-five patients who had been diagnosed with chronic periodontitis were included in the research group. The average age of the patients was 54. Thirty-nine of the patients were female, and 16 were male. In total, 1,320 units (teeth and implants) with periodontal infections were treated. Within the course of the initial treatment, the probing depth (PD) was measured and a modified sulcus bleeding index (SBI, scores 0–3) determined, both of which are reliable parameters for the diagnosis of chronic periodontitis, but are also suitable for assessing the progress of the disease regarding future attachment loss. In addition, a molecular biological procedure "real-time PCR" (PCR = polymerase chain reaction; Meridol® Perio Diagnostics, GABA International AG) was selected for the quantitative recording and evaluation of the microbiological load of the teeth.

Using this procedure it was possible to quantify the amounts of important periodontal pathogenic bacteria—such as *Actinobacillus actinomycetemcomitans* (A.a.), *Porphyromonas gingivalis* (P.g.), *Tannerella forsythensis* (T.f.), *Fusobacterium nucleatum* (F.n.), *Treponema denticola* (T.d.) and *Prevotella intermedia* (P.i.). In order to do this, subgingival plaque samples were taken from the infected teeth of each patient using paper points and then all samples were analysed together (pooling). The analysis took place in a fully automatic, validated process. The measuring unit for the quantitative recording and presentation of the bacterial load is the colony-forming unit (CFU).

The treatment of the patient population took place in two stages. In the first stage, each patient

received the conventional periodontitis therapy (SRP or professional scaling procedures) over the course of 2–20 years (average 14 years) in check-up appointments roughly every six months, ie, all hard and soft tooth deposits were removed using normal hand instruments. The tooth root was then smoothed to impede renewed plaque formation and support the apposition of the clinical attachments. In the case of SRP, since 1998 there has also been systematic use of Nd:YAG laser decontamination of the periodontal pockets, meaning that resective surgical intervention was reduced to a minimum. In isolated cases, the SRP was repeated or antibiotic treatment was carried out during the observation period.

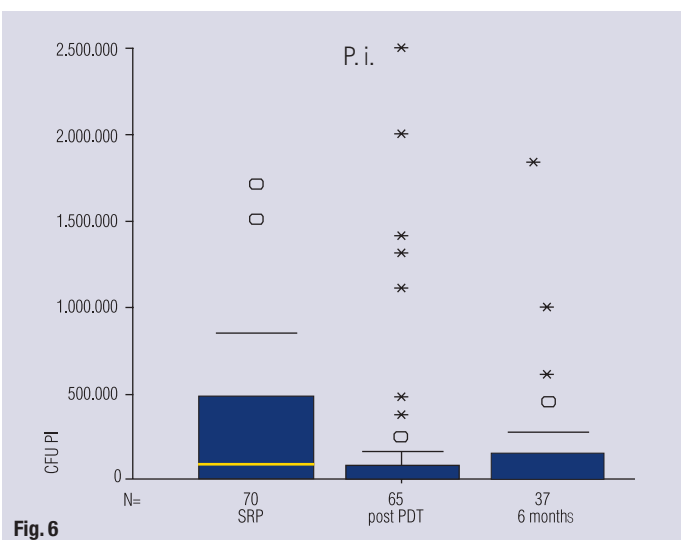
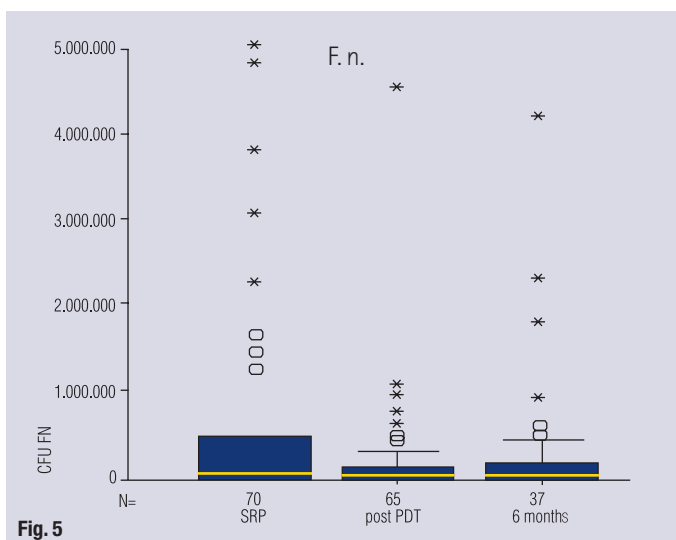
After the abovementioned treatment period, in which the patients generally all reached a stable condition, periodontitis therapy was extended, as follows, for the same patient population. First, the conventional therapy described above of professional scaling and smoothing of the tooth root was carried out again. After a period of 1–3 days—determined individually based on bleeding diathesis—all teeth were additionally treated using antimicrobial photodynamic therapy.

The first step of this process is applying a photosensitiser (HELBO® Blue Photosensitiser, HELBO Photodynamic Systems GmbH & Co KG, Grieskirchen, Austria) to the periodontal pockets. This is a bacteria-sensitive, light-active dye solution that dyes the microorganisms blue. After a photosensitiser reaction time of three minutes, the dyed area of the tooth is illuminated using a diode laser with a wavelength of 660 nm and a diode power of 100 mW (HELBO Thera Lite Laser) for a minute each.

One week after and 6-months after the antimicrobial photodynamic therapy, follow-up examinations were carried out on the patients. The parameters of probing depth and modified sulcus bleeding

Fig. 5... *Fusobacterium nucleatum* ...

Fig. 6... *Prevotella intermedia* ...



index were determined, and once again the most important periodontal pathogenic bacteria were quantified using the molecular biological procedure previously described. In the case of most of the patients, once the data had been collected in the 6-month check-up, another treatment was carried out that included treatment with a photosensitiser and the HELBO TheraLite Laser in addition to the obligatory professional scaling.

In order to facilitate a direct comparison of the distribution of the values of the different marker bacteria over time, the results of the microbiological examinations were displayed using a boxplot. The significance of the differences in the results of the clinical parameters during the different treatment stages was determined using the Tukey HSD post hoc test. Significant statistical differences were accepted with a confidence interval of 95%.

Results

The results of the microbiological examinations are shown in Figures 1–6. The condition at the end of the first stage, which showed a typical individual steady condition in terms of periodontal health, was compared with further developments of the described parameter after the introduction of aPDT.

During a comparison of the results of aPDT with the condition at the end of phase I (conventional therapy alone), it could be seen that immediately after treatment with aPDT there was a significant reduction in all periodontal pathogenic bacteria. When the 6-months check-up was carried out in the second treatment stage, there was a tendency for the levels of the marker bacteria A.a., T.f. and T.d. to increase again, but in the majority of cases this was not to the same level as at the end of the first treatment stage after the use of conventional therapy alone.

The results for the marker bacterium A.a. must be interpreted cautiously as it is also possible to achieve false negative results. To ensure samples were reliable they had to be taken from approximately 25 teeth, which is often too laborious in daily clinical practice.³⁶ The median of the bacterial contamination reduced systematically over the course of treatment in stage two.

The results of the clinical parameters (see Figs. 7–11 & Table 1) support the tendency of positive results for the microbiological analyses. In comparison to conventional treatment of chronic periodontitis alone, the average probing depth could be significantly reduced at the end of the observation period (6-months check-up) of the second treatment stage using conventional therapy and aPDT (Fig. 9). The modified sulcus bleeding index had also significantly improved by the 6-months check-up of the second treatment stage (Fig. 10).

The occurrence of periodontal pockets with a probing depth of 4–6 mm had significantly reduced by the end of the observation period of the second treatment stage (Fig. 7). Periodontal pockets with a depth over 6 mm could also be significantly reduced after the 6-months check-up using the combined

	Tukey HSD			
	SRP	post SRP / PDT	6-months recall	
Pocket 4–6 mm	0,000	0,000	0,000	SRP
Significance	0,000	0,250	0,250	post SRP / PDT
				6-months recall
Pocket > 6 mm	SRP	post SRP / PDT	6-months recall	
Significance	0,000	0,001	0,001	SRP
	0,000	0,951	0,951	post SRP / PDT
				6-months recall
Probing depth	SRP	post SRP / PDT	6-months recall	
Significance	0,000	0,000	0,000	SRP
	0,000	0,046	0,046	post SRP / PDT
				6-months recall
Sulcus blood index	SRP	post SRP / PDT	6-months recall	
Significance	0,000	0,000	0,000	SRP
	0,000	0,971	0,971	post SRP / PDT
				6-months recall

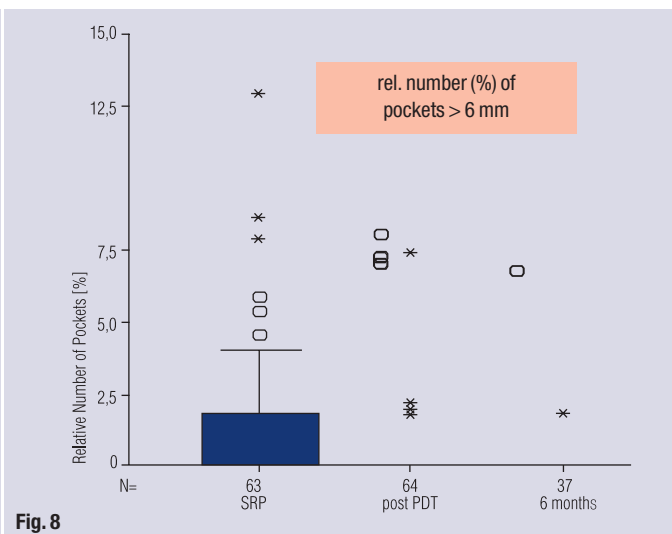
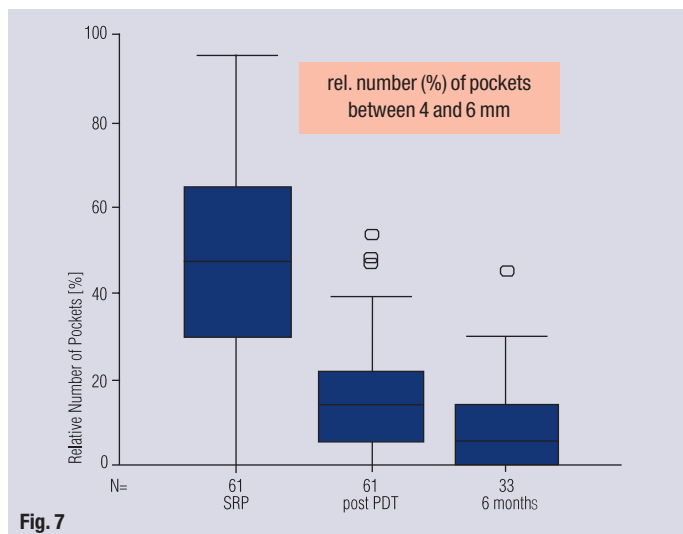
Table 1

procedure of SRP and aPDT (Fig. 8). The significance is shown in Table 1. Both the SBI and the occurrence of probing depths 4–6 mm and > 6 mm were statistically significant in the considered periods after SRP/aPDT, and after 6 months (fields highlighted in grey).

Discussion

This clinical study examines the effect that the adjunctive use of photodynamic therapy can be expected to achieve as part of conventional treatment of patients with chronic periodontitis. The results of the current investigation show that the treatment of teeth with periodontal infections with a photosensitiser and subsequent illumination with a suitable laser led to a significant improvement in the clinical parameters of the occurrence of probing depths of 4–6 mm and > 6 mm, and the SBI. Microbiological examinations have also shown a reduction in the bacterial load. Median values sank systematically.

The available results confirm the results of other studies, whereupon a significant reduction in periodontal pathogenic microorganisms could be achieved through the combined use of a photosensitiser and a laser.^{28, 29} A clinical study carried out by



Dörtbudak-Kneissl et al.²⁶ proved that there was a significant reduction in the marker bacteria A.a., P.i. and P.g. when a photosensitiser was used with a soft laser. According to Dörtbudak-Kneissl et al.²⁶, total sterility is not an absolute prerequisite for the cure of an inflammation.

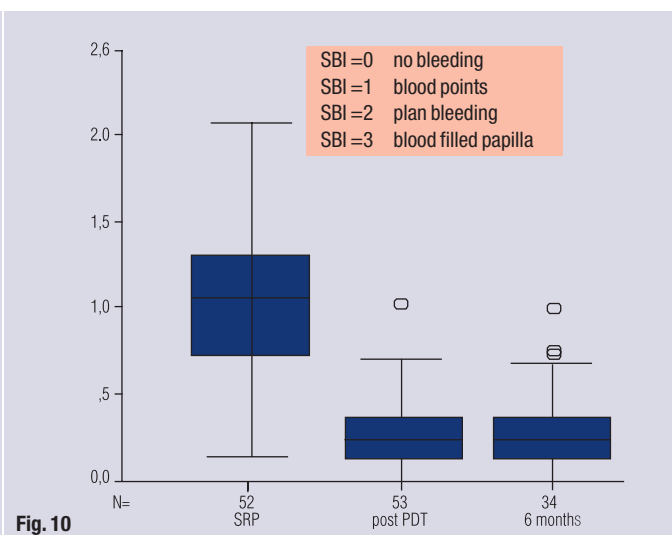
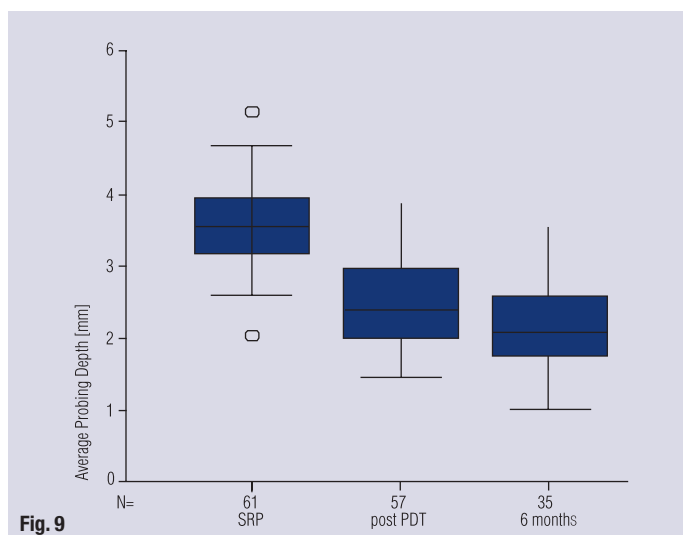
The clinical parameters used to assess the actual periodontal condition are the pocket depth measurement, bleeding on probing, the degree of loosening, and pus discharge from the pocket. When there are probing depths of more than 5 mm, there is a clear correlation to the amount of periodontal pathogenic bacteria.³⁰ After scaling and root smoothing, there is more frequent re-infection of deep pockets.³¹ However, what is ultimately decisive for the progress of the course of an illness is bleeding on probing. This parameter is the decisive sign for the reaction of the tissue to the integrative stimulus effects (pocket depth, bacteria composition, number of bacteria).

Therefore, bleeding on probing is the most important parameter for a risk prognosis regarding fu-

ture attachment loss.³²⁻³⁴ As a result, during this study both the frequency distribution of the probing depths (risk of re-infection) and a modified bleeding index were taken as the decisive criteria for coming to a definite conclusion on the further progress of the loss of periodontal supporting connective tissue. During the observation period a statistically significant reduction of individual risk could be achieved and proved for these decisive parameters when using aPDT.

Conclusion

As part of the current, prospective long-term study on patients it could be shown that in comparison to first using conventional treatments of chronic periodontitis alone—with mechanical removal of supra- and subgingival plaque and then smoothing the tooth roots—a subsequent combination of conventional professional scaling or SRP treatment and antimicrobial photodynamic therapy resulted in significant, sustained improvement



of the levels of important clinical success parameters for the treatment of periodontitis. The microbiological examination also showed an immediate reduction in the number of important periodontal pathogenic bacteria when a combination of conventional therapy and aPDT was used.

The use of the antimicrobial photodynamic procedure could be integrated into the treatment process very simply and without any complications. It did not result in any side effects in the patients tested apart from a short-term discolouration of the gum lasting a few hours due to dyeing the plaque with the photosensitiser. Further clinical long-term studies are needed to be able to provide reliable, verified proof of a differentiated conclusion on the frequency of use of aPDT for patients with a high periodontal pathogenic bacterial load, combined with a marked defence weakness.

This research is a precursor, with temporal and contextual parts, of a major comprehensive study. The publication presents the data held by the author in spring 2006. As a result of the keen interest among colleagues, these first results are hereby published in advance. The extended version, containing the complete first annual results and treatment of aggressive periodontitis and peri-implantitis with a tested treatment plan will be published soon. The duration of the entire study is therefore intended to be 5 years.

Summary

The aim of the study was to find out how antimicrobial photodynamic therapy (aPDT) would affect microbiology, pocket depth and the bleeding index when used as an addition to conventional therapy for chronic periodontitis. Fifty-five patients who had been suffering from periodontitis for an average of 14 years (2–19 years) were given a full examination as part of a regular check-up (microbiology, pocket depth, modified SBI). Then, most continued to be treated with professional scaling, and a few with SRP (scaling and root planing), but now in combination with aPDT. The results 1-week and 6-months after the combined therapy showed a considerable remission of the pathogenic marker bacteria, and a lasting, substantial decrease in pocket depth and bleeding index among patients previously treated with conventional therapies. This therefore proved the very positive therapeutic effect of HELBO Photodynamics.

The literature list can be requested from the editorial office.

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laser

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Deployment of a 410 nm Diode Laser Prototype

First experiences with the “blue diode”

author_Georg Bach, Germany

Based on their market launch in 1995 within the scope of the IDS in Cologne, the diode lasers in dentistry experienced a development, which is to be described as “more than turbulent”; with the result that today diode lasers are the most represented laser technology in dental offices and are used with great success primarily for soft tissue cuts and peri-implantitis and periodontitis therapy.

Diode lasers currently available on the market significantly differ technically; a large number of so-called “entry-level lasers”, which normally feature a low output power and are operated primarily in cw mode but attract with a lower price, basically represent Development Stage I of the diode lasers since their basic research one and a half decades ago.

In direct contrast is a small number of so-called “high-tech diode lasers”, normally more than twice as expensive as entry-level devices but instead equipped with digital or high-power pulse technology instead and definitely higher power ratings, which in the context of dental surgery is reflected in significantly improved cutting results. Between them, there is a small

group of medium-class diode lasers pulsed up to 10,000 Hz. In terms of pricing they are exactly positioned between the two “extremes”.

The option to apply in dentistry other wavelengths than the 810 and 980 nm used to date, has caused in the past many authors to point out that from a pure technical standpoint it is possible to develop almost any number of hard diode laser wavelengths. The device introduced in this article represents the result of those considerations. Its basic uses in dentistry need further testing and clarification:

This is a hard diode laser device, produced by an Asian manufacturer, which emits monochromatic 410 nm wavelength light (“blue light”).

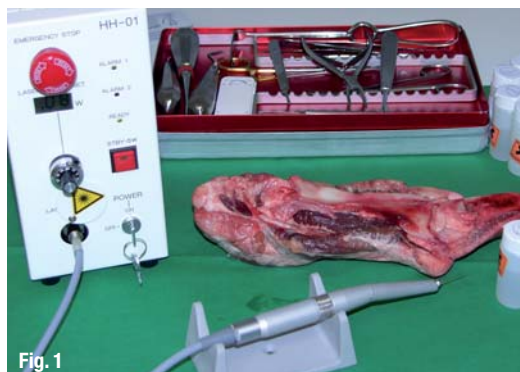


Fig. 1_410 nm Diode laser prototype.



Fig. 2_Experimental Setup for Soft Tissue Surgery.

_Prototype

Hard Laser

The three components are combined in a very compact cage (10 x 20 x 30—W-H-D).

Those are:

- _ the electric control unit,
- _ the control module,
- _ the laser head.

Monochromatic 410 nm wavelength light is emitted by stimulation, having specific properties.

_ It is monochromatic (also especially pure, it consist of only one wavelength).

_ It is coherent (the waves are aligned in time and space).

Potential Uses

The prototype was tested for the following applications in dentistry

- _ in dental surgery (cuts)
- _ for decontamination (microbiological test)
- _ for hardening of composites (dental filling materials).

_1. Blue Laser Diode in Dental Surgery

Cutting

Most experiences and long-time results are available in the field of dental surgery, the result of which is a comprehensive number of citable bibliographical references and publications with established data. With appropriate laser wavelengths, all cuts commonly applied in dental surgery and periodontology, can be performed. The laser light used in each case should have a good absorption in regards to water or hemoglobin. To a very large degree and with accurate selection of power rating and time parameters, a carbon-free and narrow cut very similar to the established scalpel cut is possible. In the absence of carbon and a good postsurgical approximation of the former wound flaps provide good prerequisites for healing by first intention, which is more comfortable and faster for the patient and occurs with full histological reconstruction of the formerly separated tissues from its continuity. If laser is not suitable for cutting and is absorbed poorly, the power rating and/or the exposure

time must be increased in order to even achieve an effect resp. the "desired" cutting effect. This is usually accompanied by a very strong carbonization of the wound edges and an enlargement of the width of the cut.

Post surgically wound carbonization must be re-absorbed and the wide gap in tissue continuity must be bridged. The only way this can be achieved is by second intention healing or, in other words, per granulationem. Wound healing by granulation is tedious and often painful for the patient. Normally the esthetic result is poor, and the (special) tissue originally available is replaced by simple repair tissue. In a current up-to-date study (2001) McDavid, Vobb and colleagues point out that bone damage can be avoided by an accurate selection of parameters. They used a CO₂ and Nd:YAG laser. Chebotareva and Zubov arrived at the same conclusions, and, in addition, could also report positive characteristics for faster healing of soft tissue. This was confirmed in total by Luomanen and Virtanen from Helsinki, who histologically backed up their assessment by means of fluorochrome coupled lectins.

Device Settings

Cuts were made on the anthropomorphic phantom using the diode laser prototype.

The following parameters were applied:

Power:	Mode:
0.45 watts	cw
0.65 watts	cw
0.70 watts	cw
0.86 watts	cw
0.99 watts	cw

Clinical Effects

With settings from 0.45 watts and less, no realizable effects of laser light application in terms of a continuity dissection could be determined. The 0.65 watts setting indeed showed almost carbon-free soft tissue edges but at the same time poor efficiency as compared to diode laser devices with high-power pulse technology. With 0.70 watts, an improved efficiency could be achieved with lower carbonization of soft tissue edges at the same time. With the selection of



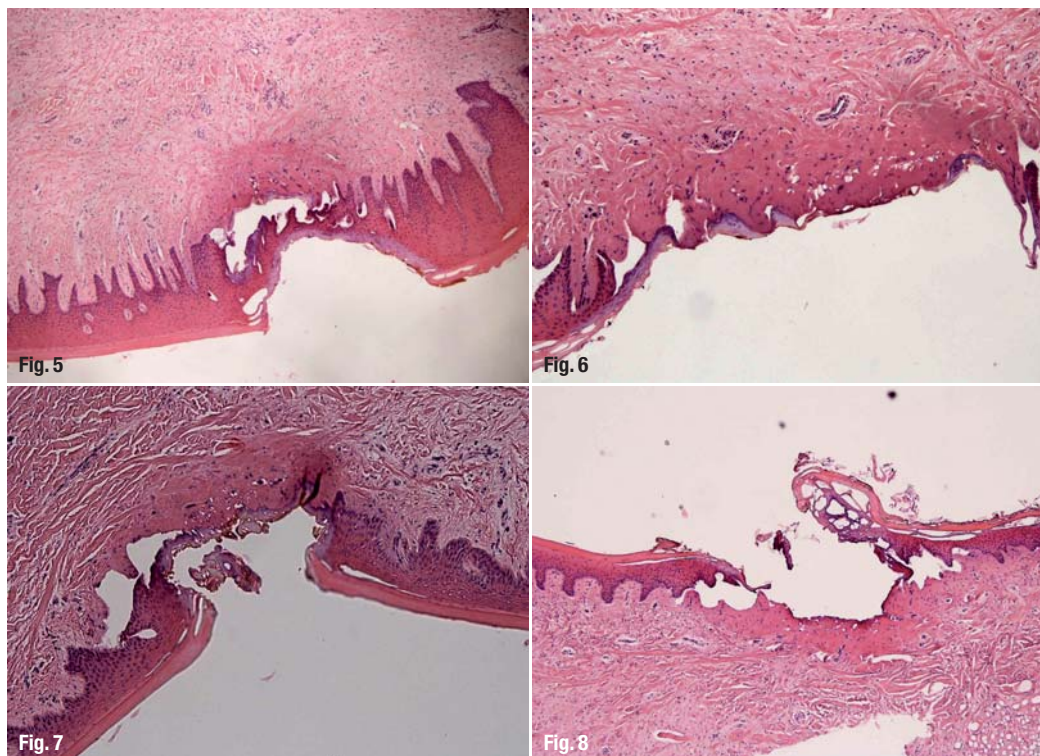
Fig. 3



Fig. 4

Fig. 3 _Achieved Results After a Diode Laser Cut.

Fig. 4 _Tissue samples prior to processing.

Figs. 5 – 8_Histological Results.

higher power settings, an improvement of the cutting efficiency could indeed be achieved however at the cost of an increased laser cut induced carbonization.

Histological Findings

The cuts, which were performed by laser, were preserved in formaldehyde after they were removed from the pig's jaw-bone and sent for histological examination.

Bottom Line

A power setting of 0.70 watts in cw mode allows for the best possible achieved compromise in terms of efficiency and avoidance of a wide carbon layer. What can be said, though, is that the achievable results with the introduced device are inferior to the ones obtained by diode laser (with digital pulse technology) and other wavelengths. In terms of a cut within the scope of a dental procedure and in soft tissue surgery, the 415 nm diode is recommended within with very strong limitations only.

_2. Soft Tissue Management

After completion of the invasive-resective phase of a surgical periodontal therapy but within the scope of implantology, mucous gingival corrections are often required. In this context, free or connective tissue transplants as well as vestibuloplasty are often considered, also including singularly performed gingivectomies and the removal of pseudo-pockets as they are quite common during non-invasively performed conventional-conservative periodontal therapy. Those minimally invasive mucogingival proce-

dures are performed elegantly and quickly to date with the available diode laser systems. In this context, many authors point out the high absence of bleeding, significant pain reduction during surgery and the short time to heal associated with cuts performed by laser. Kreisler and colleagues (2001) report positive effects on a new attachment creation of ligamentary structures after diode laser application and confirm the decontaminating effect of injection laser.

Device Settings

Gingivoplasty was performed on the anthropomorphic phantom with the diode laser prototype. The following parameters were used:

Power:	Mode:
0.45 watts	cw
0.65 watts	cw
0.70 watts	cw
0.86 watts	cw
0.99 watts	cw

Clinical Effects

With settings from 0.45 watts and less, no realizable effects of laser light application in terms of a continuity transection could be determined. The 0.65 watts setting indeed showed almost carbon-free soft tissue edges but at the same time poor efficiency in comparison to the diode laser devices with high-power pulse technology. With 0.70 watts, an improved efficiency could be achieved with lower carbonization of the soft tissue edges at the same time. With the selection of higher power settings, an improvement of the cutting efficiency could indeed be achieved at the cost of increased carbonization by laser cut.

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Histological Findings

The cuts, which were achieved with the laser after their removal from the anthropomorphic phantom (pig's jaw-bone) were preserved in formaldehyde and sent for histological examination.

0.45 watts—"Channel-shaped change. Incomplete defect with spongiosis; a small coagulated subepithelial base with a narrow ring-shaped defective zone with a superficially brownish discoloration caused by laser coagulation."

0.65 watts—"A flat bed of the suprabasal and almost completely destroyed epithelium appears showing a narrow underlying coagulation front of the stroma."

0.70 watts—"In the lamellation and embedding of the material, a defect is observed including the epithelium in this area with a slit-shaped increase of the side epithelium from the connective tissue base and a narrow coagulation front in the stroma."

0.86 watts—"The tissue exhibits a clear channel-shaped epithelium defect reaching almost to the stroma with a 30–40 µm wide coagulation front."

0.99 watts—"The material shows stronger dehiscence partly due to the laser coagulation, and in part wedge-shaped defect formation with a 30–100 µm wide coagulation front."

Bottom Line

The power setting of 0.70 watts in cw mode allows for the best possible achieved compromise in terms of efficiency and avoidance of a wide carbon layer. What can be said, though, is that the achievable results with the introduced device are definitely less than the ones obtained by diode laser (with digital pulse technology) and other wavelengths. In terms of an optimization of soft tissue or soft tissue management, for soft tissue surgery the 415 nm diode is recommended only with very strong caveats.

II. Microbiological Examinations With the Goal of Assessing the Eventual Quality Rating of the Device During Decontamination of Germ-Infested Tooth and Implant Surfaces

The concept of laser decontamination was coined in 1994 by the laser study group of Freiburg University (Krekeler, Bach and Mall) in the context of then newly established diode lasers. In the meantime, the concept of decontamination is used by many other authors in connection with other wavelengths. The decontamination with a laser describes the option to kill germs on teeth and implant sur-

faces with a laser, which are common during peri-implantitis and the marginal parodontopathy and to disable the endotoxins of those microorganisms. In 1994 Bach, Mall and Krekeler, Moritz in 1996 and Gutknecht in 1997 could demonstrate the diode laser effectively eradicates particularly the gram-negative, anaerobic germ spectrum of the quickly developing parodontopathy and the peri-implantitis, and assigned a higher significance for the efficient combat of those "problem germs" with the laser during the integration of approved treatment procedures for both illnesses. In 2000, for the first time, the aforementioned Freiburg study group presented a 5-year study "(Diode) Lasers in Periodontology".

The authors pointed demonstrated that by the integration of the diode laser decontamination in confirmed periodontitis and peri-implantitis procedures, the prospects for both of these clinical pictures, which formerly often took an unfavorable course can be considerably improved. Bach, Mall and Krekeler found a decrease of the recurrent rate of 33% after 60 months (control group not treated with laser) and of 11% (group treated with the support of a diode laser). After the hard diode laser decontamination had established itself as a factual domain for this wavelength, a further goal of this examination was to test the properties of the 415 nm prototype for this field as well. This potential possibility was first examined within the scope of microbiological growing compounds. A diode laser light in the 415 nm wavelength was applied to microbiological growing plates, which were flooded with the following germs spiked with the three-step smear procedure, in a further examination row:

- a) *Actinobacillus actinomycetemcomitans* (FR68/27-7)
- b) *Prevotella intermedia* (016/16-2)
- c) *Porphyromonas gingivalis* (W381 and FR68/27-2)

Device Settings

The following parameters were applied:

Power: Mode:

0.45 watts cw

0.65 watts cw

0.70 watts cw

0.86 watts cw

0.99 watts cw

Application length: 30 seconds and 1 minute.

Microbiological Findings

The growing plates, spiked and irradiated with laser light were stored according to normal microbiological protocol; after 48, and 72 hours respectively, a "reading" was done. It could be determined that following a mere 30-second irradiation of the samples, no significant result in terms of limiting bacteria

growth could be observed in any of the performance models. This is also true for the specimens undergoing one-minute laser light irradiation and settings of less than 0.70 watts. With the 0.86 and 0.9 watts settings, obstruction of germ growth could be observed in the prevotella intermedia. The zones had a radius of approx. 3 mm around the central irradiation area. Minor equivalent effects were observed with the A.a. and the P.g. In comparison to the results, which had already been documented in 1994/1995 using cw mode 810 nm diode lasers, the results are definitely more moderate.

Bottom Line

The power setting of 0.9 watts in cw mode allows for a moderate decontaminating effect in the microbiological test. It is not yet clear if those results can be applied to a clinical environment. What can be said, though, is that the achievable in vitro results with the introduced device do not correspond to the ones established with a diode laser (also with digital pulse technology). For laser light decontamination, the use of a 415 nm wavelength is therefore only possible within limitations.

Hardening of Composite Samples

For the ("blue") argon laser it is known that its laser light can harden dental composite filling material. Many authors point out that in comparison with lamp hardening, clearly better homogeneous joining of the composite materials is achieved. In support of those observations the "blue diode laser light" was tested in regards to its potential to possibly harden filling materials. 2 mm wide composite pieces (taken from a tube) were irradiated with a hard diode laser using 415 nm wavelength. In terms of a hardening of the respective samples, a clinical significant effect could not be achieved with settings under 0.6 watts and within a time frame of 1.5 minutes (which would be clinical but not relevant and acceptable), therefore the tests were aborted. With the 0.7/0.8 and 0.9 watt settings, hardening effects could be achieved, with 0.8 and 0.9 watts, however, with undesired effects on the composite surface in terms of (heat) bubbles and discolorations. With 0.7 watts, a hardening effect and at the same time undesired manifestations were achieved, which could have been avoided as described with the higher power settings. The hardening effect, however, was of a very superficial nature and was in the area of approx. 0.5 to 0.7 millimeters in the sample piece. Below it, the composite was in the same consistency, as though it was recently removed from the tube. Because of the already clinically evaluated results, a further (raster electronic microscope) analysis of cut samples was not taken into consideration.



Fig. 9 Microbiological Examinations for the Clarification of a Decontamination Effect.

Discussion

„Not everywhere where the word Diode is written, is also the same diode inside!“—striking but also to the point, one cannot phrase it as the quoted periodontologist and implantologist from Hanover. The diode laser dentistry completely suffers because at the moment three development stages of the injection laser are offered and promoted in the marketplace. For the ingenious, the multitude of offered diode laser devices is confusing indeed where some equipment is offered for the dental market, which because of their physical laser characteristics has very limited use in dentistry! Here, the introduced device and the wavelength of 415 nm (blue diode) fill a vacant position—the only possible use is in decontamination. Because of the experiences and indications with other devices, diode lasers with high power ratings and high-power and digital pulse technology can be mentioned here. In no way blue diodes can be recommended for use in soft tissues; here the bar is raised by the mentioned potent diode lasers and also by the other wavelengths—higher than the device ever can jump. The small size of the device gives some cause for enthusiasm—integration in a dental treatment unit can be realized with no problems—an old dream of laser users in their quest to move away from the (bulky) auxiliary unit. The results achieved with the introduced device, however, do not justify any of those considerations at the present time and the current stage of development of the device.

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Conventional diode laser **versus** high-power pulse technology

Periodontal and soft tissue surgery with different diode lasers—an in vitro study

authors H.K. Koch, U. Hellerich, Th. Venzke (*) and Georg Bach (**)

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Diode lasers were introduced to dentistry in the middle of the nineties of the past century and have proven their worth there particularly during their application in periodontics and implant dentistry. After the first diode or injection lasers were operated exclusively in CW mode (continuous wave), in the beginning of the new millennium they were supplemented with high-power and digital pulse technology equipment. The high-power pulsed diode lasers (up to 20,000 Hz) were developed under the premise of improved cutting performance because the pure CW mode lasers, in this case, were clearly inferior in other wavelengths.

The following article would like to introduce an in vitro study (on a pig's jaw-bone), where cuts with different cross-sections were carried out on the periodontium and on the soft tissues.

_Diode Lasers Used

Diode lasers were assigned to so-called "reference classes" and deployed.

_Reference Class I

This equipment corresponds to the level of diode laser technology, as it was available at the time of market launch in 1995, equipment with a power output of up to approx. 6 watts and primarily operated in CW mode. This technical data is still today part of the simple diode lasers, the so-called "entry-level lasers", which attractively introduce the first-time user to the

The following dental lasers were used:

Fig. 1 _Reference Class I "CW mode/entry-level laser" Oralix 01 IST.

Fig. 2 _Reference Class II "high-power pulse technology/state of the art" Elxxion Claros.

Fig. 3 _Reference Class III "intermediate stage" SIRO laser.





Directions of cuts performed on the anthropomorphic phantom, each with 400 μ m fibers:

Fig. 4_Oralia 01-IST.

Fig. 5_Preparation of the laser cuts for histological processing.

Fig. 6_Documentation of the specimens and shipment.

laser dentistry with a lower price. Here, the first diode laser device ORALIA 01 IST developed for dentistry as such was used.

Reference Class II

Equipment in the reference class II constitutes the one with high-power and digital pulse technology in the 20,000 Hz class, which corresponds to the highest stage of development at the moment. As a representative in this reference class, an Elexxion Claros device was used.

Reference Class III

Equipment in reference class III is between class I and those of class II; They allow pulses of up to approx. 10,000 Hz, are mostly operated in pulsed mode as well, and, therefore, differ considerably from the "entry-level lasers" (Class I) but do not reach the technical development stage of equipment in Class II. Here the SIRO laser by the Sirona Company was used.

Wavelengths

The Oralia 01 IST device and the Elexxion Claros emit laser light with 810 nm wavelength, whereas the SIRONA device features a wavelength of 980 nm.

Equipment Data Programs

Such settings were selected, which were specified by the manufacturer as appropriate for the selected indication in the equipment manual.

They were:

- SIRO laser (Sirona Company)—Program S6: 4 watts with the 400 μ m fiber (prototype fiber)
- CLAROS laser (Elexxion Company)—Program "General Surgery" 9.99 watts/ 20.000 Hz with a power output of 30 watts with the 400 μ m fiber
- 01-IST laser (Oralia Company)—Settings "Surgery" 2.2 watts in CW mode with the 400 μ m fiber

In order to avoid differences in the cut due to varying fiber diameter (light guide), a 400 μ m fiber not yet released on the market, which corresponded to the ones in other equipment, was used in the Sirona Company device. Sirona Company in Bensheim provided this fiber, which is on the brink of a market launch.

Cuts on the Anthropomorphic Phantom (Pig's Jaw-Bone)

Two cuts per laser were done on the anthropomorphic phantom

- in the marginal periodontium—"periodontal cut"
- in the gingiva of the vestibule—"surgical cut"

Directly after the laser cut, the respective specimens with a generously chosen border area were carefully removed with the scalpel and raspator, stored in a preserving liquid, and placed for histological preparation and examination.

Histological Results

Following preparation the specimens were histologically examined and provided the following results:

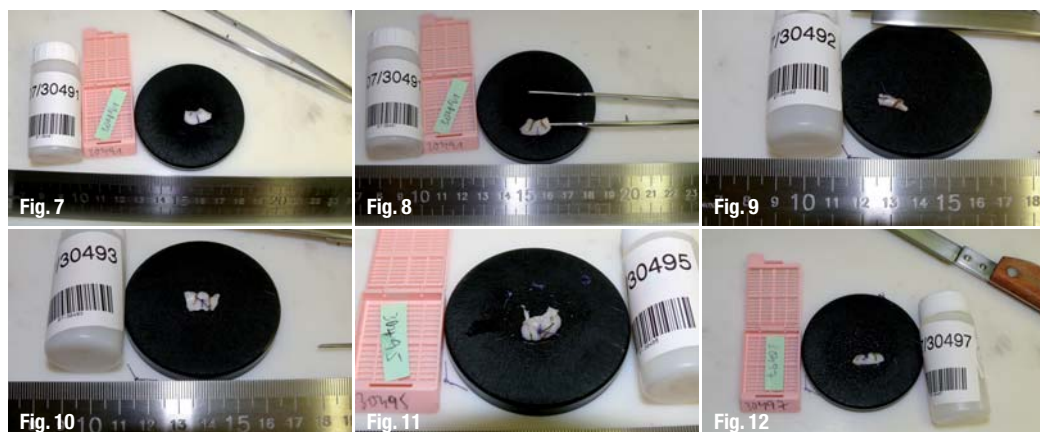
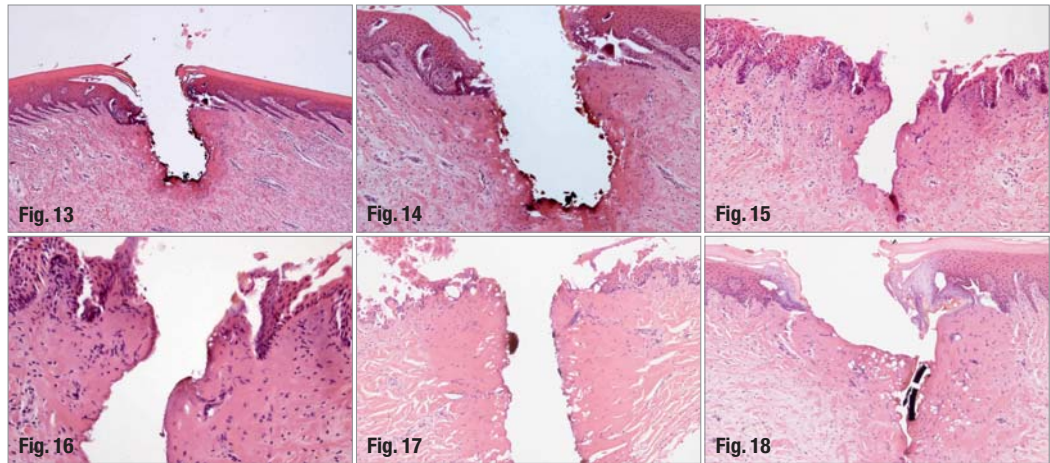


Fig. 7 to 12_ Histological documentation of the tissue specimens prior to processing.



Histological specimens:

Fig. 13 and 14_ Specimens of incision by Oralia 01 IST.

Fig. 15 and 16_ Specimens of incision Elexxion Claros.

Fig. 17 and 18_ Specimens SIRO laser.

Reference Class I:

a) Oralia 01 IST—periodontal cut:

"From a coagulated subepithelial background, a narrow ring-shaped defective zone with superficially brownish discoloration by the laser coagulation appears due to an incomplete cut and lifting of the epithelium."

b) Oralia 01 IST—surgical cut:

"A flat sinking of the suprabasal and almost completely destroyed epithelium appears including a narrow underlying coagulation front of the stroma."

Reference Class II:

a) Elexxion Claros—periodontal cut:

"Narrow, and almost vertically leading laser coagulation fronts on a totally inconspicuous underlying stroma. Lateral stretch of the coagulation fronts of up to 100 µm, and 30–50 µm depth."

b) Elexxion Claros—surgical cut:

"Low-reaction, sharply edged laser coagulation fronts after laser incision."

Reference Class III:

a) SIRO laser—periodontal cut:

"Very bland in the U-shaped profile, approximately at the double epithelium height, there is an indentation (150–200 µm) caused by laser coagulation through the epithelium and the stroma with minimal damage in the vicinity. Tissue damage occurs only in a small section."

b) SIRO laser—surgical cut:

"Alterations relating to laser coagulation with otherwise inconspicuous squamous epithelium, and largely inconspicuous gingival mucous membrane with occasional marginally contained laser coagulation defective zones."

Summary of the Histological Findings

There were significant differences in the evaluation of the histological findings of tissue samples, which were obtained with different diode lasers.

If the tissue samples, which were processed with a diode laser operated in the CW mode exhibited severe destruction of the tissue surroundings, then the samples processed with pulsed diode lasers showed far less marginal and destruction effects. Significant differences between the pulsed lasers (10,000 vs. 20,000 Hz max.) could not be determined, likewise no significant changes in the histological findings, which were obtained with a 980 and an 810 nm laser.

Discussion

The differences in the results from the histological examination of the samples processed with different lasers are significant. A cut is achieved in CW mode with equipment data recommended by the manufacturer, causing considerable tissue damage of the separate structures, referring not only to the area of the actual cut but also considerably affecting adjacent tissue structures. The results obtained from the in-vitro samples raise considerable doubts about the further eligibility of cuts with pure CW mode diode lasers as significantly better results can indeed be achieved using pulsed diode lasers.

Here the question of pulse technology (up to 10,000 Hz) or high-power pulse technology (up to 20,000 Hz) is of secondary nature because both provided similarly satisfying results.

Also, the much discussed question of "810/980" nm wavelength, which absolutely has its validity during the selection of parameters for decontamination of germ infested tooth or implant surfaces, in this examination played only a secondary role as well. A diode laser cut must not only be compared to different diode laser types but also to the results, which were obtained using different wavelengths. From this point of view, the time of the simple CW mode diode laser, in terms of the cut, seems to be coming to an end, and from now on only those lasers should be used (advertised and offered) for decontamination exclusively.

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Advanced Dental Laser Surgery

authors_Rudolf Walker, Gerd Volland, Germany

The laser application in dental surgery has become a standard tool for many dental clinics around the world. The instrumentation became less costly and more advanced. The use of a diode laser demonstrates many advantages compared to the scalpel, but as in life one has to deal with some disadvantages also. One of the main hurdles has been the price and the teaching about laser applications in dentistry.

The main advantages for the laser are the cutting effect on tissue at the same time tissue is removed and bleeding is almost stopped. By using the laser beam in the bare fiber mode one of the disadvantages is the temperature rise at the edges of the wound. Due to this effect the wound healing is prolonged in comparison to the standard scalpel cut. Those edges do show a carbonization zone, which is responsible for the prolonged healing time.

However to achieve proper cutting the surgeon has to apply enough laser energy to cut and vaporize tissue. To overcome the prolonged healing the stitches have to be in the wound longer than it would be compared to the standard scalpel cuts.

With the electro cauter the edges of the wound are even more coagulated than with the laser beam. The wound healing does show the same effect like the laser cuts. The patient has the advantages of the laser cut, however has to accept the longer wound healing.

To avoid all those disadvantages we have developed a scalpel which carries the laser energy from the diode laser to the sharp edges of this knife.

This sapphire knife was developed in cooperation with surgeons working daily with this new technology now.

As a producer of the FOX diode laser we have developed this knife to overcome the problems of the free beam laser and also the problem of cutting with the scalpel alone (Fig. 1). The revolution is the coagulating, cutting knife. The scalpel can be used as a standard surgical knife with all the advantages of the tactile feedback, but at the same time having the laser to coagulate at the sharp edges. The laser light exits the knife at the edges where it cuts (Fig. 2).

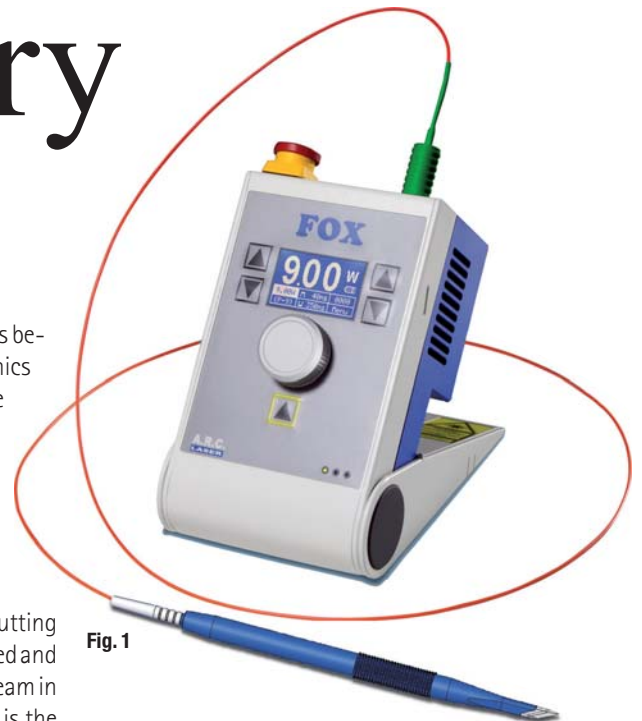


Fig. 1

The temperatures achieved with the sapphire knife are in the range of $> 65^{\circ}\text{C}$ to allow coagulation, but less than 100°C to avoid carbonization. The cut is only performed by the knife itself. To allow the laser to exit at the right edges a mathematical calculation has been performed for maximum transmission and reflection inside the knife. Thus the absorption inside the knife is minimal and no temperature rise at the handle is produced. The result is a cut which is almost free of bleeding and no cleaning of the wound is required during surgery. Higher visibility at the cuts and faster healing compared to the laser cuts are the results of this exiting invention (Figs. 3–6).

Using this knife during the last month we have demonstrated the superiority of this technique. The very first tests have been performed using a pork liver to research the cuts and look at the histology of the



Fig. 2

Fig. 1_FOX with sapphire knife (JAZZ).

Fig. 2_Sapphire knife (side view).

(For the necrosis zone please look Fig. 7.)



Fig. 3



Fig. 4



Fig. 5



Fig. 6

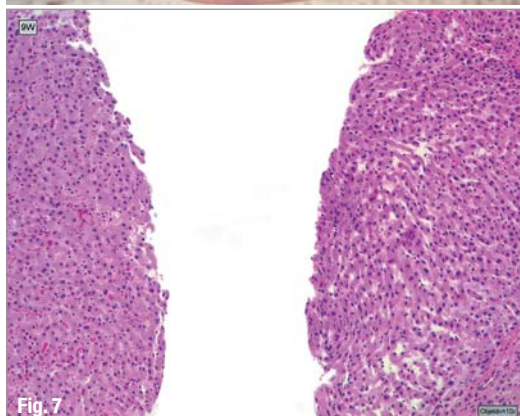


Fig. 7

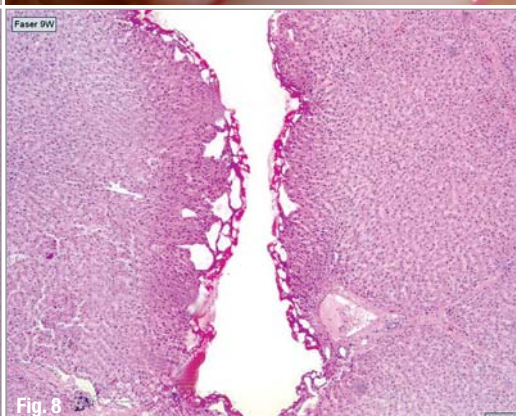


Fig. 8

Fig. 3-6 Patient 75 years lower jaw Implants with recurring inflammation at the implant (regio 33).

Fig. 3 Initial situation Missing attached gingiva at implant regio 33.

Fig. 4 Vestibulum plastic cuts with lateral denaturation.

Fig. 5 Deep cut: muscle cut in two and inlaying strands pre suturing.

Fig. 6 First day post OP. Prosthesis was immediately prolonged at the edge. Fibrin eschar. Patient without pain and complains.

Fig. 7 Cut in a liver using the JAZZ.

Fig. 8 Reference cut with a free laser beam into a liver.

wound edges. The histology has proven that the edges do not show any major necrosis zones. The cuts are clean with minimal demonstrations of heat been applied.

To compare those cuts with the standard free beam laser cuts, one can immediately see the difference. The large necrosis zones with the laser are highly visible and therefore lead to the prolonged healing time, whereas the cuts with our new JAZZ are clean and almost comparable to the standard scalpel cuts (Figs. 7 and 8).

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Er:YAG laser and desensitizing effects on dentine and neck of tooth

author_Olaf Oberhofer, Germany, Anton Sculean, Switzerland



_Aim

The aim of this clinical study is to compare the desensitizing effects on dentin and tooth neck of Dentin protector (Ivoclar Vivadent, Ellwangen, Germany), Duraphat (Colgate, Hamburg, Germany) and Er:YAG laser (KEY III, KaVo, Biberach, Germany). In private dental offices the dentin hypersensitivity since years is a common cause of discomfort in patients. Around 7 per cent of the patients in the dental office of the author shows this problem. Reasons for dentin exposure are gingival recession following periodontal disease or periodontal therapy and trauma from tooth brushing (Schwarz 2002). A successful reduction of hypersensitivity over long period was not reported at all in literature. Dentine hypersensitivity is a common painful condition about which relatively little is known. A review of the literature reveals that most research has been concerned with the clinical assessment of therapeutic agents (Addy 1992). About the etiology of dentin hypersensitivities is not much known (Addy 1990). The most common therapy of hypersensitive dentin is using fluorid solutions (Gedalia et al. 1978) or iontophoresis with fluorid paste (Jensen 1965, Johnson et al. 1982). Since beginning of the 90's using of laser systems has shown good results. In literature two different methods using laser in hypersensitivities

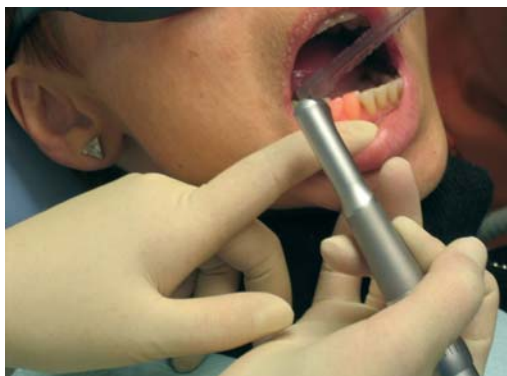
are described: the indirect application is a therapy with laser combined with tin-fluorid application and the direct application of laserlight (Bach 2007, Moritz 2006). In history there were a number of studies using Nd:YAG laser (Gutknecht et al. 1997, Gelskey et al. 1993), CO₂ laser (Moritz et al. 1996), GaAlAs laser (Matsumoto et al. 1985, Gerschmann et al. 1994) and Er:YAG laser (Schwarz et al. 2002) about this problem. All the studies couldn't show positive long term results.

_Method

25 patients (11 females and 14 males, aged between 18 and 46 years, mean age 32 years) who shows a total of 172 contralateral pairs of hypersensitive and caries free teeth. There were no caries lesions on neighbouring or selected teeth, no desensitising therapy during the last 9 months and no cervical filling.

_Study design

Split mouth design. Teeth in the first quadrant were treated with Dentin Protector (Ivoclar Vivadent, Ellwangen, Germany), in the second quadrant with Er:YAG laser (KEY III, KaVo, Biberach, Germany, 80 mJ, 3 Hz, Handpiece 2060 defocused max. two minutes per tooth in permanent movement across the sensitive area), in the third quadrant with Duraphat (Colgate, Hamburg, Germany) and the fourth quadrant served as an untreated control group. All patients were member of the oral hygiene programme and received the last professional tooth cleaning four weeks before treatment. The assessment of sensitivity was accorded by an pain scale in four degrees (Table 1). The neighbour teeth were shielded by casting material (Panasil, Kettenbach, Eschenbach, Germany). A three second cold air blast (18–20 °C) in distance of 2 mm was the qualitatively stimulation on the side to be



tested. The other test sides received application from Dentin Protector or Duraphat according to the instructions by the manufacturer. Before treatment the teeth has been cleaned by floss and polishing.

Recording were assessed before treatment, immediately after, one week, one month, two months and six months after treatment by a blinded examiner.

_Results

No complications were observed. All treatment forms resulted in improvements of discomfort immediately and after one week. After one month examination the DP group increased up to 56 % and the Duraphat group increased up to 57 %, the laser group increased up to 42 % of the

Pain scale	
Degree	Description
1	no discomfort during application of the stimulus
2	slight discomfort during application of the stimulus
3	mild discomfort or pain during application of the stimulus
4	severe discomfort or pain during and continuing for longer than five seconds after application of the stimulus

Table 1

baseline score. After two month examination the DP group increased up to 64 %, the Duraphat group increased up to 68 % and the laser group stayed nearly unchanged at 42 % of the baseline score.

After six month examination the DP group increased up to 102 %, the Duraphat group increased up to 103 % and the laser group slightly increased up to 55 % of the baseline score. The control group shows no improvement of discomfort all six months.

Compared to the control group all three treatment method showed reductions of discomfort all six month. The decrease of the positive effect with Er:YAG laser has been shown after six months, the decrease of the positive effect of

DentinProtector and Duraphat has been shown after two months. Desensitizing with Er:YAG laser (KEY III, KaVo, Biberach, Germany) was effective. In comparison to the use of Duraphat (Colgate, Hamburg, Germany) and DentinProtector (Ivoclar Vivadent, Ellwangen, Germany) the maintenance of the results was longer.

Mean degree of pain over 6 months (n = 25)

	baseline	after	1 week	1 month	2 months	6 months
Er:YAG laser	3,52	1,36	1,48	1,52	1,52	1,96
DentinProtector	3,6	1,6	1,96	2,04	2,32	3,68
Duraphat	3,6	1,64	2,16	2,08	2,48	3,71
Control	3,6	3,56	3,52	3,36	3,52	3,68

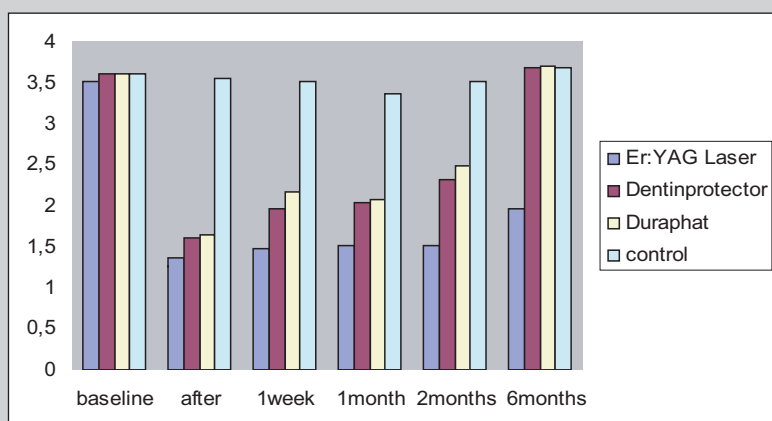


Table 2

After six months there was a slightly increasing of discomfort in the Er:YAG laser group too. It seems that the Er:YAG laser is a suitable tool for treatment of dentine hypersensitivity. Further studies are needed over a long time period to evaluate long term stability of the positive results.

For literature, please contact the author.

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The Right Wavelength— Areas of application and indications for different kinds of laser

An interview with Prof Dr Norbert Gutknecht



Prof Dr Norbert Gutknecht

Lasers have been used in dentistry since 1964. The idea was to permit treatment of mucosa, hard tooth tissue and bone without involving contact, vibration or pain. They have been increasingly used in various areas of application since the early 1990s. The president of the World Federation for Laser Dentistry (WFLD) and German Society for Laser Dentistry (DGL), Prof Dr Norbert Gutknecht, gives an overview of laser applications that are the subject of controversy, and discusses options for their use in these areas. Every laser has its own special properties, the most significant and fundamentally characteristic one being the wavelength, which defines the position of the laser beam in the electromagnetic spectrum. The interaction of a laser beam with human tissue is essentially due to the energy it delivers into it. The defining factor here is the absorption of the laser beam. Absorption spectra can be visualized for tissue and its components on each wavelength. Besides absorption, reflection and transmission play a role.

Professor Gutknecht, let's start with endodontics. What wavelengths are used here?

The use of lasers in endodontics is aimed at reducing the germs in the root canal, especially in the lateral dentinal tubules (necrotic, gangrenous pulp in the corona and root). We therefore need a wavelength that has high transmission through hydroxyapatite and water. The absorption curves show that with first priority the Nd:YAG laser, to be precise the pulsed Nd:YAG laser, is an option here. It has shown the best results in measurements of transmission and the reduction of germs. Even at a depth of penetration exceeding 1,000 µm, an approximately 85 per cent reduction of germs is still achieved. Going down from

there, the second priority would be the diode laser, with a wavelength of 810 nm. Microbiological research has shown that it achieves the second highest reduction of germs. At approximately 63 per cent, however, this reduction puts it significantly below the Nd:YAG laser. Then, below that, we have the 980 nm diode laser. Due to its increased absorption in water, it does not possess a high transmission value. At the same depth of 1,000 µm, it only manages to reduce germs by between 30 and 40 per cent.

None of the other wavelengths, such as those of the Er:YAG, Er,Cr:YSGG or CO₂ lasers, plays any role in this treatment. Their absorption in hydroxyapatite and water is so high that a reduction in germs takes place mostly in the main canal. As a thermal effect, a reduction of germs in the lateral dentinal tubules can still be detected to a depth of 300 to 400 µm. So these wavelengths are not very suitable for treating endodontic problems. Er:YAG and Er,Cr:YSGG lasers can, however, be used for removing organic tissue and smear layers.

In periodontology we distinguish between closed curettage with a probing depth of 5 to 6 mm and open curettage at probing depths of over 6 mm. What wavelengths are appropriate in periodontology?

If we want to perform closed curettage with laser assistance in cases of periodontal disease, we can reduce germs with the laser after completing pretreatment and removing the concrement by the conventional method. In closed curettage, we can only use wavelengths whose interaction does not destroy the adjacent hard tissue but which, on the other hand, have good interaction with the soft tissue within the germ spectrum existing in the periodontal pocket. Here, the

pulsed Nd:YAG laser can both destroy the germs accumulating on the surface of the hard tissue and—because it couples with pigmented surfaces— tremendously reduce the germs in the pocket. 96 per cent of the germs that are found in the periodontal pocket are pigmented and can thus be selectively destroyed by the laser. Direct coupling with the soft tissue is comparatively gentle, ie, it does not involve a substantial removal of tissue. This permits a relatively conservative procedure and is also associated with really rapid healing of the wound. With the Nd:YAG laser, anesthesia is required in fewer than 50 per cent of cases.

An alternative in this area would be the 810 nm diode laser, whose light has very good coupling with pigmented tissue, so it, too, effects a very high reduction of germs and one can regard it as a match for the Nd:YAG laser. Its coupling with the existing soft tissue is greater, as is its removal of tissue, and it also evolves more heat, so anesthesia cannot be dispensed with during treatment.

The 980 nm diode laser can also be considered in laser-assisted closed curettage. At this wavelength, high coupling with water in the periodontal pocket brings about a similarly high reduction of germs, but at the same time the thermal effect on the tissue is greater because of lower coupling with hemoglobin. This in turn means that we may generate surface necroses if we do not work with extreme care at this wavelength. On this wavelength, too, the temperatures reached are relatively high and anesthesia is necessary.

In laser-assisted open curettage we have a clear, unambiguous application for the Er:YAG laser and, to some extent, where there are special indications, also for the CO₂ laser (10.6 µm; cw = continuous wave). The device of choice in support of treatment with open curettage is the Er:YAG laser. It is especially suitable if we can vary pulse lengths and repetition rates very widely. This allows us to carry out extremely good interradicular and interdental cleaning, and the bone tissue can also be very efficiently freed from infected soft tissue. We can moreover generate a really fine retentive pattern on the root and bone surfaces, which is of the greatest significance for reattachment.

What pulse length is recommended for use with open curettage?

If the surgeon giving treatment has the option of varying the pulse length of an Er:YAG laser, short pulses of 60 to 120 µs are ideal. With this pulse length, thermal stress is extremely low so thermal damage to the hard tissue need not be anticipated at all. There is a positive tendency to bleed postoperatively, so wound healing is unproblematic.

The Er,Cr:YSGG laser falls into the category of erbium lasers, which can be used in open curettage. It must, however, be remembered that its absorption in water is two orders of magnitude lower than that of the Er:YAG laser. This means that, if the operation is

not carried out correctly, the thermal effect on the tissue will be very much greater.

Lasers are also being increasingly employed in implant dentistry. What wavelengths are used when uncovering implants, for example?

There are several options for uncovering implants, using various wavelengths. The first wavelength ever used for uncovering implants was that of the CO₂ laser, 10.6 µm – with the slight disadvantage that this carbonizes the tissue surfaces. The 810 nm and 980 nm diode lasers can be used as alternatives. The area of thermal damage is however larger than with a CO₂ laser. Very good results can be achieved with Er:YAG lasers when uncovering implants if the pulse length can be varied or special tips can be used. With pulse lengths of 800 to 1,000 µs, there is an interaction with tissue with a greater thermal effect. This means we can seal smaller vessels without having to leave carbonized or necrotized areas of tissue behind. On the other hand, of course, in the larger vessels we have as always a slight bleeding tendency, which however means that, in comparison with diode and CO₂ lasers, wound healing is accelerated, postoperative swelling is reduced, and the wound area heals up with less inflammation. In terms of wound healing physiology, this makes the long-pulse Er:YAG laser an ideal instrument for uncovering implants. With CO₂, Er:YAG and Er,Cr:YSGG lasers, no damage at all is done to implants because these wavelengths have a high reflection potential and thus there is hardly any absorption on the metal surfaces. Pulsed Nd:YAG lasers are unsuitable for uncovering implants.

What wavelengths should be used in treating periimplantitis?

The treatment of periimplantitis is performed similarly to closed or open curettage. Both the diode and the Nd:YAG lasers have their areas of indication. Most studies of the treatment of periimplantitis with diode lasers are based on 810 nm diode lasers.

The best procedure for the treatment of a large periimplantitis defect is however to uncover the implant that has been altered by inflammation. Only under visibility can the granulation tissue and the infected tissue be completely removed—above all, only in that way can the infected tissue in the convolutions/spirals of the implant be reached. In this process, treatment with a short-pulse Er:YAG laser is ideal. The shorter the pulses, the more efficiently the granulation tissue can be removed and the less problematic it is to clean the implant surface. Pulse lengths between 60 and 200 µs and very low energy settings make it possible to clear away the infected tissue thoroughly. Similarly good results are achieved with the Er,Cr:YSGG laser.

What needs to be observed in soft-tissue surgery, and what wavelengths do you use in this area of application?

For cutting soft tissue, eg, when incising an abscess, where a sterile cut with as little bleeding as possible is required, the 810 nm and 980 nm diode lasers and the pulsed Nd:YAG laser can be used.

One has to be much more cautious when performing surgery on soft tissue. In frenectomy (operations on the frenula of the lips, cheeks or tongue), the 810 nm diode laser and CO₂ laser are very suitable. The Nd:YAG laser and 980 nm diode laser should be used with great caution because the stronger thermal effect of this wavelength (< 100 µs) very often causes necroses.

If very long pulse lengths (> 700 µs) can be set, Er:YAG lasers, too, are again suitable for frenectomy and for soft-tissue surgery in general. The Er,Cr:YSGG laser should also be mentioned, and finally the classic Er:YAG laser, but only with special surgical tips.

Could you please explain the difference between a CO₂ laser and a long-pulse Er:YAG laser?

The difference is their absorption coefficients. The Er:YAG laser is very much more strongly absorbed in water, ie, by its interaction with water alone it separates soft tissue in the cells without a strong thermal effect being required. Microscopic ruptures are caused and these lead to increased bleeding. The CO₂ laser, by contrast, has very high absorption on the tissue surface. Because of its different mode of operation—in most cases it is a continuous-wave laser—there is greater thermal stress at the surface and not in the depths of the tissue. It therefore leaves carbonized surfaces, but on the other hand there is less tendency to bleed. A positive compromise can be achieved with the long-pulse Er:YAG laser because the very long pulses give a larger thermal component and small vessels are thereby sealed. There is thus less tendency to bleed, but it is not totally prevented, and this in turn means more rapid healing.

A provocative question: Is depth of penetration something dangerous? What is your assessment of the depth of penetration of a laser in different types of tissue?

Precisely in medicine and dentistry, of course, the subject of depth of penetration is highly important. It would be wrong to generalize when evaluating depth of penetration, it always has to be considered in conjunction with the relevant wavelength and the tissue to be operated on. One normally tries as far as possible to minimize the depth of penetration by matching the wavelength to the tissue. There is only one exceptional case in which transmission is desired. Precisely in the case of infected hard tissue in the root canal, or infected bone material, a reduction of germs will also be required in the deeper layers. In addition, it must be ensured that as much of the laser light as possible is absorbed by the tissue. The greater the depth of penetration, the less easily one can control the thermal effects in deeper layers of tissue and the sooner necroses occur.

What affects the depth of penetration of a laser into soft tissue?

The widespread and very frequently discussed notion that Nd:YAG lasers have the greatest depths of penetration into soft tissue is correct only under certain conditions. It is true that the Nd:YAG laser would have an extremely high depth of penetration if one were using a standard industrial laser, which has a continuous-wave mode of operation and emits its power by a non-contact mode. The Nd:YAG laser systems provided by the various manufacturers for use in dentistry are free-running pulsed Nd:YAG lasers. Their pulse width is between 90 and 150 µs, and their energy is delivered through a fiber in contact mode directly into or onto the tissue. Because of the high energy density, there is a very rapid change in the surface of the hard tissue. The depth of penetration is thereby significantly reduced. Professor Joel White at the University of California, San Francisco (UCSF) has made a very graphic study of this point. At the RWTH in Aachen, we have been able to show in a study that a free-running pulsed Nd:YAG laser has a depth of penetration of approximately 0.1 to 0.3 mm, whereas a continuously running Nd:YAG laser has a depth of penetration of up to 6 mm.

The repetition rate and pulse length of a diode laser are specific to different areas of application. What precise significance do these settings have?

Because of its basic physical construction, a standard diode laser emits a continuous laser beam and is thus a continuous-wave laser. With a diode laser, when we speak of pulsing we really mean chopping, ie, interrupting the laser beam. This can be done by switching it on and off electronically. But this is not equivalent to a pulsed laser as the term is normally understood, which outputs high-peak power with individual pulses that can reach several thousand watts. If we want to have pulsed diode lasers with low average power, total power falls. In order to achieve an adequate result on the tissue, one would have to increase the power again without reaching the peak pulse power of the Nd:YAG laser. Attempts are currently being made in many systems to pulse diode lasers electronically so that they have a characteristic similar to that of the Nd:YAG laser, or at least to achieve a free-running pulsed laser system.

Should cooling with a water spray be used during treatment with a diode laser?

There is no comparative research on this point. From a biophysical point of view, however, one must say that the use of a water spray would be counter-productive because water is a good thermal conductor and carries heat away, whereas we want to achieve a thermal effect. Cooling the surface of the tissue is also associated with the danger of inducing a necrosis in deep tissue. Water sprays should therefore not be used with a diode laser.

Let's turn to the subject of the literature and further training: What academic sources are serious and trustworthy for laser dentistry?

There are quite classical standards for classifying academic literature. The most trustworthy literature is review literature. The journals listed in the various indices, eg, Citation Index and MedLine (PubMed), are highly respected academically. Journals that have an impact are quoted and may be quoted over and over again. There are really only three journals that meet these criteria, in my opinion. They are "Lasers in Medicine and Surgery", "Lasers in Medical Science" and the "Journal of Clinical Laser Medicine and Surgery". These are respected academic journals with impact. Where the literature on lasers is concerned, this kind of journal does not exist in Germany.

What is the relationship between the German Society for Laser Dentistry (DGL) and the German Society for Dental, Oral and Mandibular Medicine (DGZMK)?

The DGL is the first laser society to have been incorporated into its national parent dentistry society, the DGZMK. Here in Germany, the DGZMK is the parent society under whose umbrella many other specialist societies are associated. A condition for such an association is clear scientific rigor and an orientation toward clinical practice. The DGL meets these criteria, which is why it is the only society in Germany at the

present time that represents our special field and is also legally entitled to represent it.

A question for you as president of the World Federation for Laser Dentistry—WFLD: is there a defined "state of the art" for laser dentistry?

There are of course many "state of the art" assertions, the only question is what they are based on. The objective of the WFLD, and also my personal wish, is actually to get all dental laser societies around one table, to examine for scientific rigor and content all the published standards and education models that have so far appeared.

The World Federation for Laser Dentistry (WFLD), is holding its next World Congress from March 2–4, 2010 in Dubai. What is the importance of the WFLD Congress?

It is a great honor for the WFLD to be integrated in one of the most outstanding dental exhibitions and conferences worldwide, the AEEDC in Dubai. The 2010 Congress is offering an extensive program, from presentations of the latest state of the art, accompanied by brief papers by young scientists, practical workshops dealing with interesting therapeutic questions, and exhibitions by laser system manufacturers who will be providing information about the latest technological advances in laser treatment. So any dental surgeon who is interested can obtain an objective and

AD

18TH ANNUAL CONGRESS OF THE DGL

Deutsche Gesellschaft für Laserzahnheilkunde e.V.

[november 6–7, 2009 in cologne, germany | hotel pullman cologne]



"Lasers in Implantology and Oral Surgery"

Scientific Director: Prof. Dr. Norbert Gutknecht

comprehensive overview of the spectrum of laser dentistry at this Congress.

You mention options for further training. What academic training is recognized for laser dentistry?

A society, no matter what its level, whether national or even worldwide, can neither point the way ahead for training nor provide an academic education. Training courses provided by societies are not academically recognized. A training course, eg, one run by the DGL ("The Specialist") is merely evidence for the participant and documentation for others that he is very strongly concerned with this subject, and the society produces this evidence for him by setting an examination. In academic terms, this certificate has no significance. Thus, if we want to have a specialist, that is, a specialized dental surgeon, that person must get an academic degree. So only university degrees are recognized. It is for the universities alone to acknowledge a given level of education. Training, workshops, seminars or the like that are organized by companies are of course justified. It is frequently the case, however, that training courses developed by firms are mainly beneficial to their own interests. Anyone making out a certificate must prove his entitlement and his ability to provide an education. A university can award diplomas for courses and training units that are carried out at the university or by academic personnel of the university. They have to keep to very special guidelines. It would take too much space to list here all the guidelines that are associated with the award of a certificate.

This brings up the question of protection against lasers. What institutions are entitled to train someone correctly as a laser safety officer (LSO)?

The matter of persons responsible for laser protection is still one of the most controversial questions all around the world. Some countries do not provide any training for such a post. I personally, as a university lecturer and as the president of the WFLD, find it irresponsible for lasers to be supplied or provided without their operators having to show evidence of having passed such an examination. It is moreover a deception to offer courses in laser protection that do not meet the curriculum prescribed by law. Training as a person responsible for laser protection should be given only in certified institutions. The law prescribes a training course lasting at least one day, but in many cases one-and-a-half days, in technical safety and biophysics alone.

What would you regard as the ideal training for a dental surgeon who would like to call himself a dental surgeon instructor?

In order to be competent to hold the title of a dental surgeon instructor, in my judgment, a dental surgeon must meet very specific preconditions. Unfortunately,

time and again I see colleagues taking on the title of a dental surgeon instructor, or even being given this title by manufacturers or marketing companies, while they have only a rudimentary knowledge of laser dentistry. A dental surgeon instructor should know not just the basics but should have solid training in the field of lasers. He should have sufficient practical experience in order to present and demonstrate this new technology to his colleagues with real authority. A dental surgeon instructor needs to have far more than just a vague idea of the name of the device and its manufacturer. Anyone who wishes to train dental surgeons should, in my opinion, have the courage to follow the appropriate training. This will give him an objective insight into laser technology at the greatest variety of wavelengths and into the greatest variety of indications for those different wavelengths.

In view of the large number of dental lasers on the market, how important do you consider it for field staff also to have specialist training?

Unfortunately, it is only in a tiny minority of cases that correct information is available to the dental surgeon. This leads many of our colleagues either to view these systems negatively, or to allow themselves to be persuaded because they think the laser will quickly compensate for specific gaps in their knowledge or capabilities. A technical adviser should undergo serious, solid training in order to learn what kind of product he is dealing with, as well as to learn that there are other lasers and other wavelengths, and that indications have to do not only with the size, shape and color of the device, but also with its wavelength and area of application. These are fundamental prerequisites for providing this technology in the form it deserves.

Given the flood of information, how can a dental surgeon filter out the appropriate laser for himself?

I must answer your question quite openly and honestly: a dental surgeon with no prior knowledge of laser technology is in no position to find the correct laser for himself on the basis of brochures or similar material. In order to be able to make a decision, he should take the effort to visit informational scientific events such as the WFLD Congress in March 2010, the congresses organized by national dental laser societies, or other serious informational events. The technology and the multiplicity of indications are far too great for anyone who has not devoted time to them to know their way around. I would go so far as to say that even people who have already devoted time to them occasionally have difficulties selecting the suitable product for the appropriate therapy. In this field, comprehensive advice is indispensable.

Professor Gutknecht, thank you for this informative interview.



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WFLD appoints Prof Dr Norbert Gutknecht as new president

Prof Dr Norbert Gutknecht, Professor at the Department of Conservative Dentistry, Periodontics and Preventive Dentistry at the RWTH Aachen University, has been appointed as new President of the World Federation of Laser Dentistry, WFLD, on 30 July 2008. The WFLD, founded in 1988 in Tokyo, Japan, is a non-profit organisation promoting exchange, advancement and dissemination of scientific knowledge, encouraging the use of lasers for application and research in the oral and dental environment. Its 20,000 members are spread over five regions (North-America, South-America, Europe, Middle-East-Africa, Asian-Pacific). Membership is highly encouraged: people who are interested in research, development and the use of laser technology in the field of dentistry, medicine and surgery are welcome to enhance communication between all levels of laser technology, thereby seeking to improve standards in laser dentistry, to further education, research and development and to offer meetings for the exchange of ideas and methodology in the field of laser dentistry. The latest World Congress took place in Hong Kong from 28–30 July 2008 and was scientifically very successful with more than 650 participants and 230 lectures. 25 German dentists attended the Congress. Besides Prof Gutknecht, Prof Frentzen (President of the European region of the WFLD and Secretary-General of the German Society for Laser in Dentistry), Associ-

ate Professor Dr Braun, Dr Berger, Dr Borchers, Dr Brader, Dr Brede, Dr Brink, Dr Ingenegeren, Dr Meister, Dr Klaus, Dr Kleemann, Dr Koort and Dr Schindler participated in the programme.

For the next two years, Prof Dr Gutknecht takes over the presidency of the World Federation of Laser Dentistry and will be responsible for organizing the next World Congress in March 2010, taking place in Dubai, UAE. Since 18 years, Prof Dr Gutknecht has been one of the leading experts in the field of laser in dentistry. He is one of the founder members and has been the President of the German Society for Laser Dentistry since 2005. Additionally, he is the Scientific Director of the first accredited Professional Master in Dentistry, the Master of Science (MSc) in Lasers in Dentistry, which is taught at the University of Excellence RWTH Aachen University, at the RWTH International Academy. Since 2004, more than 80 dentists from all over the world have graduated successfully. As the Scientific Director of the Professional Master Prof Dr Gutknecht was awarded with the Bronze Award for "Life-long learning" of the European Union in 2006. The next German taught Professional Master Course will start on 16 March 2009 in Aachen, Germany. The programme is also offered in English language at RWTH Aachen University, starting on 14 September 2009, and in Dubai, UAE, on 9 November 2009.

Worldwide Dental Laser Societies

NDLS – Nordic Dental Laser Society

Nordic Dental Laser Society (NDLS) is a non-profit educational association with members primarily from the Nordic Countries. It has no commercial interest, nor is it bound to any industrial or commercial enterprise. It was established 2006 in Copenhagen (as Norsola) and has today nearly 100 members. The aim of the Society is the promotion and evidence based dissemination of knowledge in the use of lasers in



dentistry and oral/maxillofacial surgery and the corresponding equipment and techniques. The objectives of the Society is: to promote the exchange of ideas and information within a fully integrated Nordic network, to establish standards of operation for laser technologies, to strengthen relations with other branches of medicine and with other societies, professional and scientific groups, to intensify cooperation between universities and research institutes, etc. in order to foster joint research, to promote and coordinate post graduate studies

The NDLS has arranged three Symposium in

Copenhagen and Stockholm with invited speakers from leading educational and scientific Universities and Institutes from Europe. The program has been designed to enriched the participants knowledge in Science and the practical use of Lasers in Dentistry.

Further more educational postgraduate studies, courses and workshops on University level will be started under 2009 (in Stockholm and Copenhagen) as well as the invitation of leading speakers in different meetings. The education will be in co-opera-

tion with the most prominent. Educational Institutes in Lasers in Dentistry, which ensures the quality of the studies in this most advanced treatment method in Dentistry. Members of the NDLS-board will also actively assisted the authorities to provide adequate regulations and recommendations for the dentists working with laser-assisted dentistry. NDLS board are also welcoming interested persons, associations, institutes etc from outside The Nordic countries to join us.

GSLD – Greek Society for Laser Dentistry

Our epoch's dentistry presents a highest pace advance. A plethora of new materials fabricated with high standards in addition to contemporary treatment techniques are offered to the current dental science. Accordingly, the anticipation concerning the dental prognosis is diminishing. Lasers in dentistry proved to be more than a trend in high tech dental treatment and defeated any barren skepticism, becoming a substantial adjunctive tool in the hands of the modern clinician. The Greek Society for Laser Dentistry—GSLD—stands for the branch of the World Federation for Laser Dentistry—WFLD—in Greece and was founded in 2006. GSLD presented itself in November 2006 during the 26th Annual Greek Dental Congress held in Athens as the first and only academic society in this field. The participants of the congress along with the dental companies had then the opportunity to be informed about the causes of this academic and non profit society. GSLD came also in contact with didactic personnel of the two Dental Schools of the country and was estimated as a trustworthy team, since all of its members have or are in the process of completing studies in the field of dental lasers, competing the standards of European Union's directives. Catalytic was also the presence of RWTH Aachen University and AALZ Institute during the congress.

Continuing education

GSLD defines its causes in an effort to synchronize and harmonize the modern Greek clinician with the technology of LASER in dentistry. Through hands on workshops and continuing education seminars organized by Academics from around the world as well as its founding members, it intends to provide gnostic practices, to promote research, to stimulate participation in international con-

gresses and courses and to familiarize dental personnel, dentists, dental students, dental companies and patients with this field of dental science. GSLD members have an active presence in international congresses transmitting all new research data and techniques to the Greek dental public differentiating it from simple user of a LASER to an educated operator of a tool. GSLD is proud to collaborate with RWTH Aachen Dental School, the AALZ Institute, Fraunhofer Institute, the Dental Laser Academy and affiliated LASER dental societies around the world. GSLD is a private legal entity and has an elected five member board consisting of President Dimitrios Strakas DDS, MSc, Vice-president Vasileios Zarganis DDS, MSc, Secretary-General Dr. Dimitrios Charoulis DDS, MSc, Treasurer Athanasios Tselios DDS, MSc, and Member Athanasios Poullos DDS, MSc.

GSLD Congress

In March 2008 the first National GSLD Symposium took place and was coronated with success. The Symposium beared the title "Implantology and LASER Dentistry" and among speakers where invited colleagues from abroad together with professors of the laser department in Athens Polytechnic School. Keeping the promise of an annual congress, GSLD organizes this year on March 27 to 29 the 2nd National Congress titled "LASER in Dentistry: New Clinical Reality" in Athens. Honored speaker of this year's congress, is the president of WFLD Prof Dr Norbert Gutknecht, who will also demonstrate the operation of several dental LASER apparatus during the hands on workshops. Adding to the most of interest presentation of Dr Jan Tuner from Sweden, those of the GSLD members the Greek dental audience will experience a three days brainstorm in the fields of LASER appliance in everyday dental practice.

We hope that the latest in dental technology to streamline the patients' treatment will once again attract and satisfy the active participants.



Laser-assisted Dentistry

A report from Nordic Dental Laser Society and the Third International Symposium in "Lasers in Dentistry", Hotel Hilton, Slussen Stockholm, November 22—23, 2008.

author_Peter Fahlstedt, Sweden

Between 22—23 November 2008, Nordic Dental Laser Society (NDLS) held the Symposium Laser-assisted Dentistry. This was the Third International Symposium in "Lasers in Dentistry" since the establishment of the association in 2006. In a snowy environment constituting the "old town" of Stockholm, the light from the invited speakers spread new knowledge and enlightening to the nearly 100 participants under these two cold winter days. Mainly dentists from the Nordic countries experienced an up-to-date presentation of evidence base, practice and economical benefits from the use of lasers in dentistry.

The opening speaker the first day, Physicist Dr Jörg Meister from AALZ, RWTH Aachen University,

Germany, presented a solid ground consisting of the physical background behind the properties of lasers. A needed knowledge for the acceptance of the following lectures. Prof Dr Marita Luomanen DDS, Dep for microbiology, Helsinki University Finland, speaking of Science and Clinic of Dental laser Treatment, presented even new interesting actual research on cellular level. After lunch and active discussions with the exhibiting suppliers of dental laser equipment, the participants had opportunity to experience Clinical Case presentations from the work of Dr Talat Qadri DDS, Karolinska Institute Huddinge, Sweden; Dr Peter Steen Hansen DDS, MSc in Lasers in Dentistry, Denmark, and Dr Peter Fahlstedt DDS, MSc in Lasers in Dentistry, Sweden. The range of



treatment presented covered laser-assisted treatments in all fields of Dentistry. This gave the audience practical advices and visible techniques to make, if possible, even better choices in their daily treatments. As last speaker the first day, Prof Dr Norbert Gutknecht DDS, AALZ, RWTH University Aachen, Germany, presented Evidence Based Laser Dentistry, convincing even the most sceptic listener that Lasers in Dentistry and Science are couplet on highest level. The field of coming research are grand but the evidence based up to day are laying a solid ground for the laser user, who are gaining high quality education.

After free activities in the late Stockholm Saturday night, all were joined together early next morning, when Prof Gutknecht once again let the audience to witness the long, careful and patiently work that are leading to the acceptance of these Scientific Evidence. This day the research behind the treatment protocol of to days laser-assisted endodontical treatment were presented. One of the most respected researcher, author and educator in Low Level Laser Therapy, Dr Jan Tunér DDS, Sweden, continued with a most interesting speech in this well-known method of treatment of inflammatory, infected or decayed tissue. He presented both new and historical research and theories, not least on cellular level, behind the mechanisms leading to desired effects of LLLT. He was well complemented by Dr Per Hugo Beck-Kristensen DDS, Denmark, who let the present dentists taking part of his 20-years of experiences from practical use of LLLT in dentistry.



As a queen on the top of this appreciated series of lectures, Dr Anna-Maria Yiannikou DDS, MSc x 2, Cyprus, and AALZ, gave an unquestionable well performed description of the economical benefits of Lasers in Dentistry.

The evaluation of the symposium gave the board of NDLS good feedback and strength to perform an even more successful symposium next time. We thank all excellent speakers, the participant suppliers of dental laser equipment and the main sponsor Praktikertjänst AB, Sweden, for the fine deliverance of needed knowledge in this most promising method of dental treatment.

The symposium clearly stated that the evinced based knowledge is already a fact, even if further high quality research in all fields of Lasers in Dentistry is needed. Now it is up to all involved parts to make the best informed decision to supply interested dental personnel with a sufficient amount of this knowledge.





Selected Events 2009/2010

MAY 2009

May, 14–17

2nd Congress of World Federation for Laser Dentistry European Division

Istanbul, Turkey

Phone: +90 2 16 4 56 02 19
E-mail: wfld@opteamist.com

OCTOBER 2009

October, 23–24

1st Meeting of the South American Division of the World Federation for Laser Dentistry

São Paulo, Brazil

Phone: +55 11 30 91-76 45
E-mail: acca@usp.br or pfreitas@usp.br

5th Congress of the Brazilian Association in Laser Dentistry (ABLO)

NOVEMBER 2009

November, 06–07

Annual Congress of DGL

Cologne, Germany

Phone: +49-3 41/4 84 74-3 08
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Web: www.oemus.com

LASER START UP 2009/ 13th Starters Congress in Lasers in Dentistry

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MARCH 2010

March, 02–04

Biannual WFLD World Congress in Conjunction with UAE International Dental Conference & Arab Dental Exhibition

Dubai, UAE

E-mail: office@dgzi-info.de
Web: www.aeedc.com



**1st Meeting
of the
South American
Division of the
World Federation
for Laser Dentistry
(WFLD)**



5th Congress of the Brazilian Association in Laser Dentistry (ABLO)



Foto: Flávio Versades

October, 23-24 2009

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Manufacturer News

Fotona

Fotona to Showcase New Laser Features and Accessories at IDS

Continuous science-based improvements are furthering the applicability and scope of Er:YAG and Nd:YAG laser systems, which are the gold standard systems of laser dentistry and dermatology. Lasers in the Fotona AT-HT family provide both of these laser types. At the IDS tradeshow Fotona will launch a new range of flexible fiber tips for the AT-HT system family. These specialized tips enable more effective root canal therapies by allowing the dentist to reach deep into the root canal to deliver laser energy where it is needed. The



Root Canal therapy with the Fotona Flexible Fiber Tip. Courtesy of Dr Simonovic.

dual wavelengths available in AT-HT laser systems allow for the combined elimination of the smear layer with Er:YAG and the disinfection of the root canal with Nd:YAG, the only such solution on the market. Lasers in the AT family support the widest range of parameters in the industry: Nd:YAG pulsewidths from 100 μ s to 650 μ s and power ranges from 20 mJ to 10 J, Er:YAG pulsewidths from 50 μ s with 1,000 μ s and power ranges from 20 mJ to 1.5 J. Both lasers are equipped with Fotona's VSP technology for perfect pulse shape control. In effect, the worlds fastest Er:YAG laser for hard tissue drilling has broadened its operating range with the finest low pulse, high repetition rate capability for delicate soft tissue surgery and a flexible fiber tip to enhance root canal therapy. While the Nd:YAG laser

has gained the ability to deliver long 650 μ s pulses to enhance its coagulation capabilities. These expanded parameter ranges allow laser dentists to execute the finest and fastest treatments in the most demanding dentistry and dermatology applications. Fotona's best-in-class lasers are complemented by wireless foot-switch technology, which allows that practitioner to assume a comfortable position while working, regardless of space constraints or other environmental factors. Fotona's user interface has a comfort mode, that allows easy, simple access to the most commonly used functionality, as well as an advanced interface, that gives the practitioner total control. To find out more about Fotona systems and technologies visit us online at www.fotona.com.

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Sirona

SIROLaser delivers excellent results in connection with ceramic restorations

If bleeding occurs during impression-taking and treatment, this can have a serious impact on the quality of ceramic restorations. The CEREC user Dr Helmut Goette deploys the SIROLaser to overcome this problem. In this article he describes his therapy approach with reference to a typical case. Today, lasers are widely used in endodontics, periodontics and dental surgery. Sirona's compact and powerful SIROLaser now plays an indispensable role in my CEREC treatment procedures. I use it for haemostasis purposes and to define the preparation margins. It is essential to prevent bleeding at all stages of the CEREC procedure. The contamination of the anti-reflective powder with blood during impressiontaking is especially critical. The data can be flawed, resulting in incorrect height readings and inaccurate dimensions of the proximal box. To achieve an absolutely clean environment I apply a rubber dam and use the SIROLaser to arrest any bleeding. Bleeding is especially problematical during adhesive bonding. Blood and saliva contamination can

destroy the etched microretentive enamel and dentine surfaces. Proper adhesive bonding is then impossible, and treatment failure is the consequence. A combination of the SIROLaser and a rubber dam effectively rule out such contamination.

Case study: haemostasis prior to impression-taking

A 38-year-old male patient came to my dental practice complaining of bite oversensitivity in tooth 25. The oral examination revealed an extended glass ionomer filling with a replacement palatal cusp and a missing mesial contact point. I recommended a replacement filling, as glass ionomer is not indicated for cusp replacement and this was the cause of the oversensitivity. The tooth was vital. An X-ray did not reveal any signs of periapical periodontitis. After the defective filling had been removed copious bleeding occurred in the mesial proximal box. With the aid of the SIROLaser I arrested this bleeding and then exposed and defined the preparation margin. For this purpose I selected the "Periodontology" program preset (2.5 W and 75 Hz). In addition I prepared a distal box, and defined an additional preparation margin with the aid of the SIROLaser. The outcome was a clear and dry representation of the operation site for the preparation. The CEREC optical impression yielded a clearly defined 3-D model. The automatic detection

function had no trouble in marking the preparation margins. Thanks to the rubber dam, the optical impression and the adhesive bonding of the restoration were performed under absolutely dry conditions. I chose CEREC Blocs (shade: S2-M) for the restoration. Adhesive bonding was performed by means of Syntac-Heliobond (Ivoclar Vivadent) in combination with Tetric EvoCeram (Ivoclar Vivadent), shade A2. The restoration was inserted with the aid of an ultrasonic handpiece. Haemostasis remained effective throughout the treatment process. As a result repeated laser therapy was not required prior to adhesive bonding.

To sum up

I have used the SIROLaser for CEREC treatment with great success since its introduction around three years ago. It is ideal for haemostasis during impression-taking and treatment, as well as for gum contouring and for the correction of the preparation margin.

Dr Helmut Goette

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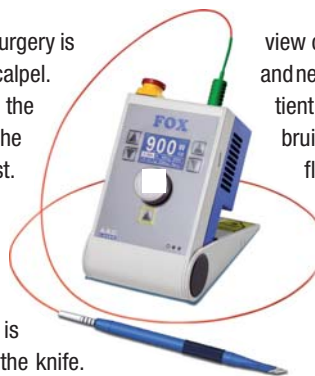
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KaVo

World market leader in innovation

KaVo Dental GmbH is one of the world's leading suppliers of products for dentists and dental technicians. The company celebrates its 100th anniversary in 2009 and looks back with pride on 100 years of history. Over its 100 years, KaVo has set new standards again and again, has been in the forefront of new trends and has developed into a respected supplier of all types of high-quality equipment and instruments for dentists and dental technicians. Since its establishment in 1909 KaVo has been a leader in the dental market. Since its founding last century KaVo has made its mark on dentistry with numerous significant innovations and the development of innovative tech-



nology. The company has evolved into a full-service supplier and a provider of complete solutions for the dental practice and laboratory.

High-quality and reliable products

KaVo supplies a complete range of products and technologies designed to make the varied and complex work of dentists and dental technicians more efficient and easier. The company consistently focuses on the economic factors for the user and continuous improvement of work processes. KaVo supplies modern treatment units, turbines, handpieces and contra-angle handpieces along with innovative X-ray, diagnostic, laser and CAD/CAM technology designed to meet the requirements of contemporary dentistry. KaVo is also the first choice for dental laboratories for CAD/CAM, laboratory handpiece installations, articulators and all

types of laboratory equipment. With its consistent brand philosophy and 100 years of experience, the well-respected company intends to maintain its leading position in the dental market for the next century and successfully face the challenges of the dynamic dental market. The market leader with its head office in Biberach/Riß has more than 3,300 highly motivated employees worldwide at the production facilities in Biberach/Riß (parent plant in Germany), Warthausen (Germany), Nervi (Italy), Des Plaines (USA), Joinville (Brazil) and in its various international marketing companies. Since the spring of 2004, KaVo has been a subsidiary of the US Danaher Corporation and plays a key role in its dental division.

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elexxion

Quick, effective and low-pain—the new diode laser Elexxion claros nano

The medical technology company elexxion AG, located in Radolfzell, is a specialist in the development, production and distribution of dental laser systems. Elexxion plans to include the introduction of its innovative diode laser claros nano at this year's IDS. The patented DPL pulse technology of claros nano simplifies treatments both for dentists and their patients. In the smallest space elexxion has combined the ultra-short pulse duration of 16 µs with safety and easy handling. The pauses this creates give the tissue time to recover from the thermal impact and thus minimise the heat damage to the tissue. The interaction of high pulse

power and short pulses enables the physicians to work more quickly and precisely. The patient benefits especially from the gentle, effective and conservative incision. Briefly: from a painless treatment. Simultaneously, the patented pulse engi-



The little nano can be installed at the workplace with very little effort.

neering prevents the tissue from carbonising and, hence, shortens the healing time. The Elexxion claros nano can be used for a wide variety of appli-

cations in soft tissue. It is also suitable for surgical interventions such as biopsies, frenectomies, removal of fibromas as well as for cosmetic applications, root canal decontamination and periodontosis treatments. With optional applicators laser bleaching is also possible. Despite this large spectrum of applications, in the eyes of many dentists the laser is still a luxury instrument. The new reasonably priced product line claros nano should help dentists lose this prejudice. The claros nano, like all the other products made by elexxion, is available immediately in Germany and Austria exclusively through the sales partner Pluradent.

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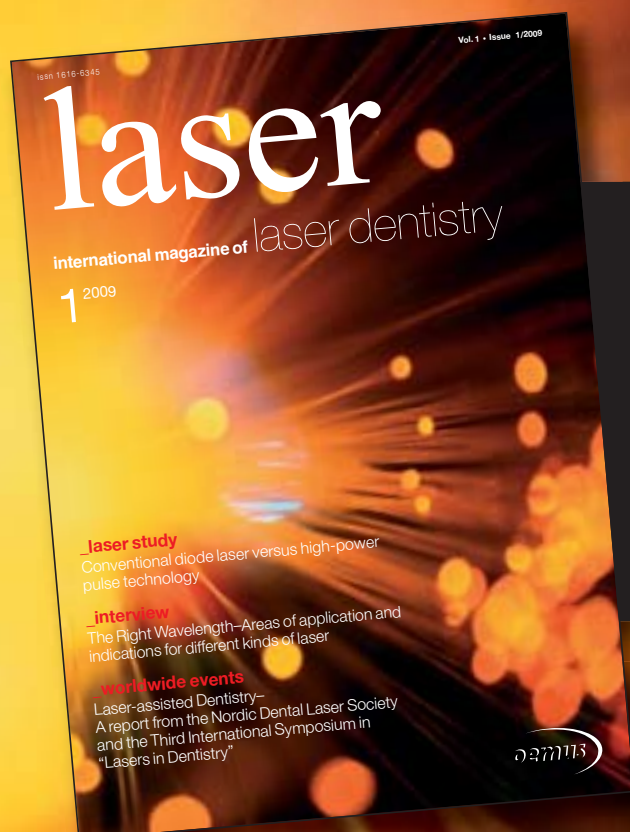
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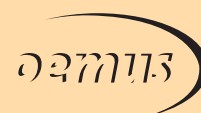
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