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# laser

## international magazine of laser dentistry

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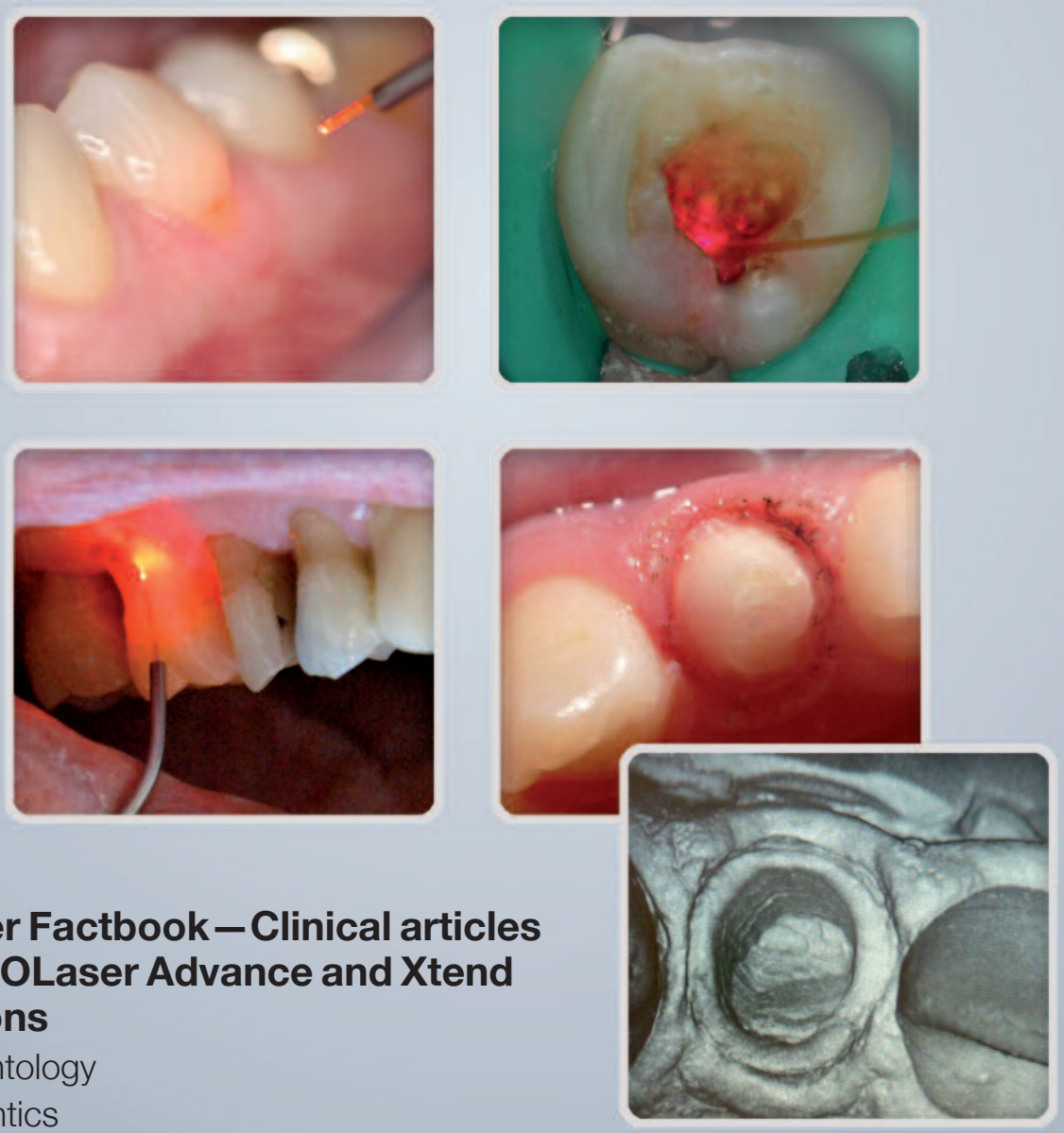

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- Periodontology
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# GREETING

Prof. Dr Roland Frankenberger

## Dear colleagues,

As the President of the German Society of Conservative Dentistry (Deutsche Gesellschaft für Zahnerhaltung; DGZ), I am delighted to have the opportunity of writing a small foreword for this edition.

Let me be honest: For years, "laser dentistry" was a double-edged sword. On the one hand, there are few instruments that symbolize modernity and innovation in the field of dentistry more than the laser. When patients see the bright yellow sign outside the treatment room stating "Caution—Laser in Use", they immediately know that the practice does not work with outdated instruments or "lightsabers". Sometimes, however, the "laser world" seemed to be slightly strange to me because you belonged to a sworn society, which, admittedly, sometimes promised more than it was able to keep. In 1992, during a presentation, I heard for the first time that, thanks to lasers, we would no longer have to pick up a curette for periodontal treatment. In addition to that, for decades, laser systems were simply too expensive.

That has changed completely. Nowadays, "laser dentistry" is scientifically recognized, our study group publishes articles, e.g. in top journals such as "Lasers in Medical Science". Compared to earlier years, the financial situation has significantly eased. I am very happy to say that Prof. Dr Andreas Braun, an internationally recognized scientist from the area of "laser dentistry", is part of my team. This has almost turned us in the conservative dentistry branch in Marburg into a "laser department".

This journal shows you the possibilities and the limits of a 970 nm laser in the field of dentistry. As a dentist in conservative dentistry, I am particularly happy about the fact that a great number of interesting aspects of daily work is revealed and that the topic 'laser' is conveyed objectively, but with enthusiasm.

I hope you enjoy reading this issue.

With kind regards,

Prof. Dr Roland Frankenberger

# EDITORIAL

Prof. Dr Andreas Braun

## Dear colleagues,

Ongoing research means that all medical disciplines are subject to continuous change. As such, new findings and treatment strategies in the field of dentistry can and should also be integrated into efficient treatment concepts which meet the needs of contemporary dental care. However, it should not be assumed today that the findings from yesterday are no longer valid and that the latest therapy methods are inevitably better. Modern and patient-oriented treatment demands careful consideration based on the most recent research reports.

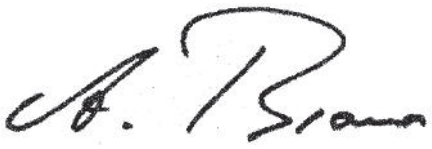
Systems based on laser technology are generally used for a wide range of dental treatments in the oral cavity. For example, the laser-based removal of caries is described. Since, in contrast to a conventional drill, there are no mechanical vibrations, this kind of treatment is relatively pain-free compared to the traditional treatment method. The laser also represents an alternative to the use of formocresol for pulpotomy in deciduous teeth. In terms of caries detection, fluorescence-based techniques involving either probe or camera systems have become established. With respect to endodontics, both thermal and non-thermal laser-based treatment techniques are employed. For example, more than 95 per cent of endodontic microorganisms can be eliminated via a correctly performed chemo-mechanical root canal preparation. A combination of chemo-mechanical treatment and laser application can, however, in certain cases, result in an additional reduction of microorganisms compared to conventional endodontic therapies.

When considering the potential dental indications for laser technologies, it must also be taken into account that not all application areas can be covered by a single laser. This limitation is due to the fact that a number of different wavelengths are required for the specific therapeutic and diagnostic indications; these wavelengths are absorbed to differing extents by the radiated tissue in each case. The wish for a truly multi-indicative laser system for dentistry therefore remains, for the time being at least, unfulfilled. However, the latest research results are promising.

The 970 nm diode laser which is the focus of this issue covers a wide range of dental indications. These include incisions/excisions as part of gingivectomy, gingivoplasty, implant exposure and the removal of tissue changes (e.g., fibromas and epulis). The coagulating, hemostatic effect is also used to advantage here. In light of the growing resistance to antibiotics, laser-induced germ reduction as a supporting measure for periodontal, peri-implant or endodontic treatment measures can restrict the adjunctive administration of medication with an antibiotic effect to cases which would otherwise be impossible to solve. Adjunctive treatment in the case of oral ulcers is also described and is linked to a reduction in pain and accelerated healing.

The following articles describe the application and treatment options when using a 970 nm laser for dentistry. The articles chosen cover both daily and less frequent dental treatments and, in particular, focus on new treatment strategies in combination with conventional techniques. The treatment measures described may be a possible source of new ideas for day-to-day work at the practice and result in the closer integration of pioneering technology in our discipline.

With kind regards,



Prof. Dr Andreas Braun

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# CONTENT

# Germ reduction during endodontic treatment of a geminated tooth with a 970 nm laser

Prof. Dr Andreas Braun
Dr Matthias Johannes Roggendorf
Prof. Dr Roland Frankenberger

**ABSTRACT**
Failures in the context of endodontic treatment can usually be attributed to inadequate germ reduction, including with untreated root canal sections. Therefore, effective germ elimination during endodontic therapy is absolutely necessary. The entirety of the preparatory procedures for the root canal prior to placement of a filling is referred to as chemomechanical preparation of the root canal. Root canal rinsing is an essential part of this treatment phase since mechanical preparation of the root canals alone does not normally result in adequate germ elimination. Since, up to now, it has usually not been possible to eliminate all germs in the root canal, adjunctive antimicrobial procedures can be expediently integrated in an endodontic treatment concept.
This case describes the endodontic treatment of a geminated tooth (12) with apical periodontitis and partial pulpal necrosis. A microbiological germ analysis shows the adjunctive antimicrobial effect of the 970 nm laser. Thanks to enhanced germ reduction, it can be assumed that the chances of preserving the tooth are improved. A planned surgical procedure within the scope of a treatment plan to improve the initial morphological situation for healing could possibly be avoided.

**KEYWORDS**
Diode laser, 970 nm, pulpal necrosis, apical periodontitis, microbiology, geminated tooth

## Introduction

Effective germ elimination during endodontic treatment is absolutely necessary[1,2] because treatment failure can often be attributed to the inadequate reduction of germs. The bacterial flora in endodontic infections is related to the flora in the oral cavity and has a bacterial population of between 102 and 107 different germs per infected root canal.[3] Since mechanical preparation of the root canal alone usually does not result in the sufficient elimination of germs, chemical disinfection of the root canal is an essential part of the work phase to be carried out before the root canal filling, which is referred to as a whole as chemomechanical preparation of the root canal. In the process, over 95% of the microorganisms in the endodontium can be eliminated.[4] Even though many methods and rinse solutions for chemical preparation are available, sodium hypochlorite in a concentration of 0.5–5 % is still recommended as the first choice. In order to further improve germ reduction in the root canal, adjuvant antimicrobial procedures may also be used. This includes the use of laser energy, which can be performed athermally (e.g., as part of photodynamic therapy) or thermally. The antimicrobial properties of laser systems such as the diode laser are principally based on thermal effects. In this regard, a 980 nm laser is ascribed as having an antibacterial effect which can be demonstrated up to the depth of dental hard tissue.[5]

**Fig. 1:** X-ray of tooth 12 before treatment. A geminated tooth with two distinctive root structures is evident. Furthermore, internal resorption was suspected. – **Fig. 2:** Clinical picture of tooth 12 after systemic antibiosis by the previous dentist. The vestibular view does not show any signs of an endodontic-related acute inflammatory event. – **Fig. 3:** Clinical picture of tooth 12 from palatal. The partially irregular morphology of the tooth crown indicates the formation of a geminated tooth.

## Case report

On May 6, 2013, a 12-years old-female patient came to the Department of Operative Dentistry and Endodontology at the Medical Center for Dental, Oral and Maxillofacial Sciences of the University Hospital of Gießen and Marburg in Marburg, Germany. She had been complaining of swelling on the right side of the face for four weeks, which subsided after being treated systemically with antibiotics by her regular dentist. Furthermore, the referring dental practitioner reported that tooth 12 exhibited grade II mobility and a distal probe depth of 7 mm with secretion discharge. The X-ray taken in the dental practice showed tooth 12 to be geminated with two distinctive root structures (Fig. 1).

Furthermore, internal resorption was suspected. There was no historical evidence to indicate a past trauma; however, the regular dentist reported that a mesiodens had been removed in 2007, without elaborating further on the surgery performed. In a follow-up appointment on April 9, 2013, no clinical symptoms or mobility of tooth 12 were reported (Figs. 2 and 3).

Since, despite a positive sensitivity test, an apical translucency in the apical area of the mesial part of the root was visible on the X-ray, pulpal necrosis in combination with chronic pulpitis of the distal part was diagnosed because it had to be assumed that the pulp chamber of the mesial and distal root canal opened into the same coronal pulp chamber.

Prior to the procedure, the different treatment options were discussed with the parents and the young patient. Due to the suspicion of internal resorption and the apical lesion on the mesial root, the prognosis following conventional root canal treatment was assessed as only partially successful. Root canal treatment with subsequent surgical resection of the mesial part of the root and curettage of the apical granulation tissue[6] was stated as the classic treatment recommendation in order to handle the chronic inflammatory event at this point. In addition, classic root canal treatment with adjunctive laser irradiation of the inner canal walls was addressed. The thermal effect of the laser could also have an impact on the large apical mesial lesion, so that the secondary surgical procedure may not be necessary. Given that with this treatment approach impairment of possible subsequent resection of the mesial root was not expected, the parents together with their daughter chose this option.

After infiltration anesthesia of tooth 12 with Ultracain D-S 1 : 200.000 (Sanofi-Aventis, Frankfurt/Main, Germany), trepanation and exposure of the coronal pulp cavity was performed employing a rubber dam. Tissue with a strong blood supply in the distal and necrotic tissue in the mesial root canal was ascertained as the trepanation finding (Fig. 4).

Thus, the suspected clinical diagnosis was confirmed. After removal of the root canals (Fig. 5), coronal enlargement of the canal openings was performed with Gates-Glidden drills using the step-down technique and endometric determination of the canal lengths.

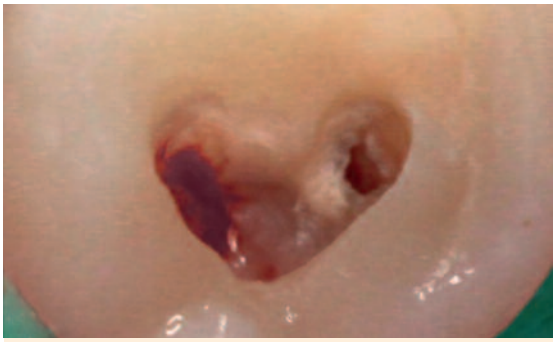

**Fig. 4:** Trepanation finding after opening the pulp cavity. Tissue with a strong blood supply in the distal and necrotic tissue in the mesial root canal.

Due to the suspicion of an irregular canal pathway, a silver point image was produced with the previously electronically determined lengths (Fig. 6).

Chemomechanical preparation of the root canals followed using hand instruments of up to ISO size 35 and the subsequent step-back technique with 1 mm increments up to ISO size 50 and regular rinsing with a 2.65 % solution of sodium hypochlorite. Afterwards, the canals were filled with a paste containing a glucocorticoid and an antibiotic (Ledermix, Riemser, Greifswald, Germany) since this compound is known to have antiresorptive properties.[7]

At the following treatment session, the two root canals looked different after removing the temporary protective filling. While there were no noticeable problems distally, mesially there was slight blood and secretion discharge. After rinsing the canal system with a 2.65 % solution of sodium hypochlorite, a microbiological sample was taken using sterile paper points. Laser irradiation of the inner canal walls was then carried out for one minute each by moving a laser fiber from an apical to coronal direction. For this, the class IV SIROLaser Advance (Sirona, Bensheim, Germany) 970 nm

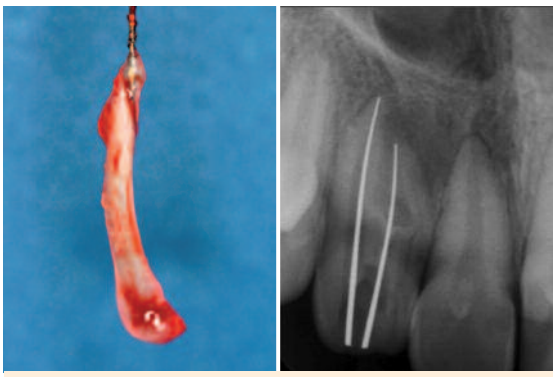

**Fig. 5:** Removed pulp tissue from the sensitive distal root canal of tooth 12. – **Fig. 6:** Silver point image for radiologically assisted determination of root length and canal pathway.

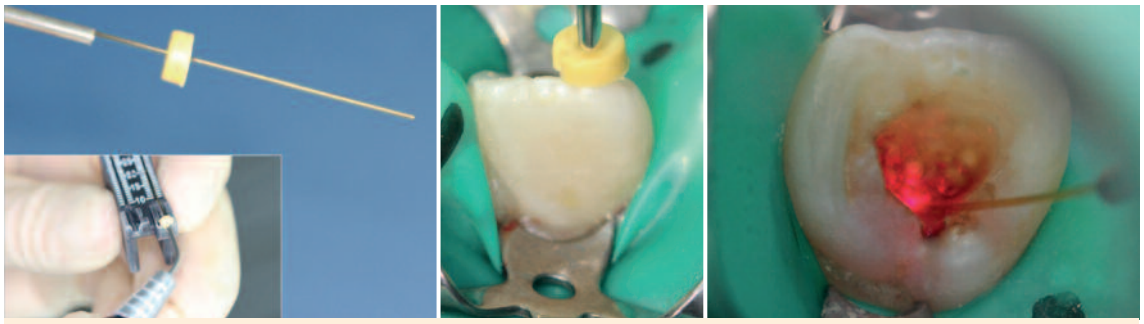

**Fig. 7:** Use of a silicone stopper to mark the working length of the laser fiber in the root canal. – **Fig. 8:** Clinical picture of the laser fiber inserted into the root canal along its complete working length. – **Fig. 9:** Laser irradiation of the inner canal walls for 1 minute per canal with a laser fiber from an apical to coronal direction.

diode laser was used with software version 2.0.6 and the dental team was equipped with the appropriate laser protective glasses for the 970 nm wavelength. The treatment room was designated as a laser workplace from the outside. In addition, a warning light was activated which was located at the entrance door to the treatment area. For the reduction of germs in the root canal, the manufacturer recommends a setting of 1.5 W with pulsed frequency (PF), a duty cycle of 50% and a frequency of 15 Hz. However, since in this case, an adjunctive effect on the healing of the apical lesion was intended, the presetting "gangrene treatment" was selected which has a setting of 3 W with a pulsed frequency (PF), a duty cycle of 50 % and a frequency of 20 Hz. The handpiece was used with a 200 µm (core diameter) fiber and was activated via the finger switch (Figs. 7–9).

Following final rinsing with a sterile physiological saline solution, another microbiological sample was taken with sterile paper points (Figs. 10 and 11).

In addition, another temporary obturation was carried out after filling the canal walls with the glucocorticoid/antibiotic paste and filling the canal lumen with a $Ca(OH)_2$ paste (Ultra-Cal, Ultradent, Cologne, Germany).

The microbiological analysis of the canals using a real-time PCR procedure resulted in a total bacterial count of $7.3 \times 10^3$ mesially and $4.2 \times 10^3$ distally after rinsing with sodium hypochlorite. After subsequent laser irradiation, no further bacteria could be detected in either of the two canals.

During the final treatment session, no blood or secretion discharge from the canal system was observed after removal of the temporary root canal dressing. A suspected resorption lacuna in the middle area of the mesial canal on the basis of the radiological image was not clinically evident during probing of the canal walls. Therefore, a gutta-percha root canal filling was carried out with vertical and horizontal condensation using the MTA Fillapex sealer based on a mineral trioxide aggregate (Angelus, Londrina, Brazil) without a thermoplastic root filling technique. After a radiological check-up of the root filling (Fig. 12), the root canal openings were sealed (SDR, DENTSPLY DeTrey, Constance, Germany) with an adhesive technique (AdheSE, Ivoclar Vivadent, Schaan,

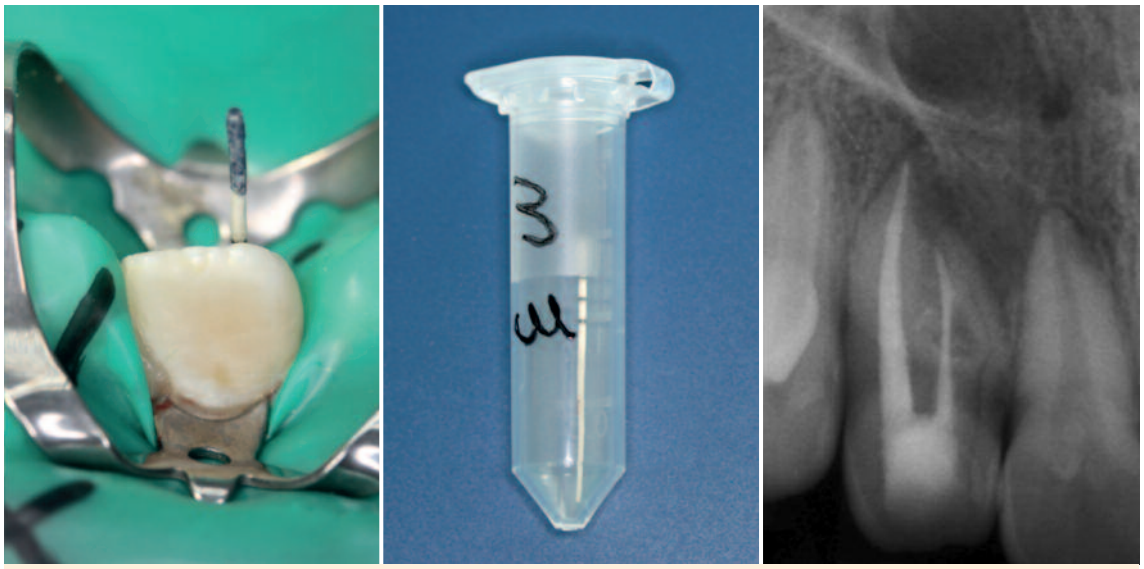

**Fig. 10:** Microbiological sampling after laser irradiation of the inner canal walls with a sterile paper point. – **Fig. 11:** Paper point prepared for transporting for real-time PCR analysis after removal from the treated root canal system. – **Fig. 12:** Follow-up X-ray image after root canal filling. Compared to the original image, a tendential decrease in the apical change is noticeable.

Liechtenstein) and the trepanation cavity was filled with a nano-filled composite resin (GrandioSO, VOCO, Cuxhaven, Germany).

A non-physiological mobility grade and increased probing depth could no longer be determined at this point. A comparison of the original X-ray image with the follow-up image after root canal filling showed a tendential decrease in size of the mesial apical change. However, additional follow-up check-ups are needed to assess the long-term success of the endodontic treatment carried out. If clinical symptoms of a chronic or acute inflammation appear or the radiological noticeable changes become larger in the course of follow-up sessions, implementation of the original treatment plan with surgical resection of the mesial part of the root should be considered. Under normal circumstances, the next follow-up is scheduled for three months time.

## Concluding remarks

In addition to shaping the root canal system, the goal of chemomechanical root canal preparation is the extensive elimination of germs from the canal system. Conventional rinse protocols are effective; however, the elimination of germs can be further enhanced with a diode laser.[8] Based on this observation, adjunctive diode laser irradiation was used in this case to achieve extensive disinfection of the canal system and possibly also the adjacent structures involved in order to forego surgical intervention. To this end, additional germ reduction could be confirmed by means of a microbiological analysis. The absence of indications of chronic or acute signs of inflammation as well as the slight decrease in the radiologically identifiable apical lesion confirms the chosen treatment approach. Nevertheless, the findings are subject to the follow-up check-ups in order to assess the long-term success of the treatment.

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# Use of a 970 nm laser for removal of a retromolar mucous membrane change

Prof. Dr Andreas Braun
Dr Matthias Johannes Roggendorf
Prof. Dr Roland Frankenberger

**ABSTRACT**
Depending on the laser parameter setting, a 970 nm diode laser can be used for coagulating cutting and the removal of oral soft tissue. This procedure is ascribed as offering an essentially blood-free surgical area and reducing the bacteremia risk. In this case report, the excision of a retromolar mucous membrane change, the subsequent healing process and the histological assessment of the removed tissue are described. The histological findings of the removed tissue were consistent with an irritation fibroma. The healing process was without irritation, discomfort and pronounced pain sensations for the patient. The blood-free working area allows the practitioner to work in a carefully controlled manner when removing mucous membrane changes without compromising the histological preparation of the tissue. This treatment method is very well accepted by patients as a suture is not required and there are virtually no post-treatment complaints.

**KEYWORDS**
Diode laser, 970 nm, mucous membrane, irritation fibroma, excision, pathology

## Introduction

Dental laser systems are currently used for a wide range of different treatment methods. These include the surgical removal of pathologically changed tissue[1], the incision of soft tissue, biopsies and gingivectomies[2], frenectomies[3] as well as various periodontal treatment techniques.[4] The use of lasers is also described for the processing of dental hard tissue[5] and, indeed, laser treatments are ascribed as being almost painless as the mechanical vibrations associated with conventional treatment methods do not occur.[6] Depending on the laser type and the laser parameters set, the systems (e.g., $CO_2$ laser, Nd:YAG laser, diode laser) can be used for coagulating cutting or the removal of oral soft tissue.[7] Such techniques are ascribed as offering an essentially blood-free surgical area and reducing the bacterial colonization of periodontal lesions.[8,9] In this context, the bacteremia risk can also be reduced with the following treatment steps. As a rule, the antimicrobial effect of laser energy can be achieved athermally (e.g., as part of photodynamic treatment) or thermally. The antimicrobial properties of laser systems such as the diode laser are principally based on thermal effects. A 980 nm laser is ascribed as having an antibacterial effect which can be demonstrated into the depths of dental hard tissue.[10]


**Fig. 1:** SIROLaser Advance 970 nm diode laser. Laser parameters for various treatment stages can be selected from presettings and can also be individually adjusted.

## Case report

On March 6, 2013, a 48-year-old female patient presented at the Medical Center for Dental, Oral and Maxillofacial Sciences with a lentil-sized retromolar mucous membrane change in the palatoglossal arch region. The change was noted for the first time a few weeks before. After visiting her standard dentist, a suspected irritation fibroma was diagnosed and photo documentation was made in order to record any changes in the size and surface structure and also the reaction of the adjacent tissue. Although there were no discernible changes over the two-week monitoring period, the patient still expressed the wish to have the tissue removed. The patient stressed that she was very sensitive to pain and was afraid of the possibility of postoperative hemorrhaging following the surgical removal of the tissue. In order to accommodate the patient's concerns, in addition to conventional removal with a blade and subsequent suture, the use of a laser system was

**Fig. 2:** Patient wearing eye protection prior to the start of treatment. The laser protective glasses cover the operating wavelength range of 970 nm.

also offered. With this treatment method it could be assumed that a suture would not be necessary given the coagulating effect of the laser. Moreover, based on experience to date in connection with the use of lasers on patients, only very little to no sensation of pain has been reported. The SIROLaser Advance (Sirona, Bensheim, Germany), a 970 nm Class IV diode laser, with software version 2.0.6 was used for removal of the newly formed tissue. For the excision of tissue, for example the excision of a fibroma, a setting of 6 W with pulse frequency (PF), a duty cycle of 50 % and a frequency of 10 Hz are recommended by the manufacturer. As in this case there was no reliable diagnosis and the subsequently planned histological examination of the removed tissue was not to be impaired by heat necrosis, the presetting "Gingivectomy" was selected which specifies a setting of 3 W in CW and a resulting duty cycle of 100 %. The handpiece was used with a 200 µm (core diameter) fiber and was activated via the finger switch. As there were nothing of note in the patient's general medical history, Ultracain D-S 1:200 000 (Sanofi-Aventis, Frankfurt/Main, Germany) was used as the local anesthetic and, in total, 1.2 ml was infiltrated around the tissue to be removed. Following inspection of the anesthetic using a sharp probe in the surgical area, the patient and surgical team all put on protective glasses suitable for a wavelength of 970 nm. The treatment room was designated as a laser workplace from the outside. In addition, a warning light was activated which was located at the entrance door to the treatment area. The tissue to be removed was then excised after being grasped using surgical forceps. The fiber was guided circularly and vertically around and into the depths of the tissue. By pulling gently with the surgical forceps, it was possible to separate the tissue horizontally at a depth. Given the coagulating effect of the laser, there was no acute bleeding which would have required a suture. The wound area was rinsed with physiological saline solution to clean and moisten the treated tissue. The removed tissue was transferred to a prepared vessel with formalin and sent directly to the Institute for Pathology at the Gießen and Marburg University Hospital, Marburg, Germany, for histological examination. The wound area was covered with Solcoseryl Dental Adhesive Paste (Valeant Pharmaceuticals, Bad Homburg, Germany). The patient was advised to protect the surgical area as far as possible. Furthermore, she was also given the option of taking a

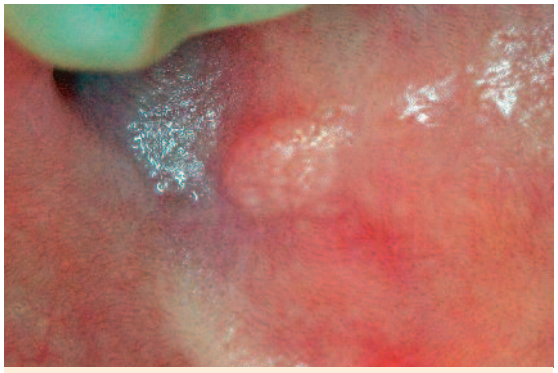

**Fig. 3:** Initial situation prior to the surgical intervention. Lentil-sized retromolar mucous membrane change in the palatoglossal arch.

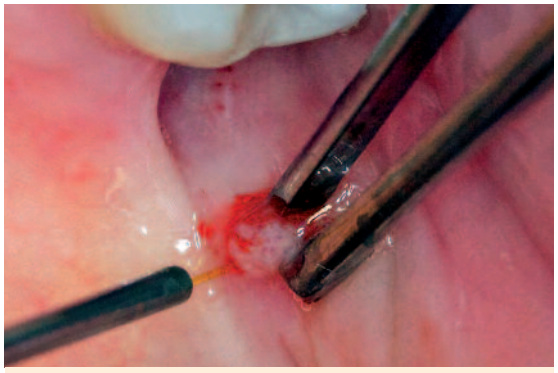

**Fig. 4:** Fixation of the tissue to be removed using surgical forceps and positioning of the approach at the base of the tissue change.

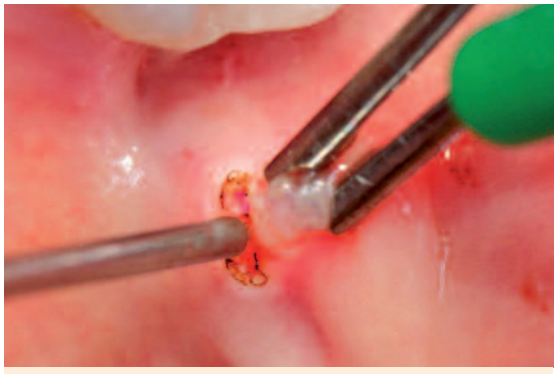

**Fig. 5:** Incision vertically to the tissue surface with the tissue change grasped using forceps.

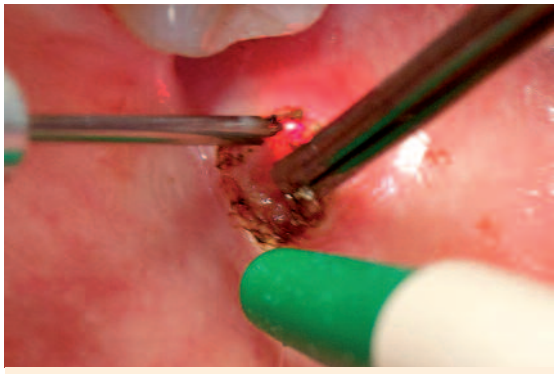

**Fig. 6:** Incision which runs horizontally to the tissue surface with the working fiber for complete excision of the changed tissue.

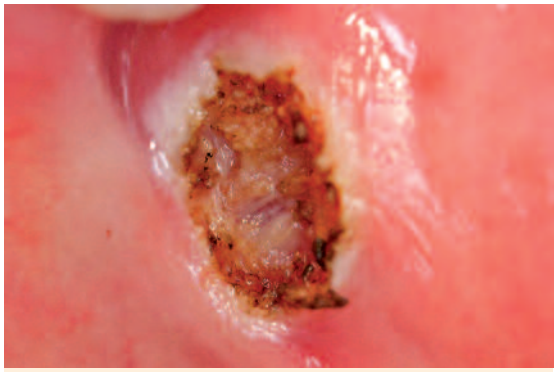

**Fig. 7:** Postoperative situation following complete excision of the tissue change. Thanks to the coagulating effect of the laser, no acute bleeding can be seen.

**Fig. 8:** Rinsing of the surgical area using physiological saline solution to clean and moisten the treated tissue.

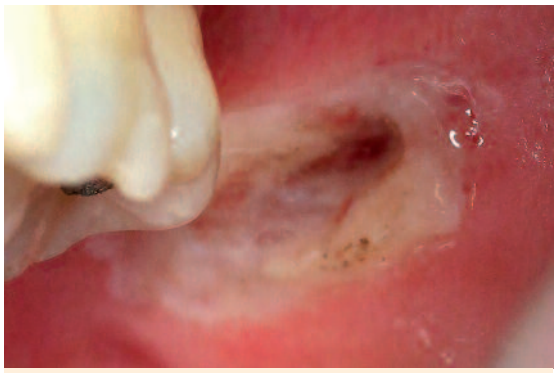

**Fig. 9:** Inspection of the wound two days after the intervention. Irritation-free wound area with the expected fibrin coating. No signs of postoperative hemorrhaging in the area from which the tissue was removed.

pain tablet should she experience pain once the anesthetic had worn off. She was told, as far as possible, to avoid eating whilst the anesthetic was still effective in order to prevent unchecked biting into the oral mucosa. The patient was requested to return for routine wound checks two and nine days after the intervention. This allowed an irritation-free wound area with the expected fibrin coating to be recorded. In the area from which the tissue had been removed, the patient could feel a discernible recess which did not impede the intake of food. There was no postoperative hemorrhaging and this was also not observed by the patient. The findings report issued by the Institute for Pathology describes the tissue removed following HE (hematoxylin-eosin) and PAS (periodic

**Fig. 10:** Histological preparation of the tissue change. Tumor-free oral mucosa with the general findings of an irritation fibroma (original magnification 1 : 80).

acid-Schiff) staining: Tumor-free oral mucosa with slight epithelial hyperplasia and focal mild parakeratosis, fiber-increased stroma, normal mucosal gland sections at depth. Overall, the findings are consistent with an irritation fibroma. Wound inspection continued for a period of two months after the intervention. At this point in time, the wound was fully healed and the recess which was discernible immediately after removal could no longer be felt and there were no signs to indicate the formation of new tissue. There was neither visually pronounced scarring nor scarring which could be discerned when eating. The patient reported feeling a burning sensation in the area from which the tissue had been removed during healing. This sensation rescinded continually and could not be described as very painful at any time. A further inspection was carried out after six months as part of a routine dental check-up.

## Concluding remarks

Laser systems can be used in a variety of ways for dental treatments. In most cases, this technology offers similar results to those achieved with conventional methods. In this case, the indication for use of the laser system was further supported by the patient's wishes: If a patient states that he is very sensitive to pain, a method should be chosen with which there is little risk of postoperative hemorrhaging and where a suture is not absolutely necessary[11] in order to avoid a second intervention to remove the suture. Furthermore, it must also be possible to acquire a tissue preparation which can be assessed histologically which enables a reliable diagnosis of new tissue formation to be made. In this case, all the require-

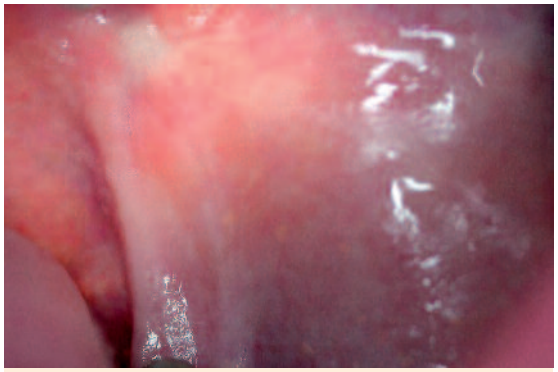

**Fig. 11:** Inspection of the wound two months after the intervention. Completely healed wound area without visible scar formation, no signs of the formation of new tissue.

ments for the use of a 970 nm diode laser for the surgical intervention were satisfied. This method thus complements conventional techniques for tissue removal and enables, subject to correct use, histological examinations of the tissue samples removed to be made.

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# Pulpotomy and the treatment of dentin hypersensitivity with a 970 nm diode laser

Jesko Gärtner

**ABSTRACT**
This article presents two indications for laser treatment which rarely occur in the dental practice: The desensitization of dentin hypersensitivity and pulpotomy. Pulpotomy refers to the removal of the coronal pulp while preserving the vital radicular pulp, an indication that is mainly limited to pediatric dentistry. This applies to the exposed pulp of primary teeth that has suffered traumatic injury or been damaged by deep caries, as well as that of not fully developed permanent teeth. The former, in particular, are subjected to this treatment because a pulpectomy with subsequent endodontic treatment of the primary tooth is problematic; in the latter, the tooth has a chance to develop fully through the remaining radicular pulp. In the following, pulpotomy is discussed within the context of the endodontic treatment of 60 teeth in the pediatric dental practice and their clinical recovery. Hypersensitivity among the patients of every dentist is prevalent in both sexes and is experienced as severe, sharp pain after chemical or tactile stimulation of the tooth. The causative factors are assumed to be overreaction and misinterpretation of these stimuli with regard to the healthy tooth. The formation of the main defects on the affected teeth is multifactorial—this may be causally related to the occurrence of erosive, mechanical or abrasive processes.[1,24] Today, these reactions are explained via the displacement model of the fluid in the dentinal tubules. The cervical region of canines and premolars are the most affected. Until now, the treatment of hypersensitivity was done with active ingredients, like nitrates and fluorides.[2] This paper shows the management and results in the treatment of hypersensitivity, which are based on the treatment of these patients with a diode laser (SIROLaser Advance). The procedure was done on 47 teeth in 16 patients with a significant reduction in pain. In addition to professional dental treatment, changes in oral hygiene at home need to be discussed with the patient, appropriate tools have to be provided and understandable instructions given.

**KEYWORDS**
Diode laser, SIROLaser, 970 nm, pulpotomy, dentin hypersensitivity

## Introduction

*Pulpotomy*

Primary teeth should be preserved as long as possible until their physiological loss in order to ensure chewing function and normal bite development as well as for phonetic and esthetic reasons.[3] In the case of deep caries, endodontic treatment is often necessary if indirect capping is not possible. Indications are:

– No pain or mild pain
– No more than one third of the root is resorbed
– Restoration of the tooth must be possible
– Vitality of the remaining radicular pulp
– Immobility of the tooth.

The pulpectomy on the primary tooth is limited due to different factors:[4]

– Duration of treatment
– Condition of root canal is difficult to determine
– Damage to the successional tooth germ due to over instrumentation. Overpacking or transferring infected material beyond the apex
– Root filling material often withstands physiological resorption
– Danger of fracture gracile roots.

Thus, if possible, the aim should be only partial amputation of the pulp.

The long-term preservation of a permanent tooth is only possible if it has a proper crown-to-root ratio and the dentin walls are sufficiently stable to ensure normal function. After endodontic treatment of carious, young permanent teeth with not yet fully developed roots, apexogenesis and normal root development is only possible if the radicular part of the pulp remains intact.[5] Also in this case, a partial pulpotomy is to be performed in the caries profunda treatment with vital pulp or reversible pulpitis if the pulp chamber was opened and indirect pulp capping is not possible. After opening the pulp chamber and its partial removal, hemostasis is crucial; the bleeding should stop within a few minutes. On the one hand, coagulation at the amputation site promotes inflammation, prevents the formation of a hard tissue bridge and facilitates internal resorption processes leading to pulp necrosis; on the other hand, prolonged bleeding indicates inflammatory changes in the


**Fig. 1:** SIROLaser Xtend and SIROLaser Advance.

pulp. Amputation of the coronal pulp is often performed with diamond instruments under water cooling. Along with formocresol as a pulpotomy medicament, which is a potential mutagen[6], electrosurgical devices[7], ferrous sulfate[8] and lasers are also used due to their hemostatic effect. The first applications of laser in pulpotomies were with the $CO_2$[9], Nd:YAG[10] and Er:YAG lasers[11]. The 980 nm diode laser was also the subject of a randomized split mouth study by Saltzman et al.[12], in which a conventional formocresol-zinc oxide eugenol pulpotomy was compared to a diode laser pulpotomy with mineral trioxide aggregate (MTA). The study showed that in a 15-month observation period both methods were equivalent.

*Desensitization of dentin hypersensitivity*

Despite the large number of patients with dentin hypersensitivity, there is relatively little understanding of the clinical conditions. Nevertheless, the prevalence of this condition continues to increase. This can be attributed to the overall improvement in oral health, which means that patients retain their own teeth for a much longer time and to a greater extent. In current studies, a prevalence of up to 57 % is given for dentin hypersensitivity without periodontal diseases. In patients with periodontal diseases of different etiology, the figures are 60 to 98 %.[13] The most frequently affected patients are between the ages of 23 to 55—middle-aged patients. The discomfort that patients with dentin hypersensitivity experience on a daily basis often results in limited oral hygiene in order to prevent the stimulation of pain. Successful treatment depends on eliminating the causal factors to the greatest extent possible, in order to make good and successful oral hygiene possible again as an important component of an efficient prophylaxis against this condition.[14] According to the current state of studies in this area, there are no long-term satisfactory treatment approaches available.

The dentin surfaces of the buccal portion of the tooth in healthy tissue are covered with tooth enamel or cement and there is no dentin hypersensitivity. Recession, abrasion, erosion, attrition or habit results in the removal of the protective structures and exposure of the hypersensitive tooth. Patients describe the pain after physical, tactile or chemical stimulation as short, severe and sharp.[13,15] In terms of intensity, manifestation and characteristics, there is no similarity to the sensation of pain of other diseases—in addition, the pain is not related in any way to a prosthetic restoration or carious lesions. An accepted explanation of the causes of dentin hypersensitivity is Brannström's theory that movement of the fluid in the dentinal tubules occurs due to a chemical, osmotic, physical or mechanical stimulus. This mechanism activates the pain fibers in the tooth pulp.[16,17,18] However, the exact physiological mechanisms in the pulp are not conclusively known and have not been fully assessed. A decisive factor is certainly the number of dentinal tubules in the affected area. Despite undergoing treatment for dentin hypersensitivity by means of closing the dentinal tubules, the patients are often not pain free; as an extension of Brannström's theory, this

**Fig. 2:** First premolar with exposed dentin.

means that inflammatory processes of the tooth pulp also play an important role. Nevertheless, the existence of bacteria is not the primary factor.[14]

Besides the aforementioned reasons for dentin hypersensitivity, other factors may also play a significant role. Wedge-shaped defects resulting from incorrect brushing techniques accompanied by up to 90 % dentin hypersensitivity, bleaching, uneven loading and inadequate restoration need to be checked in order to make a reliable diagnosis. Overall, there are multiple factors contributing to dentin hypersensitivity. Along with a reliable diagnosis and elimination of patient-related risk factors, clinical management of dentin hypersensitivity must interrupt the hydrodynamic mechanism and reduce tooth pulp inflammation.[19] For some time now, desensitizers have been used to close the dentinal tubules. These materials include primer systems, dentin adhesives and toothpastes. In addition, the treatment approaches pursued are soft tissue management, fillings and, as a last resort, endodontic restoration of the tooth.

Criteria for these desensitizers and treatment approaches according to Grassmann (1935) and Renton-Horpes (1992) that are valid even today are:[16,17,18]

– No pulp irritation
– No soft tissue irritation
– Painless application
– Uncomplicated handling
– Quick effect
– Adequate and long-lasting effect
– No side effects.

No known substance can meet all these requirements—mainly the criteria of a long-lasting effect and the related freedom from pain are only partially met. The application of the materials described above has an average efficacy of 4 weeks. Consequently, only an acute relief of the clinical situation can be achieved, but no long-term improvement. The further development of toothpastes with additives such as nitrates and bio-glass will have to be observed in the future. These additives have the potential of providing the patient with significant advances in the way of aids for oral hygiene at home.

In modern dentistry, laser can offer great support as a technology in the treatment of dentin hypersensitivity to provide an adequate, lasting form of treatment. It can be used with or without topical applicators. Many studies have clearly elaborated that the long-term effects of laser light irradiation are superior to previously used treatment mechanisms. Due to the complexity of the laser treatment, it must be professionally done and only by a dentist. It is imperative to notice the different interactions of the tissue structures as well as the biophysiological tissue changes depending on the wavelength and kind of laser (active medium).

Use of a low level laser (diode laser) creates inhibition of cyclooxygenase, biostimulation linked to the additional ATP synthesis and pain relief.[20,21] Irradiation with a diode laser with a power output setting of up to 60 mW does not result in any morphological surface changes of the dentin structures.[16,17,18] In contrast, a middle output laser (Nd:YAG, Er:YAG or $CO_2$ laser) causes morphological changes in hard tissue. A therapeutic effect with this type of irradiation is a sealing of the dentinal tubules. Nevertheless, both classes of lasers increase treatment efficacy in direct comparison to the application of different desensitizers.[16,17,18] Management of dentin hypersensitivity with a diode laser has been investigated in many studies and very good results regarding its efficacy have been confirmed. According to the present situation of studies in the area of irradiation with different laser systems, the diode is one of the best-researched forms of clinical treatment.

The treatment of the patients described in this paper was performed via irradiation with a diode laser at a wavelength of 970 nm (SIROLaser Advance, Sirona) with the additional application of fluorides. In addition to biostimulation processes in the form of the bioactivation of odontoblasts for tertiary dentin formation, photobiomodulation as well as a "melting effect" takes place. This results in crystallization of the dentin and simultaneous coagulation of the fluid medium, e.g., fluoride or other desensitizers in the dentinal tubules. The rate of successful treatment is 65–98 %.[22]

No side effects in the respective treatment situations have been observed up to now.

**Fig. 3:** Tactile stimulation with a WHO periodontal probe.

## Materials and Methods

*Laser*

The SIROLaser Advance (Sirona Dental Systems, Bensheim, Germany) (Fig. 1) is an infrared diode laser with a wavelength of 970 nm and a power output of 0.5–7 W in continuous wave and pulsed mode. The frequency of the laser in pulsed mode can be set to between 1 Hz and 20,000 Hz. The duty cycle—the ratio of pulse duration to reciprocal value of the frequency setting— can be set between 1 % and 99 %. The treatment parameters of the manufacturer were selected for each treatment; the exact values can be found for the respective indications. For a pulpotomy, a 200 mm fiber was used and a fiber with a diameter of 320 µm was used for desensitization.

*Pulpotomy*

In the last four years, a pulpotomy was performed with the SIROLaser Advance on around 60 patients with primary teeth or not fully developed permanent teeth in our pediatric dental clinic (the treatment can also be done with SIROLaser Xtend). After exposing the pulp under local anesthesia, it was removed with a sterile bur; the following depuration and sterilization of the pulp area was performed with a laser with the preset parameters for pulpotomies (power output 3 W pulsed, duty cycle 50 %, frequency 5 Hz) using a laser fiber with a diameter of 200 mm in direct contact. Afterwards, the pulp was rinsed with chlorhexidine. The coagulation of the laser was sufficient, so the use of ferrous sulfate was not necessary. Care was taken for the bleeding to stop within a few minutes. Calcium hydroxide was applied to the rest of the pulp and the tooth was filled. A follow-up check took place after 7 days, 28 days and 6 months.

*Desensitization*

Treatment of the patients took place only in the dental practice of Jesko Gärtner and performed solely by him—the same applies to the stimulations before and after the treatments. The content of the treatment was the triggering of hypersensitivity through defects to the cervical region of the tooth and gingival recession of different etiology (Fig. 2). This triggered a sensation of pain via tactile or evaporative stimulations.

A total of 16 patients—10 females and 6 males—between the ages of 19 and 52 were treated. In these patients, 47 teeth were treated with the diode laser. Parallel to the treatment, the patients were asked to carry out regular and adequate oral hygiene at home. In preparation for laser irradiation, a professional dental cleaning was performed. In addition to the general oral health and oral hygiene status of the patients, the vitality of the affected teeth was determined and documented right before the investigation. The sensation of pain was reviewed and assessed by the patients in the following way:[23]

*Tactile stimulation*

For the tactile stimulation, a WHO periodontal probe (Aesculap DB 767 R, Tuttlingen, Germany) was guided in a lateral and vertical movement over the affected tooth surface (Fig. 3).

*Cold air stimulation*

After tactile stimulation, the respective tooth surfaces were blown with the air blower (maximum output) of the dental unit for 5 seconds. At the same time, the dentist covered the neighboring teeth with his fingers to avoid triggering any additional irritation; a rubber dam for isolating the area was purposely not used. All of the stimulations were performed on clean, air-dried surfaces and carried out by the same dentist. The stimulation was interrupted if there was a sensation of pain or after a maximum of 5 seconds.

The pain intensity was documented directly before and after the laser irradiation (initial value) using a numerical scale of 1 to 10 (Tab. 1). In a further control process carried out after 14 days, application of the fluid and irradiation with a diode laser was repeated and the pain sensation was documented.[24]

Application of the fluoride was carried out 30 seconds before laser irradiation.

| Numerical rating scale of pain intensity | Translation of verbal rating scale |
|---|---|
| 0 | No pain |
| 1–3 | Mild pain |
| 4–6 | Moderate pain |
| 7–9 | Severe pain |
| 10 | Intolerable pain |

**Tab. 1:** Comparison of numerical and verbal assessment.

The patient group was arranged with the following exclusion criteria:[13,25]

– Active periodontal illness
– Carious lesions on the affected teeth
– Tooth fractures
– Enamel cracks
– Regular intake of painkillers, tranquilizers or antidepressants
– Soft tissue management within the last six months.

*Course of treatment*

After the initial pain situation was documented, the exposed and pain-sensitive buccal tooth surfaces were coated with a fluoride-containing fluid and, after a wait time of 30 seconds, were treated with laser irradiation (970 nm, 500 mW, approx. 15 J/cm$^2$, cw) for 30 seconds. The irradiation was done in a non-contact procedure at a distance of 5 mm (Fig. 3). In total, each tooth was irradiated for 30 seconds at 3 intervals. Isolation of the neighboring teeth was done with cotton rolls. Following the last interval, the pain situation was diagnosed again and repeated in another inspection of this procedure after 14 days and 28 days. The entire treatment period was from July 2009 to April 2013; the longest inspection interval is 29 months.

**Fig. 4:** Irradiation of the tooth surface with SIROLaser Advance.

Parallel to laser irradiation, all the patients received individual oral hygiene instructions as well as specially selected toothbrushes (Curaprox 820 supersoft, Curaden, Kriens, Switzerland). After the last check-up, it was suggested that the patients use a soft toothbrush for the continuing oral hygiene at home (Curaprox 820 soft, Curaden, Kriens, Switzerland) and a toothpaste containing potassium nitrate (Sensivital, Sunstar, Etoy, Switzerland).

## Results

*Pulpotomy*

In the follow-up period, the pulpotomy was clinically successful in approximately 95 % of the patients, i.e., the tooth was free of symptoms and further surgery was not required.

*Desensitization*

Almost all of the patients reported a very significant improvement in their dentin hypersensitivity within the treatment period of one month. On average, the premolars and canines were most often irradiated (34 % and 32 %, respectively) in the supervised patient group. An average of 2.94 teeth was irradiated per patient. The age range of the patients was between 19 and 52. The results show differences for the pure application of desensitizers with regard to tactile as well as air stimulation—related to this, a considerably stronger therapeutic effect results than exhibited with nitrate and fluoride used as the sole application. After application of the fluoride fluid and irradiation with the diode laser, 63 % of the teeth were at pain level 0 and 27 % at level 1–2, thus the absolute reduction of dentin hypersensitivity is 91 % and in 9 % there were variable results (moderate sensation of pain: 6 %; severe sensation of pain: 2 %).

The longest monitoring period is 29 months. In these cases, there is still an improvement with a pain level of between 0 and 2.

## Discussion

*Pulpotomy*

The results of the pulpotomy performed with a diode laser (95 % success rate) are close to the values given in the literature for the Er:YAG laser (75 %) and Er,Cr:YSGG (80 %) by Olivi et al.[26] Gutknecht gives a success rate of 99 %.[27] For the Nd:YAG, Liu gives a clinical success rate of 97 %.[10]

*Desensitization*

Dentin hypersensitivity is characterized by the fact that all stimulations—which are usually not problematic on healthy tooth surfaces—trigger a sensation of pain and consequently limits oral hygiene. Due to this drawback, there is an accumulation of plaque, which also promotes periodontal deterioration and leads to a vicious cycle. Overall, dentin hypersensitivity represents a widespread problem, which requires effective treatment. In this regard, laser—also in combination with fluoride—may be an appropriate treatment. Laser light irradiation encompasses all the important criteria for successful treatment of dentin hypersensitivity: It affects cellular metabolism, triggers anti-inflammatory mechanisms and relieves pain. These effects allow an explanatory approach that leads to high effectiveness.[24] In addition, it is painless, quick, easy to use, minimally invasive (conservative) and the patient acceptance rate is excellent. Due to the multifactorial occurrence of dentin hypersensitivity, other factors like habit or occlusal components should not be disregarded. Overall, comprehensive treatment concepts will be necessary for successful treatment of these patient groups.[13] The results already demonstrate the high effectiveness of laser irradiation—also compared to the application of desensitizers.[21] In order to make an actual statement on the lasting value of these results, long-term studies are certainly necessary. In these studies, the sustainability of the results of laser irradiation needs to be examined. The benefits for the patient and the therapeutic long-term effects need to be elaborated.

In this regard, further efforts should be taken to better understand the biochemical and physiological processes as well as the formation mechanisms.

## Conclusion

The results show the high effectiveness of laser treatment and the very fast reduction of pain at the same time. This corresponds to the existing research, which currently describes the best results in the area of laser irradiation with simultaneous application of a topical fluid.[16,17,18] Generally, the results show that the response situation of the tissue structures seems to decrease with age and the tissue response to therapeutic measures diminishes between the ages of 40 and 45; at the same time, the effects of irradiation are not as strong and first occurred after the second or third irradiation session.[16,17,18]

In terms of the outlook for possible long-term studies, it is noted that the longest control period in the patient group investigated is 29 months and these patients also continue to present themselves as pain free or at a pain level of 1 to 2, thus the long-term effects of the treatment performed can evidently be established.

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# The use of a 970 nm diode laser in implantology

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**ABSTRACT**
This article summarizes the current literature on the use of diode lasers in implantology and, based on case documentation, describes the indications and applications of a newly developed diode laser (SIROLaser Advance, Sirona, Bensheim, Germany) which takes both ergonomic and clinical perspectives into account. In applications in implantology and implant prosthetics, this laser has shown itself to be consistent with previous experience with diode lasers. The various indications were treated with the infrared diode laser (970 nm). The performance parameters were set in accordance with the pre-set values in the laser.
Diode lasers can be used in a wide variety of ways, even in this dental specialty, thanks to their broad range of applications. In particular, the coagulation of vessels and the associated low postoperative bleeding combined with a good field of view and rapid healing are considerable advantages compared to conventional protocols and methods. The fine working tip of diode lasers allows very precise working; for users they represent a major improvement and, indeed, are often seen as indispensable.
The results of the treatments concur with the current scientific literature.

**KEYWORDS**
Diode laser, 970 nm, implantology, surgery, vestibuloplasty, peri-implantitis, exposure of implants, gum excision, hemostasis

## Introduction

Dental implants have fundamentally changed prosthetics in the last 25 years. In this time implants have been used both as a replacement for missing individual teeth as well as for constructing fixed partial or full dentures. The advantages compared to conventional techniques include prevention of bone loss due to a lack of loading. At the start of this millennium the number of implants inserted each year was estimated at close to one million.[1] And this figure keeps growing. The diode laser has proven itself to not only be useful but, increasingly, as indispensable in many standard procedures in implantology, supplementing the instruments in the implantology practice. In this article the use of a dental diode laser with a wavelength of 970 nm is described for the indications vestibuloplasty, exposure of implants, acceleration of treatments in implant prosthetics, and treatment of peri-implantitis.

*Vestibuloplasty*

Where the peri-implantitis is of uncertain origin, an indispensable and essential condition is a stable margin of attached gum for prevention or treatment of peri-implantitis. The implant is often in direct contact with the mobile mucosa as a result of unfavorable soft tissue/bone situations or even as a result of the surgical procedure during implantation, which must often be combined with augmentative measures and tension-free plastic coverage of the augmented site using periosteal incision. This must be eliminated to prevent peri-implantitis. If after exposure and insertion of the prosthetic abutment it is apparent that the position of the superstructure in the mobile mucosa has shifted, then the attached gum should be immediately expanded using vestibuloplasty. Vestibuloplasty is a surgical indication for the 970 nm diode laser and was described in addition to other indications. Romanos et al. report that neither bleeding nor uncontrolled pain, scar formation nor functional disorders occurred although swelling occurred in one case out of 23.[2]

*Exposure of implants*

According to Yeh et al., the use of a laser to expose implants has the following advantages compared to conventional techniques:[3] reduction in bacterial and viral secondary infections,[4] depolarization of nerves, causing less pain as a result,[5] and, not least, the hemostatic effect of laser surgery which reduces postoperative swelling.

*Accelerating treatments in implant prosthetics*

Procedures in implant prosthetics such as gum excision/reduction after conventional exposure or preparation for implant impressions are cases of “minor surgery” and were

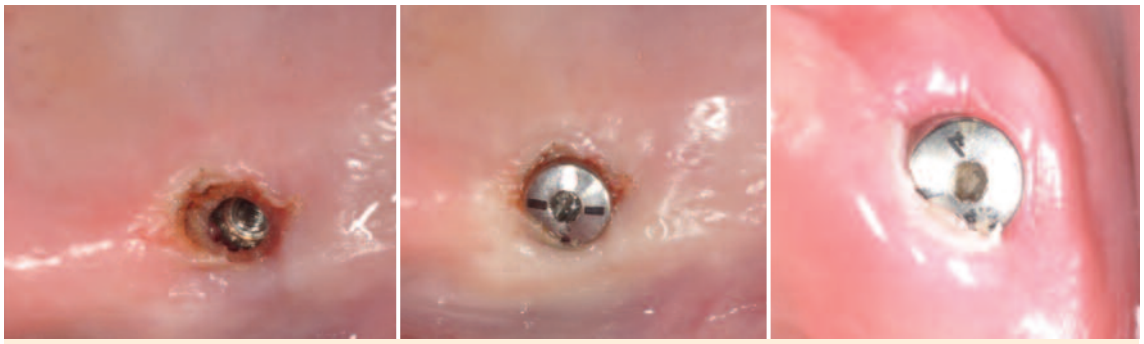

**Fig. 1:** Implant exposed with the SIROLaser. – **Fig. 2:** Exposed implant with gingiva former. – **Fig. 3:** Thickened hyperplastic tissue.

described in the literature by Romanos[2] and Manni[13] amongst others.

*The laser as an adjunct in the treatment of peri-implantitis*

Peri-implantitis refers to an inflammatory process that affects the entire tissue around the implant that is integrated into the bone and leads to a loss of alveolar bone.[6] Microbiological investigations reveal the connection between loss of implant and bacterial infections.[7] The bactericidal action of the diode laser for implant disinfection is described by Goncalves et al.[8] A good indication of the efficacy of the laser as an adjunct in the treatment of peri-implantitis is seen in the success of laser treatment for periodontitis. Kamma et al. compared the results of scaling and root planing (SRP) compared to SRP + laser and laser treatment alone in a controlled study with 30 patients. They showed that the combination of SRP + laser achieved a better effect than either SRP or laser alone.[9] For peri-implantitis Bach and Neckel showed in a 5-year comparative study that the laser was beneficial as an adjunct to conventional therapy.[10]

Treatment with the diode laser immediately near the implant is not a thermal hazard due to heating of the implant provided care is paid to ensuring the irradiation time is appropriate.[11,12]

## Materials and methods

The effect of the diode laser in surgery is described adequately in the literature.[2,13]

The SIROLaser Advance is a 970 nm diode laser from Sirona Dental Systems, Bensheim, Germany. The operating modes of the laser are continuous wave (CW), chopped mode (also known as pulsed mode), and peak-pulse mode. In the CW operating mode, the laser emits continuous light at the set power. In the chopped mode, the laser emission switches on and off at an adjustable frequency between 1 Hz and 20 kHz and the duty cycle can be adjusted between 1 % and 99 %. The peak-pulse mode is a pulsed mode with a fixed amplitude of 14 W at the diode, a constant pulse width of 28 µs and a mean maximal output of 6 W. The maximum output of the laser is 7 W in the CW and chopped pulse modes and 14 W in the peak-pulse mode.

The laser is made up of a base unit with an intuitive operating interface via a touch screen and a handpiece that is connected to the laser via an optical fiber cable. Length-adjustable application fibers are screwed onto the handpiece in an optical coupler. Application fibers are available with a diameter of 200 µm for endodontics and 320 µm for periodontology and surgical applications. All handpiece parts that are potentially in contact with patients can be sterilized in an autoclave. The laser can be controlled either with a foot switch or a finger switch on the handpiece.

In the laser menu preset treatment parameters (power, frequency, duty cycle) for the most common indications in surgery, endodontics, and periodontology can be used. Thanks to a powerful battery, the laser can be placed on the tray of the treatment center near the patient without a cable interfering with the treatment.

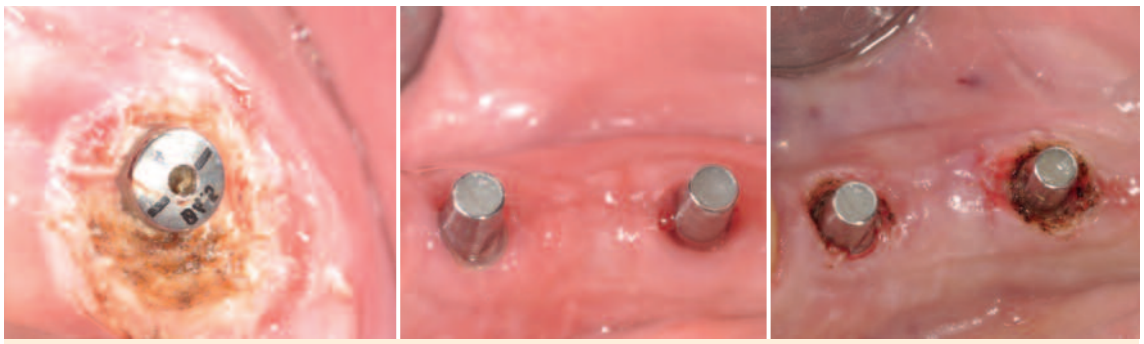

**Fig. 4:** Situation after ablation and reduction of the tissue. – **Fig. 5:** The prosthetic platform of the abutment lies below the gingival margin. – **Fig. 6:** Implant posts after exposure of the platform.


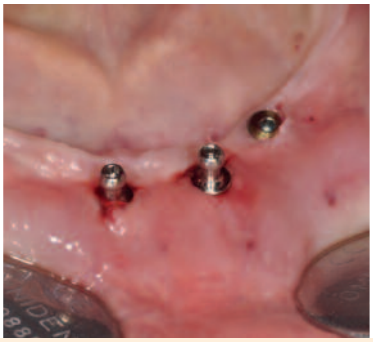
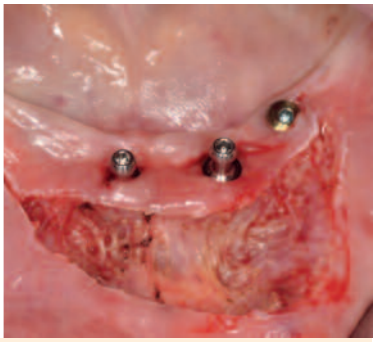

**Fig. 7:** Implant after attachment of the transfer posts. – **Fig. 8:** The superstructure has shifted in the mobile mucosa. – **Fig. 9:** Vestibuloplasty with an almost bloodless incision.

## Case reports

Clinical application of the diode laser used in implantology and implant prosthetics is widespread. The prevention of postoperative bleeding in particular enables surgical and prosthetic treatment procedures to be combined in a single session. The simultaneous vascular occlusion and postoperative hemostasis also improves the surface granulation and prevents relapses with vestibuloplasty.

*Implant exposure*

In the incision/gingivectomy mode with the preset laser parameters, the laser allows exposure of the implant (Fig. 1). Hemostasis improves the field of view and the cover screw can also be removed even with a very small opening and replaced through the gingiva former (Fig. 2).

*Gingiva excision/reduction after conventional exposure*

The SIROLaser Advance is also well suited to ablation of thickened hyperplastic soft tissue that often develops as a result of implant exposures combined with sliding flap and pre-existing thickened gingiva situations (Fig. 3).

The incision action and hemostasis allow soft tissue to be reduced specifically and with a good field of view using low levels of anesthesia and the surface conditioning of the incision face ensures rapid regeneration of the tissue (Fig. 4).

*Implant impression using direct and indirect procedure (transfer impression)*

Because superficial bleeding can be prevented using the laser, it is possible to take an impression of the implant immediately after exposure. This is true for both direct and indirect impressions. With direct impressions the prosthetic platform of the implant abutment often lies below the gingival margin (Fig. 5).

Thanks to the fine working tip of the SIROLaser Advance that we used, the gingiva can be reduced precisely around the posts and the platform exposed (Fig. 6). This enables a precise impression to be taken. For the open impression, the transfer posts are secured to the implant (Fig. 7) and the impression is taken using the open-tray technique. Again, the laser enables a single procedure thanks to sealing of the superficial vessels.

*Indication for vestibuloplasty after exposure*

In this case, after exposure of the stud abutment, it was noted that the superstructure had shifted in the mobile mucosa (Fig. 8), the attached gingiva is expanded using vestibuloplasty.

The diode laser enables quick and easy vestibuloplasty with low levels of anesthesia. The fine working tip enables a very targeted incision which is also sufficiently long and deep without risking significant postoperative bleeding (Fig. 9). Success is further secured for prosthesis wearers by relining the functional margin (Fig. 10). The characteris-



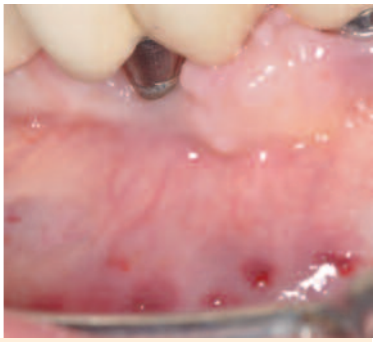

**Fig. 10:** Relining of the functional margin. – **Fig. 11:** Vestibuloplasty four days after the procedure. – **Fig. 12:** Vestibuloplasty; the margin of the attached gingiva is too narrow.

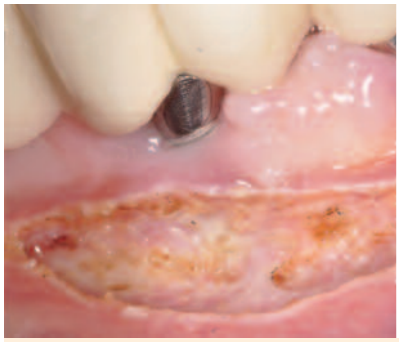

**Fig. 13:** Vestibuloplasty; it can be seen that the tension on the free mucosa is reduced. – **Fig. 14:** After 12 days the wound has healed completely and there is a broad band of attached gingiva. – **Fig. 15:** Peri-implantitis with loss of attachment.

tics of the laser incision keep postoperative pain low, while surface conditioning of the mucosa prevents relapse and ensures regeneration is rapid, starting as early as three to four days afterwards (Fig. 11).

*Indication for vestibuloplasty after implant placement*

If it only becomes apparent after implant placement that the free gingiva is in contact with the implant or the implant abutment or if the margin of the attached gingiva is too narrow, vestibuloplasty should be carried out now at the latest (Fig. 12). The diode laser makes the procedure easy and effective with an incision length and depth based on requirements. Thanks to the surface tissue conditioning, complex sutures and suturing are not necessary because the surface freely granulates and a relapse to the degree comparable to scalpel incisions does not occur. Immediately after the laser procedure, the tension on the free mucosa is already reduced and the soft tissue sits higher against the implant (Fig. 13). As early as 12 days later the wound has healed completely and there is a wide band of attached gingiva (Fig. 14).

*Indication for vestibuloplasty combined with peri-implantitis therapy*

If peri-implantitis has developed with loss of attachment, vestibuloplasty should be carried out with treatment of the peri-implantitis (Fig. 15). The advantage of the laser is again apparent with an almost bloodless postoperative wound which can be left to freely granulate (Fig. 16). The tension on the mobile mucosa is thus removed and the peri-implant soft tissue and the pockets can now be cleaned and trimmed in accordance with the relevant protocols. The use of the SIROLaser Advance in peri-implantitis mode aids disinfection and cleaning of the pockets around the implant. The gingiva again heals rapidly. As early as seven days later, free granulation is well advanced (Fig. 17) and after 14 days it is complete (Fig. 18). The peri-implant tissue appears stable, there is no bleeding on probing, and the patient experienced hardly any pain during the procedure and the entire postoperative phase.

*Indication for supporting peri-implantitis therapy*

An acute case with slight loss of attachment (Fig. 19) and with minor involvement of the hard tissue (Fig. 20) is treated with no flap. The laser allows access to difficult areas and facilitates the standard treatment protocol for peri-implantitis treatment during disinfection. Even after a short time, the inflammation has healed (Fig. 21), there is no bleeding on probing, and the patient is free of pain (Fig. 22).

## Discussion

Treatments with the SIROLaser Advance in the cases described above concur with the current literature in terms of their results. The surgery carried out with the 970 nm diode laser from Sirona is bloodless, associated with low pain levels, and free of side effects such as swelling, uncontrolled dysfunction, and scar formation. The diode laser is a valuable aid for peri-implantitis treatment, particularly in cases



**Fig. 16:** Almost bloodless postoperative wound after surgery with the diode laser. – **Fig. 17:** Free granulation after seven days. – **Fig. 18:** Completed healing after 14 days.

**Fig. 19:** Peri-implantitis with slight loss of attachment.

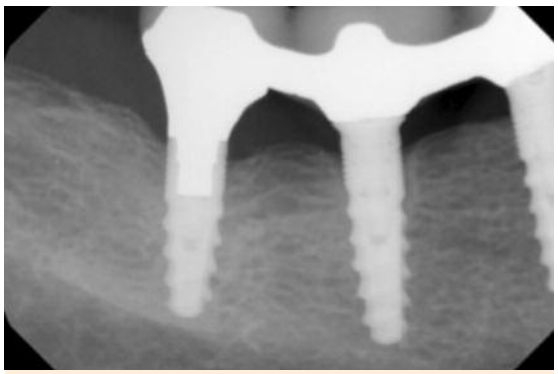

**Fig. 20:** The X-ray image shows minor involvement of the hard tissue.

**Fig. 21:** Not long after the therapy the wound has already healed.

**Fig. 22:** No bleeding on probing.

of early intervention. Even difficult areas are accessible with the laser for adjuvant disinfection.

All the indications named above also form part of the range of applications possible with the SIROLaser Xtend. The laser, which is equivalent in design to the SIROLaser Advance laser, differs basically in that it has a lesser maximum output (5 W CW, 10 W peak-pulse) but this is not relevant for the indications described.

The SIROLaser Advance can thus be regarded as an expedient addition to the implantology practice.

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# Imprint

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# Use of a 970 nm laser for adjunctive periodontal therapy of tooth 16

Michael Krech
Prof. Dr Roland Frankenberger
Prof. Dr Andreas Braun

**ABSTRACT**
The main objectives of periodontal treatment are deep scaling of the root surface to remove bacterial plaque as completely as possible and preventing resettlement of pathogenic periodontal bacteria. In this context, the supportive use of a diode laser can contribute to the removal of pathogenic bacteria from diseased periodontal structures. Due to limited clinical view during subgingival instrumentation, careful selection of laser parameters and treatment approaches are particularly necessary for non-surgical procedures.
This case report describes the supportive laser treatment in the conventional treatment of periodontitis of tooth 16, which in addition to increased probe depths also exhibited a class II furcation defect. The periodontal structures were completely free of clinical inflammation and infection after additional pathogen reduction using the diode laser. Yet without further treatment or at least admission to a respective periodontal recall program, the prognosis of the tooth must be considered to be critical due to the furcation defect. Another therapeutic intervention, possibly even a surgical intervention at the affected tooth cannot be ruled out.

**KEYWORDS**
Diode laser, 970 nm, periodontitis, furcation defect, pathogen reduction

## Introduction

There are several possible uses of laser systems in periodontal treatment.[1] It must, however, be taken into consideration that to date, no laser system has met all the requirements of complex periodontal therapy. For the detection[2] and removal of calcified deposits[3], other systems are needed than for periodontal surgery or pathogen-reducing measures. Laser energy can have an athermal (e.g. photodynamic)[4] or thermal antimicrobial effect. For laser systems such as the diode, Nd:YAG, or $CO_2$ lasers, antimicrobial properties are based primarily on thermal effects. Because the tissues absorb laser energy differently during periodontal therapy and particularly due to the limited clinical view under subgingival instrumentation, the laser parameters and approach must be selected carefully. Clinical studies have revealed clinically relevant antibacterial effects. Using the diode laser prior to ultrasonic instrumentation of teeth affected by gingivitis is credited with preventing bacteremia caused by treatment.[5] In patients with chronic periodontitis, using adjunctive therapy with a 980 nm diode laser yielded slightly better clinical parameters than conventional therapy.[6] Overall, on the basis of existing data, it can be established that adjunctive laser treatment improves the healing of diseased periodontal tissue.

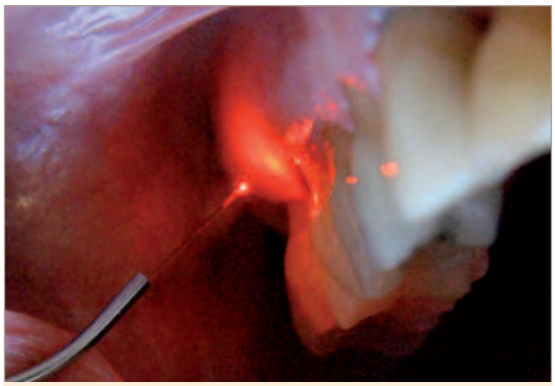

**Fig. 1:** Laser fiber with a core diameter of 200 µm prior to therapy of tooth 16.

## Case report

On June 13, 2013, a 76-year-old patient came to the Department of Operative Dentistry and Endodontology in the Medical Center for Dental, Oral and Maxillofacial Sciences of the University Hospital of Gießen and Marburg in Marburg, Germany. The reason for his visit was his annual check-up and plaque removal. During the examination, the patient's periodontal pockets were also measured withgeneral probing depths of 2–3 mm. Periodontal pockets of up to 4 mm with bleeding on probing could be observed in tooth 16. A buccal class II furcation defect was also detected at tooth 16. When pressure was applied to the surrounding gums, some pus was produced from the buccal gingival pocket. The patient was advised to have periodontitis therapy at this tooth. In addition to conventional cleaning with hand instruments, supportive laser therapy was offered to increase reduction of pathogens in the diseased periodontal tissues.

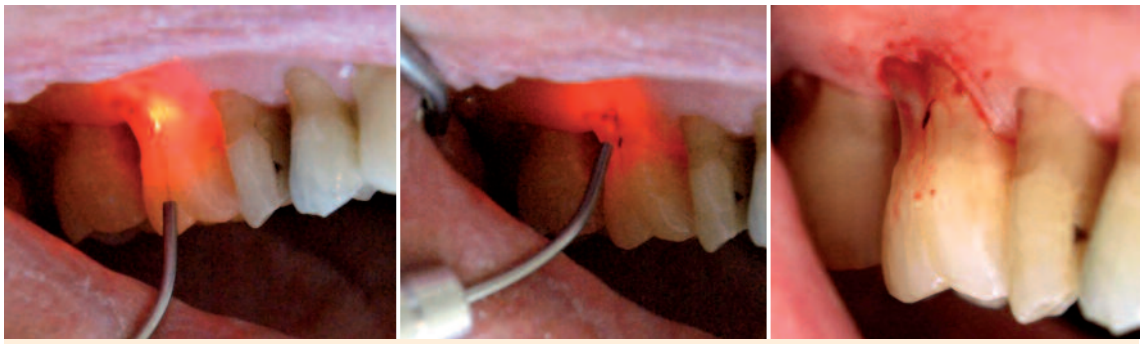

**Fig. 2:** Axially positioned laser fiber prior to pathogen-reducing irradiation of periodontal lesion of tooth 16. The probe was inserted into the gingival pocket for irradiation. – **Fig. 3:** Laser irradiation of exposed buccal furcation (class II furcation). – **Fig. 4:** Postoperative situation after laser treatment of the periodontal lesion and the affected furcation area.

The SIROLaser Advance (Sirona, Bensheim, Germany), a 970 nm class IV diode laser with software version 2.0.6 was used for treatment. The laser menu includes preset parameters for periodontal treatment: laser root planing, perio pathogen reduction, peri-implantitis. For this patient, the "perio pathogen reduction" program with the preset parameters 1.5 W, 10 Hz, and a pulse duty cycle of 50 % was selected. To reach all areas of the periodontal pocket, a laser fiber with a diameter of 200 µm was used (Fig. 1).

At the time of treatment, the patient was in good condition. No anesthesia was applied in consultation with the patient. During the first session, the dental surface of tooth 16 was conventionally cleaned using hand instruments. Two weeks after conventional therapy, the patient was still not completely free of inflammation and supportive laser therapy was then applied. After both the patient and treatment team had been equipped with protective glasses and a signal lamp at the door cautioning against entering the laser therapy room during treatment was turned on, laser therapy began. The laser fiber was inserted into the periodontal pocket from mesial, distal, palatinal and buccal direction for 60 s each and the laser was activated using a finger switch (Fig. 2). Additionally, the furcation area was irradiated from buccal direction for a duration of 60 s (Fig. 3). To ensure that the area was always sufficiently moistened and to prevent the laser fiber from sticking to the gingiva, the periodontal pocket was flooded with physiological saline solution prior to each cycle. We dispensed with a postoperative wound dressing in the treated area (Fig. 4). The patient was also instructed not to exclude the treated tooth during regular oral hygiene. Postoperative follow-up of the wound showed a periodontal tissue free of inflammation and infection (Fig. 5). We recommended regular follow-ups at two-month intervals.

**Fig. 5:** Clinical situation at follow-up. No clinical signs of inflammation or infection of the periodontal structures.

## Concluding remarks

The clinical picture after periodontal therapy of tooth 16 was consistent with expectations based on the available data on supportive laser treatment. What was particularly interesting in this case was that the patient was clinically free of inflammation and infection only after supportive laser therapy had been performed. However, without further treatment or at least admission to a respective periodontal recall program, the prognosis of a tooth with a class II furcation defect must be considered to be critical. Another therapeutic intervention, possibly even surgical intervention at the affected tooth cannot be ruled out.

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# Use of a Diode Laser for Gingival Troughing in Conservative and Prosthetic Dentistry

Dr Almut Marsch

**ABSTRACT**
This case report describes the successful use of the SIROlaser Advance / Xtend for gingival troughing to visualize preparation margins. The indication for gingival troughing to visualize the preparation margin is only a small area of use of the diode laser in dental surgery, but it has a great effect on workflow in the practice. Using a diode laser considerably facilitates and accelerates the workflow. This is illustrated using examples of digital and analog impression taking. In conservative dentistry for subgingival cavities as well, laser gingival troughing can have a favorable effect on the success of treatment. In addition to modeling the surrounding periodontium, a particular advantage of using the laser is the resulting (virtually) bloodless, dry field. This aspect is important for conservative treatment, as the majority of available adhesives require an absolutely dry, bloodless surface to develop their full potential.

**KEYWORDS**
Gingival troughing, diode laser, 970 nm, gingivoplasty, gingival troughing, CEREC, CAD/CAM

## Introduction

The successful use of the diode laser in soft tissue surgery is undisputed in literature.[1] Due to the availability of new treatment equipment, there have been some changes in the standard procedures in dental practices in recent years. In dental prosthetics, the laser with its coagulating effect opens up new possibilities in impression taking.

The visualization of the preparation margin is a decisive factor for a perfect restoration in both conservative and prosthetic dentistry. Errors in this stage of treatment lead to over/under-contouring and the risk of gingivitis, discolored margins, secondary caries, and premature loss of the restoration. The detailed visualization of the preparation margin is difficult, especially if it is in a subgingival location, making gingival troughing necessary.

When making analog impressions, the aim is to create a space into which the impression material can flow freely. A dry and bloodless field increases precision, however most modern impression materials can withstand low moisture due to their thixotropic properties. This is different for digital impressions. For this, both the dry, bloodless field produced by the laser and the precise visualization of the preparation margin are important. This is particularly important because the CAD/CAM model can no longer be modified.

In addition to modeling the surrounding periodontium, a particular advantage of using the laser is the resulting (virtually) bloodless, dry field. This aspect is important for conservative treatment, as the majority of available adhesives require an absolutely dry, fluid and bloodless surface to develop their full potential.

There were formerly various methods available for gingival troughing:[2]

a) Mechanical methods with retraction cords or paste.
b) Chemomechanical methods with retraction cords soaked with a hemostatic solution.
c) Surgical techniques such as gingivectomy.
d) Electrosurgery with an electrotome. In this method, the gingival sulcus is widened with a thin electrode; the disadvantage is the tendency to recession.
e) Laser surgery with the Nd:YAG[3], Er:YAG, Er,Cr:YSGG laser[4], or diode laser. The hemostatic effect varies depending on the laser system.

A comparison of gingival troughing using laser, electrotome, and retraction cords has already been described in literature.[5] Laser proved to be superior to the other two methods; the disadvantages of widening with retraction cords are bleeding and the tendency to recession and when using the electrotome, more recession occurred than when using laser.

## Materials and methods

In my practice, laser gingival troughing is performed mainly for preparing CEREC (CAD/CAM) restorations. In around 80 % of approx. Ten CEREC (CAD/CAM) sessions per month, the diode laser is used to create an optimal CAD/CAM model. The diode laser used is the SIROLaser Advance (Sirona Dental Systems, Bensheim). The SIROlaser Advance has a wide range of

**Fig. 1:** The mesial papilla and a small overlap in the distolabial area made it difficult to get an optimal digital impression. – **Fig. 2:** Situation after removing part of the mesial papilla; the circular chamfer is readily visible. – **Fig. 3:** Digital impression with CEREC.

applications. It is used in the fields of periodontology, endodontics, and surgery. Other indications are for the treatment of herpes, aphthae, and dentin hypersensitivity.

The infrared diode laser with a wavelength of 970 nm has a maximum capacity of 7 W continuous output but can also be operated with a pulse frequency of up to 10,000 Hz and a variable duty cycle. The cover of the handpiece and the removable fibers can be autoclaved in order to comply with hygiene standards. The most common indications for treatment in dental practices have preset parameters and thus allow quick access, but can also be customized at any time. The following preset parameters were used for gingival troughing:

– Power 2.0 W
– Mode PF (pulsed)
– Duty cycle 50 %
– Frequency 20 Hz
– Recommended fiber 320 µm.

After activating the laser, the tip of the fiber is moved gently over the tissue. The fiber should be kept parallel to the tooth to avoid unnecessary contact with the dental hard tissue and unintended irradiation of the bone.

In the following case, analog impressions were made in addition to digital impressions, as the processing was to be carried out by an external laboratory to optimize the color. This young patient had lost a large amount of dental hard tissue due to trauma to the front teeth. The attempt to reconstruct the tooth with a composite was unsuccessful. As already mentioned, the laser is frequently used only as a supportive measure in difficult areas to optimize the treatment result. In this case, the mesial papilla and a small overlap in the distolabial area made it difficult to get an optimal digital impression (Fig. 1).

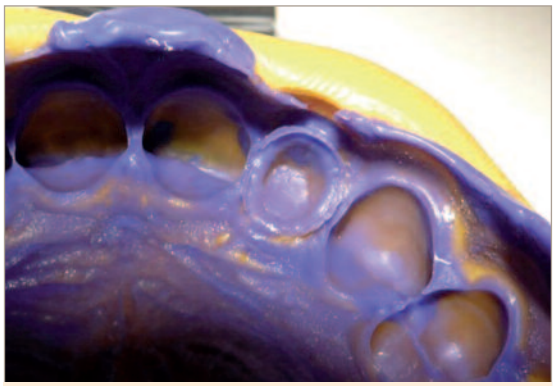

**Fig. 4:** Analog impression.

Overlapping gingival tissues while scanning can lead to faulty impressions, as these areas may not be scanned. Therefore, when making digital impressions, it is important to have a precisely defined preparation margin. This is all the more important because the fit can be checked only in the mouth. Only a tactile, not visual, inspection can be made of the proximal areas. Using the laser, some tissue was removed from the mesial papilla to make a circular chamfer visible (Fig. 2). Then, both a digital (Fig. 3) and an analog (Fig. 4) impression were made.

## Summary

The future of dentistry is digital. Based on this premise, the supportive use of laser for gingival troughing is appropriate. In many cases, the conventional method using retraction cords and the corresponding coagulants may be sufficient for making analog impressions. For the high requirements of digital scanning, additional equipment such as the laser or HF device are advantageous because of their coagulation properties, as only dry surfaces yield a clear image. The laser in pulse mode is better than most HF devices because of its gentle action that allows tissues to heal more quickly. From the economic point of view, a laser is certainly a better investment because of its wide range of uses.

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# Therapy of the recurring epulis granulomatosa

Dr Tristan M. W. Schiele

**ABSTRACT**
Epulis granuloma is a primarily oral disease which is caused by hormonal factors, irritation or physical trauma. It is characterised by an overgrowth of tissue. This article discusses the laser-supported therapy of recurring epulis granulomatosa with reference to a patient case.

**KEYWORDS**
Diode laser, 970 nm, epulis granulomatosa

## Introduction

In surgical dental practices, there are quite a few cases where you will be faced with an epulis. During pregnancy there may also be a clinical epulis, depending on hormone levels, which will often disappear after the birth of a child (epulis gravidarum). In most other cases, excision is the most promising therapy (epulis fibromatosa or granulomatosa). This can be done either with conventional methods like the electrotome or, thanks to the further development of dental lasers, with a diode laser system like the SIROLaser Advance.

In some special cases, the practitioner will be faced with the problem of a recurring epulis. On initial clinical inspection, there is no chance of diagnosing this correctly. This article will explain the diagnosis, therapy and histological summary of the recurring epulis granulomatosa under the special circumstances of a laser therapy with the SIROLaser Advance. We have used this method for several other cases of epulis with remarkable results. As of today, we have successfully treated 10–15 cases with the SIROLaser Advance.

## Diagnosis

The patient makes regular, twice-yearly visits to our practice. In early 2012 he came to us with the clinical picture of an elevated, inflamed small area of about 3 x 4 millimeters between teeth 14 and 15, reaching through the approximal space to the palatal part of the papilla. It immediately bled on probing, was a dark red color and showed a definite border to the vestibular gingiva. During anamnesis, the patient told us that he didn't feel any pain or discomfort. It had appeared over a few weeks without specific changes in habits. With this information, we diagnosed an epulis and decided to excise it.

## Therapy

The area was anaesthetized from tooth 13 to 16 and the epulis was excised conventionally with the electrotome approximately 0.5 mm below the level of the surrounding gingiva. Due to the location of the wound, no further surgical dressing was applied. It was an open granulation.

Eight days later, the patient came for post-operative treatment, as is standard in these cases. The wound showed quite complete healing. No pain or other complications were reported.

Six months later, the patient showed up for a recall appointment and reported that the epulis had recurred to its former appearance. As a result, we decided to try a new method that is made possible by the SIROLaser Advance, a 970 nm diode laser from Sirona Dental Systems GmbH, Bensheim, Germany (Fig. 1).

The second procedure was quite similar to the first. However, we decided to excise a larger area with a safety distance of about 1–1.5 millimeters. Eight days later, the patient showed the same indications of almost complete healing.

In January 2013, the patient had another recall appointment. The clinical finding was the same so we changed our diagnosis to a recurring epulis granulomatosa. In this case, there was direct contact with the alveolar bone. We say the epulis is pedunculated with the alveolar bone. The proper therapy is a complete excision of the epulis and parts of the alveolar bone. In some cases, adjacent teeth could be affected, making an extraction necessary. The incidence of a malignant tumor is very low, but possible.

We anaesthetized the area from tooth 13 to 16 with an anesthetic that contained a high dose of adrenaline (1 : 100,000) to avoid having too much blood in the surgical area. We excised the entire epulis, with a safety distance of 1.5 mm, and the periosteum through the approximal space to the palate with the SIROLaser Advance. This was because we wanted to try another method of saving the adjacent teeth by not excising the alveolar bone. We then decontaminated the entire area with the SIROLaser Advance and, additionally, with a sterile isotonic saline solution and Penicillin G (1 Mega). We remodeled the approximal papilla and the surrounding gingival with a micro-invasive papilla reconstruction plastic and a 5-0 atraumatic suture. We stored the excision in a sterile isotonic saline solution for the histological examination.

The patient was instructed not to get food near the surgical area. We also instructed him not to eat any carbohydrates or dairy products for eight days. Post-operative treatment was done after two, eight and fourteen days. Again, no pain or other complications were reported so we removed the suture. Three months later, there was no recurring epulis. The anatomical-histological finding was a benignant epulis granulomatosa.

## Conclusion

We can say that this therapy was successful but there are no studies or articles about this method so more trials are still required before it can become an objective surgical standard. In dental surgeries, there are very few cases of a recurring epulis. In most cases you will find a superficial epulis fibromatosa, granulomatosa or gravidarum which are easy to excise. Sometimes they heal without treatment. For cases that require surgery, the SIROLaser Advance is a unique and promising therapy approach. The biggest advantage lies in the bloodless surgical procedure. The laser also seems to have an antibacterial effect. It reduces post-surgical pain levels and the risk of unwanted aftereffects in modern micro-invasive dental surgery.


**Fig. 1:** SIROLaser Advance on dentist element of TENEO treatment center.

# The treatment of herpes labialis with a diode laser (970 nm)—a field study

Dr Simone Suppelt

**ABSTRACT**
Herpes labialis is an infection caused by the herpes simplex virus HSV 1 and, less frequently, HSV 2. In dental practices the diode laser is mainly used in periodontology, endodontics and minimally invasive surgery. Many of those affected by herpes are unaware that laser treatment can successfully alleviate their symptoms.
In this field study, 11 patients who suffer from acute herpes were treated with a 970 nm diode laser. The areas which the patients described as being affected by herpes were irradiated at a distance of 1–3 mm (2.0 W, 10 Hz, 50 % duty cycle, 320 µm optical fiber).
Several patients felt the symptoms subside during the treatment. For the majority of patients, the symptoms did not occur again after treatment. All of the patients were satisfied with the treatment.
Laser treatment of herpes labialis using a 970 nm diode laser is an effective way for me to help my patients both quickly and simply.

**KEYWORDS**
Diode laser, 970 nm, herpes labialis, HSV

## Introduction

With a wavelength of 970 nm and a maximum output of 7 W cw, the SIROLaser Advance dental diode laser has a wide range of indications. In my practice, the laser is mainly used in periodontology and endodontics to reduce germs in pockets or in root canals. I also use the laser for small surgical procedures, such as removing fibromas, separating the labial frenulum, operculectomies or opening abscesses. The advantages of laser treatment in surgery are clean incisions, the hemostatic effect, the reduction in germs along the incision and the related quick healing of wounds without scarring. For the indications that I treat, the laser offers preset and adequate treatment parameters such as output, pulse frequency and duty cycle. The treatment process is made significantly easier as these parameters can be accessed in the menu. In addition to these frequent indications, I use the laser to treat herpes labialis.

Herpes simplex viruses (HSV) cause various infection types. Around the world, around 60–95 % of adults are affected by HSV.[1] Herpes labialis (also referred to as a cold sore) is probably the most common form which is essentially triggered by the herpes simplex virus type 1. The initial infection (often in the form of herpetic gingivostomatitis) may even be asymptomatic, following this the HSV persist in the body and repeat episodes can vary in terms of their nature, severity and frequency. The initial infection can lead to severe complications, particularly in infants and small children.

An outbreak of herpes labialis can be accompanied by various symptoms. As a rule, in the early stages such symptoms include dry lips and a tingling/itching sensation. In subsequent stages, swelling and a feeling of tightness occur which can rapidly be accompanied by a sensation of burning or other sense of pain. Blisters can subsequently form which may then burst open and scab over.

Herpes infections are often not treated as they normally heal by themselves after 10–14 days. Superficial anti-viral treatment using ointments is well known (e.g., aciclovir and penciclovir).[2]

The treatment of herpes labialis with the aid of a diode laser offers the dentist the interesting option of extending the range of applications in his practice and also alleviating the pain suffered by patients both quickly and simply.

Studies with different approaches confirm the success of laser treatment:

a) Photodynamic therapy can be used as an effective treatment option.[3] This reduces the frequency of the occurrence of herpes labialis and also reduces the time required for the infection to heal.

b) Repeat laser treatment with 690 nm (diode) and a lower intensity can be used to reduce the frequency of reoccurrence of herpes infections.[4] Jovanovic et al. recommend the use of a helium neon laser (633 nm) given its properties which reduce pain and shorten the herpes infection.[5]

c) In the higher intensity range, initial treatment trials with the Nd:YAG back in 1999 resulted in a reduction in symptoms and stopped the further course of the herpes infection.[6] Moghtader reported on the successful treatment of herpes labialis with a combination of higher intensity (1.5 W pulsed, 1,500 Hz, average output 1 W) and soft laser (100 mW, one minute).[7]

## Materials and methods

Eleven patients (Fig. 1) were included in the field study once differential diagnoses such as recurrent aphthous ulcers, herpes zoster, herpes with HIV, erythema multiforme and contact dermatitis were all ruled out. The patients were asked to give their name and gender and to describe the normal course after the outbreak of herpes, the frequency of outbreaks and current symptoms. Following this, the patients were treated with a SIROLaser Advance (Sirona Dental Systems GmbH, Bensheim, Germany).

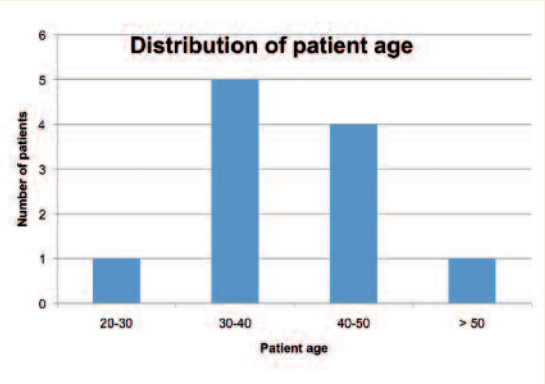


**Fig. 1:** Age distribution of the patient population in the herpes field study

The eleven patients in this field study suffer to differing degrees from herpes labialis with outbreaks ranging between 1 and 12 times a year (Fig. 2).

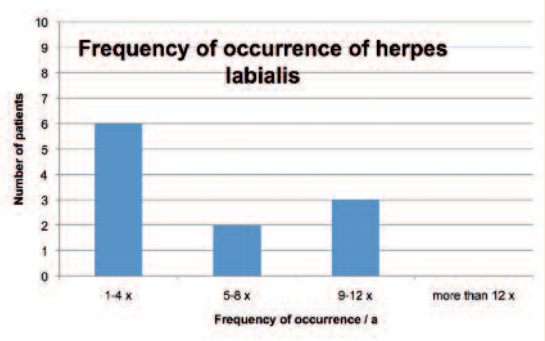


**Fig. 2:** Frequency of occurrence of herpes labialis in the patient population.

The symptoms of outbreaking herpes infections vary from patient to patient. Blister formation is the only almost universal symptom (Tab. 1).

| When you suffer from herpes—which symptoms do you experience? (multiple answers possible) | Number of patients |
|---|---|
| Dry lips | 6 |
| Tingling, itching sensation | 7 |
| Burning, sensation of pain | 6 |
| Swelling, feeling of tightness | 7 |
| Blister formation | 10 |
| Bursting of blisters and scab formation | 7 |
| Secondary inflammation | - |
| Other | - |

**Tab. 1:** The various patients displayed different symptoms during an outbreak of herpes.

The stage of the herpes infection at the time of participation in the field study had varying manifestations (Tab. 2).

| At what stage are you now during laser treatment? (multiple answers possible) | Number of patients |
|---|---|
| Dry lips | 2 |
| Tingling, itching sensation | 3 |
| Burning, sensation of pain | 4 |
| Swelling, feeling of tightness | 8 |
| Blister formation | 6 |
| Bursting of blisters and scab formation | - |
| Secondary inflammation | - |

**Tab. 2:** Stage of herpes labialis prior to treatment.

Treatment was performed with the SIROLaser Advance, a 970 nm diode laser from Sirona Dental Systems GmbH. Using the manufacturer's treatment settings—2.0 W, 10 Hz, 50 % duty cycle, 320 µm optical fiber—the lip areas described by the patients as being affected by herpes were each irradiated three times at a distance of 1–3 mm for 30 seconds. In addition the patients were asked to indicate any sensation of pain, at which point the distance was increased up to 8 mm. Patients who continued to experience symptoms were allowed to repeat the treatment.

## Results

All patients felt a sensation of warmth during treatment. In several cases the tingling, itching, burning and sense of pain as well as the feeling of tightness subsided even during the treatment (Tab. 3).

| What did you feel during the treatment? | Number of patients |
|---|---|
| Sensation of warmth | 11 |
| Reduction in tingling and itching | 3 |
| Reduction in burning and sense of pain | 3 |
| Easing of swelling | 3 |

**Tab. 3:** Symptoms during treatment.

| Which stages have not reoccurred since treatment? | Number of patients |
|---|---|
| Burning, sensation of pain | 6 |
| Swelling, feeling of tightness | 4 |
| Blister formation | 6 |
| Bursting of blisters and scab formation | 4 |
| Secondary inflammation | 2 |

**Tab. 4:** Symptoms which no longer occurred after treatment.

Seven of the eleven patients were so satisfied with the result after the first treatment that they did not require a second treatment. One patient was treated twice, another three times and another six times.

After treatment, some patients confirmed that certain symptoms no longer occurred (Tab. 4). This indicates that the duration of the herpes infection is reduced by means of laser treatment.

All the patients (100 %) were satisfied with the laser treatment of their herpes labialis which was undoubtedly due in part to the fact that, on the one hand, the effects were seen quickly and, on the other hand, none of the patients suffered any complications or complaints as a result of the laser treatment.

## Discussion

Compared to treatments in studies with lower intensity, treatment with the SIROLaser Advance has a considerably higher applied irradiance. Whilst with Jovanovic et al. 14–32 mW/cm$^2$ was used for irradiation, a value which is typical for soft laser treatment and LLLT, the figure in this study was, in absolute terms, 48–222 W/cm$^2$, i.e., more than a thousand times greater. The corresponding values from Moghtader are, at approx. 8–12 W/cm$^2$, mathematically slightly below those of the SIROLaser (a diameter of 4 mm is given for the irradiation area). In principle, Jovanovic treated her patients five times for an irradiation time of 5 minutes. She reported a decrease in symptoms after the first treatment. According to Moghtader "as a rule" a patient is pain-free after 24 hours, otherwise a second sitting follows. With the SIROLaser, too, one sitting was sufficient in 64 % of all cases. A correlation between the speed of the reduction of symptoms and irradiance should be investigated; however a systematic assessment is beyond the realms of what is possible in a registered practice.

The spontaneous reduction of symptoms during and after laser treatment results in a considerable easing of the complaints caused by herpes labialis. Treatment would appear to be more successful the sooner the patient begins with the laser treatment after the start of the herpes infection. This field study confirmed to me that laser treatment of herpes labialis is a very good way to quickly and simply help my patients without any side effects.

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# The application of diode laser (970 nm) in the treatment of aphthous ulcers

Dr Simone Suppelt

**ABSTRACT**
Aphthae are very painful lesions on the mucous membrane of the oral cavity, which heal spontaneously after 7–10 days. This condition affects around 10–15% of the population, however most people usually do not consult a doctor or dentist. Many studies show that laser treatment offers relief from the pain associated with aphthous changes. Aphthous ulcers can be treated in the dental practice with a diode laser, which is mainly used for periodontics, endodontics and minimally invasive surgery.
In this field study, ten patients with acute aphthous stomatitis were treated with the SIROLaser Advance, a 970 nm diode laser. The aphthous ulcerations were irradiated with the laser fiber in non-contact mode at a distance of 1–3 mm (2.0 W, 10 Hz, duty cycle 50%, 320 µm optical fiber).
Several patients felt the symptoms subside during the treatment. For the majority of patients, the symptoms did not occur again after treatment. None of the patients experienced complications or discomfort as a result of the treatment. All of the patients were satisfied with the treatment.
The treatment of aphthous ulcers with a laser presents a good opportunity to help patients quickly and easily. The results of this field study are consistent with the results in the literature.

**KEYWORDS**
Diode laser, 970 nm, aphthous ulcers

## Introduction

Benign recurrent aphthous stomatitis (RAS) usually refers to painful lesions on the mucous membrane of the oral cavity. They are surrounded by a reddened, inflamed border and have a white fibrin coating on the inner surface.

Recurrent aphthous ulcers can be classified into three different types—the herpetiform and major types, which rarely occur and the minor type. The key characteristics of the minor type are summarized below:

– Common; 90 % of all RAS (10–15 % of the population)
– Episodic 3–6 times per year
– Short duration, lesions < 10 mm, heals without scarring
– Few lesions, largely isolated
– Spontaneous healing within 7–10 days
– Pain subsides after 3–5 days
– Does not usually interfere with daily activities
– Limited to the oral cavity.

The etiology and formation mechanism of RAS are largely unknown. It is believed that genetic factors, among others, may play a role. Enabling triggers, such as trauma, stress, food intolerances, hormonal imbalances, zinc and iron deficiencies and cigarette smoking are discussed.[2] Therefore, treatment of RAS is also not specific and usually symptomatic aimed at reducing the symptoms (especially the pain), decreasing the number and size of the lesions as well as prolonging the time to the next episode. The symptomatic and, in particular, local application of gels and ointments (such as chlorhexidine or corticosteroids) should be critically evaluated due to the possible side effects.[1]

The treatment of aphthous ulcers with a diode laser gives the dentist an interesting opportunity to expand the range of services offered in the practice and to alleviate the discomfort of patients quickly and easily.

Case studies using different approaches confirm the success of laser treatments. However, controlled studies are still missing:

a) In their five-year study, Bladowski et al.[3] compared drug therapy, laser treatment and a combination of both and highly recommend the use of laser.
b) Repeat laser irradiation with the Nd:YAG laser in two studies by Brader et al.[4,5] resulted in pain relief as well as shorter healing times.
c) Early on, the Nd:YAG laser was used for the direct removal of aphthous ulcers. The treatment is described by Convissar and Massoumi-Sourey[6] as painless; the patients reported an immediate decrease in symptoms.

d) The biostimulating effect of low-level laser treatment with diverse diode lasers was positively assessed for the treatment of children.[7,8]
e) Caputo et al.[9] see laser treatment as an important alternative to improve the quality of life of marginalized groups (HIV patients). Al Mulla et al.[10] also come to a similar conclusion with regard to disabled patients.

## Materials and methods

After introduction of the patients, differential diagnoses such as virus infections (herpes simplex labialis or oralis, stomatitis, cytomegalovirus, chicken pox, coxsackievirus, HIV), bacterial infections (ulcerative gingivitis, syphilis), fungal infections, neoplasms, hematological illnesses and autoimmune diseases, were ruled out.

Afterwards, treatment with the diode laser was carried out. In this study, the SIROLaser Advance diode laser from Sirona Dental Systems GmbH, Bensheim, Germany, was used. It works with a wavelength of 970 nm with a maximum output of 7 W in continuous wave operating mode. The laser irradiation can also be emitted in "pulsed mode" with a pulse rate of 1 to 10,000 Hz and a duty cycle of between 1 % and 99 %. The laser is easy to handle and the parameters for frequently occurring indications are stored in the instrument and can be easily called up via a menu. The laser parameters recommended for aphthous ulcers were used. They are as follows:

– Output power: 2 W,
– Pulse mode with a rate of 10 Hz,
– Duty cycle 50 %
– Use of a 320 µm fiber optic at a distance of 1–3 mm, with no tissue contact.

Each of the aphthous ulcers were irradiated three times for 30 seconds at a distance of 1–3 mm. In absolute terms, the resulting irradiance was between 222 W/cm$^2$ and 48 W/cm$^2$; this value is between the one for surgery (approx. 10,000 W/cm) and that for low-level laser treatment (a few milliwatts to a few 100 mW/cm$^2$). In addition, the patients had to indicate any sensation of pain, at which point the distance was increased up to 8 mm (irradiance approx. 8.2 W/cm$^2$, close to the LLLT).

Afterwards, the patients received an anonymous questionnaire to fill out and return once the symptoms had subsided completely. The questions referred to their age and gender, frequency of occurrence of the aphthous ulcers, the typical severity of the symptoms, the usual treatment methods performed, the general progression, and the status before laser treatment. Additional questions focused on the subjective experience of the patients during the procedure (reduction of pain, sensation of warmth, relief of other symptoms) and their progression after the laser treatment (complications, satisfaction). Patients who felt the laser treatment was not effective enough were allowed to repeat the treatment.

## Results

The ten patients in this field study consisted of five women and five men of different ages. The distribution is shown in Figure 1.

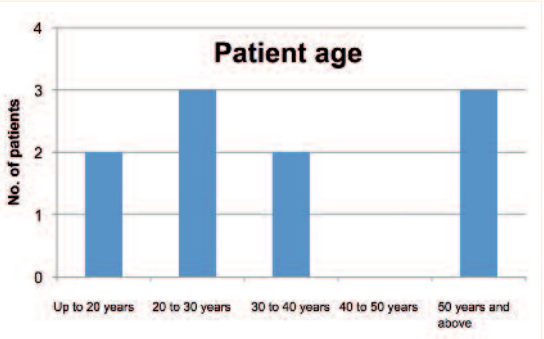


**Fig. 1:** Age distribution of field study participants.

The patients suffer from aphthous ulcers to different degrees with episodes 1 to 8 times a year (Tab. 1).

| Frequency of occurrence | Number of patients |
|---|---|
| 1–4x | 7 |
| 5–8x | 3 |
| 9–12x | 0 |
| > 12x | 0 |

**Tab. 1:** How many times a year do you have episodes of ulceration?

Usually, the patients have single aphthous ulcers. The symptoms of the ulcers differ from patient to patient. Only the sensation of pain (e.g., when touched/pressed) as well as difficulty swallowing are regularly occurring accompanying symptoms (Tab. 2).

| Symptoms | Number of patients |
|---|---|
| Single aphthous ulcer | 8 |
| Several aphthous ulcers (> 2) | 3 |
| Small blisters | 1 |
| Swollen lymph nodes on neck | 1 |
| Pain | 7 |
| Pain–when touched/pressed | 6 |
| Pain–difficulty swallowing liquids and food (e.g., sweet, sour, etc.) | 4 |
| Other | - |

**Tab. 2:** What symptoms occur when you have aphthous ulcers (multiple answers possible)?

Topical medications are used by 70 % of patients for symptomatic relief of pain (Tab. 3).

| Alternative treatment methods | Number of patients |
|---|---|
| None | 3 |
| Special ointments/gels/sprays | 7 |

**Tab. 3:** What alternative treatment methods do you usually use?

| Severity | Number of patients |
|---|---|
| Single aphthous ulcer | 8 |
| Several aphthous ulcers (> 2) | 1 |
| Small blisters | 1 |
| Swollen lymph nodes on neck | 0 |
| Pain | 6 |
| Pain–when touched/pressed | 5 |
| Pain–difficulty swallowing liquids and food (e.g., sweet, sour, etc.) | 3 |

**Tab. 4:** In which stage are you with the laser treatment? (multiple answers possible).

| Immediate reaction to treatment | Number of patients |
|---|---|
| Sensation of warmth | 9 |
| Reduction of pain | 4 |
| Reduction of small blisters | 2 |

**Tab. 5:** What did you feel during and after the treatment?

| Are you satisfied with the treatment? | Number of patients |
|---|---|
| Yes | 10 |
| No | 0 |

**Tab. 6:** Are you satisfied with the laser treatment of the aphthous ulcers?

| Were there complications ? | Number of patients |
|---|---|
| Yes | 10 |
| No | 0 |

**Tab. 7:** Were there complaints/complications due to the laser treatment?

| Was the treatment repeated? | Number of patients |
|---|---|
| Yes | 9 |
| No | 1 |

**Tab. 8:** Was the treatment repeated?

The stage and severity of the aphthous ulcers at the time of participation in the field study varied (Tab. 4).

Almost all of the patients experienced a sensation of warmth during the treatment. In several cases, the pain subsided during or immediately after treatment and the skin symptoms were reduced (Tab. 5).

All of the patients were satisfied with the laser treatment of the aphthous ulcers (Tab. 6) this is with certainty in part due to the fact that effects were seen quickly and that none of the patients experienced complications or complaints (Tab. 7) afterwards.

In 90 % of the patients, the treatment was successful after only one session; the treatment was repeated for just one patient (Tab. 8).

## Discussion

A reduction in the sensation of pain associated with aphthous ulcers using an Nd:YAG laser (2 W, 25 Hz, non-contact, 50–60 seconds) is described by Blandowski et al.[3]—the result here was an almost immediate analgesic effect (24 h). Similar results were obtained by Brader (2008) in the application of an Nd:YAG laser with comparable parameters. It can be assumed that the basic differences in the parameters of pulsed Nd:YAG and diode lasers with regard to wavelength, pulse output power and duration are not relevant for treatment success as long as the average values for irradiance, average output power and treatment duration concur (Tab. 9). Thus treatment with the infrared diode laser at 970 nm and similar average parameters produce similarly successful results.

The spontaneous reduction of symptoms during and after laser treatment results in a significant relief of the discomfort caused by RAS.

The field study confirms that laser treatment of an aphthous ulcer with the diode laser is a very good alternative to help my patients quickly and easily without side effects.

Actually, the only thing that speaks against laser treatment is that many patients are not familiar with it. This can partially be attributed to the fact that generally only few dentists have a laser in their practice.

| | Nd:YAG from Brader | SIROLaser Advance |
|---|---|---|
| Wavelength | 1,064 nm | 970 nm |
| Pulse energy | 80 mJ | 100 mJ |
| Pulse rate | 30 Hz | 10 Hz |
| Pulse duration | 100 µsec | 50 msec |
| Pulse output power | 800 W | 2 W |
| Average output power | 2.4 W | 1 W |
| Type of treatment | Non-contact irradiation | |
| Duration of treatment | 30 sec/cm$^2$ | 3 times every 30 sec. |
| Treatment distance | 10–12 mm | 1–3 mm |
| Irradiance | 113 J/cm$^2$ | 48–222 W/cm$^2$ |

**Tab. 9:** Comparison of laser parameters of Nd:Yag and diode laser.

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# Treatments without bothersome filing

Jesko Gärtner

**ABSTRACT**
A very high degree of treatment safety is vital for ensuring a good prognosis for root fillings. For endodontic interventions, the author uses devices for endometric length measurement in combination with a laser.

**KEYWORDS**
Diode laser, periodontitis, endodontic treatment

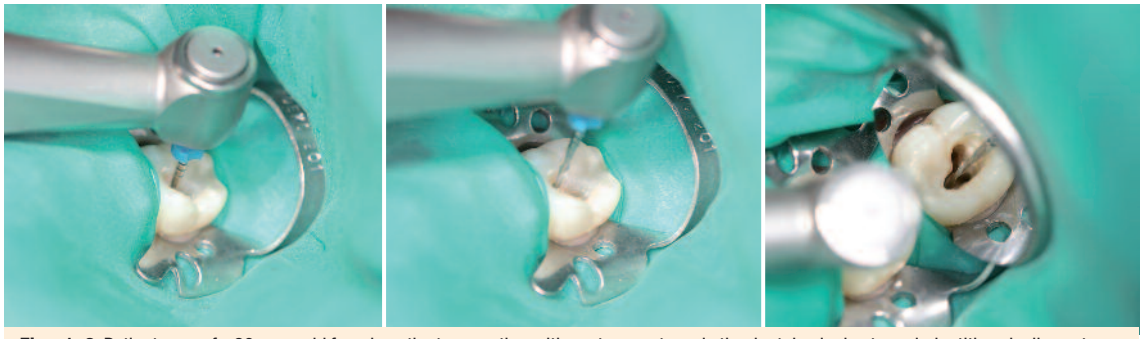
**The absolute number of endodontic treatment** cases would appear to vary from season to season. We normally perform endodontic treatments in our practice on a daily basis—including on milk teeth given the relevant diagnosis.

Root treatment is not a pleasant experience for patients. That's why it is vital that diagnoses which are as precise as possible are made and that an extremely high degree of treatment safety is achieved for root filling, particularly with teeth which have to be crowned or which require prosthetic restoration. After all, it is unsatisfactory for the patient and myself if a tooth which has underdone endodontic or prosthetic treatment once again causes pain after three or four years. I aim to present my patients with an optimal result which is complaint-free in the long run in terms of both the patient's subjective perception and on an objective level as determined by clinical diagnoses.

To achieve this goal with the best possible prognosis, in the case of root fillings I combine endodontic technology systems with the additional support offered by lasers. At my practice I work with devices from the SIROEndo series produced by the company Sirona which is based in Bensheim, Germany. I use the SIROLaser Advance as the laser device.

For root fillings I make sure that the filling material in the canal also reaches as exactly as possible to the anatomical apex. This means that the seal must be made at the point where the tooth opens up to the bone. When using a conventional instrument without endometric length measurement, it is possible for me to go beyond this point and apply the instrument beyond the anatomical apex. This is extremely unpleasant for the patient as the periosteum is one of the most sensitive structures in the human body. This can be avoided with the Apex Locator which is integrated in the endodontic device from Sirona. Thanks to this system component, I am able to achieve a very high degree of measuring accuracy when determining the length of the root canal. I thus save the patient from pain and can even offer him the possibility of working without anesthesia prior to the treatment. Moreover, I am able to completely do away with the X-ray for the purpose of an intermediate control. A further advantage of this technology is that, after having determined the working length, I can set the handpiece of the endodontic device so that the motor stops automatically as soon as I reach the apex with the instrument. This further increases treatment safety as I thus work exclusively in the root canal and never beyond. The nickel-titanium file system ensures considerably enhanced comfort during treatment. Patients regard cutting instruments as less unpleasant as they allow me to work more quietly. As one patient aptly put it: "With this treatment method, there's less rumbling in my head."

Greater root filling quality, time savings as intermediate controls are no longer necessary and less pain are the benefits which I stress to my patients when planning the treatment. The laser which I use for bacteria management reinforces the



**Figs. 1–3:** Patient case of a 26-year-old female patient presenting with acute symptoms in the dental pulp due to periodontitis apicalis acuta.

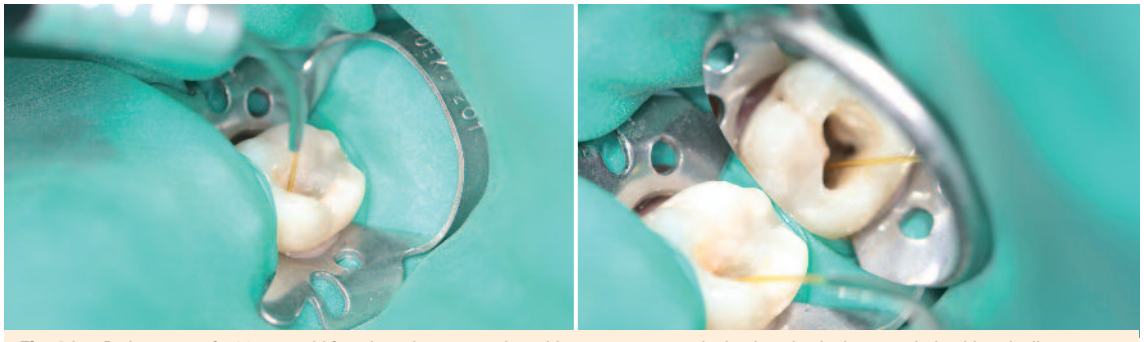


**Fig. 4 & 5:** Patient case of a 26-year-old female patient presenting with acute symptoms in the dental pulp due to periodontitis apicalis acuta.

impression of a modern and gentle endodontic treatment in our practice.

I work much more safely with the laser in conjunction with the endodontic devices. I approach my work by firstly determining the length of the root canal endometrically instead of with the x-ray image since with the latter there may be deviations of up to one millimeter between the radiological apex and actual anatomical apex. If I rely solely on the X-ray image, there is a risk of over-instrumentation both with the endo instrument and with the laser. I minimize this risk with the Apex Locator. Measurement prevents me from treating areas beyond the end of the root.

**Fig. 6:** Initial radiograph.

**Fig. 7:** Control radiograph.

If the tooth is devitalized following inflammation and I have to remove dead cell material, I use the laser to prevent the inflammation from spreading further. Thanks to its depth effect, it is considerably more effective at achieving sterility than rinsing, particularly in the lateral canals. Prior to sterilization I always remove both dead and vital material with the laser. This means that the patient does not have to suffer unnecessarily due to residual vitality or if widespread inflammation has not completely receded following the one-off administration of medication. If it is necessary to remove a vital dental nerve in the sense of vital extirpation, then lasers do not offer any advantages with respect to the safety and success of the treatment. The interplay of the endo and laser device ensures maximum treatment safety. Figures 1 to 5 show the case of a 26-year-old female patient who presented with acute pulp complaints due to acute apical periodontitis. The X-ray images show the initial situation and the control exposure following root canal filling. There were no intermediate controls. The treatment procedure was as follows: During the first appointment, I opened the tooth cavity and then removed the dental nerve. Intracanal medication was then administered to the patient. During the second appointment, I performed mechanical preparation of the root canals including endometric length measurement and bacteria management with the aid of a laser as well as filling of the root canals and a final control exposure. The entire treatment was conducted using a rubber dam. My conclusion: Treatment of the patient was short, safe and pain-free. The prognosis is very positive.

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**THE CONTROLLED APPROACH TO IN-DEPTH WORK**

In addition to the laser devices SIROLaser Advance and SIROLaser Xtend, Sirona based in Bensheim, Germany, also offers the endo device SIROEndo Pocket for endodontics. Thanks to the intelligent electronics, it ensures maximum working efficiency and user comfort. For more information, please go to:www.sirona.com

# Using lasers to tackle periodontitis

Stefan Gottschalk

**ABSTRACT**
Innovative technological features are essential in preventing advancing dental diseases such as periodontitis. Laser therapy proves to be a state-of-the-art measure of modern dentistry to tackle periodontitis. In this article, dentist Stefan Gottschalk combines background information on periodontitis treatment with his case report, describing how laser therapy and intensive preventive care can be successful in modern periodontitis therapy.

**KEYWORDS**
Diode laser, periodontitis therapy, prophylaxis

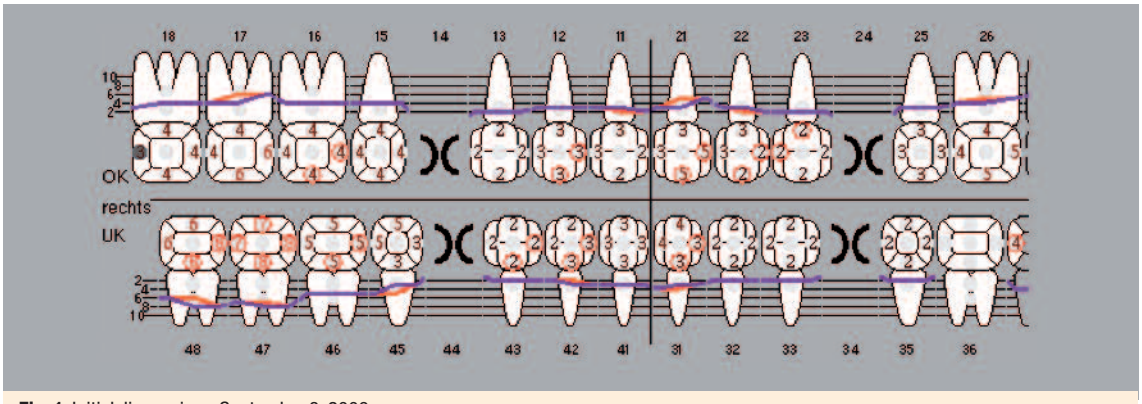


**Fig. 1:** Initial diagnosis on September 3, 2009.

**Periodontal diseases** are advancing. Above all adults and elderly patients are affected. In many cases their condition is chronic. Recurrent inflammations of the periodontium pose a significant challenge. On top of the effective therapy the intensive cooperation of the patient is necessary in order to achieve a stable long-term situation. With reference to a specific case dentist Stefan Gottschalk (Bensberg, Germany) describes how he treated a female patient suffering from progressive periodontitis with the aid of laser therapy and intensive preventive care.

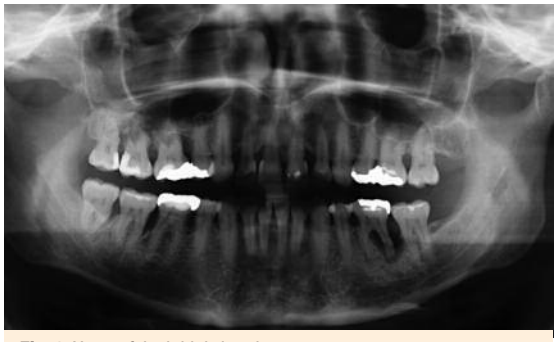

**Fig. 2:** X-ray of the initial situation.

When we set up our dental practice in Bensberg in 2005 we decided to concentrate on preventive care and periodontics in addition to restorative dentistry. During our time at university we had established, on the one hand that a growing number of patients suffer from gingivitis and periodontitis. On the other hand, there is a shortage of specially trained dentists to treat such patients. For this reason we acquired detailed knowledge of the periodontium and developed this knowledge during our university studies and clinical training. In 2006 we obtained a specialist qualification in periodontics under Professor Kleinfelder. Today we can say that an estimated 90 per cent of our patients suffer from gingival and periodontal disease. This condition frequently remains undetected for a long period; many cases show a correspondingly advanced progression. In

**Figs. 3a–c:** Extracted tooth 36 showing strong calculus deposits.

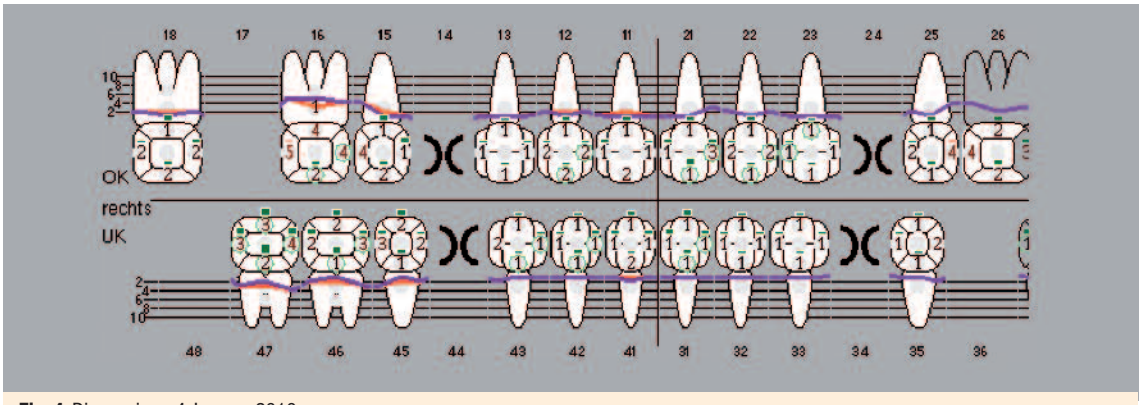


**Fig. 4:** Diagnosis on 4 January 2010.

spite of difficult initial situations we achieve a 90 per cent success rate now. This is due, firstly, to our effective array of instruments—we use a combination of laser and ultrasound devices—and, secondly, it is also a result of the intensive collaboration with patients in the area of preventive care and oral hygiene. Unfortunately, patients today have to pay themselves most of the costs of periodontal treatment and follow-up in Germany. For this reason intensive counselling must be provided in order to ensure their compliance. We give top priority to this in our dental practice. Good collaboration is a prerequisite not only for the reimbursement of therapy costs by the german health insurance funds, but also for the sustained success of periodontal therapy.

## Applying high-tech in the gum pockets

From a medical viewpoint the effective treatment of periodontitis requires great caution. We use two high-tech devices made by the dental equipment manufacturer Sirona: the SIROLaser Advance and the PerioScan. In combination with each other these devices facilitate atraumatic and effective treatment. We started working with lasers during our clinical training. The potential of this technology was so convincing that we integrated laser therapy into our practice concept from the outset. Instead of a scalpel, we use the laser for the excision of inflamed tissue, as well as for effective and long-term bacteria management in the gum pockets. The 'smart' PerioScan ultrasonic system is used for root planing and scaling. In contrast to mechanical instruments the PerioScan can detect and remove calculus.

For the past five years we have deployed the SIROLaser and its successor SIROLaser Advance (diode laser devices designed to treat soft tissue) for periodontal therapy purposes. Its features convince us again and again as this laser allows us to remove diseased tissue gently and thoroughly without having to surgically open the treatment site. In addition, we are able to combat existing infections and prevent new infections. Handling the laser is very simple. The user inserts the tip into the gum pocket and vaporizes the dark-pigmented inflamed tissue—gently and with only minimal discomfort and bleeding. The light-coloured healthy tissue absorbs the laser radiation only to a very limited extent and hence remains unaffected. The laser technology is so 'smart' that the user can work precisely and effectively even without a direct view of the treatment site. With a certain amount of practice the user knows exactly how to move the laser in the gum pocket for a perfect result and when the pocket is practically free of infected tissue.

At the beginning infected tissue adheres to the laser tip. After two or three passes the intensity of vaporization decreases significantly. Correspondingly less tissue adheres to the tip. If the tip is clean when withdrawn from the gum pocket it is safe to assume that the infected tissue has been completely removed. A further advantage is that all four quadrants can be treated during a single appointment. This is not possible in the case of surgical procedures due to their invasive nature and the resultant stress on the patient. So typically only one quadrant is treated per treatment session. By contrast, laser therapy is quicker, less invasive and less painful. This benefits older patients in particular who frequently suffer from chronic diseases.

## Case study

In the following case we used the SIROLaser Advance to treat progressive periodontitis in a 40-year-old female patient. She visited our practice in September 2009 suf-

**Fig. 5:** X-ray after periodontal treatment.


**Fig. 6:** SIROLaser Advance.

fering from severe periodontitis. The patient stated that she had been undergoing periodontal treatment for ten years—but without success. During the first treatment session we diagnosed that eight teeth displayed pocket depths of five to eight millimetres. A further 11 teeth had an attachment loss of three to four millimetres. Due to the severity of the periodontitis we were unable to save teeth 17, 36 and 48; they were extracted a week later. During two subsequent appointments at an interval of one week we removed all the supragingival calculus and instructed the patient in the use of interdental brushes and dental floss. Thanks to the patient's cooperation, she was free of supragingival calculus and infection after three weeks.

In the middle of October we then performed a complete periodontal procedure on the upper and lower jaws during a single appointment. In addition to curettes and scalers we used the SIROLaser Advance and PerioScan. After administering an anaesthetic we deployed the laser device to reduce bacteria and germs in the pockets, remove inflamed tissue and dry out the root surface. In our experience lasered calculus are easier to be removed with the aid of curettes and the PerioScan than calculus that is not lasered. A further reason for deploying the laser first is to minimize the number of pathogens that enter the patient's bloodstream. This is of particular benefit to cardiac patients and allows the dentist to dispense with prophylactic antibiotic coverage. The patient in our case study was not impaired by surgical incisions or sutures. After a brief follow-up examination the following day she was able to return to work.

One week later we once again lasered all the periodontal tissues in order to remove any remaining bacteria. This procedure was painless due to the fact that all the infected tissue had been removed. The patient did not require an anaesthetic. In January 2010 the patient was recalled for a check-up. The laser was once again deployed to remove bacteria. This was followed by professional tooth cleaning (PTC). The gum pockets showed a significant improvement. Isolated bleeding from tooth 16 (distal) and 47 (mesial) was scaled under local anaethsthetic and then treated with the aid of the laser.

The overall periodontal status of the patient has significantly improved. There are very good chances that her situation will continue to improve and then remain stable in the long term. The patient responded very positively to our counselling efforts, the atraumatic treatment method and the measurably good results.

## Conclusion

The laser plays an indispensable role in periodontal treatment. It makes the therapy process easier, faster and more efficient. From the patient's viewpoint laser therapy is gentler, less painful and much less stressful. Elderly patients benefit from this in particular since many of them suffer from various chronic health issues. Thanks to its intuitive user-friendly features, the SIROLaser Advance is easy to learn. The SIROLaser Advance in our dental practice is in constant use and has more than paid for itself.

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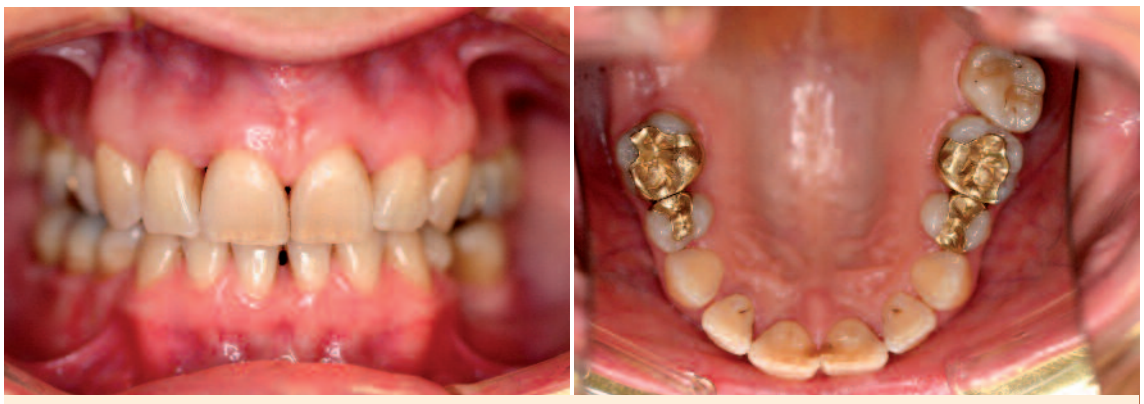

**Figs. 7a & b:** Clinical status after the last laser treatment procedure and professional tooth cleaning (January 2010).

# Virtually no blood loss when treating periodontitis

Stefan Gottschalk

Dentist Stefan Gottschalk from Bensberg in Germany uses modern methods to treat periodon-titis. In this exclusive interview, he spoke about the advantages of lasers for both users and patients, touching key aspects of modern dental laser technology such as indication, effective-ness, appropriate procedures, clinical success and patient acceptance.


**Fig. 1:** PerioScan

***Mr. Gottschalk, how do you approach periodontal treatment?***

Naturally, I start with a diagnosis. At our joint practice, periodontal diagnostics are a core component of all routine check-ups. According to the statistics, around 90 percent of all patients suffer from inflammation of the gingiva or periodontium. And what use is even the best crown if the base of the tooth is not stable as a result of bone resorption?

***In your view, what is modern periodontitis treatment?***

We use modern technologies in all treatment fields in our practice, including periodontitis treatment for which the SIROLaser Advance is employed. In the first step, we remove subgingival inflamed tissue in a gentle and thorough manner. With the laser, only the inflamed tissue is removed. The technology behind this method is highly intelligent; when lasering the inflamed dark-pigmented tissue which absorbs the rays vaporizes whilst the light, healthy tissue is left undisturbed. The treatment is minimally invasive and there is hardly any bleeding. In addition to the removal of diseased tissue, bacteria are also killed off.

***What would you rate handling of the laser?***

Use of the laser demands a certain degree of skill, but this is quickly achieved. With a bit of experience, one soon learns how to ideally guide the laser through the gingival pocket and when the treated pocket is essentially free of inflamed tissue.

***How do you then proceed?***

The removal of coating and calculus is the second treatment step. This is where the ultrasonic device PerioScan,


**Fig. 2:** SIROLaser Advance

also from Sirona, comes into its own. The device offers the advantage that it automatically detects the majority of calculus. As soon as the ultrasonic tip touches the gingival pocket, it reliably provides information regarding the condition of the root surface using visual and acoustic signals. If it detects calculus, we can remove this in one step and then check again without having to remove the tip from the gingival pocket. Switching between detection and removal is quick and simple using the footswitch which means that the working process does not have to be interrupted. As practitioners, we can use the PerioScan in a targeted manner which renders the treatment very efficient and is also gentle on the root surface substance. In turn, our patients benefit from a gentle and virtually pain-free treatment method.

***To what extent are the results of your treatment methods sustainable?***

Bacteria management is all important. To this end, three factors have a role to play: Firstly, we cannot achieve anything without the cooperation of our patients. Before we start treatment, the patient's teeth are cleaned professionally and we advise on tooth and interdental space care. Secondly, we combine use of the PerioScan and SIROLaser Advance in several sittings. The ultrasonic device is employed to locate and remove calculus, it provides optimal support in terms of root planing and scaling. Using the laser device, we kill bacteria below the gingival margin. As such any inflammation is treated and new incidences are prevented. Thirdly, our patients are monitored continuously following treatment. They are ordered in a periodontal ranking. Depending on the state of their gums, they are expected to present three to four times a year for a check-up. After one year, the situation is reviewed again. We aim to subsequently see all periodontitis patients at intervals of six months.

***How do patients react to your treatment methods?***

We have received a lot of positive feedback and have even been able to save teeth which others may have given up on. The alternative to our laser treatment method is flap surgery–compared to use of a laser, this is a rather bloody operation which is far more stressful for the patient. Moreover, the surgical removal of inflamed tissue also removes a considerable amount of healthy tissue given the nature of the procedure. We don't regard this as necessary. Periodontal treatment with the SIROLaser Advance and PerioScan is comparably easier, quicker and less painful. This is a plus, for example, for many older patients and patients suffering from chronic diseases for whom conservative periodontal treatment represents a risk to health.

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# Innovative aids for treating caries with CEREC restorations

Dr Bernhard Kirn

**ABSTRACT**
The treatment of caries is one of the most frequently performed interventions at registered practices. In such cases, it is extremely annoying for both the patient and practitioner if secondary caries make further treatment necessary within a short space of time. This results in patient dissatisfaction, particularly with high-quality solutions such as all-ceramic CEREC restorations, as further treatment is then required and galling further costs are incurred. In order to avoid this, practitioners can use state-of-the-art devices, which still enable minimally invasive techniques to be employed.

**KEYWORDS**
Diode Laser, CEREC, FACE®

**In the case of carious teeth,** the key question is whether all of the caries bacteria has actually been removed from the cavity. If the answer here is no, secondary caries occur below the restoration and it may be necessary to repeat treatment within a short period of time. This is both inconvenient and annoying for the patient and dental practitioner, particularly when high-quality restorations are involved. Dental practitioners are not readily able to replace an all-ceramic restoration, which is somewhat more expensive for patients than a composite filling, to ensure long-term patient loyalty.

At the same time, excessive treatments are also to be avoided. Ideally, the long-term preservation of the restoration should be guaranteed and the intervention should be rendered as minimally invasive as possible. To this end, a range of technical aids are available to dental practitioners today. These include, for example, a device for caries detection and a laser for enabling virtually pain and blood free interventions.


**Fig. 1:** SIROInspect.

## Reliable detection of caries

There are three "conventional" methods for establishing whether a tooth has been affected by caries. Method one: Visual assessment. Unfortunately this method is fraught with error, firstly because tooth discoloration can be completely natural and secondly because it is almost impossible to make a reliable diagnosis in areas that are barely visible.

Method two: The coloring method. Coloring of the affected areas of the tooth is often not very accurate, as visualization of the margins between the carious and healthy tissue is rather indistinct. Method three: The probe. With this, material that has been demineralized due to microbial attack and is thus soft and carious can be distinguished from healthy tooth material. False diagnoses can, nevertheless, not be ruled out, as there is also soft tooth material which is not carious—it is possible that the scale of softening is further advanced than the actual spread of the bacteria.

In 2012, Sirona launched a system onto the market that helps to reliably detect caries. SIROInspect is based on so-called FACE® technology ("Fluorescence-Aided Caries Ex-


**Fig. 2:** CEREC AC, Omnicam and CEREC MC XL.

cavation") and takes advantage of the teeth's fluorescence properties: Whilst healthy dental hard tissue is shown as green, infected dentine turns red when violet light is shone on it. This is due to the porphyrin compounds contained in carious hard tooth substance. Users are provided with comprehensive information about the condition of the dental tissue and are able to reliably diagnose caries. The risk of secondary caries below the CEREC restoration is as good as ruled out.

This technology represents a major step forward, particularly when compared to probes, which can only provide information about the hardness of the tooth point by point. Moreover, no dyes are used with FACE® technology.

## Practically blood-free treatment with a diode laser

A blood-free environment is extremely important, particularly with CEREC treatments, as the fitting accuracy and durability of ceramic restorations depends largely on a detailed, optical impression. Bleeding can result in the preparation or tooth margins not being recorded properly. This in turn can mean that the prosthetic proposal is not optimally designed and thus does not fit when inserted.

**Fig. 3:** SIROLaser Xtend and SIROLaser Advance.

To prevent this, the laser can be used with CAD/CAM treatments in two specific situations. Firstly, to stop bleeding as required—this proves necessary in around 70 percent of cases.

A good example of this is the excavation of subgingival caries; in this case, bleeding impedes the view of the cavity and makes it impossible to use the SIROInspect. Reduction of the gingiva with the SIROLaser stops bleeding without the need for further tools, such as paste, and thereby ensures improved control and time savings. What is more, this procedure is far more pleasant for patients. The diode laser can also be used during the preparation procedure.

With conventional hemostasis methods, the gingiva can still adhere despite hemostasis. This means that the preparation margin is not displayed clearly enough. In such cases, it proves difficult to precisely specify the preparation margin in a 3-D CAD/CAM model, which can result in incorrect calculation of the biogeneric proposal. To prevent this, the preparation margin can be traced using the diode laser just like with a thin mechanical pencil.

## Summary

SIROInspect and SIROLaser Advance provide ideal support for CEREC treatments, particularly when it comes to minimally invasive and virtually pain-free treatment. The caries detection system and improved wound healing thanks to the diode laser, serve to considerably enhance the comfort of the treatment provided. This allows dentists to approach minimally invasive treatments with an unbeatable sense of security and also puts patients at ease; after all, subsequent treatments and additional costs are avoided.

# SIROLaser in the daily practice, a comparison between SIROLaser and its successor SIROLaser Advance

Alexander Krauße

**ABSTRACT**
In my practice, which specializes in periodontics and pediatric dentistry, SIROLaser and SIROLaser Advance were used for endodontics, periodontics and surgical procedures. Along with the similarities of both lasers (same physical parameters and consequent identical range of indications), a comparison of the lasers shows differences in terms of their user-friendliness and handling.

**KEYWORDS**
Diode laser, 970 nm, SIROLaser, SIROLaser Advance, indication range, laser comparison

## Introduction

The history of the dental laser dates back to 1964 with studies of lasers on dental caries[1] and to 1965 as Stern et al. carried out the first studies of the effects on dental hard tissue and vaporized tooth enamel with a ruby laser.[2] After the ruby laser, many others followed, such as the $CO_2$ laser, the argon ion laser, and the first pulsed lasers, Nd:YAG and Er:YAG. While the suitability of the lasers for surgery quickly became apparent, it was not until 1996 that the first dental laser was approved for use on dental hard tissue in the United States and a pulsed Er:YAG by Premier Laser Systems Inc. was put on the market.

Since then, different laser systems have been established, which differ with regard to their indication range due to their physical characteristics. Lomke gives a good overview of the existing lasers on the dental market and their respective range of applications.[3] Broadly speaking, the dental lasers can be categorized according to their application. Hard tissue lasers are, as the name suggests, mainly used to work on dental hard tissue. Classic representatives of these lasers are Er:YAG and Er,Cr:YAG, although the former is also used in endodontics for pulp removal and preparation of the root canal. Due to their low hemostatic effect, the suitability of these lasers for surgical cutting is limited. Classic representatives of surgical cutting lasers are the $CO_2$ laser, which certainly has the best performance of all soft tissue lasers, the argon ion laser, and the diode laser. Due to the complicated handling and maintenance of the argon ion laser, it is only of historical importance. Along with cutting performance, the diode laser can also reduce bacteria in the root canals and periodontal pockets.


**Fig. 1:** SIROLaser with handpiece.

Our practice specializes in periodontics and pediatric dentistry. Therefore, we decided to purchase a diode laser in 2007 and chose the SIROLaser from Sirona Dental Systems, Bensheim, Germany.

The SIROLaser is a small compact device with a maximum output of 7 W cw and is capable of pulsed operation with a duty cycle of 50 % and a frequency of 1–10,000 Hz. The radiation of 970 nm produced in the laser is directed to the treatment site via a 3-meter long fiber. It is locked in position in a handpiece and angled with pre-bent tips (small tubes with different bending angles). The laser is activated with a foot or finger switch, which is connected to the control unit with a cable. At that time, in comparison to the competitors, the device had the smallest dimensions combined with high power output. I treated many patients in endodontics, periodontics, and surgery with this laser. For some time now, I have also been using SIROLaser Advance in my prac-

tice, the successor of the SIROLaser. A comparison of both devices is discussed below.

## Comparison of the lasers

*Construction*

Visually, the lasers differ in their construction. The control unit of the SIROLaser (Fig. 1) is externally considerably more compact than that of its successor, but this is not necessarily an advantage. When all the components are connected, the SIROLaser takes up just as much space as the SIROLaser Advance (Fig. 2). While in the SIROLaser, the long working fiber is directly connected to the laser and the massive high-grade steel handpiece is essentially only used as a handle for the fiber (Fig. 3), in the SIROLaser Advance, conduction of light from the laser to the handpiece is ensured by a firmly installed cable (Fig. 4), which is coiled tightly in place in a groove on the laser. The handpiece of the new model has a removable sleeve, which houses the coupling point for the replacement fibers (Fig. 5). This makes installation and replacement of the fibers much easier than with the previous model. The complex connector for the finger switch was not needed on the SIROLaser Advance, as it could be integrated in the control unit due to the fixed cable connection. The color display of the SIROLaser Advance is significantly larger than the monochromatic one of the previous model and also easily readable even in poor lighting conditions.

Whereas the foot control in the SIROLaser is connected with a cable, the SIROLaser Advance uses an optional wireless foot control.

*Technical data*

The technical data of both lasers (Tab. 1) can be found in the operating instructions.[4,5] Common to both lasers are the physical parameters for laser irradiation, such as wavelength (970 nm), maximum output in cw operation (7 W), and the frequency in pulse operation (1–10,000 Hz); the laser fibers used on the patient are also identical, meaning that both lasers have the identical treatment range.

**Fig. 2:** SIROLaser Advance with handpiece.

The main difference between the lasers is that the new SIROLaser Advance has been equipped with a new peak pulse mode. For this type of operation, very short laser pulses (28 µsec) are delivered with a power output of 14 W followed by comparatively long intervals, so that an average output of up to 6 W is reached.

Another difference is the availability of a battery. While the SIROLaser can only be operated with a power supply, the battery of the SIROLaser Advance gives you the option of setting up the laser freely in the treatment room without a power cord.

*Handling*

There are important differences between the lasers regarding handling. When preparing for a procedure, easy installation of the working fiber with the SIROLaser Advance

| | SIROLaser | SIROLaser Advance |
|---|---|---|
| Wavelength | 970 nm | |
| Pilot beam | 635–650 nm | |
| Optical power | 7 W | |
| Operation modes | cw, pulsed mode | cw, pulsed mode, peak pulse |
| Frequency | 1–10,000 Hz | 1–10,000 Hz |
| Duty cycle | 50 % fixed | 1 %–99 % |
| Optical fiber | Bare fiber | Short fiber on handpiece |
| Available optical fiber | Quartz/doped quartz 200 µm, 320 µm | |
| Activation | Foot control/finger switch | Foot control/finger switch |
| Menu navigation | Yes | Yes |
| Touchscreen | No | Yes |
| Battery operation | No | Yes |
| Tips | 30°, 45°, 60° pre-bent | Freely selectable bending angle, includes bending tool |

**Tab. 1:** Comparison of SIROLaser and SIROLaser Advance technical data.

**Fig. 3:** SIROLaser handpiece with attached finger switch.

**Fig. 4:** SIROLaser Advance handpiece with integrated finger switch.

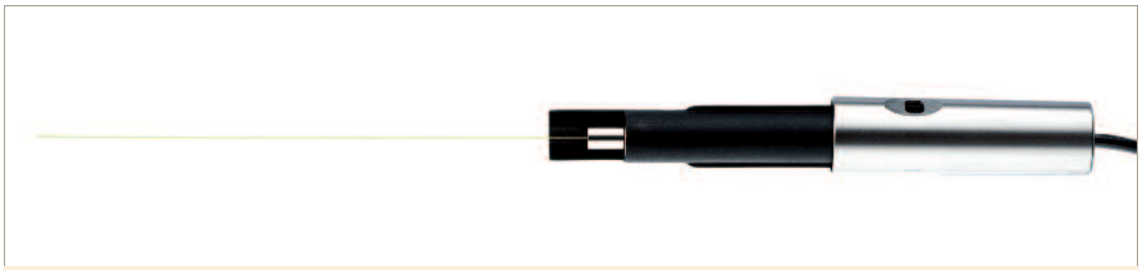

**Fig. 5:** SIROLaser Advance handpiece with removed handpiece sleeve.

saves time compared to attaching the three-meter long fiber on the SIROLaser. The connection of the cabled foot control of the SIROLaser is not included in the SIROLaser Advance because the integrated finger switch is sufficient.

The menu of the newer model offers significant advantages for making settings before treatment, although the time from switching on the laser until it is ready to use could be shorter. The laser parameters are clearly depicted on the color display. It is immediately clear that the parameters displayed in red are not the ones recommended by the manufacturer and a help menu, which is missing with the previous version, indicates the recommended parameters and gives suggestions for treatment. This contributes to treatment safety. During the procedure, the extension sleeves of the SIROLaser Advance, which have a freely adjustable bending angle, are a clear advantage over the fixed pre-bent ones of its predecessor. In the treatment of periodontal pockets, in particular, which often involves frequent changing of the angle of the laser fiber to the handpiece, it can be quickly bent with the sterilizable bending tool provided. In my experience, the fit of the new sleeves is significantly better than with the previous model.

After the treatment, the fiber and handpiece with the SIROLaser, including the sleeves, are sterilized. With the SIROLaser Advance, only the replacement fiber and handpiece sleeve need to be sterilized. The extension sleeves of the SIROLaser Advance are intended to be used only once.

*Safety and hygiene*

Laser safety is ensured by the conformity with international standards IEC 60601-2-22 and IEC 60601-1-6. Both lasers comply with these standards. In addition, both lasers are comparable in terms of hygiene and all of the parts that come into contact with the patient are autoclavable.

*Indication range*

Due to the fact that the physical parameters of the lasers are completely comparable, the indication range of both is identical. The SIROLaser Advance offers a few more pre-set indications than its predecessor (Tab. 2).

In my practice, along with a reduction of bacteria in the root canal and periodontal pockets, the surgical indications fibroma, fistula (adjuvant therapy), frenectomy, gingivectomy, gingivoplasty, and operculectomy were treated with the laser. All of the procedures were bloodless and free of side effects such as necrosis and scar formation.

| | SIROLaser | SIROLaser Advance |
|---|---|---|
| Endodontal germ reduction | X | X |
| Gangrene germ reduction | X | X |
| Pulpotomy | | X |
| Periodontal lesions/laser curettage | X | X |
| Periodontal pockets/perio-dontal germ reduction | X | X |
| Peri-implantitis | X | |
| Gingivectomy | X | |
| Exposing implants | X | X |
| Operculectomy | X | X |
| Frenectomy | X | |
| Hemostasis | X | X |
| Gingival incisions | X | |
| Aphthous ulcers | X | X |
| Herpes | X | X |
| Desensitization | | X |
| Abscess | | X |
| Epulis | | X |
| Fibroma | | X |
| Fistula | | X |
| Frenectomy | | X |
| Gingivoplasty | | X |
| Incision/Excision | | X |
| Gingival troughing | | X |

**Tab. 2:** Comparison of pre-set indications of both lasers.

## Summary

The SIROLaser and SIROLaser Advance are identical in terms of their physical parameters; therefore their indication range is also identical. With regard to safety and hygiene, both are comparable.

A direct comparison of both lasers shows differences in handling and equipment. The SIROLaser Advance as the successor of the SIROLaser is easier to operate, has a user-friendlier menu and more preset indications.

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# Laser and CEREC: High-tech combination for optimal workflow

Dr Michael Maier

**ABSTRACT**
Making digital impressions has been established for many years. CAD/CAM systems, such as CEREC from Sirona, stand for precise work, a less delicate manufacturing process and, above all, high patient comfort. During treatment, a blood-free environment is extremely important to guarantee that the impression is free from errors. Diode lasers, in particular, are suited for hemostasis and can also be used to expose the preparation margins. Using lasers during CAD/CAM treatments ensures fast, clean and precise results. The image enhancement, which a practice may experience, should also not be underestimated.

**KEYWORDS**
Diode laser, CAD/CAM, restorations, gingival troughing, hemostasis

**The first impression counts.** Of course that also holds true for dentists, particularly if we want to convince our patients to make their next appointment with us and to have them recommend our practice to friends and relatives. A positive image is extremely valuable, especially during times when dentists often have to earn their money through out-of-pocket expenses.In my opinion, there are three important factors for achieving a convincing practice appearance. Firstly, well-trained and friendly personnel. Secondly, attractive design and bright rooms. Thirdly, extensive dental know-how as well as state-of-the-art technical equipment. If these three factors are fulfilled, your patients also feel comfortable, which, in the end, is essential for the success of a dental practice. An image is mainly created by word of mouth and personal recommendations. It is my experience that technical equipment plays an ever-growing role for patients. A modern practice shows them that the dentist is up-to-date. What also stands out is that my patients ask for high-tech treatments more frequently, e.g. for laser.

## Treatment without time loss

At my practice, I use the SIROLaser Advance developed by Sirona located in Bensheim, Germany. My experience with the predecessor of this model, the SIROLaser, was excellent and I use the diode laser up to four times per day, on average. For me as a dentist, it is important that the laser is versatile, that it can also be used in endodontics and periodontology. The device exhibits a high degree of efficiency with low maintenance requirements. But first and foremost, it is flexible and easy to use. Due to the compact design, it is easy and fast to move from one room to the next and is ready for use within just a few moments. Due to the self-explanatory and well laid out menu navigation as well as the preset programs that can be controlled via touchscreen, the desired parameters can be quickly programmed– be it gingival tissue removal or root canal treatment. This way, you can get to work without losing any valuable time. I mainly use the SIROLaser Advance for surgical interventions for reducing gingival tissue. Removing excess gingival tissue helps me to get a better overview, especially when I have to prepare subgingival regions. It allows me to work in a targeted and clean manner and avoids traumatic lesions to the gingiva, which always signifies worsened wound healing and bleeding.

## Laser ensures blood-free treatment

It is imperative that bleeding be minimized for digital impressions. The accuracy of the fit and durability of ceramic

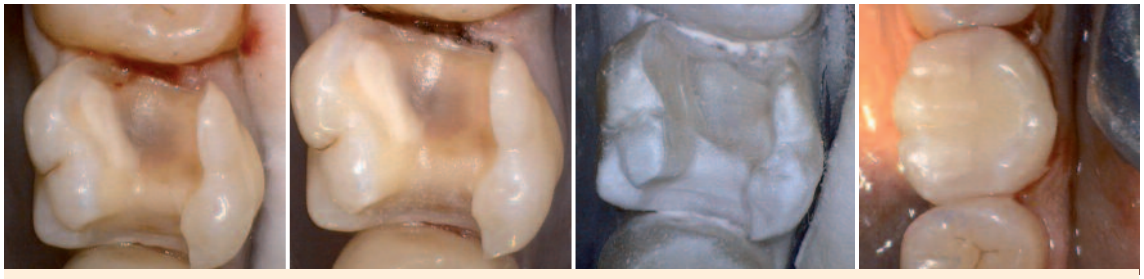

**Fig. 1:** Tooth 16 after preparation. – **Fig. 2:** After hemostasis. – **Fig. 3:** Digitalized image of the tooth situation. – **Fig.4:** Ceramic restoration after CEREC treatment.

**Fig. 5:** In combination with CEREC, SIROLaser Advance is ideal for hemostasis and for treating the preparation margins.

restorations predominantly depend on a detailed optical impression. To guarantee this, however, the scan powder must not come into contact with blood, since this can lead to imprecise results. When the preparation or tooth margins are not clearly recorded, this can result in the restorations not fitting when inserted. To prevent this, the laser can be used with CAD/CAM treatments in two specific situations: For hemostasis: I always use the laser when there is bleeding during the CEREC treatment–which happens in approximately 70 per cent of cases. If, for example, I have to remove caries from the tooth before using the CAD/CAM system and if it is subgingival, I often do not see clearly where the healthy tooth begins due to bleeding. I then remove a part of the gingiva with the laser and stop the bleeding. I can then excavate under visual inspection. I also gain better control and save on time since constantly spraying, washing and stopping the bleeding, e.g. via retraction thread or paste, is not necessary. This is also significantly more pleasant for the patient. I also use the laser to prevent blood oozing in the gingiva. This bleeding is often minimal, but enough to contaminate the powder during the CEREC treatment.

## Exact representation of the preparation margin

I also use the SIROLaser Advance to treat the preparation margin. Traditional hemostasis methods may inhibit bleeding, but the gums may still be sticky so that the preparation margin cannot be displayed clearly enough. However it is important that it can be well seen in the 3-D model of the CAD/CAM system to clearly determine the preparation margins; otherwise the biogeneric proposal is falsely calculated. This is why I use the diode laser and its fine fibers to trace the preparation margin just like with a thin mechanical pencil. In doing so, I can remove 0.3 mm or even less gingival tissue around the preparation margin. In the following case, I used CEREC in combination with the soft tissue laser. The example shows a male patient, born in 1967, exhibiting a fractured ceramic inlay in tooth 16. After having prepared the tooth using the SIROLaser Advance (preset parameters: 2 W, 20 Hz, 50 % duty cycle, 320 µm fiber; Fig. 1) as well as having used the hemostasis program for stopping the bleeding (preset parameters: 3 W, continuous wave, 320 µm fiber; Fig. 2), I had no problems applying the scan powder for the following image with the CEREC Bluecam. Using the digitalized image (Fig. 3) and the model calculations of the software, I constructed a fitting inlay with just a few clicks. The milling unit CEREC MC XL that I use in my practice milled this restoration within a few minutes out of a prefabricated ceramic block (IPS empress a2 HT, Ivoclar Vivadent). We were able to insert the finished product during the same appointment and secure it with Variodent Ultra. From my point of view, the results (Fig. 4) are very satisfactory, and the patient agrees.

## Summary

Since CEREC and SIROLaser and its successor SIROLaser Advance came onto the market, I have worked with them successfully. I personally have had only good experiences with the combination of these two systems. The advantages of the CEREC treatment in combination with the SIROLaser Advance include blood-free procedures, a clear overview and better healing. Both the CAD/CAM system as well as the diode laser have a permanent place in my practice's daily routine. CEREC is significantly more pleasant for the patients than traditional methods of making impressions. Working with the SIROLaser Advance is faster, more exact and is simply fun. And the patients, at least in my experience, like to come back.

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# Diode lasers: Effective and economic

Dr Almut Marsch

**ABSTRACT**
Guaranteeing the best possible medical care for the patient is the top priority for all dentists. At the same time, the dental practice is a business which, in times of ever-increasing competition, endeavors to ensure that patients remain loyal. This is a real balancing act. According to the author Almut Marsch, her diode laser allows her to achieve just the right balance.

**KEYWORDS**
Diode laser, 970 nm, endodontics, germ reduction

**I started working with the SIROLaser Advance,** a diode laser developed by the company Sirona which is based in Bensheim, Germany, in 2009. The wavelength of this laser (970 nm) allows a wide range of possible applications. The use of the laser is beneficial to both the practitioner and the patient—all in all, a win-win situation. For patients, treatment is gentler, safer and associated with quicker healing. As the practitioner, I firstly benefit from the lack of blood in the treatment area during surgical interventions as a result of the laser. This facilitates dental work and, secondly, tangibly reduces the amount of time required.

As a CEREC user I value this advantage during excision and hemostasis to visualize the preparation margin. The second positive property of the laser is the reduction of detrimental bacteria in the tissue which, in turn, aids safe healing and allows a good prognosis to be made, a fundamental factor for patient satisfaction. I have had many positive experiences with the use of laser, particularly in the field of endodontics.

## Endodontics: Lasers reliably reduce bacteria

We've all been there: The patient presents at the practice with a swollen cheek and complains of severe pain. The assumptions based on the clinical situation are confirmed radiologically–severe apical osteitis. In days gone by this would have certainly been a case for extraction or an infaust prognosis, particularly if endodontics were not one of the practitioner's specialist fields. Since working with laser, I have successfully solved many such cases without any problems and with long-term success.

Treatment case: As in the case described above, a patient came to me with severe pain in the left lower jaw (see images). Tooth 35 was quickly identified and diagnosed as the cause both clinically given the problems when biting and radiologically due to apical lucency about the size of a pea (Fig. 1). Trepanning was performed and the tooth was prepared following production of an optical impression (Fig. 2) and rinsed with sodium hypochlorite solution. After drying of the canal, I treated it using the SIROLaser Advance.

One week later, within the framework of insertion of medicinal lining, the diode laser was used again. At this point in time, the patient's symptoms had improved significantly and the tooth was no longer sensitive to bite. In the next appointment, the tooth could be filled, once again using the laser (Fig. 3). The control exposure taken 18 months later confirms that the apical osteitis has completely disappeared (Fig. 4).

Success stories like this are certainly not the exception. With conventional root canal treatments using rinsing fluids, in most cases only the amount of bacteria in the main canal is reduced. Bacteria in the apical delta area and around the apexare, however, still present. When using the laser, a bactericidal effect is achieved in the periapical tissue and the small accessory canals. This certainly explains the success seen in seemingly hopeless endodontic cases.

Take, for example, one of the last times when I stepped in for a colleague on holiday; using the SIROLaser Advance I was able to successfully treat a female patient with a swollen cheek and profuse pus discharge in three appointments following trepanation and without the need for antibiotics. The patient was quickly free from symptoms.

## "Laser sword" instead of a scalpel

And, of course, the attractiveness of the laser goes beyond the field of endodontics. On the basis of the informa-

**Fig. 1:** Initial radiograph showing pea-sized lightened area in the apex.

**Fig. 2:** Measurement radiograph preventing the treatment.

**Fig. 3:** Radiograph after laser-supported filling of the tooth.

**Fig. 4:** Control radiograph 18 month later.

tion in the media, it is generally believed that everything is simpler, better and less painful when a laser is used. This impression is confirmed when one considers separation of the labial frenulum in children. Even some adults would run out of the room in a state of panic if I were to use a scalpel for such interventions. Yet when I talk about my "laser sword", children forget their fears and become almost enthusiastic. Parents are relaxed and I, as the practitioner, value the fact that the treatment area remains virtually blood-free and clear. Naturally, such positive experiences have a beneficial effect on the practice's image.

In addition to its value as a marketing and patient loyalty instrument, procurement of the SIROLaser Advance is also worthwhile given its broad range of possible applications. It can even be used for pain management with aphthous ulcers and herpes.

Its bacteria-reducing effect aids periodontological treatments and, in the case of most surgical interventions, it offers a gentler and less fear-inducing alternative to the scalpel.

## Like a modern smart phone

Compared to the previously used Nd:YAG laser which has a similar range of applications as the diode laser, it is essentially the compact design of the SIROLaser Advance which impresses me most.

Yet the value for money offered and the quick availability also speak for the diode laser. The device is space-saving, handy and very easy to use. The support offered by Sirona is outstanding and includes user training for those who are new to laser applications in the product price. The self-explanatory menu guide reminds me of modern, intuitive smart phones. Given the preprogrammed settings, anyone is able to start treatment quickly and easily. Moreover, thanks to its long-life battery, the device can be used without cables which makes me very mobile.

## Summary

I can't imagine working without the SIROLaser Advance. It is highly regarded by my patients and gives the practice a modern and innovative image and also helps to improve patient loyalty. I can use the laser in a great variety of ways to make my day-to-day work much easier.

Diode lasers such as the SIROLaser Advance from Sirona thus help to ensure optimal patient care and boost the success of the practice. As such, this investment quickly paid for itself.

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# SIROLaser Factbook – Clinical articles about SIROLaser Advance and Xtend applications

A compact and informative collection of scientific articles and case reports about SIROLaser Advance and SIROLaser Xtend with their indications in:

- Endodontics
- Periodontology
- Surgery
- Desensitization
- Aphthous and herpetic ulcers

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