Diode laser surface decontamination in periodontitis therapy

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

High-performance diode lasers emit monochromatic coherent light at a wavelength of 810 nm. This light is absorbed particularly well by dark surfaces. Thus, the injection laser (diode laser) is ideally suited to perform cuts, as are common in dental surgery, as well as for the removal of benign tumors in the oral cavity, for exposing implants and for use in mucogingival surgery. This excellent cutting performance of the diode laser can be attributed to the exceptional absorption of the laser light by the hemoglobin in the tissue. Aside from an application in soft-tissue surgery, the diode laser is also used for decontaminating surfaces that are colonized by germs (on implants and teeth). It was proven in these applications that especially a gram-negative, anaerobic germ spectrum is sufficiently damaged by the laser light.

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

Material and methodology
We are presenting treatment results for three patients who received dental treatment over a period of 15 years (12/94-04/10). Initially, these three patients suffered from a profound parodontopathy with inadequate degermination of supportive tissue. The course of treatment for these three patients proceeded according to the following regimen:

1. Initial therapy (12-1994 through 01-1995)
   - Motivation and instruction of the patient
   - Cleaning and polishing
   - Application of disinfecting agents

2. Resective phase (01-1995 and/or 02-1995)
   - Creation of a mucoperiosteal flap
   - Removal of granulation tissue
   - Decontamination with diode laser light (p=1.0 Watt; tmax=20 sec)
   - Apical shifting of soft tissue 3.
   - Reconstructive phase (01-1995 and/or 02-1995)

Bone augmentation, if required
   - Mucogingival corrections, if required

4. Recall phase (from 05-1995 to present)
   - After 4 weeks, 6 months, 1 year and then annually: complete survey of clinical evidence, X-ray diagnosis, repeated decontamination with diode laser light of exposed root areas, if required.

Imaging procedures
As a general rule, the orthopantomogram (pano ramic tomography) and in special cases/as a supplementary measure dental film images as a parallel technique were the applied imaging procedures.

A-scan and B-scan ultrasonography was also used in a few cases of exacerbated inflammations. An orthopantomogram was taken preoperatively and immediately post-operatively, and a pano-ramic tomography every three years thereafter.

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

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

The advantage of these hybridization tubes was that no live material from the probed areas was required for cultivation, thus reducing work in the dental practice. In addition, the results were available much faster than with the classic microbial examination. The disadvantage of these rapid tests is a relatively high price and the fact that the examined germs and evaluated the so-called marker germ values.

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

Light laser decontamination
Decontamination was an essential part of the overall therapy. It was achieved with diode laser light of 810 nm wavelength, 1 watt of power and an application time of 20 seconds per tooth and implant under fiber contact.
Three patient cases 1995/2010

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

CASE 1

Fig. 15 X-ray image dating back to 1994 (requested by a previous dentist).

Fig. 16 Panoramic tomography taken in 1995 (commencement of treatment).

Fig. 17 Initial X-ray image taken in 2001 (6-year follow-up).

Fig. 18 Initial clinical images taken in 2010.

The holding therapy case

Female patient, born in 1954.

Medical history

The patient went to the Sunday emergency service at the Freiburg dental clinic because of pain in tooth 37. A profound parodontitis was diagnosed there, and the patient came to our department on the following Monday requesting treatment. She had received a complete fixed restoration from her dentist 6 months ago, but without a preprosthetic X-ray diagnosis. Ms. D. is a healthy and very health-conscious physiotherapist.

Clinical baseline findings (1995)

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

X-ray diagnosis (1995)

The panoramic tomography (orthopantomogram) shows severe horizontal and vertical bone lesions. Teeth 35 and 26 have dish-shaped defects. Trifurcation 54 is opened radiologically in continuous wave mode. When adhering to these parameters (time limitation and power limitation) it can be guaranteed that the germ spectrum causing the disease can be sufficiently damaged and at the same time that pulpa and/or peri-implant or peri-implantum-parodontal tissue structures do not suffer any thermal damage (Bach and Krekeler [1994]).

Diagnosis

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

CASE 2

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

Figs. 17–19 Baseline findings in 1995.

Fig. 20 Four-year follow-up 1999.

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

Course of treatment 1995–2010

Tooth 37 was extracted within the scope of initial pain treatment, as were teeth 26, 17 and 51. Removable immediate prostheses were incorporated because all three pontic reconstructions had to be destroyed during the extraction therapy. The pretreatment phase proved to be unproblematic; the patient was very motivated and eager to learn the oral hygiene techniques as instructed.

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

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

First re-inflammations of the marginal parodontopathy were noticed in 2006; all of the teeth 14, 15 and 27 was performed once again. Due to sub- clinical but latent discomfort, teeth 15, 14 and 27 were removed at the beginning of 2010 and a new concept for treatment of the maxilla was developed.

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

Epicrisis

Very remarkable in this patient was the considerable amount of trust she had—in spite of bad experiences in the past—in the new laser-assisted therapy concept, which was out of the ordinary at the time. Her compliance was exceptionally good for the entire 15 years. Because of her conscientious oral hygiene and strict adherence to the recall system she remained recurrence-free for more than a decade. This still holds true for the mandible, while the described massive degeneration of supportive tissue required the removal of three maxillary teeth.

Thanks to the diode laser assisted periodontal therapy and the continuous recall, the patient was able to retain the majority of her teeth in the maxilla and the fixed prostheses for a longer period of time. It was only recently that this concept in the maxilla had to be modified in favor of a removable one; however, this occurred 15 years after a similar suggestion (removable prosthesis) had been made by her attending dentist at the time.

CASE 3

Fig. 15, X-ray image dating back to 1994 (requested by a previous dentist).

Fig. 16 Panoramic tomography taken in 1995 (commencement of treatment).

Fig. 17 Initial X-ray image taken in 2001 (6-year follow-up).

Fig. 18 Initial clinical images taken in 2010.

Fig. 19 Fig. 20

Fig. 21 Fig. 22

Fig. 23 Fig. 24

The principle of increasing the number of abutment teeth is still being pursued twelve years after commencement of treatment (OPG dating back to 2007).

Fig. 23 Current panoramic tomography taken in 2010.

Figs. 24–26 Clinical images taken in 2010. In the frontal view as well as in the lateral views and both jaw views without irritations prevail for the most part.

Fig. 21, X-ray diagnosed, stating that he was completely healthy.

Second case (Figs. 15–24)

Success due to (laser-assisted) recall case

Male patient, born in 1958.

Medical history

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

He consulted the successor of his former dentist at the dental practice. However, this dentist did not pay much attention to his descriptions (discomfort) and only remarked once that “there is nothing that can be done!”. The patient had obtained the last OPG that had been taken and brought it to the initial examination at our clinic, but he refused (three months later at our clinic) a new X-ray diagnosis, stating that he was completely healthy.
Clinical baseline findings in 1995

Teeth 27 and 57, 58 showed a degree of loosening of I–II. The side teeth showed increased probing depths, and a BOP was detected in general. The front mandible was found to be without irritation due to the patient's deep-set alveolar spaces and soft deposits. There were edentulous spaces 16, 25, 26, 27, 45, 46, 55, 56.

X-ray diagnosis (1995)

The treatment planning (orthopantomogram) shows an adult dentition with general horizontal bone loss and profound vertical bone lesions on the following teeth: 17, 24, 27, 47 and 48. The patient was not able to remove the calculus, even with periodontal cleaning.

Diagnosis

Adult marginal periodontitis.

Course of treatment 1995–2010

The entire pre-treatment phase proved to be without complication due to the patient's initially high compliance. The teeth of the maxilla and the mandible were treated with a mixed open (side-tooth area) and closed (front-tooth area) curettment in the subsequent surgical phase. The surgical part of the periodontal treatment was completed in April of 1995. Since then the patient has been in the recall system, which he took very seriously and which helped him to remain recurrence-free after a period of 15 years.

Clinical baseline findings (1995)

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

X-ray diagnosis (1995)

In the maxilla, the osseous alveolar crest had been markedly reduced. The alveolar ridge in the area of the tooth gap 12, 11 is severely atrophied. Bone mass in the mandible is also reduced, although not as extensively as in the maxilla. Tooth 45 had received a root canal treatment. The crown edges of the cast restorations do not align perfectly with the contour of the teeth and mostly have an overhanging design.

Diagnosis

Severe adult marginal periodontitis.

Course of treatment 1995 to present

Our most difficult task initially was to appease the patient's dissatisfaction because he felt he had been taken for a ride. After we had successfully done that, the patient eagerly followed our instructions and followed a frequent and sufficient oral hygiene regime. He grew especially fond of interdental cleaning which he had to be extracted, as did tooth 23 in the left half of the maxilla, which had been there for a longer period of time. We treated with three implants that received crowns after a three-month osseointegration period. We arranged with the patient that he should participate in a quarterly recall and make a new appointment upon completion of the respective recall. He has been recurrence-free since then.

The X-ray images showed a marked tendency for reduction of the osseous crestitious in region 12, 11, and after their osseointegration, two blocked crowns. Due to the severe bone degeneration and the patient's wish to forego augmentation, we arrived far below the cement-enamel junction of the adjacent teeth in one oral implant; however, this did not pose a problem due to the patient's extremely long upper lip. The patient has been in our recall system for 15 years now; he has not missed one recall appointment and has been recurrence-free ever since. A successive prophylaxis, curettment with a laser light device, and ultim ately successful._

3rd Case (Figs. 25–34)

The “completely delightful long-term patient”

Male patient, born in 1952.

Medical history

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

Discussion

The patient had received primarily cast restorations. Tooth 24 (note: this tooth was also extracted) and another tooth showed any substantial changes in the course of the osseous limbus alveolaris. The implants also did not show any changes of the perimplant osseous condition in comparison to insertion up to the present day.

Episcirsis

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

Episoeis

I feel that—on the “credit side”—we have the patient’s excellent cooperation, which has not diminished to this day, and the long recurrence-free period. In this context, one should not forget the extent of the previous periodontitis. These aspects leave a very satisfying impression.Implants in regions 12, 11, 13, and after their osseointegration, two blocked crowns. Due to the severe bone degeneration and the patient’s wish to forego augmentation, we arrived far below the cement-enamel junction of the adjacent teeth in one oral implant; however, this did not pose a problem due to the patient’s extremely long upper lip. The patient has been in our recall system for 15 years now; he has not missed one recall appointment and has been recurrence-free ever since. A successive prophylaxis, curettment with a laser light device, and ultimately successful._

X-ray diagnosis (1995)

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

Diagnosis

Severe adult marginal periodontitis.

Course of treatment 1995 to present

Our most difficult task initially was to appease the patient’s dissatisfaction because he felt he had been taken for a ride. After we had successfully done that, the patient eagerly followed our instructions and followed a frequent and sufficient oral hygiene regime. He grew especially fond of interdental cleaning which he had never been mentioned to him before. In May 1995 we started the corrective phase, which was completed in July. We carried out lobe surgery with apical soft tissue fixation in all quadrants. The patient received two implants in regions 12, 11, and after their osseointegration, two blocked crowns. Due to the severe bone degeneration and the patient’s wish to forego augmentation, we arrived far below the cement-enamel junction of the adjacent teeth in one oral implant; however, this did not pose a problem due to the patient’s extremely long upper lip. The patient has been in our recall system for 15 years now; he has not missed one recall appointment and has been recurrence-free ever since. A successive prophylaxis, curettment with a laser light device, and ultimately successful._

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