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 periodontopathy who have undergone resective surgical therapy, at times including reconstructive work. Correspondingly, there is only a limited amount of literature regarding the non-exposed root areas. 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. By the end of 1994 patients were treated with this “new” laser wavelength for the first time, which had not been used in dentistry up until that time. The Freiburg laser work group led by Krekeler and Bach, who were the first ones to deal with the integration of diode laser light in dentistry, noticed the considerable advantages of this new technology.

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

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 periodontopathy with inadequate degeneration 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 disinfesting 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
   - Reconstructive phase (01-1995 and/or 02-1995)

3. Recall phase (from 05-1995)
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 measurement 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 excrated inflamations. 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 anatomical 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

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

The result was considered negative if less than 0.1 % 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 marker germ and high if more than 10 % was identified as marker germ.

Laser light decontamination

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

CASE 1

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

Fig. 2-4. Baseline findings in 1995.

Fig. 5a & b. Tooth 37 was not conservable in spite of hemisection (August 1995), resulting in a large ostehious space in the third quadrant (November 1995).

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5. Reconstructive phase (01-1995 and/or 02-1995)
CASE 2

Fig. 15. Panoramic tomography taken in 1995.

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

Fig. 17. Baseline findings taken in 1995.

Fig. 18. Four-year follow-up in 1999.

Fig. 19. Panoramic tomography taken in 2004; dental implants were inserted to increase the number of abutment teeth.

Diagnosis

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

Course of treatment 1995–2010

Tooth 57 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.

In continuous wave mode. When adhering to these parameters (time limitation and power limitation) it can be guaranteed that the germ spectrum causing the disease can be sufficiently damaged and at the same time that pulpa and/or peri-implant or periodontal tissue structures do not suffer any thermal damage (Bach and Krekeler [1994]).

Three patient cases 1995/2010

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 3

Fig. 25. X-ray image dating back to 1994 (requested by a previous dentist).

Fig. 26. Panoramic tomography taken in 1995 (commencement of treatment).

Fig. 27 & 28. Initial clinical images dating back to 1995.

Fig. 29. Follow-up X-ray image taken in 2004 (6-year follow-up).

Fig. 30. 11-year follow-up in 2006.

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 at the beginning of the new decade.齿 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 14 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 antececedent 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 1

The holding therapy case Female patient, born in 1954.

Medical history

The patient went to the Sunday emergency service at the Freiburg dental clinic because of pain in tooth 37. A profound parodontopathy was diagnosed there, and the patient came to our department on the following Monday requesting treatment. She had received a complete fixed restoration from her dentist 6 months earlier. She wanted 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 profuse, hard plaque, and soft deposits, also under the trifurcation.

X-ray diagnosis (1995)

The panoramic tomography (orthopantomogram) shows severe horizontal and vertical bone lesions. Teeth 55 and 26 have dish-shaped defects. Trifurcation 54 is opened radiologically.

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2nd 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 varying probing depths, and a BOP was detected in general. The front mandible was found to be without irritation, and the interdental spaces had soft deposits. There were edentulous spaces 16, 25, 26, 27, 45, 46, 55, 56.

X-ray diagnosis (1995)
The pre-treatment radiography (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 decided to participate in a prospective recall system, which he took very seriously.

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) curettage 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 initially and which helped him to remain recurrence-free for four years after the surgical treatment. From 1999 to 2005 the recall started to become difficult because the patient did not show up in spite of appointments or rescheduled appointments on short notice. At the beginning of 2005 increased probing depths were found on 23, 24 and 27 and three additional teeth exhibited bleeding when probed. Another curettage with laser light decontamination resulted in a decrease of the inflammation; however, 27 could not be saved and had to be extracted. He was then referred to our clinic. The patient was quite obviously unhappy with the loss of two teeth and the referral (“I feel pushed off”). He is a physical education teacher at a high school and stated that he was completely healthy.

Clinical baseline findings (1995)

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

X-ray diagnosis (1995)

In the maxilla, the osseous lamina 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 interventional cleaning which he had never 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 high 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 with maintenance of the oral hygiene, growth of a component crown, which had become insufficient, was carried out over the course of several years.

Discussion

The diode laser decontamination study (Krejci [Rahm University Dental Clinic, Freiburg/Breisgau]) that started in 1984 and 1985 was made up of 25 patients, of which seven are still receiving treatment. The extremely long examination period (15 years) naturally limited the number of patients we could examine and treat. Some of the patients, who are no longer in our recall system, have unfortunately passed away in the meantime, while others have moved away or found a different dentist who is located closer to their new residence (usually a care home). Over the years, three “patient types” have emerged—the “holding therapy” type, the “implantative recall type to avoid being the unsuccessful type” and the “successful type”. The purpose of this paper is to present these three types by way of individual examples. Diode laser light decontamination proved to be very helpful in all examined patients—feel that, based on the current results, this assessment is justified because the incorporation...