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 even with reconstructive work. Correspondingly, there is only a limited amount of literature available due to the aforementioned facts. 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 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 muco-surgical 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 degeneration of supportive tissue. The course of treatment for these three patients is presented 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.
3. Reconstructive phase (01-1995 and/or 02-1995)
   - Bone augmentation, if required
   - Muco-gingival 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 the hemoglobin in the tissue.

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 disadvantage of these rapid tests is a relatively high price and the fact that the employed product only detects special marker germs so that not all microbial organisms in the sulcus can be identified.

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 0.1-4.59 % 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.

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.

CASE 1

The periodontal lesions (vertical bone degeneration) on tooth 15, 14, 24, 25 are so advanced that these teeth can be considered non-conservable.

Fig. 12. The periodontal lesions

There are essential modifications in comparison with the baseline findings regarding the maxilla. Some teeth have to be extracted. Furthermore, a removable bridge (telescopic bridge) was inserted.
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 pulp 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 2

The holding therapy case

The patient went to the Sun-
day emergency service at the Freiburg dental clinic because of pain in tooth 57. 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 ago, but without a pro-
thetic 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 tooth 26 and tooth 45. Mesial probing resulted in profound, 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 55 and 26 have dish-shaped defects. Trifurcation 54 is opened radiologically.

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 treat-
ment, as were teeth 26, 17 and 55. Removable immediate prosthe-
ses were incorporated because all three pontic reconstructions had to be destroyed during the extraction therapy. The pretreat-
ment phase proved to be unpro-
blematic; the patient was very moti-
tivated and eager to learn the oral hygiene techniques as in-
structed.

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

This condition was main-
tained from the end of 1996 to 2008. The patient conscien-
tiously observed all recall ap-
pointments. Aside from the usual cleaning, motivation and in-
struction steps, a diode laser light application was always per-
formed. Special emphasis was placed on the periodontally se-
verely damaged premolars and the remaining molar 27.

First re-inflammations of the marginal parodontopathy were noticed in 2000. Removal of teeth 14, 15 and 27 was per-
formed once again. Due to sub-
liminal 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 pros-
thesis (cuspids 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 pa-
tient 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 ordi-
nary at the time. Her compli-
ance was exceptionally good for the entire 15 years. Because of her conscientious oral hygiene and strict adherence to the recall system she remained recur-
rence-free for more than a decade. This still holds true for the mandible, while the an-
tecedent massive degeneration of supportive tissue required the removal of three maxillary teeth. Thanks to the diode laser as-
sisted 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 pe-
riod of time. It was only recently that this concept in the maxilla had to be modified in favor of a re-
movable one; however, this oc-
curred 15 years after a similar suggestion (removable prosth-
es) had been made by her at-
tending dentist at the time.

X-ray diagnosis, stating that he was completely healthy.
Clinical baseline findings in 1995

Tooth 27 and 57, 58 showed a degree of loosening of I–II. The side teeth showed high probing depths, and a BOP was detected in general. The front mandible was found to be without irritation. The interdental spaces had soft deposits. There were edentulous spaces 16, 20, 26, 27, 25, 45, 46, 55, 56.

X-ray diagnosis (1995)
The panoramic radiography (orthopantomogram) shows an adult dentition with general horizontal bone loss and profound vertical bone lesions on the following teeth: 17, 24, 27, 17 and 47. The patient had received primarily cast restorations. Tooth 24 shows two apical radiolucencies and an apex and a discrete periapical transluscent zone.

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. In 2005, we could find that his teeth 12 and 11 were “loose” 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 lingus 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 has 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 forgo 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 deep-set upper lip. The patient had 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 prosthetic treatment of single (component) crowns, which had become insufficient, was carried out over the course of several years.

Epicrosis

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.