Conventional Versus Laser-Assisted Therapy of Periimplantitis: A Five-Year Comparative Study

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Between 1994 and 1999, 50 patients were treated with either profound parodontopathy (30) or periimplantitis (20). Half of each of the two groups of patients was treated conventionally, and the other half was treated with laser support. Before the operation, microbiological examinations were carried out, in addition to registering the clinical findings and taking x-rays. These procedures were repeated after the operation, and again after 6, 12, 24, 36, 48, and 60 months. The surgical part of therapy for each half of the patient groups included surface decontamination with diode laser light (1-watt output, maximum of 20 seconds) in addition to conventional procedures. The values of the laser-supported therapy were lower than those specified in the relevant literature. The relapse rate of the two diseases (13% for the periimplantitis and 23% for the parodontopathy group) after 5 years was lower than the comparative values of researched literature where decontamination was not included in the therapy. We think that integrating diode laser light decontamination in the approved treatment schemes for periimplantitis and parodontitis contributes considerably to the success of this therapy. (Implant Dent 2000;9:247–251)

Key Words: diode laser, laser decontamination, profound parodontopathy, periimplantitis

Contrary to other solid-state or gas lasers, the surgical diode lasers emit coherent, monochromatic light of wavelengths between 800 and 900 nm (ie, in near infrared).[1,2,10,40,41] This radiation is absorbed in dark media, as in hemoglobin. It, therefore, has a remarkable surgical cutting efficiency in well-vascularized tissue.[3–5,9,29,30,33]

A primary indication for the application of the diode lasers is the decontamination of surfaces with bacterial overgrowth by mostly black pigmented anaerobic rods.[6–8,38] In recent years, numerous research groups (Bach, Mall, Krekeler, Freiburg/Hotz; Sigmaringen/Hartmann; Tutzing/Gutknecht; Aachen/Moritz; Wien) have verified the lethal effect of diode laser radiation on dark pigmented anaerobic, Gram-negative rods.[20,26,27] The authors of all the named research groups focused on the most frequently associated bacteria in periimplantitis: Fusobacteria, the Prevotella and Porphyromonas species. The main aim of this study was to evaluate, in a clinical setting over a period of 5 years, the efficient and lasting quality of laser decontamination in comparison with conventional periodontal techniques (initial therapy, resective phase, reconstructive phase, and recall phase).

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Methods and Materials

Thirty patients were treated and followed up over a period of 5 years (December 1993 to December 1998). All patients were suffering periimplantitis (PI) with significant breakdown of the supporting tissues. The patients were divided randomly into two groups: 15 patients underwent a conventional (initial therapy, resective phase, reconstructive phase) therapy with subsequent recall as described below (group 1); and the other 15 patients were treated the same as group 1 as well as being decontaminated with the diode laser (group 2). At the first examination, bleeding on probing (BPO) was found around the implants in 90% of the patients. The probing depths were 3 mm to 7 mm in all patients. Furthermore, swelling of the gingiva and, in some cases, necrotic and loose papillae were prominent, indicating periimplant mucositis.

Periimplantitis has a bacterial etiology predominantly. Since the first studies of Slots (42) in 1979, there has been compelling evidence that associates the group of black pigmented anaerobic rods, particularly in chronic adult periodontitis and periimplantitis. These germs cause loss of connective tissue, resorption of bone, pocket formation, and if not treated, eventually the loss of the implants.

Pathologically, the most relevant

germs are Fusobacteria, *Prevotella intermedia*, and *Porphyromonas gingivalis*. The highest incidence of PI is the middle years of life (30–50 years of age); it was also found in our two experimental groups. It was evident also that more women than men suffered from this aggressive periimplantitis .

For our study all patients included had to fulfill strict criteria: 1) probing depths >5 mm, overall BOP, additional clinical signs of inflammation (loose or necrotic papillae, swelling, rubor, secretion), and radiological evidence of bone loss around the implants. The following criteria resulted in exclusion for the study: serious illness, abuse of alcohol or nicotine, and lack of compliance. The rather strict criteria for both groups limited the number of patients available for the study.

Treatment Protocol for Both Groups

There was a basic treatment protocol for both groups.

1. Initial therapy

Motivation and briefing of the patients
Scaling and localized cleaning
Application of disinfecting agents (Hexoral [chlorhexetidinedigluconat, 1.5%]; blend-a-med-Forschung, Mainz, Germany)

2. Resective phase

Preparation of a mucoperiosteal flap
Pocket debridement
Apical repositioning of the flap

3. Reconstructive phase

Osseous augmentation (if necessary)
Mucogingival corrections (if necessary)

4. Recall phase

Assessed the periodontal status (obtained clinical and radiological records after 4 weeks, 6 months, 1 year, and each year thereafter).

Performed a dental hygiene program every 6 months.

[1] Especially in clinical practice, it is costly to sample and cultivate anaerobe bacteria with a considerable risk of losing information. Furthermore, the test results are available much quicker than when using traditional microbiological techniques. Another disadvantage of these quick tests is that only given marker bacteria can be registered.

Protocol of Laser Application in Group 2

In all patients of group 2, laser decontamination was performed in the resective, reconstructive, and all recall phases. An Ora-laser 01 IST (Oralia, Konstanz, Germany) was used. This is a diode laser, which emits 810 nm with a maximum power output of 6 W and three optical fibers with 200-, 400-, and 600-μm diameter. The laser was set to a continuous wave mode, 1-W power and the 600-μm fiber, and was applied for a maximum of 20 seconds to each implant. It has been demonstrated by Bach and Krekeler in 1994,[2] using these parameters, that no damage to the implant surface occurs.[3–8,20]

Radiological Examinations

The standard radiological documentation was a panoramic radiograph (PSA) and a full-mouth set of radiographs in parallel technique. The x-rays were taken preoperatively, postoperatively, and at the 2, 3, 4, and 5-year follow up. The panoramic radiographs were used for a general overview of the alveolar ridge and adjacent anatomical structures. The reproducible dental radiographs were scanned for disintegration of the cortical plate and overall bone loss. In addition to these techniques, A- and B-Scan ultrasonic procedures were used to evaluate the inflammatory state during acute exacerbation of the disease.

Microbiological Tests

Along with the radiological examination, testing was performed for bacteria. The bacteria were not examined in the classical microbiological examination technique (germ samples, breeding, pure-culture microscope preparation, gas chromatography, special germ identification procedures, and antibiograms); instead, the DNA-RNA-hybridization probes were used (DMD/Pathotek test by Wyberth, Lörrach). These hybridization probes have the advantage that they do not need vital bacterial material for testing.[1] First, the test site was carefully dried with a cotton pad. The test paper tip was inserted in the pocket and withdrawn after 10 seconds. It was packed immediately in a sterile container and sent to the manufacturer for processing. The germs were determined and an assessment form was returned. The rating was negative when less than 0.1% of the identified bacteria were marker germs; 0.1% to 0.99% marker germs were rated low (a moderate value has a reading between 1.0% and 9.9%). A high rating is defined as more than 10% identified marker germs. At the same time, a clinical reevaluation was performed noting, 1) probing depths, 2) BOP, 3) a plaque index, and 4) tooth loosening. Furcation involvement was checked.

RESULTS

For the 18-month period, we did not find increased probing depths, BOP or any sign of an inflammatory process in any of the patients independent of the administered therapy. At the 24-month follow up, we found, in group 1, two patients with increased probing depths, BOP, and clinical signs of inflammation. The number rose to 5 after the 4-year follow up, and to 8 after 5 years. Between 3 and 5 years, four implants had to be removed because of progressive recurrent inflammation. After the 60-month period, five patients from the group treated conventionally showed no inflammatory state.

In group 2, there was a different outcome. Up to the 36-month follow up, in the group treated with laser, we found no signs of relapse. At the 3-year control, there were two patients and after 5-years, five patients with increased probing depths and clinical signs of inflammation. No implant had to be removed during the survey period. After 60 months, 11 patients of the laser-treated group were free of inflammation

Microbiological Results

For the first 2 years, no marker germs could be detected with the hybridization probes in group 1. After 24 months, the microbiological samples showed an overgrowth of the marker germs from moderate to high ranges in 8 of 15 patients treated conventionally.

In the patient group treated with

the laser, the elimination of marker germs could be maintained over the complete survey period in 10 of 15 patients. The 36-month follow up brought up positive test results in two patients and the 60-month examination in five patients. All these readings were in the low and moderate ranges.

After 48 months, Fusobacteria only could be found in one patient; whereas it was registered in three patients in group 1. These bacteria are assigned a predominant role in the pathophysiological breakdown of the supporting periodontal tissues. Another very important result was the significant reduction of the other Gram-negative, anaerobe bacteria throughout the entire test period, which is considerably higher in the group treated with laser than in the conventional group.

Relapse

A case was considered to be a relapse when one of the following criteria reappeared:

- Probing depths larger than 4 mm
- Implant mobility
- Excessive soft tissue inflammation with active pocket (BOP, sezarnation)
- Loss of an implant

The relapse rate in the group treated conventionally was 34%. In the group treated with laser assistance, the rate ran up only to 11%.

Loss of Implants During the 60-Month Study Period

Within the 5-year survey in group 1, 1 of 99 implants had to be taken out (1% of all teeth). In the group that had undergone therapy and laser decontamination, none of the implants had to be removed!

DISCUSSION

A study period of 5 years in periodontitis demands a lot of discipline—from the patients as well as the therapists. The number of patients in each group was a result of the strict criteria used (ie, no abuse of nicotine over 5 years) in the survey. On the other hand, these rigorous requirements minimized the risk of exterior factors (ie, nicotine, no compliance) that might falsify the results.[27,28]

Under these circumstances, the two groups that we examined were sufficient for statistical evaluation. As to the number of implants, initial clinical state, and compliance, the two groups were almost identical, therefore, a comparison was certainly admissible. Thermal destruction of bacteria on the wound, bone, and implant surface can be established with minimal energy densities. A clinical setting of 1 watt was used for a maximum of 20 seconds on each tooth. This amount of laser energy (maximum 20 joule) has been shown to have no pathological effect on the soft and hard tissues, as well as the implant surface.[2,5]

The clinical and microbiological results of our study show a significant difference between the group treated conventionally and the group treated with laser. In comparison with an overview of the literature[12,13,15,24,25,29,31] that examined the outcome of patients with advanced periodontal disease, in which an average recurrence rate of 30% is shown, it was found that in the group treated conventionally had the same results. The group treated with laser, however, had a relapse rate of 11%. A similar reduction of the bacterial readings in the laser-assisted group could be found.[4–7,26,27,34]

We conclude that the integration of diode laser decontamination in an approved therapeutic protocol of advanced periimplantitis is reasonable and results in a significant improvement of the patient's implant survival and function.

CONCLUSIONS

The following conclusions can be deduced:

- Diode laser decontamination has a lethal photothermal radiation effect on dark pigmented, anaerobic Gram-negative rods.
- Diode laser decontamination shows (by using maximum 20 seconds on a tooth or implant at the power of 1 watt) no pathological effect on the soft and hard tissues at the implant surface.
- Diode laser decontamination should be integrated as a basic treatment mode.

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ABSTRACT: Zwischen 1994 und 1999 wurden insgesamt 50 Patienten behandelt, von denen 30 an schwerer Parodontopathie und 20 an Periimplantitis litten. Die Hälfte jeder Gruppe wurde konventionell, die andere mit Laserunterstützung behandelt. Vor der Operation wurden mikrobiologische Untersuchungen durchgeführt sowie die klinischen Befunde erfaβt und Röntgenaufnahmen gemacht. Alle drei Verfahren wurden nach der Operation sowie nach 6, 12, 24, 36, 48 und 60 Monaten wiederholt. Neben konventionellen Behandlungsmethoden erstreckte sich der chirurgische Teil der Therapie bei beiden Hälften der Patientengruppen auf eine Reinigung der Oberflächen mit Hilfe von Diodenlaserlicht (1 Watt Leistung, max. Dauer = 20 Sek.). Die Werte der lasergestützten Therapie lagen erheblich unter den in der zugehörigen Literatur genannten. Die Rückfallrate betrug bei den Krankheiten nach 5 Jahren jeweils 13% im Falle der Periimplantitis und 23% im Falle der an Parodontopathie leidenden Patienten. Diese Werte lagen niedriger als die Vergleichswerte der Autoren, die bei ihrer Therapie keine Reinigungsverfahren einsetzten. Unserer Meinung nach führt der zusätzliche Einsatz von Diodenlaserlicht als Ergänzung der bewährten Behandlungsverfahren bei Periimplantitis und Parodontopathie zur einer erheblichen Verbesserung der Erfolgsaussichten der Behandlung.

SCHLÜSSELWÖRTER: Diodenlaser, lasergeführte Reinigung, schwere Parodontopathie, Periimplantitis

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ABSTRACTO: Entre 1994 y 1999, se han tratado un número total de 50 pacientes, 30 de los cuales sufrían de una parondopatía profunda y 20 de periimplantitis. La mitad del grupo fue tratada convencionalmente, y la otra mitad con el apoyo de láser. Antes de la operación, examinaciones microbiológicas fueron realizadas además del registro de conclusiones clínicas y la obtención de radiografías. Estos procedimientos se repitieron después de la operación y después de 6, 12, 24, 36, 48 y 60 meses. La parte quirúrgica de la terapia para cada mitad del grupo de pacientes incluyó una descontaminación de la superficie con una luz láser de diodo (salida de 1 watt, máximo de 20 segundos) además de procedimientos convencionales. Lo valores de la terapia apoyada por láser fueron definitivamente más bajos que aquellos especificados en la literatura relevante. La tasa de relapso de las dos enfermedades del 13% para la periimplantitis y 23% del grupo de parodontopatía después de 5 años fue más bajo que los valores comparativos de los autores que no incluyeron descontaminación en su terapia. En nuestra opinión, integrando

la descontaminación con la luz láser de diodo en los esquemas aprobados de tratamiento para la periimplantitis y parodontitis contribuye considerablemente al éxito de este terapia.

PALABRAS CLAVES: láser con diodo, descontaminación con láser, parodontopatía profunda, periimplantitis

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SINOPSE: entre 1994 e 1999, um número total de 50 pacientes foram tratados, 30 dos quais sofrendo de parondopatia profunda e 20 sofrendo de periimplantite. Metade de cada grupo foi tratada de maneira convencional e a outra metade com ajuda de laser. Antes da operação foram feitos exames microbiológicos, além do registro de descobertas clínicas e raios X. Estes procedimentos foram repetidos após a operação e após 6, 12, 24, 36, 48 e 60 meses. A parte cirúrgica da terapia para cada metade dos grupos de paciente incluiu a descontaminação da superfície com luz de laser de diodo (saída de 1 watt, máximo de 20 segundos) além de procedimentos convencionais. Os valores da terapia auxiliada por laser foram definitivamente menores do que aqueles especificados na literatura correspondente. A taxa de reincidência das duas doenças de 13% para o grupo com periimplantite e de 23% para o grupo com parodontopatia após 5 anos, foi menor do que os valores comparativos dos autores, que não incluíram a descontaminação em sua terapia. Em nossa opinião, a integração da descontaminação por laser de diodo em modelos de tratamento aprovados para periimplantite e paradontite contribui consideravelmente para o êxito desta terapia.

PALAVRAS-CHAVES: laser de diodo, descontaminação por laser, parodontopatia profunda, periimplantite

Periimplantitisの従来の治療法とレーザー併用治療法 — 5年間比較研究

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概要：

1994年から1999年までの5年間に、profound parodontopathyの患者30人とperiimplantitisの患者20人からなる、計50人の患者が治療を受けた。両グループとも半数は従来の治療法のみで治療され、残りの半数の治療にはレーザーが併用された。それぞれの施術前に、臨床所見記録とX線撮影とともに、微生物学的検査が行われた。これらの検査はさらに施術直後、6ヶ月後、12ヶ月後、24ヶ月後、36ヶ月後、48ヶ月後、60ヶ月後にも繰り返された。両グループの半数は、外科的処置として従来の処置に加えて、ダイオードレーザー（出力1Wで最長20秒）による表面汚染除去処置を受けた。レーザーを併用して治療された患者の検査結果は、数値的に、関連著作に挙げられる数値を確実に下回った。レーザー併用グループの5年後の再発率はperiimplantitisで13%、profound parodontopathyで23%で、従来の治療法のみで治療されたグループのそれを下回った。筆者達の意見では、ダイオードレーザーによる表面汚染除去処置を従来認められてきた治療に併用すると、periimplantitisとprofound parodontopathyの治療成功率を大幅に高めることができる。

キーワード：

ダイオードレーザー、レーザー汚染除去法、profound parodontopathy、periimplantitis

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