Periimplant lesions—causes and treatment options

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_Introduction

While in the early stages of implantology, issues concerning the "healing" of artificial abutment teeth were in the focus of interest, those early complications have become rare due to improved implant forms, optimised minimally invasive diagnostic and surgical techniques, and especially because of improved implant surfaces.

Instead, "long-term complications" with implants that have been osseointegrated for many years, which are functioning and have developed periimplant infections, have become the focus of interest for dentists/implantologists.

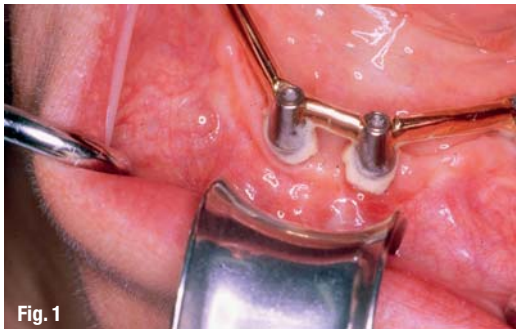
This type of infection on/around the implant, which can lead to serious bone loss and, if untreated, will result in the loss of the artificial abutment tooth (and generally also in the loss of the superconstruction), is referred to as periimplantitis.

There are two possible causes:

a) Infectious/bacterial (as defined by MOMBELLI, 1987).
b) Functional/aseptic, e.g. due to stress phenomena caused by not observing a balanced proportion of implant length/crown length and disregarding serious deficits of the osseous implant site (as defined by JASTY, 1991). Functional/aseptic periimplantitis is usually the exception.

The majority of periimplant infections are of bacterial/infectious origin. According to information provided by the only chair holder of dental implantology, Professor Dr Herbert Deppe, a prevalence of up to 15 per cent of implants can be expected after 10 years.

Thus, the prevention and treatment of periimplantitis have now become two of the major tasks in implantology. This article will provide information about tried and tested laser treatments, but also about new therapeutic approaches with laser light for the treatment of bacterial periimplantitis.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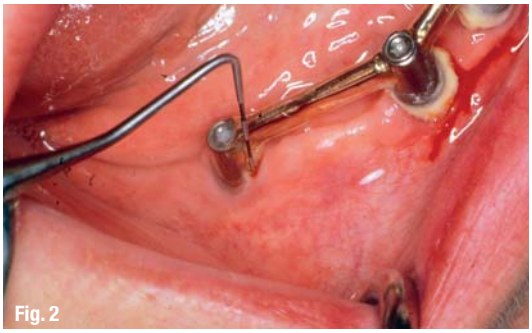
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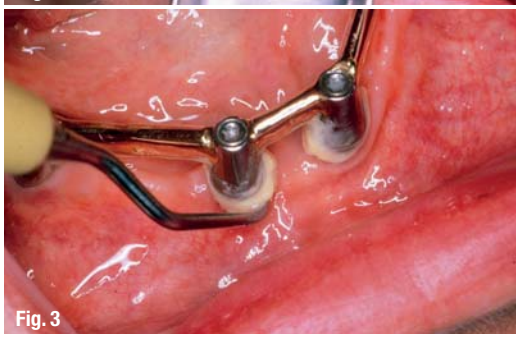
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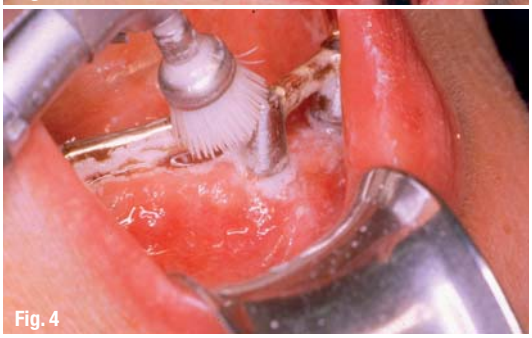


Fig. 4

Figs. 1–4_The hygiensation phase: The hygienisation phase is an essential treatment step at the beginning of periimplantitis treatment. Hard and soft plaque must be removed from the superconstruction and at the transition from gingiva to superconstruction. To avoid scratches on the implant surface, many authors recommend the use of plastic curettes or curettes with titanium covered ends. Additional disinfectant measures, i.e. rinsing with chlorhexidine digluconate, may be necessary. Polishing is the final step in this initial treatment regimen. Now the patient has to be guided back to the straight and narrow: He or she has to be willing and, with enhanced instructions, also able to clean the superconstruction sufficiently. A continuous recall system guarantees the respective success monitoring. If the periimplant lesion is limited to mucositis, the hygienisation phase may even be the final step in the treatment of periimplantitis.

_Treatment of the infectious form of periimplantitis

The four-phase treatment scheme

Many authors agree on a four-phase regimen for the treatment of periimplantitis:

1) Initial treatment: This initial phase of PI treatment consists of diagnosing periimplant lesions (as early on as possible), cleaning and hygiene procedures as well as motivating/instructing the patient suffering from periimplantitis.
2) Surgical resective phase: After local anaesthesia and the creation of a soft-tissue flap, an image of the periimplant defect (generally with its unique crater-like form) is taken, the granulation tissue is removed and the bone is cleaned.
3) Augmentative/reconstructive phase: The primary goal—although not always achievable—is an augmentation which will ultimately lead to a restito ad integrum: In this case, as opposed to an augmentation, the patient's own bone is not the gold standard; bone substitutes have become established.
4) Recall-Phase: All authors agree in their definition that recall is just as important as the actual treatment of a periimplant infection. If there is no adequate and short-term recall after the successful treatment of periimplantitis, recurrence will be just a matter of time.

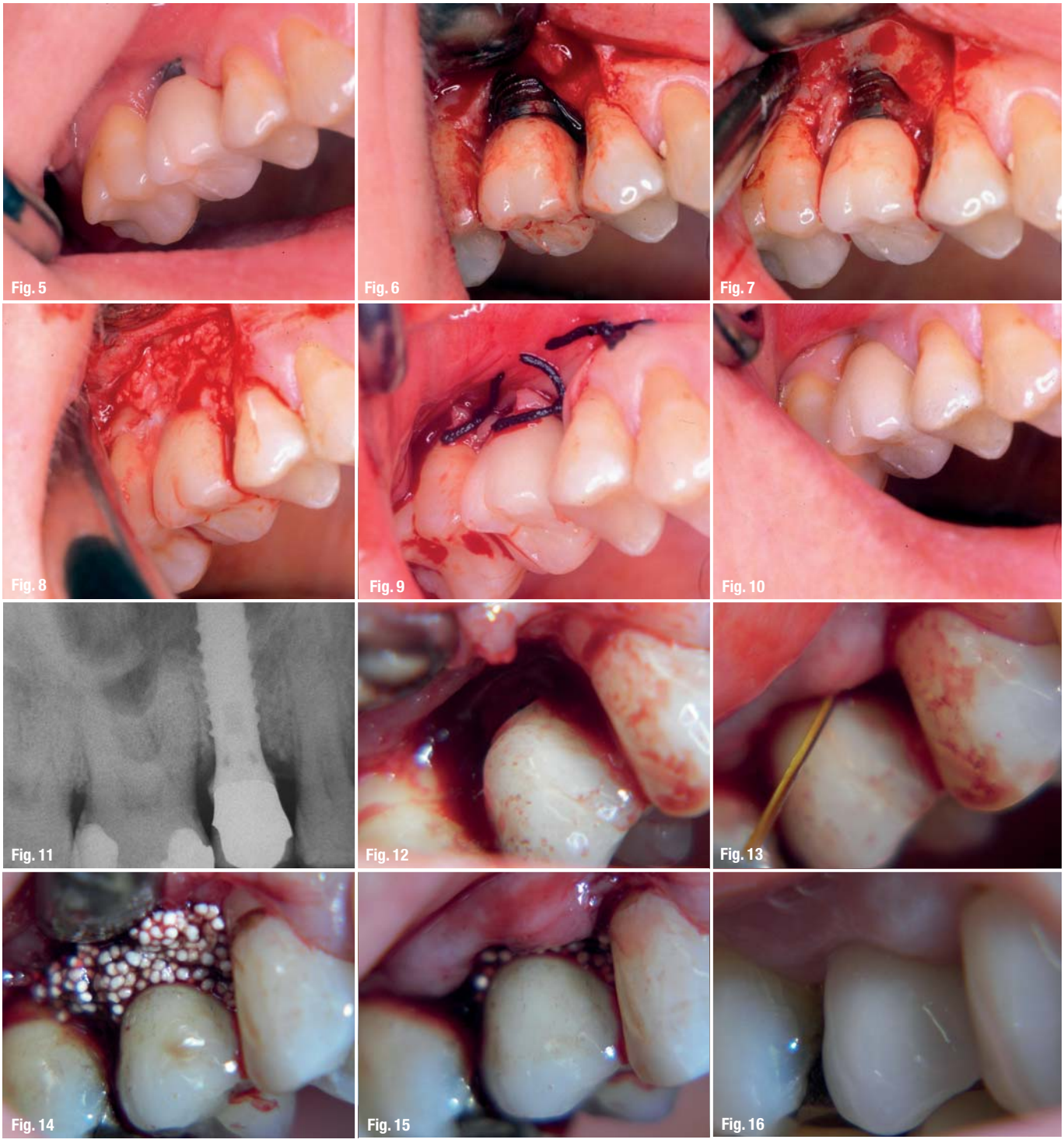
_Explantation as a treatment option for periimplantitis

Explantation would indeed be a "treatment option" if the defect situation proves very difficult for executing the above-mentioned regimen or if the osseous lesions are so severe that there is only a poor overall prognosis for the implant. At times, explantation may even be the only choice if it can be assumed that, by leaving the implant in place, the infection would result in further bone loss that could prevent implantation at a later time or complicated augmentative measures.

_Use of laser light

There is more and more mention of the use of laser light in both the resective/surgical and the recall phases primarily. In principle, two types of laser light applications can be defined:

a) Laser light application without morphological changes on the implant surface and without ablative effect: decontamination.
b) Laser light application with abrasive effect: ablative treatment (possibly in combination with decontamination).



Figs. 5–10_Simplified laser-assisted treatment of periimplantitis with a pasty bone substitute: The original clinical image (Fig. 5) already shows the typical symptoms of periimplantitis, which are confirmed after the creation of flaps (Fig. 6). A profound bone defect has developed around the artificial abutment tooth; the granulation tissue is thoroughly removed (Fig. 7). A pasty bone substitute (Ostim®) can be applied congruently with the defect (Fig. 8); the wound is then closed with a suture (Fig. 9). The last image of this case study (Fig. 10) shows the two-year check-up, which revealed a stable and aesthetically pleasing result. Proponents of this procedure (use of a pasty bone substitute) emphasise the simple application of the bone substitute congruently with the defect and the advantage of a simplified treatment by foregoing the membrane ("periosteum is the best membrane").

Figs. 11–16_Laser-assisted treatment of periimplantitis with a bone substitute with improved application: The X-ray shows considerable vertical bone loss which has already reached the 50 % mark of the coated portion of the implant mesially. After thorough cleaning of the implant surface, a laser light decontamination (here with diode laser light—wavelength 810 nm—in cw mode—20 seconds—1 watt of power) is then performed in pure decontamination mode, non-ablative. Following application of the bone substitute, which is hardened with a bio linker in such a way that the particles can both be well applied and adhere to each other (easy-graft®), the wound is then closed with a saliva-proof suture.
The last image shows the check-up after two years, fortunately with no clinical problems.

The proponents of ablative treatment argue that they "kill two birds with one stone" by removing any contamination from the implant surface, by smoothing it and possibly eliminating any bacteria and microorganisms. The proponents of pure decontamination, on the other hand, point out the risks of unwanted effects on the implant surface, which would complicate or might even prevent the re-appositioning of the bone, and the excellent long-term results of pure decontamination. In this context, they also accept that, in their non-ablative form of laser treatment for periimplantitis, the implant surfaces must be cleaned with suitable manual instruments prior to laser light application.

_Technique for both of the two treatment options

1. Decontamination without ablative effect or morphological changes on the implant surface in the sense of a pure decontamination

The term "decontamination" was coined by the Freiburg Laser Research Group Bach/Krekeler and Mall in 1994-1995. They introduced the diode laser to dentistry, which had been unknown until then. For decontamination, the diode laser light (810 nm) is applied to the implant surface with the largest possible fiber (usually 600 µm) under contact and with constant movement. The authors from Freiburg indicated a maximum power of 1 W and an application time of no more than 20 seconds for the laser light treatment. A 30-second waiting period is necessary if there is a need for further laser light application on the same implant. In clinical applications, a waiting period of 20 seconds has proven to be completely sufficient. If an implant shows a surface that is exposed from the bone and that requires an application of laser light in excess of 20 seconds, the prognosis for this artificial abutment tooth should be categorised as unfavourable and the periimplantitis treatment considered questionable if not experimental.

Bach/Krekeler and Mall expressly caution against exceeding the time-time values, which would inevitably cause a heat build-up in the implant and in the periimplant bone, and thus lead to destruction. The parameters mentioned by these authors (1.0 W/ max. 20 seconds of laser light application) have been impressively confirmed by other authors (Sennhenn-Kirchner et al., Moritz et al.) and/or accepted by the device suppliers and manufacturers on the flourishing diode laser market.

Romanos et al. described the option of working with Nd:YAG lasers without changing the surface. However, there are no long-term and clinical results yet. The above-mentioned diode laser research group in Freiburg, on the other hand, submitted a ten-year study in 2005, proving a reduction in the recurrence rate from previously 30 % (without laser) to now 11 % (with diode laser). These authors called for an integration of diode laser decontamination as a standard procedure into tried and proven schemes for periimplant treatment. Long-term clinical findings for laser treatment of periimplantitis were also achieved with a further wavelength: CO_2 (gas) lasers have been used for the treatment of periimplantitis since the work of Deppe, Horch and colleagues (university of Munich) was completed.

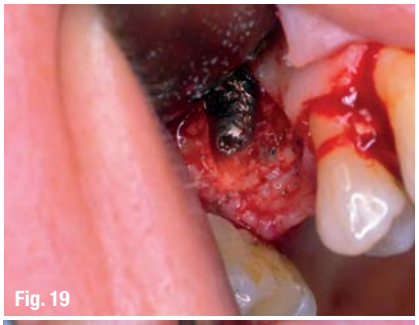
Prof. Dr Herbert Deppe and his co-authors were able to prove that the use of the gas laser, which had been regarded critically for the treatment of periimplantitis until then, is appropriate here and will later—after the periimplant infection subsides—yield a favourable starting point for the regeneration of the supporting tissue. Deppe suggests the use of the CO_2 laser in continuous-wave (cw) mode with 2.5 W of power for 10 seconds. He works with a scanner and, if necessary, also with a dental powder jet and postoperative application of a membrane. A five-year study (Deppe and Horch, 2005) is also available.

2. Procedure with ablative effect (laser curettage) and possibly an additional decontaminating effect

– Er:YAG laser: Compared to the laser light decontamination procedure described above, the ablative laser light procedure uses additional wavelengths: This laser with ablative effect used for the treatment of periimplantitis is the Er:YAG laser. This wavelength has


Fig. 17


Fig. 18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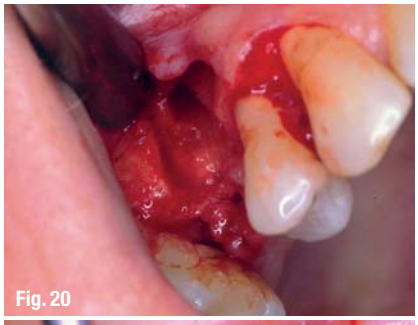
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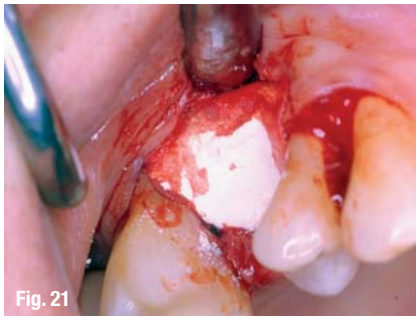
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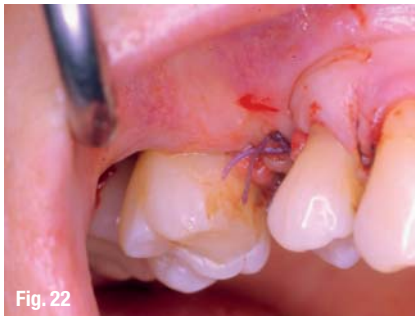
Fig. 22

Figs. 17–22_The hopeless case—the explantation: When looking at the initial clinical diagnosis (Fig. 17), only its unfavourable aesthetics might be noticeable. However, after creation of a soft-tissue flap, the "true extent of the horror" (Fig. 18) becomes visible: the defect extends all the way to the area of the implant apex. In particular, there is no bone left buccally (Fig. 19). Periimplantitis treatment does not appear very promising because of the extent of the osseous lesions. The artificial abutment tooth has to be removed, i.e. explanted (Fig. 20), leaving a profound defect. An augmentation is carried out to facilitate a new implantation at a later time, and a membrane is inserted (Fig. 21), followed by a saliva-proof suture (Fig. 22).

been successfully used in conservative dentistry for many years and is the only wavelength that has been scientifically backed, is suitable for practice and can be used to work on and prepare the hard-tooth substance. The names Keller and Hibst are closely connected to the Er:YAG wavelength.

We owe significant scientific studies of the Er:YAG laser to these two researchers from Ulm, Germany. In the past years, Keller and Hibst—after having fully researched the treatment of the hard tooth substance—turned their attention to further integrations with the Er:YAG laser, including studies regarding the use of this laser for the treatment of periodontitis and periimplantitis. For this, even special chisel-shaped laser light applicators were made available. In 2001, Schmelzeisen and Bach confirmed the suitability of the Er:YAG laser for removing tartar and concrements from the implant surface without damaging the implant surface. However, this requires a non-contact procedure with a 30 milli-joule pulse and a PRP of 10–30 ppt for a maximum of 30 seconds.

– "Er:YAG—threshold" for PI treatment: The research group around Frank Schwarz (Düsseldorf, Germany) was finally the one who determined the "threshold value" that today is generally considered binding for ablative treatment of periimplantitis using an Er:YAG laser (irrespective of device and manufacturer): 13.1 J/cm². Different values can cause thermal or mechanical damage. If Er:YAG light is applied correctly, however, it leaves a clean, homogenous and intact implant surface.
– Er,Cr:YSGG laser: First experiences were also gained with the latest laser wavelength, the Er,Cr:YSGG laser that was introduced to dentistry in the treatment of periimplantitis. The names Henriot and Ritschel (Hamburg, Germany) especially come to mind in this context. They described multiple uses of the Er,Cr:YSGG laser, more widely known as Biolase, in soft-tissue surgery and in hard tissue. The respective long-term experience and multi-centric studies are yet to be confirmed.

_Summary

There are two options for using laser light in the treatment of periimplantitis:

Pure decontamination, non-ablative

For this application, diode lasers with a wavelength of 810 nm and CO_2 gas lasers have gained acceptance. Solid scientific data and long-term studies are available for this form of diode laser light application which, however, requires conventional cleaning of the implant surface prior to the laser light application.

Ablative, possibly with additional decontaminating effect

Er:YAG laser and the Er,Cr:YSGG laser are available for this application. They can remove concrements and tartar from the implant surface without changing its original morphology. However, strict and limiting parameters must be observed with respect to performance and time. Regarding clinical and long-term experience, the ablative procedure has not yet reached the level of the purely decontaminating diode and CO_2 lasers._

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