The use of a 970 nm diode laser in implantology

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ABSTRACT
This article summarizes the current literature on the use of diode lasers in implantology and, based on case documentation, describes the indications and applications of a newly developed diode laser (SIROLaser Advance, Sirona, Bensheim, Germany) which takes both ergonomic and clinical perspectives into account. In applications in implantology and implant prosthetics, this laser has shown itself to be consistent with previous experience with diode lasers. The various indications were treated with the infrared diode laser (970 nm). The performance parameters were set in accordance with the pre-set values in the laser.
Diode lasers can be used in a wide variety of ways, even in this dental specialty, thanks to their broad range of applications. In particular, the coagulation of vessels and the associated low postoperative bleeding combined with a good field of view and rapid healing are considerable advantages compared to conventional protocols and methods. The fine working tip of diode lasers allows very precise working; for users they represent a major improvement and, indeed, are often seen as indispensable.
The results of the treatments concur with the current scientific literature.

KEYWORDS
Diode laser, 970 nm, implantology, surgery, vestibuloplasty, peri-implantitis, exposure of implants, gum excision, hemostasis

Introduction

Dental implants have fundamentally changed prosthetics in the last 25 years. In this time implants have been used both as a replacement for missing individual teeth as well as for constructing fixed partial or full dentures. The advantages compared to conventional techniques include prevention of bone loss due to a lack of loading. At the start of this millennium the number of implants inserted each year was estimated at close to one million.[1] And this figure keeps growing. The diode laser has proven itself to not only be useful but, increasingly, as indispensable in many standard procedures in implantology, supplementing the instruments in the implantology practice. In this article the use of a dental diode laser with a wavelength of 970 nm is described for the indications vestibuloplasty, exposure of implants, acceleration of treatments in implant prosthetics, and treatment of peri-implantitis.

Vestibuloplasty

Where the peri-implantitis is of uncertain origin, an indispensable and essential condition is a stable margin of attached gum for prevention or treatment of peri-implantitis. The implant is often in direct contact with the mobile mucosa as a result of unfavorable soft tissue/bone situations or even as a result of the surgical procedure during implantation, which must often be combined with augmentative measures and tension-free plastic coverage of the augmented site using periosteal incision. This must be eliminated to prevent peri-implantitis. If after exposure and insertion of the prosthetic abutment it is apparent that the position of the superstructure in the mobile mucosa has shifted, then the attached gum should be immediately expanded using vestibuloplasty. Vestibuloplasty is a surgical indication for the 970 nm diode laser and was described in addition to other indications. Romanos et al. report that neither bleeding nor uncontrolled pain, scar formation nor functional disorders occurred although swelling occurred in one case out of 23.[2]

Exposure of implants

According to Yeh et al., the use of a laser to expose implants has the following advantages compared to conventional techniques:[3] reduction in bacterial and viral secondary infections,[4] depolarization of nerves, causing less pain as a result,[5] and, not least, the hemostatic effect of laser surgery which reduces postoperative swelling.

Accelerating treatments in implant prosthetics

Procedures in implant prosthetics such as gum excision/reduction after conventional exposure or preparation for implant impressions are cases of “minor surgery” and were

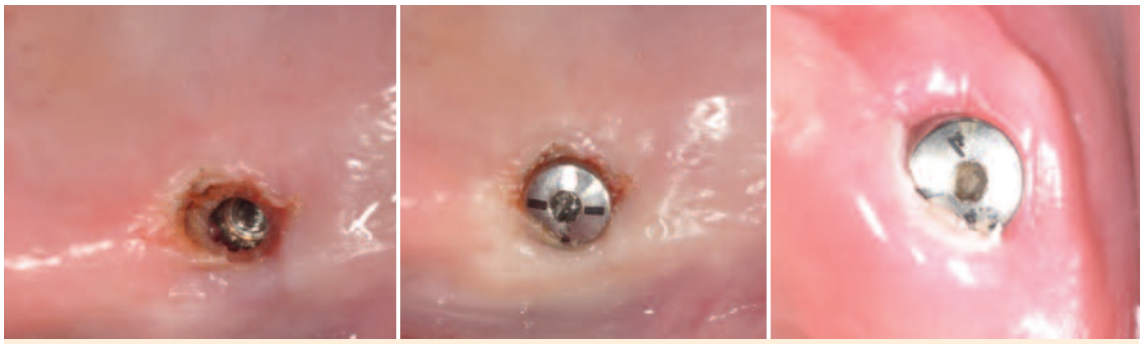

Fig. 1: Implant exposed with the SIROLaser. – **Fig. 2:** Exposed implant with gingiva former. – **Fig. 3:** Thickened hyperplastic tissue.

described in the literature by Romanos[2] and Manni[13] amongst others.

The laser as an adjunct in the treatment of peri-implantitis

Peri-implantitis refers to an inflammatory process that affects the entire tissue around the implant that is integrated into the bone and leads to a loss of alveolar bone.[6] Microbiological investigations reveal the connection between loss of implant and bacterial infections.[7] The bactericidal action of the diode laser for implant disinfection is described by Goncalves et al.[8] A good indication of the efficacy of the laser as an adjunct in the treatment of peri-implantitis is seen in the success of laser treatment for periodontitis. Kamma et al. compared the results of scaling and root planing (SRP) compared to SRP + laser and laser treatment alone in a controlled study with 30 patients. They showed that the combination of SRP + laser achieved a better effect than either SRP or laser alone.[9] For peri-implantitis Bach and Neckel showed in a 5-year comparative study that the laser was beneficial as an adjunct to conventional therapy.[10]

Treatment with the diode laser immediately near the implant is not a thermal hazard due to heating of the implant provided care is paid to ensuring the irradiation time is appropriate.[11,12]

Materials and methods

The effect of the diode laser in surgery is described adequately in the literature.[2,13]

The SIROLaser Advance is a 970 nm diode laser from Sirona Dental Systems, Bensheim, Germany. The operating modes of the laser are continuous wave (CW), chopped mode (also known as pulsed mode), and peak-pulse mode. In the CW operating mode, the laser emits continuous light at the set power. In the chopped mode, the laser emission switches on and off at an adjustable frequency between 1 Hz and 20 kHz and the duty cycle can be adjusted between 1 % and 99 %. The peak-pulse mode is a pulsed mode with a fixed amplitude of 14 W at the diode, a constant pulse width of 28 µs and a mean maximal output of 6 W. The maximum output of the laser is 7 W in the CW and chopped pulse modes and 14 W in the peak-pulse mode.

The laser is made up of a base unit with an intuitive operating interface via a touch screen and a handpiece that is connected to the laser via an optical fiber cable. Length-adjustable application fibers are screwed onto the handpiece in an optical coupler. Application fibers are available with a diameter of 200 µm for endodontics and 320 µm for periodontology and surgical applications. All handpiece parts that are potentially in contact with patients can be sterilized in an autoclave. The laser can be controlled either with a foot switch or a finger switch on the handpiece.

In the laser menu preset treatment parameters (power, frequency, duty cycle) for the most common indications in surgery, endodontics, and periodontology can be used. Thanks to a powerful battery, the laser can be placed on the tray of the treatment center near the patient without a cable interfering with the treatment.

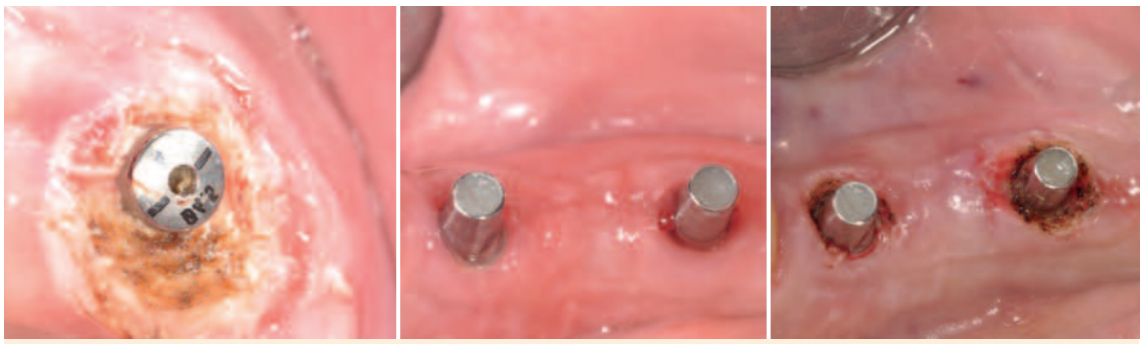

Fig. 4: Situation after ablation and reduction of the tissue. – **Fig. 5:** The prosthetic platform of the abutment lies below the gingival margin. – **Fig. 6:** Implant posts after exposure of the platform.


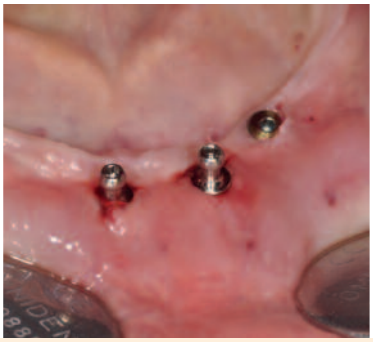
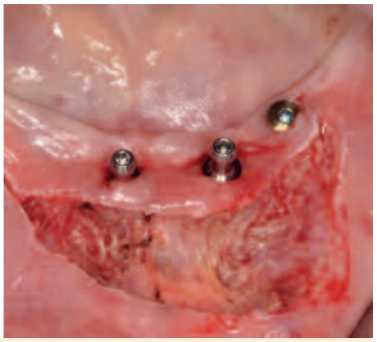

Fig. 7: Implant after attachment of the transfer posts. – **Fig. 8:** The superstructure has shifted in the mobile mucosa. – **Fig. 9:** Vestibuloplasty with an almost bloodless incision.

Case reports

Clinical application of the diode laser used in implantology and implant prosthetics is widespread. The prevention of postoperative bleeding in particular enables surgical and prosthetic treatment procedures to be combined in a single session. The simultaneous vascular occlusion and postoperative hemostasis also improves the surface granulation and prevents relapses with vestibuloplasty.

Implant exposure

In the incision/gingivectomy mode with the preset laser parameters, the laser allows exposure of the implant (Fig. 1). Hemostasis improves the field of view and the cover screw can also be removed even with a very small opening and replaced through the gingiva former (Fig. 2).

Gingiva excision/reduction after conventional exposure

The SIROLaser Advance is also well suited to ablation of thickened hyperplastic soft tissue that often develops as a result of implant exposures combined with sliding flap and pre-existing thickened gingiva situations (Fig. 3).

The incision action and hemostasis allow soft tissue to be reduced specifically and with a good field of view using low levels of anesthesia and the surface conditioning of the incision face ensures rapid regeneration of the tissue (Fig. 4).

Implant impression using direct and indirect procedure (transfer impression)

Because superficial bleeding can be prevented using the laser, it is possible to take an impression of the implant immediately after exposure. This is true for both direct and indirect impressions. With direct impressions the prosthetic platform of the implant abutment often lies below the gingival margin (Fig. 5).

Thanks to the fine working tip of the SIROLaser Advance that we used, the gingiva can be reduced precisely around the posts and the platform exposed (Fig. 6). This enables a precise impression to be taken. For the open impression, the transfer posts are secured to the implant (Fig. 7) and the impression is taken using the open-tray technique. Again, the laser enables a single procedure thanks to sealing of the superficial vessels.

Indication for vestibuloplasty after exposure

In this case, after exposure of the stud abutment, it was noted that the superstructure had shifted in the mobile mucosa (Fig. 8), the attached gingiva is expanded using vestibuloplasty.

The diode laser enables quick and easy vestibuloplasty with low levels of anesthesia. The fine working tip enables a very targeted incision which is also sufficiently long and deep without risking significant postoperative bleeding (Fig. 9). Success is further secured for prosthesis wearers by relining the functional margin (Fig. 10). The characteris-



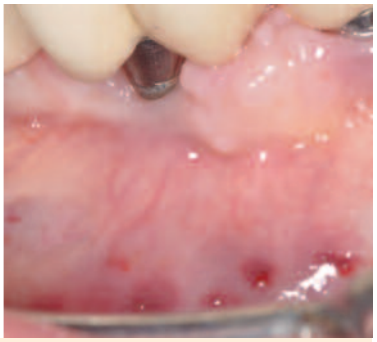

Fig. 10: Relining of the functional margin. – **Fig. 11:** Vestibuloplasty four days after the procedure. – **Fig. 12:** Vestibuloplasty; the margin of the attached gingiva is too narrow.

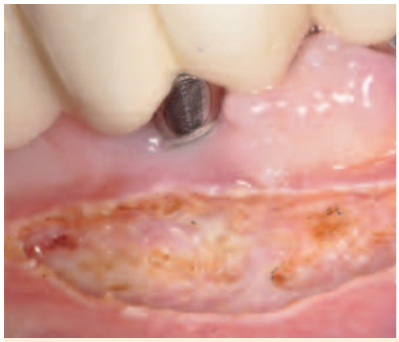

Fig. 13: Vestibuloplasty; it can be seen that the tension on the free mucosa is reduced. – **Fig. 14:** After 12 days the wound has healed completely and there is a broad band of attached gingiva. – **Fig. 15:** Peri-implantitis with loss of attachment.

tics of the laser incision keep postoperative pain low, while surface conditioning of the mucosa prevents relapse and ensures regeneration is rapid, starting as early as three to four days afterwards (Fig. 11).

Indication for vestibuloplasty after implant placement

If it only becomes apparent after implant placement that the free gingiva is in contact with the implant or the implant abutment or if the margin of the attached gingiva is too narrow, vestibuloplasty should be carried out now at the latest (Fig. 12). The diode laser makes the procedure easy and effective with an incision length and depth based on requirements. Thanks to the surface tissue conditioning, complex sutures and suturing are not necessary because the surface freely granulates and a relapse to the degree comparable to scalpel incisions does not occur. Immediately after the laser procedure, the tension on the free mucosa is already reduced and the soft tissue sits higher against the implant (Fig. 13). As early as 12 days later the wound has healed completely and there is a wide band of attached gingiva (Fig. 14).

Indication for vestibuloplasty combined with peri-implantitis therapy

If peri-implantitis has developed with loss of attachment, vestibuloplasty should be carried out with treatment of the peri-implantitis (Fig. 15). The advantage of the laser is again apparent with an almost bloodless postoperative wound which can be left to freely granulate (Fig. 16). The tension on the mobile mucosa is thus removed and the peri-implant soft tissue and the pockets can now be cleaned and trimmed in accordance with the relevant protocols. The use of the SIROLaser Advance in peri-implantitis mode aids disinfection and cleaning of the pockets around the implant. The gingiva again heals rapidly. As early as seven days later, free granulation is well advanced (Fig. 17) and after 14 days it is complete (Fig. 18). The peri-implant tissue appears stable, there is no bleeding on probing, and the patient experienced hardly any pain during the procedure and the entire postoperative phase.

Indication for supporting peri-implantitis therapy

An acute case with slight loss of attachment (Fig. 19) and with minor involvement of the hard tissue (Fig. 20) is treated with no flap. The laser allows access to difficult areas and facilitates the standard treatment protocol for peri-implantitis treatment during disinfection. Even after a short time, the inflammation has healed (Fig. 21), there is no bleeding on probing, and the patient is free of pain (Fig. 22).

Discussion

Treatments with the SIROLaser Advance in the cases described above concur with the current literature in terms of their results. The surgery carried out with the 970 nm diode laser from Sirona is bloodless, associated with low pain levels, and free of side effects such as swelling, uncontrolled dysfunction, and scar formation. The diode laser is a valuable aid for peri-implantitis treatment, particularly in cases



Fig. 16: Almost bloodless postoperative wound after surgery with the diode laser. – **Fig. 17:** Free granulation after seven days. – **Fig. 18:** Completed healing after 14 days.

Fig. 19: Peri-implantitis with slight loss of attachment.

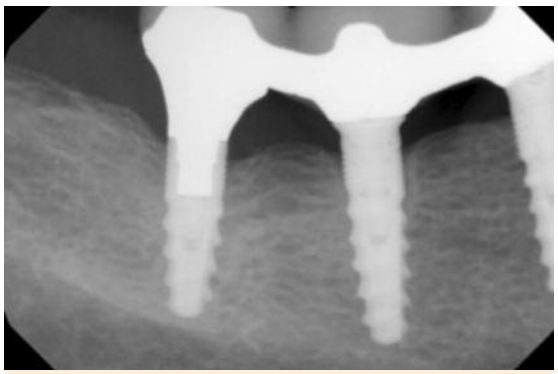

Fig. 20: The X-ray image shows minor involvement of the hard tissue.

Fig. 21: Not long after the therapy the wound has already healed.

Fig. 22: No bleeding on probing.

of early intervention. Even difficult areas are accessible with the laser for adjuvant disinfection.

All the indications named above also form part of the range of applications possible with the SIROLaser Xtend. The laser, which is equivalent in design to the SIROLaser Advance laser, differs basically in that it has a lesser maximum output (5 W CW, 10 W peak-pulse) but this is not relevant for the indications described.

The SIROLaser Advance can thus be regarded as an expedient addition to the implantology practice.

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