Conventional diode laser versus high-power pulse technology

Periodontal and soft tissue surgery with different diode lasers–an in vitro study

authors_H.K. Koch, U. Hellerich, Th. Venzke (*) and Georg Bach (**)
(*) Specialists in Pathology, Bötzinger Straße 60, 79120 Freiburg i. Br.
(**) FZA Oral Surgery, Rathausgasse 36, 79098 Freiburg i. Br.

Diode lasers were introduced to dentistry in the middle of the nineties of the past century and have proven their worth there particularly during their application in periodontics and implant dentistry. After the first diode or injection lasers were operated exclusively in CW mode (continuous wave), in the beginning of the new millennium they were supplemented with high-power and digital pulse technology equipment. The high-power pulsed diode lasers (up to 20,000 Hz) were developed under the premise of improved cutting performance because the pure CW mode lasers, in this case, were clearly inferior in other wavelengths.

_The following article would like to introduce an in vitro study (on a pig's jaw-bone), where cuts with different cross-sections were carried out on the periodontium and on the soft tissues.

_Diode Lasers Used

Diode lasers were assigned to so-called "reference classes" and deployed.

_Reference Class I

This equipment corresponds to the level of diode laser technology, as it was available at the time of market launch in 1995, equipment with a power output of up to approx. 6 watts and primarily operated in CW mode. This technical data is still today part of the simple diode lasers, the so-called "entry-level lasers", which attractively introduce the first-time user to the

The following dental lasers were used:
Fig. 1_ Reference Class I "CW mode/ entry-level laser" Oralia 01 IST.
Fig. 2_ Reference Class II "high-power pulse technology/state of the art" Elexxion Claros.
Fig. 3_ Reference Class III "intermediate stage" SIRO laser.


Fig. 1


Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6

Directions of cuts performed on the anthropomorphic phantom, each with 400 µm fibers:
Fig. 4_ Oralia 01-IST.
Fig. 5_ Preparation of the laser cuts for histological processing.
Fig. 6_ Documentation of the specimens and shipment.

laser dentistry with a lower price. Here, the first diode laser device ORALIA 01 IST developed for dentistry as such was used.

_Reference Class II

Equipment in the reference class II constitutes the one with high-power and digital pulse technology in the 20,000 Hz class, which corresponds to the highest stage of development at the moment. As a representative in this reference class, an Elexxion Claros device was used.

_Reference Class III

Equipment in reference class III is between class I and those of class II; They allow pulses of up to approx. 10,000 Hz, are mostly operated in pulsed mode as well, and, therefore, differ considerably from the "entry-level lasers" (Class I) but do not reach the technical development stage of equipment in Class II.Here the SIRO laser by the Sirona Company was used.

_Wavelengths

The Oralia 01 IST device and the Elexxion Claros emit laser light with 810 nm wavelength, whereas the SIRONA device features a wavelength of 980 nm.

_Equipment Data Programs

Such settings were selected, which were specified by the manufacturer as appropriate for the selected indication in the equipment manual.

They were:
a) SIRO laser (Sirona Company)—Program S6: 4 watts with the 400ym fiber (prototype fiber)
b) CLAROS laser (Elexxion Company)—Program "General Surgery" 9.99 watts/ 20.000 Hz with a power output of 30 watts with the 400 µm fiber
c) 01-IST laser (Oralia Company)—Settings "Surgery" 2.2 watts in CW mode with the 400 µm fiber

In order to avoid differences in the cut due to varying fiber diameter (light guide), a 400 µm fiber not yet released on the market, which corresponded to the ones in other equipment, was used in the Sirona Company device. Sirona Company in Bensheim provided this fiber, which is on the brink of a market launch.

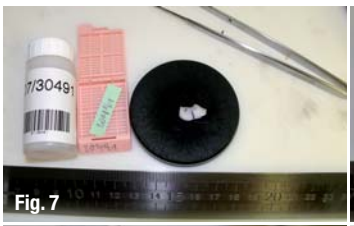
_Cuts on the Anthropomorphic Phantom (Pig's Jaw-Bone)

Two cuts per laser were done on the anthropomorphic phantom
a) in the marginal periodontium—"periodontal cut"
b) in the gingiva of the vestibule—"surgical cut"

Directly after the laser cut, the respective specimens with a generously chosen border area were carefully removed with the scalpel and raspatory, stored in a preserving liquid, and placed for histological preparation and examination.

_Histological Results

Following preparation the specimens were histologically examined and provided the following results:


Fig. 7

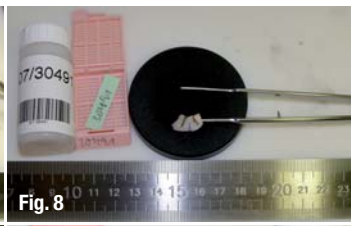

Fig. 8


Fig. 9



Fig. 10

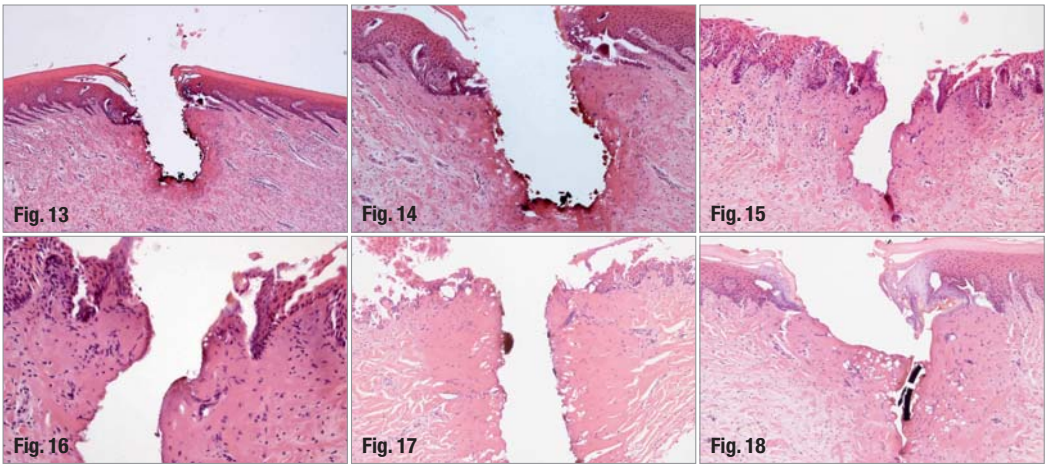


Fig. 11



Fig. 12

Fig. 7 to 12_ Histological documentation of the tissue specimens prior to processing.



Histological specimens:
Fig. 13 and 14_ Specimens of incision by Oralia 01 IST.
Fig. 15 and 16_ Specimens of incision Elexxion Claros.
Fig. 17 and 18_ Specimens SIRO laser.

Reference Class I:

a) Oralia 01 IST—periodontal cut:

"From a coagulated subepithelial background, a narrow ring-shaped defective zone with superficially brownish discoloration by the laser coagulation appears due to an incomplete cut and lifting of the epithelium."

b) Oralia 01 IST—surgical cut:

"A flat sinking of the suprabasal and almost completely destroyed epithelium appears including a narrow underlying coagulation front of the stroma."

Reference Class II:

a) Elexxion Claros—periodontal cut:

"Narrow, and almost vertically leading laser coagulation fronts on a totally inconspicuous underlying stroma. Lateral stretch of the coagulation fronts of up to 100 µm, and 30—50 µm depth."

b) Elexxion Claros—surgical cut:

"Low-reaction, sharply edged laser coagulation fronts after laser incision."

Reference Class III:

a) SIRO laser—periodontal cut:

"Very bland in the U-shaped profile, approximately at the double epithelium height, there is an indentation (150—200 µm) caused by laser coagulation through the epithelium and the stroma with minimal damage in the vicinity. Tissue damage occurs only in a small section."

b) SIRO laser—surgical cut:

"Alterations relating to laser coagulation with otherwise inconspicuous squamous epithelium, and largely inconspicuous gingival mucous membrane with occasional marginally contained laser coagulation defective zones."

_Summary of the Histological Findings

There were significant differences in the evaluation of the histological findings of tissue samples, which were obtained with different diode lasers.

If the tissue samples, which were processed with a diode laser operated in the CW mode exhibited severe destruction of the tissue surroundings, then the samples processed with pulsed diode lasers showed far less marginal and destruction effects. Significant differences between the pulsed lasers (10,000 vs. 20,000 Hz max.) could not be determined, likewise no significant changes in the histological findings, which were obtained with a 980 and an 810 nm laser.

_Discussion

The differences in the results from the histological examination of the samples processed with different lasers are significant. A cut is achieved in CW mode with equipment data recommended by the manufacturer, causing considerable tissue damage of the separate structures, referring not only to the area of the actual cut but also considerably affecting adjacent tissue structures. The results obtained from the in-vitro samples raise considerable doubts about the further eligibility of cuts with pure CW mode diode lasers as significantly better results can indeed be achieved using pulsed diode lasers.

Here the question of pulse technology (up to 10,000 Hz) or high-power pulse technology (up to 20,000 Hz) is of secondary nature because both provided similarly satisfying results.

Also, the much discussed question of "810/ 980" nm wavelength, which absolutely has its validity during the selection of parameters for decontamination of germ infested tooth or implant surfaces, in this examination played only a secondary role as well. A diode laser cut must not only be compared to different diode laser types but also to the results, which were obtained using different wavelengths. From this point of view, the time of the simple CW mode diode laser, in terms of the cut, seems to be coming to an end, and from now on only those lasers should be used (advertised and offered) for decontamination exclusively._

_contact laser

Dr Georg Bach,
Oral Surgeon
Rathausgasse 36,
79098 Freiburg i. Br.,
Germany
Phone: +49-7 61/2 25 92
Fax: +49-7 61/2 02 08 34
E-mail:
doc.bach@t-online.de

implants

International magazine of oral implantology



for specialists around

the world

❑ Hereby I wish to subscribe to implants (4 issues per year)

44 €* for German Customers | 46 €* for Customers outside Germany

*all prices include shipping and handling costs

PERSONAL DETAILS/SHIPPING ADDRESS

Name

Position/Dept.

Company

Address

Country/ZIP

Telephone

Facsimile

E-mail

Date/Signature

Your personal data will be recorded and retained by Oemus Media AG, Holbeinstraße 29, 04229 Leipzig, Germany. Your personal data is used for internal purposes only. The subscription will be renewed automatically every year until it is cancelled six weeks in advance before renewal date.

laser 1/09

PAYMENT OPTIONS

Credit Card: ❑ VISA

❑ MasterCard

Card Number

Expiry date

Name (as it appears on the card)

KPN/CVV2/CVC2 No. ☐☐☐☐

3-4 digits in the signature area on the back of the credit card

OEMUS MEDIA AG
Holbeinstraße 29
04229 Leipzig, Germany
Tel.: +49-3 41/4 84 74-2 01
Fax: +49-3 41/4 84 74-2 90
www.oemus-media.de
grasse@oemus-media.de

oemus