Laser Technique „Quo vadis?“

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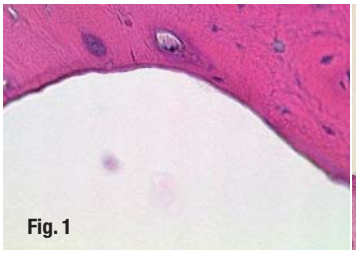
Fig. 1

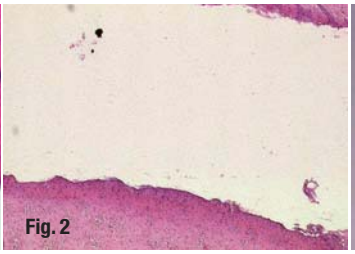
Fig. 2

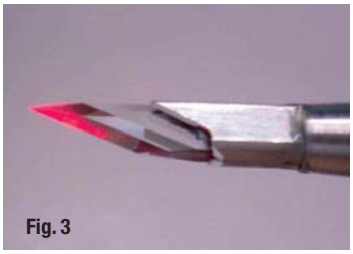
Fig. 3

Fig. 1_Cut thru bone with the erbium laser.
Fig. 2_Cut in soft tissue.
Fig. 3_Sapphire knife (A.R.C. Laser GmbH).

_In Germany the Laser technique is very widely spread, with the help of Prof Gutknecht and Prof Lampert. Different wavelengths and more acceptances has been the key to the success of laser in Dentistry. Endodonty, Cavity preparation and Paradontology are only samples of the use of lasers in Dentistry.

Some of the highlights in the oral Surgery are the minimal growth of germs and the possibility not to use stitches after surgery. With all the hype the laser has triggered, one should not forget, that the use of lasers cannot replace basic dental care. In most of the cases the laser is used as an add on to the existing technology to enhance the the basic care. Therefore all the developments in this area should aim towards an improvement of the existing technology or help to establish a more atraumatic surgery in some basic dental technologies.

In the mouth water is present at a high percentage. Most of the laser however emit laser light in the near or even far infrared, which is not well absorbed in water. Therefore the danger of a thermal damage of underlying structures is very high. To qualify the lasers used in dental today should therefore not only qualified based on their wavelength, but also based on their principle of reaction with tissue. To understand all those issues the danger of using the laser is minimized. A classification of the different lasers is used worldwide as a standard, however I would like to even go a little further and use my own classification in addition to the existing ones:

A—Laser with a photo mechanical effect
B—Laser with a photo thermal effect

To the first group of A lasers like Erbium:YAG or the Er:YSGG can be counted. By using the higher absorption in water and pulse lengths in the region of 50 to 250 µsec. those parameters in conjunction with high peak powers of more than 5,000 Watts can be used to cut teeth substances and bones without much thermal effect. However this has to be done by using a water spray at the tissue to be cut. The width of the thermal damage is in the region of 10 to 20 µ in a “spongy” bone (Fig. 1). In case of cutting off the spray or an increased pulse length peripheral necrosis zones can be achieved in soft tissue depending on the pigmentation (Fig. 2). This however is not sufficient enough to cut without bleeding, or even in deeper layers to stop bleeding in smaller vessels. To achieve a bloodless cutting a wavelength with higher absorption in hemoglobin is required.

At the second d Group of B the thermal effect is dominant. Under this group you may find Diode lasers with different wavelengths. The mostly used Diode lasers are the 810 and the 980 nm lasers. Meanwhile KTP lasers with the wavelength of 532 nm and also 1,064 nm lasers are available on the market today. More lasers will enter the arena with different wavelengths.

Not to forget the traditional lasers like the Nd:YAG laser with it’s principal wavelengths of 1,064 nm and also 1,320 nm. We also should mention the 2,100 nm Ho:YAG laser. Those pulsed lasers

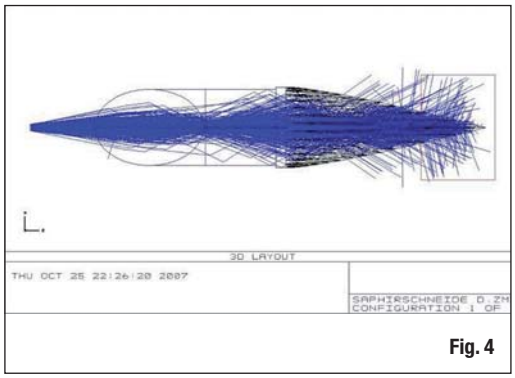

Fig. 4

can not be compared with the CW Diode lasers. Most of the pulsed lasers have peak powers in the KW range and also pulse lengths in µ seconds. The effect on tissue with those lasers is different compared to the Diode lasers. Water cooled argon lasers with their principal wavelength of 514 and 488 nm and also CO_2 lasers with their wavelength of 10,600 nm have lost their importance during the last years. Discussions about the different wavelengths, the comparison between those and the advantages, by using the absorption curves are more used by companies having a certain laser source available than having a major effect in Dentistry. More than the laser source is required to make a laser treatment successful.

_Lasers are the little helpers in your office

One thing however is important to realize. A laser treatment is much better tolerated by the patient and also by the physician then a conventional treatment. This is not the whole story yet. More important are the new accessories which can be used with the laser, to be more precise, more comfortable for the patient and consequently be more successful with this treatment. In cooperation with Universities those new modalities have to be checked and used and finally described to allow the practitioner to safely use the new technique and instrumentation.

Two additions to the laser and one more wavelength will be described below. The first studies and Protocols are available for these new devices.

1—The sapphire knife for Surgery
2—A new water jet (no spray) for Paradontology
3—A new (old) wavelength of 532nm

_The sapphire knife

The Diode laser is well established in Paradontology and Endodonty, by using the wavelength for germ reduction. However at Oral Surgery where bloodless cutting at a 10th of a millimeter a requirement for the Gingiva, those lasers are close to the limits. A disadvantage of the wavelength from 488 to 2,100 nm is the low absorption in water when cutting in the less pigmented area of tissue. As a result a slow removal of tissue will cause the edges of the wound to be folded in this will cause a less effective laser to tissue reaction. At higher power a sudden coupling of the laser energy will cause burns and as a result a large necrosis zone at the wound edges. A laser which is designed to coagulate can only cut by absorption in soft tissue. All tests have shown that a laser which is not well absorbed in water has a clear disadvantage compared to those lasers with higher water absorbance in cutting soft tissue.

Still today the golden standard in cutting soft tissue are the stainless steel scalpels or even diamonds and sapphire knifes which are used in Ophthalmology for many years. In the device described the advantages of the mechanical cutting of a knife and the coagulation of the laser is combined. The sapphire knife is attached to the laser via a Quartz fiber and therefore the laser beam is guides thru the sapphire and exits at the sharp edges.

The temperature reached at the edges is approx. 65 °C and therefore a coagulation is achieved, however the temperature is far away from the 100 °C to allow for vaporization. No tissue is removed and consequently no carbonization at the cut is seen. The cut is

Fig. 4_The laser beam is guider thru the sapphire and exits at the sharp edges.
Fig. 5_Initial situation Missing attached gingival at implant regio 33.
Fig. 6_Vestibulum plastic cuts with lateral denaturation.
Fig. 7_Deep cut: muscle cut in two and inlaying strands pre suturing.
Fig. 8_Three days post OP. Prosthesis was immediately prolonged at the edge. Fibrin eschar. Patient without pain and complains.
Fig. 9_Situation three weeks post OP.
Fig. 10_Jet water beam (A.R.C. Laser GmbH).

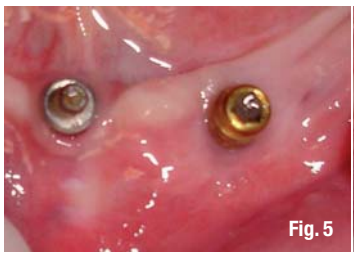
Fig. 5

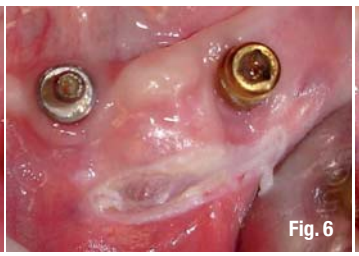
Fig. 6

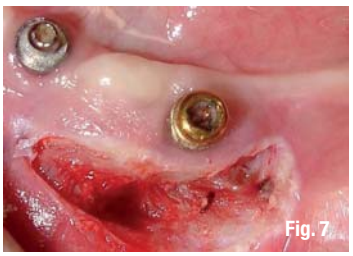
Fig. 7

Fig. 8

Fig.9

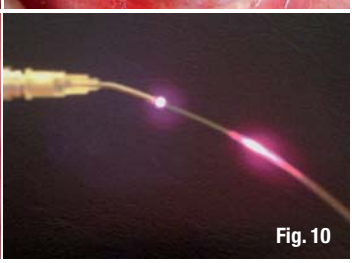
Fig. 10

Fig. 11

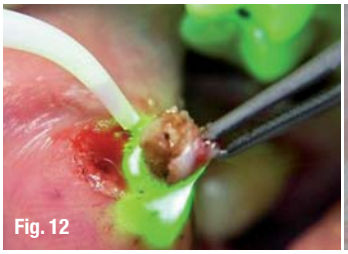
Fig. 12

Fig. 13

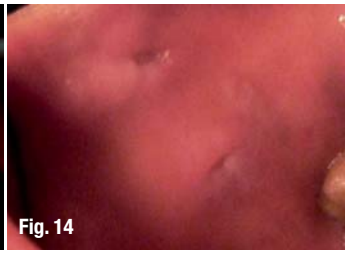
Fig. 14

Fig. 11_Initial situation Cheek fibrome.
Fig. 12 and 13_Cut with the green diode laser, wavelenght 532 nm.
Fig. 14_Situation eight days post OP.

achieved only by the sharpness of the sapphire knife. The transmission of the knife at the edges has been calculated in a mathematical model and has been worked successfully at the first cuts, since 90 % of the energy exists at the front tip of the knife. From today on the precision of a mechanical knife can be combined with the advantage of the laser beam.

Since the surface of the knife is much bigger compared to an area of the bare fiber, Power settings could be as high as 7 Watts with a 810 nm laser Diode.

_Germ reduction

The germ reduction and the attachment are the key to success in Paradontology. The concept of of continuous recalls and germ reduction with the Diode laser as well as the removal of inflammatory tissue has been proven as very successful during the years. One has to differentiate the killing of the germs without removing tissue and the coagulation of inflammatory cells.

In both instances the necrotic material is still present in the pockets and is only removed by by the sulcus fluid or will be reabsorbed inside the pockets. Therefore an important point is the rinsing of the pockets. The fluid used to perform this is depending on many factors, however is the responsibility of the physician which fluid to be used. In any case this fluid has to be sterile. During this procedure one has to take special care not to get the fluid in contact with other tissue in the mouth, however the fluid has to be applied to the area where any particles are left. Based on this a rinsing with an injection needle becomes very difficult to perform. The idea to coaxially use a fluid along the laser fiber may present a solution.

A two level foot pedal may be used to trigger the laser in the first level but to allow fluid along the fiber when the pedal is pressed into level two. So the laser and the fluid is available at the time the surgeon would like to see it. By using a sterile infusions chamber the requirements of a sterile fluid is accomplished. It is important not to go to the max. power or even increase the power during treatment since this technique is not used to cool down the pocket, but only to clean the pocket during the treatment. At this technique it is important not to use a spray, but only a water jet which will take the laser along during the treatment (Fig. 10).

_The new (old) wavelength

The green Diode pumped laser is widely spread in Dermatology for treatment of vascular lesions. We have used the laser Nuvolas from A.R.C. Laser in Germany. Since the absorption of the green wavelength in Hemoglobin is excellent coagulation can be achieved at low power levels. Therefore it may be advantages to use this laser in the presence of vascular lesions which can be seen in the mouth during the excision of fibroblasts or removal of hemangiomes. The first surgeries at the University of Sevilla have shown excellent results comparing with the 980 nm control group. Less pain post OP was reported from the patients and similar healing has been seen.

Following parameters have been used: 532 nm laser at 1,5 Watts, 300 µ Fiber – 980 nm laser 1 Watt with 300 µ Fiber.

_Summery

Today's use of Diode lasers has become a routine surgery with many physicians around the world. An enhanced treatment with different wavelengths depending on the absorption is very nicely tolerated by the patients. Germ reduction and coagulation are the most important uses of the laser in Dentistry. The combination of the new Sapphire scalpel (A.R.C. Laser GmbH), rinsing of the pockets during treatment may even more improve the use of the diode lasers in Dental surgery. The laser in combination with the items mentioned will more widely spread among surgeons. An all in one laser treatment with just one wavelength is a dream which will never come true._

_contact laser

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