Epic Pro

Re-Inventing Diode Laser Soft-Tissue Therapy Using Science and Technology

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Examining revolutionary advanced technologies, including Super-Pulse capability, CTi tips, APC and STP treatment modes of Epic Pro and the resulting clinical benefits.

BIOLASE

Background

More and more diode lasers find their way into general and specialized dental practices today. For many general dental practices that are just beginning to integrate aesthetic procedures into their everyday routines, diode lasers seem to offer easier and faster procedures with fewer complications and other advantages, including:

- Bloodless operating field, for example, for frenectomy and biopsy
- Reduced pain: many procedures can be done with only topical anesthesia
- Easy and precise gingival contouring for restorative and aesthetic applications
- Make procedures, like troughing, more efficient
- Offer new procedures, such as, tooth whitening and pain management

Surprisingly, many dental practices do not use their diodes on a regular basis. In an in-house survey, we found that many practices only use their diodes for 10% or less of the total soft-tissue procedures they do. It would seem that diodes do not in fact reliably provide benefits for soft-tissue procedures, and in many cases introduce new challenges that are difficult to master.

Classic Diode Laser Technology and its Limitations

All current dental diodes are built around a single Gallium Arsenide (GaAs) semiconductor emitter. Such a laser is quite compact and has a very low cost which can make it affordable for almost all dental practices. But this single-emitter diode laser has significant limitations and cannot provide high quality laser surgery comparable to Er:YAG/Er,Cr:YSGG or CO_2 laser with high peak powers and controlled tissue interaction.

How diodes interact with human tissue for soft-tissue procedures has been the subject of recent investigations and we now have a much clearer understanding of the mechanisms behind this interaction.

Fundamentals of Laser-Tissue Interaction

Lasers typically interact with human tissue by tissue absorbing laser energy. Each laser type has a different wavelength, and that wavelength has different absorption characteristics in tissue. Figure 1 shows some typical absorption values for lasers. Near infrared lasers, such as diodes with wavelengths from 800-1100 nm, have very poor absorption in soft-tissue, so shining the laser on tissue will not cut, just slowly coagulate and carbonize the target.

Other laser wavelengths (such as, e.g., Er,Cr:YSGG or CO_2 lasers) are absorbed at a much higher rate. In fact, the absorption of a CO_2 laser is about 1,000 times higher than a diode.

This is why a CO_2 or Er laser can cut soft-tissue through direct light-tissue interaction, while a laser at the diode wavelength can only coagulate tissue, not cut.

Tip Initiation

So, if it is not the light-tissue interaction that is responsible for cutting soft-tissue, how do diode lasers manage to cut tissue? Despite what you may have heard, diode lasers are essentially thermal cutting instruments, with the exception of non-contact applications, such as aphthous ulcer treatment. They use a hot tip to cut tissue. The hot tip is created by performing a process called “initiation”, where a light absorbing material like carbon

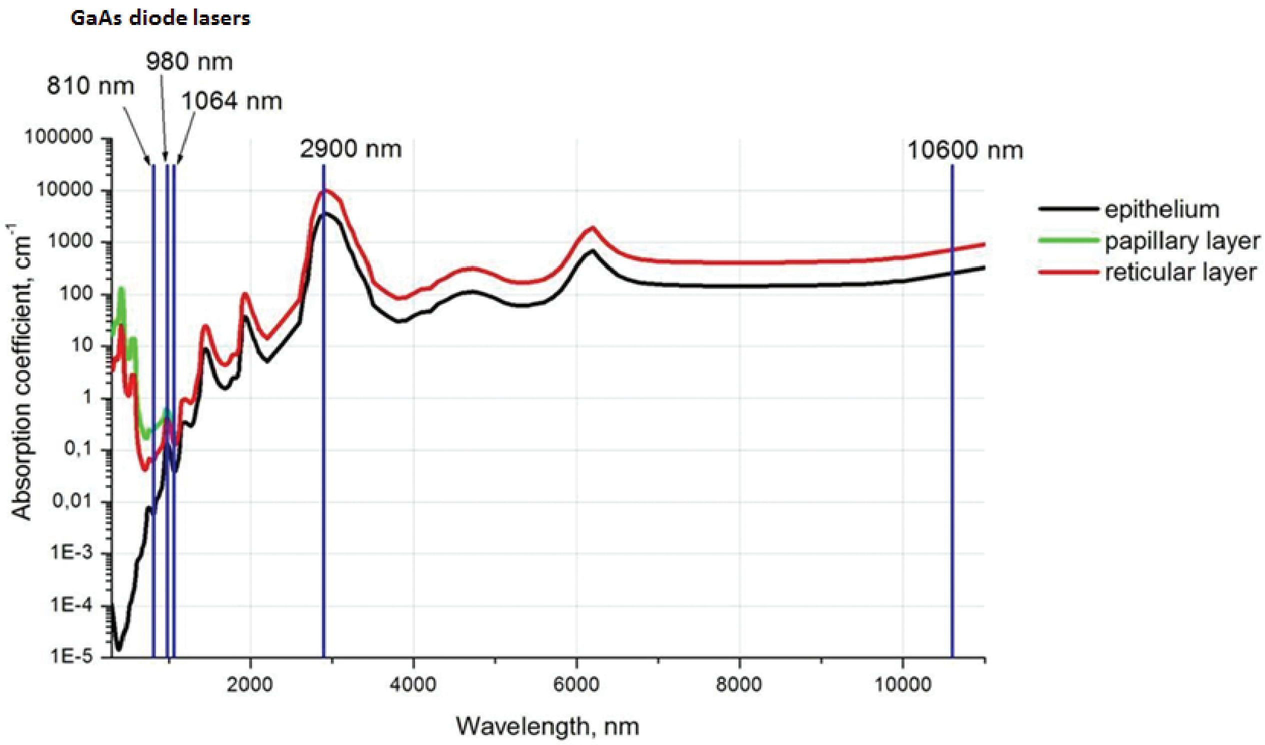

Figure 1. *Absorption spectra of typical soft-tissues*

paper adheres to the tip of the fiber. This material will absorb most of the laser light and transform it to heat, causing the tip to glow. It is this glowing tip that has the ability to cut tissue.

A hot tip on a diode laser can exhibit temperatures anywhere from 500°C to 2000°C and sometimes more. These tip temperatures depend not just on laser power, which a dentist may preset, but also on the type of tissue, speed of cutting, and initiation quality. The cutting efficiency is so dramatically different between good and bad tip initiation, that reduction in the initiation quality immediately blocks cutting, resulting in a dead fiber being dragged across tissue, with little or no cutting effect at all. Since cork or paper initiation is only superficial, like the adhesion of carbon to glass, it does get wiped off quite rapidly. Experienced diode users know this and when the clinician feels the tip starting to drag they will stop for a moment and allow the tip to denature patient tissue long enough to create a drop of carbonized protein material. This carbon sludge reinitiates the tip and cutting can continue. So, in fact, a diode laser is constantly subject to an initiation "seesaw", with laser light absorption at the tip going from 0% absorption (=no hot tip) to 50-60% absorption (=max. hot tip) every few seconds. Accordingly, tip temperatures for classic diodes vary wildly by more than 1,500 C – i.e. up to the glass fiber melting temperature.

Speed of Movement

Cutting efficiency and collateral thermal impact go hand in hand. A key factor in the quality of a cut is the cutting speed and consistent cut. Classic diode lasers require a constant painting movement to cut. This is due to the tip initiation "seesaw" and the need for constant re-initiation of the tip during a procedure. Cutting speeds are quite slow due to this effect, rarely going beyond 2 mm per second.

Collateral Thermal Effect

Because of the high variability of tip temperatures at any time during the cutting process, it is impossible to avoid a collateral thermal impact of varying proportions.

This inconsistent cutting effect is the primary reason for frustrations with the diode laser's variable ability to cut soft-tissue and has a direct and obvious impact on collateral thermal damage with these systems. Uncontrolled collateral thermal damage is the visible result of temperature fluctuations; the time on tissue is variable, but is always longer than with all other heat-based techniques. Even an experienced user cannot prevent this from happening because it is an inherent deficiency of near infrared lasers.

Pulsing Classic Diodes

Classic diodes now offer pulse modes, in which laser power is emitted in short pulses. Another disadvantage of standard dental diode lasers is lower achievable power in pulse mode. A standard singe emitter diode laser has almost equal output power in continuous wave and pulse modes (<10 W). Also, the energy emitted per each short pulse, such as 0.1 ms, is only 1-2 mJ, which is not enough to produce any tissue effect at all.

Figure 2. New Epic Pro Professional system for dentists seeking professional-grade diode lasers

a.

b.

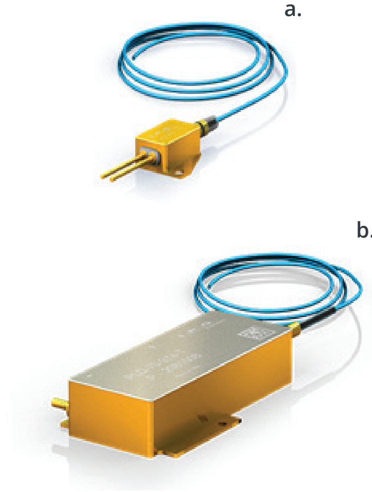

Figure 3. External views of classical diode laser module with one emitter (a) and Epic Pro Super Pulse Diode Laser module with six Super Pulse emitters inside (b) and coupling in laser power the same 100 µm fiber

Epic Pro Soft-tissue Laser: Technological Advantages

The Epic Pro is the result of years of research[1] with unparalleled level of quality and performance. The device combines some of the most advanced laser diode technology recently developed by IPG Photonics Corporation (Oxford, Massachusetts), a worldwide leader in high-tech laser manufacturing. The unit itself is compact and lightweight, making it extremely mobile for today's flexible dental practice (Fig.2).

High-Power Laser Package

At the core of the new Epic Pro is a Super Pulsed diode laser with six high-performance diode emitters with peak powers over 15 times higher than standard single-emitter diode lasers (Fig.3). So inside the new Epic Pro system there is a V6 laser engine vs. a single laser engine (or emitter in a standard diode laser).

The laser engine provides unlimited opportunities to optimize the laser parameters for a precise and desired clinical result. Additionally, the Epic Pro introduces new and unique treatment modalities previously not available on standard diode lasers.

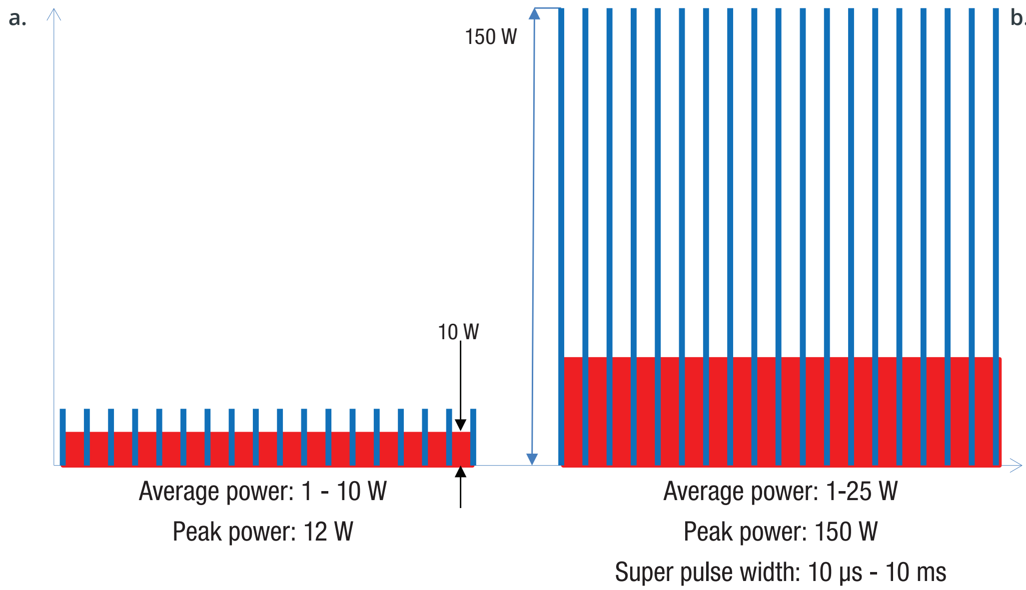

Figure 4 .Time diagram of classical dental diode laser (a) and Epic Pro Super Pulse Diode Laser (b)

Super Pulsing Capabilities

Epic Pro is the first dental laser with true Super Pulsing capability. Achievable peak powers can be as high as 150 W in a 10 µs pulse (or 10 millionths of second), which is 10 times higher than for any standard diode laser (Fig.4).

The Super Pulsing capability allows laser operation at pulse durations shorter than tissue target thermal relaxation time and with energy per pulse necessary for selective tissue target ablation or coagulation, when operating with non-initiated tip on tissues with sufficient absorption. Fig. 5b shows a comparison of tissue and vessels effect of the Epic Pro Super Pulse Diode laser, standard 10 W diode laser, and Nd:YAG dental laser with pulses shorter than the thermal relaxation time of vessels with 100 µm diameter (6 ms) and 100 µm tissue (12 ms).

Coefficients of arterial blood absorption for a 975 nm diodes laser and 1064 nm Nd:YAG laser are 6 cm-1 and 3.3 cm-1, respectively. Coefficients of absorption in tissue for 975 nm and 1064 nm are 0.48 cm-1 and 0.15 cm-1, respectively (see Fig. 5a). One can see from Fig. 4 that selective coagulation effect of blood vessels can be achieved with both Super Pulse Diode and Nd:YAG. Selective coagulation of a 100 µm tissue layer can be achieved only with the Super Pulse Diode Laser. The Super Pulse Diode Laser will also produce a stronger biofilm coagulation effect than an Nd:YAG dental laser. A standard 10 W diode laser cannot selectively coagulate blood vessels and thin tissue layers or biofilm.

Revolutionary Carbon and Titanium Dioxide (CTi) Tip Initiation Process

Diode lasers are thermal cutting tools. To make them the best thermal cutting instruments they can be, the conversion of laser light to thermal power must be as complete and consistent as possible. This conversion happens at the distal fiber tip.

Ideally, all laser energy should be converted to thermal energy and the fiber tip should survive an entire clinical procedure with modification of the thermal conversion. No diode laser to date has these properties; all diodes suffer from severe tip initiation fluctuations.

To achieve this goal, the researchers that developed the Epic Pro created a proprietary multi-stage tip initiation process, in which Carbon and Titanium Dioxide particles are embedded into the core of a laser tip and fused to the core in a complex process. To ensure optimal performance, single-use pre-initiated tips in different diameters and lengths are available from a standardized production.

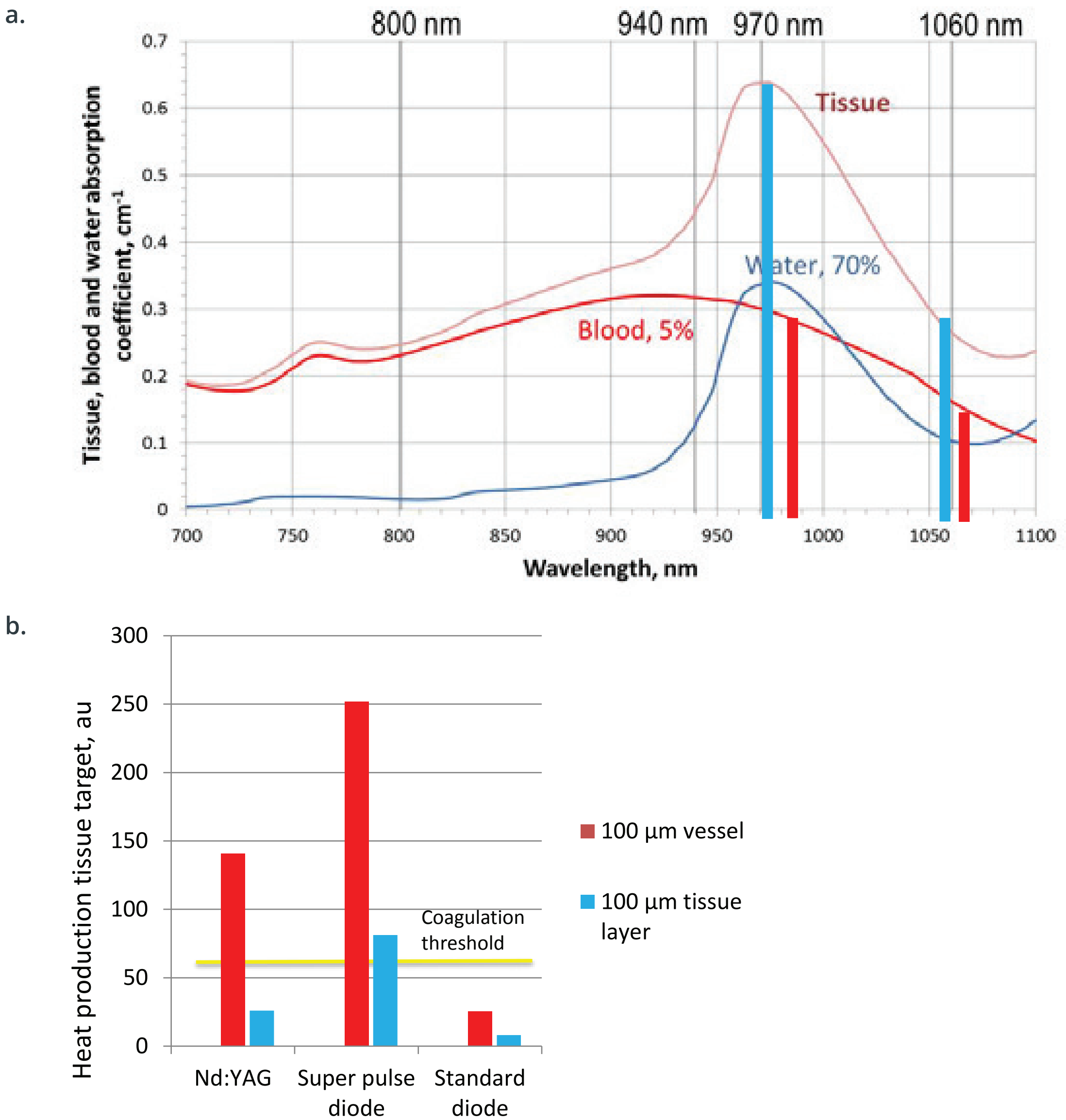

Figure 5. Spectra of absorption of water, blood, and soft-tissue (a) with absorption values for 975 nm diode laser and Nd:YAG laser. Calculated heat production and temperature rise for 100 µm diameter vessels and 100 µm tissue layer after exposure with dental Nd :YAG, Super Pulse Diode Laser and classical diode laser (b)

This CTi fused core initiation consistently converts over 90% of laser light to thermal power. Since the light converting chromophores are embedded inside the actual tip, it is also remarkably durable. The images below (Fig.6) show classic diode tips after cork initiation as compared with CTi fused core initiated tips and standard pre-initiated tips.

The ultra-durable Epic Pro CTi fused core tip can maintain tip temperatures that are twice as high as cork

a. b. c.

***Fig. 6.** Epic Pro CTi (a), BIOLASE pre-initiated tip (b), and cork initiated tip (c), microscopic view*

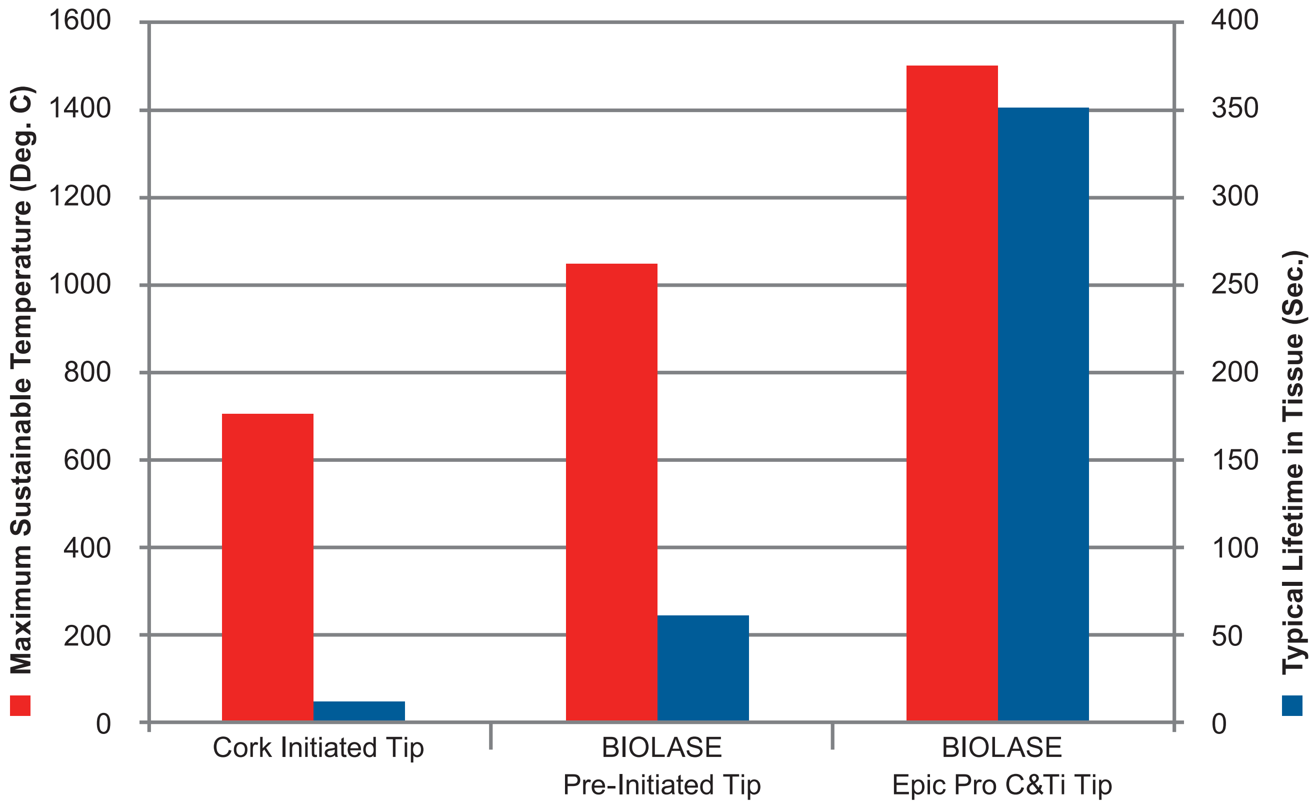

Figure 7. *Maximum sustainable temperature of maintaining pre-initiation and lifetime of initiation during tissue cutting at identical conditions for Epic Pro CTi, Epic X , and cork initiated tip*

initiated tips without losing their factory initiation. This allows significantly faster tissue cutting. Additionally, the cutting technique changes from the multi-pass painting method that classic diodes require for constant tip re-initiation to a more scalpel-like single pass technique.

This significantly reduces the time on tissue and speeds up the actual procedure; clinical procedures become more efficient, with much lower collateral thermal effect, despite the higher tip temperatures.

The useful lifetime of Epic Pro, BIOLASE pre-initiated and cork initiated tips was compared in vitro on fresh chicken meat. Cutting speeds were optimized to avoid dragging. The average speed of cutting for each tip was 15, 10 and 7 mm/s, respectively. Tip lifetime was measured as the time of initial initiation loss. As one can see from Figure 7, in these tests the CTi fused core tip lasted 30 times longer than cork initiated tips and 6 times longer than the BIOLASE pre-initiated tip for these cutting conditions.

A New Paradigm for Soft-tissue Lasers: Automatic Power Control (APC) through Thermal Feedback

The Epic Pro offers a unique level of control for soft-tissue treatment never before seen in dentistry. The Epic Pro system turns the specific characteristics of the near infrared wavelength into clinical advantage with an unprecedented level of monitoring and control.

Laser experts have identified thermal levels at the tip to be the clinically relevant diode laser parameter. Increasing or decreasing tip temperature has a direct effect on cutting speed and thermal collateral impact. Since the ultra-stable CTi fused core tips now provide a solid and stable basis for constant thermal conversion at the tip throughout the entire treatment time, researchers focused their efforts on identifying and controlling the actual thermal level of the tip as a means of controlling cutting efficiency.

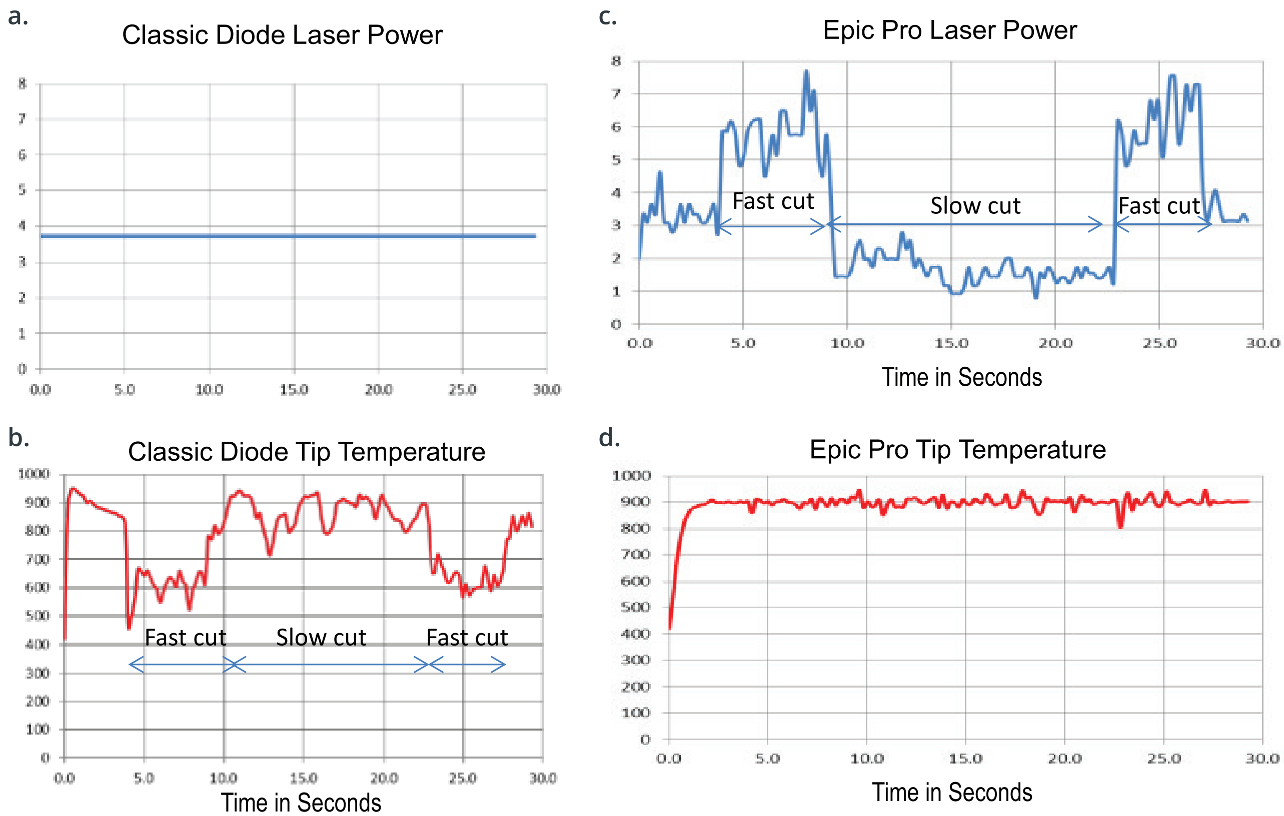

Figure 8. *Difference in thermal dynamics between classic diode laser (a,b) and Epic Pro APC mode (c,d)*

When cutting across a soft-tissue surface, the tip will encounter different clinical conditions, such as thin tissue, thick tissue, fibrous tissue, highly vascularized tissue or inflamed tissue, just to name a few. Each clinical tissue situation has a different capacity to absorb thermal energy, resulting in temperature fluctuations at the tip. Additionally, the speed of cutting plays a major role in the thermal transfer to tissue. A classic diode had no means of coping with different clinical conditions, so tip temperatures will simply fluctuate wildly, with the corresponding variations in cutting efficiency (Fig.8a, 8b).

The Epic Pro has a sophisticated computer controlled thermal feedback system that works in real time to identify and control tip thermal levels. Since this is a real time process, the Epic Pro system is capable of adjusting the thermal level at the tip almost instantaneously. Clinically, this means that cutting efficiency is constant and becomes independent of clinical conditions or cutting speed (Fig.8c,d). The Epic Pro does this by simply adjusting the power levels up or down to maintain tip thermal levels exactly at the preset level, with a range of thermal levels from 1 to 10 which corresponds to tip temperatures from 500°C to 1400°C. **Note:** Tip temperature is not tissue temperature. Due to low tip thermal conductivity, tissue temperatures are much lower than tip temperatures and rarely exceed 100°C (vaporization) or 200°C (carbonization). For classic diodes with cork initiated tips, the tip temperature can

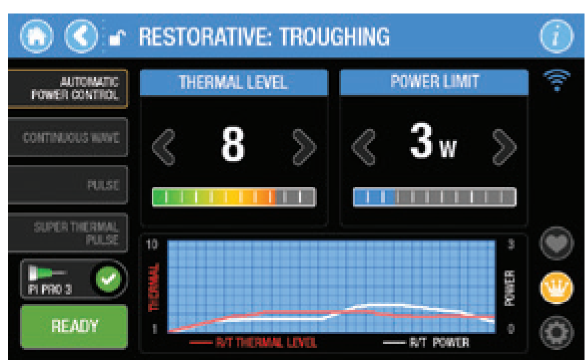

Figure 9. *Real-Time Display of Laser Power and Tip Thermal Level in Epic Pro APC mode*

exceed 1400°C during cutting with laser power settings in the 2-3 W range.

Cutting with a diode has traditionally been an arduous process. This is because a cut requires multiple passes over the area to be cut with the fiber to ensure some level of tip initiation. The technique is similar to painting short brush strokes. The Epic Pro has an incision technique closer to that of a scalpel[2]: long clean single passes with the Epic Pro PI tip generally do the job. The cutting process in APC mode is much faster and more efficient, with less thermal collateral tissue impact. And speeding up or slowing down during the incision does not cause more collateral damage. An experiment was performed comparing the collateral thermal impact of a classic diode system to an Epic Pro system with thermal monitoring and control. The results show that the Epic Pro delivers constant cutting efficiency with controlled thermal impact on tissue over a wide range of cutting speeds. The APC mode is controlled through an intuitive and powerful GUI (Fig.9).

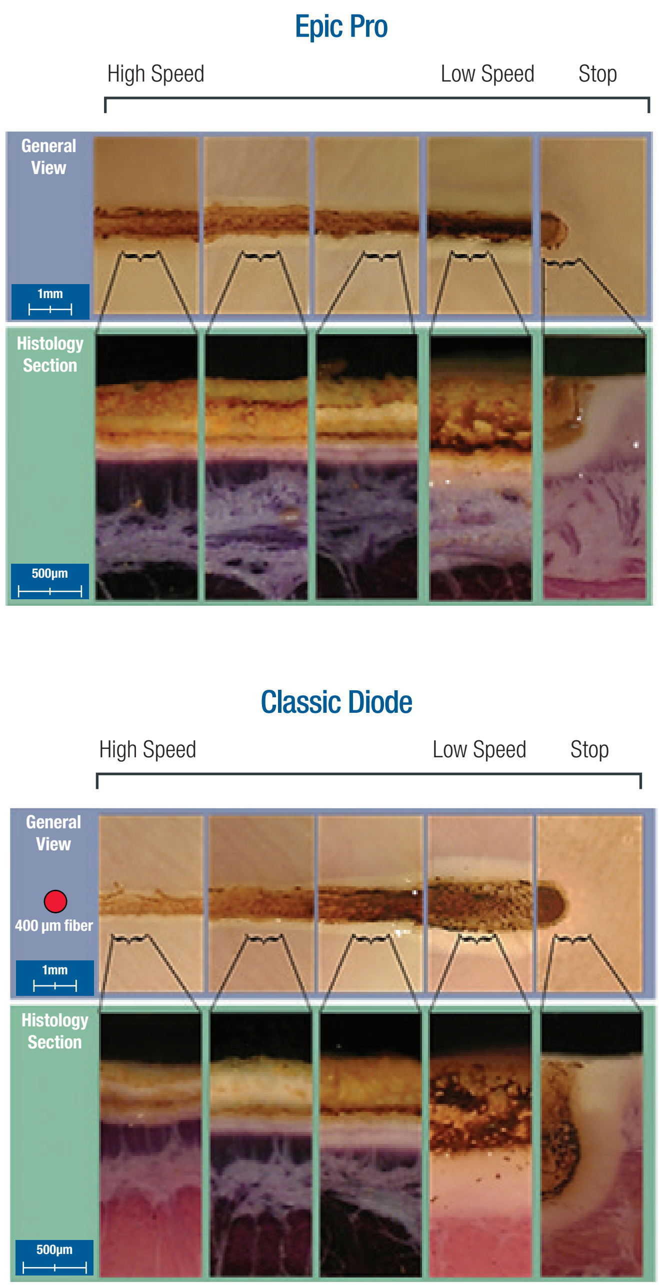

Fig 10. *Horizontal view and histology of vertical cross-section of tissue cutting with classical diode with 3 W power and Epic Pro with thermal level 8 with different speed of cutting.*

The images shown in Figure 10 represent a series of photos (top row) and histology (bottom row) of soft-tissue cutting at five different speeds of movement, from 12.5 mm per second to 0 mm per second (stop for several seconds) performed with a classical diode laser using Fixed Power in the Continuous Wave mode (a) and Epic Pro in the APC mode. These experiments were performed using a translation stage with programmable speed and controlled vertical force between the fiber and the sample. To visualize tissue damage, Nitro Blue Tetrazolium Chloride (NBTC) viability staining was used, so stained areas show live cells, while cells in white areas are dead. Note that as the speed decreases, the cutting depth and level of collateral tissue damage and carbonization increases sharply for classic diode lasers, while it remains essentially the same for the Epic Pro system. These histological evaluations illustrate how much the influence of the cutting speed to the tissue damage can be reduced by using APC mode.

Super Thermal Pulse (STP) mode: Intelligent Thermo-Optical Laser Power Conversion

The core laser system used for the Epic Pro laser is a high-tech Super Pulse Diode Laser with 6 high-performance diode laser emitters and exclusive power characteristics. This laser has the ability to generate energy pulses with high peak powers of up to 150 W, much like the more powerful CO_2 lasers. This pulsing capability of the Super Thermal Pulse mode can be used to create thermal pulses with high peak powers and a thermal emission spectrum from 1400 to 11000 nm. In contrast to the poor tissue absorbing coefficient of about 1 cm-1 for direct laser power, the broad spectrum emission overlaps with major tissue water absorption bands from 1800 to 11000 nm and has an effective absorption coefficient of about 800 cm-1, which is very close to the tissue absorption coefficient of a CO_2 laser. The result is that the thermal radiation produced by the Epic Pro system can cut tissue in contact surgery mode very similarly to a Super Pulse CO_2 laser with minimal collateral damage. Clinically, thermal pulsing has benefits that translate into exciting procedural advantages, both in terms of speed and in safety:

- Using short bursts of thermal power limits the time on tissue to a few micro or milliseconds, so the laser on-time is only a few percent, resulting in low overall tissue impact for unique managed thermal relaxation.
- High-powered bursts of thermal energy will cause an almost immediate tissue vaporization, resulting in incisions with pinpoint precision and much less collateral impact. Similar cutting efficiency is achieved with at least 30% less thermal collateral impact.
- Pulse width determines thermal impact on tissue: short pulse durations have lower collateral thermal impact than longer pulse durations.
- In STP mode, the Epic Pro laser maintains thermal levels at a preset value, so thermal levels can never exceed a maximum level. This is important to protect sensitive structures in the oral cavity, but also to protect the integrity of the tip, which reacts sensitively to excess thermal levels.
- The computer in the Epic Pro controls and manages all parameters to ensure perfect reproducibility for each procedure. Parameters controlled are:
- Pulse Width: user defined parameter maintained throughout procedure
- Thermal Level: system defined parameter maintained throughout procedure
- Average Power Limit: system varies peak power and energy per pulse to maintain the preset thermal level while maintaining a fixed pulse rate to ensure that the real time average power does not exceed the preset average power limit defined by the user.

In Super Thermal Pulse mode, the Epic Pro laser also continuously monitors the integrity of the tip and informs the user immediately if the tip initiation has failed for any reason. This unique capability protects the patient from unwanted laser light penetration into tissue and the potentially negative consequences, especially important around sensitive structures, for example during implant uncovering or close to the tooth root or nerve structures.

Translating Technological Advantages into Clinical Benefits

The Epic Pro System with its exclusive computer controlled thermal pulsing capability and real-time thermal monitoring and control opens new pathways for tissue interaction, and will provide the technological basis for new and exciting clinical modalities[3]. This will also expand the potential of everyday routine clinical procedures, making them safer, faster and easier to do for every general practitioner, and in some cases completely change the way clinical procedures are performed.

Ex Vivo Validation

The Epic Pro has been extensively tested ex vivo against conventional diode lasers and other laser types. A

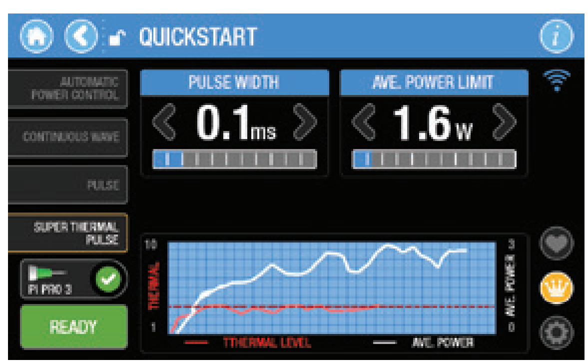

Figure 11. *Real-Time Display of Laser Power and Tip Thermal Level in Epic Pro Super Thermal Pulse mode*

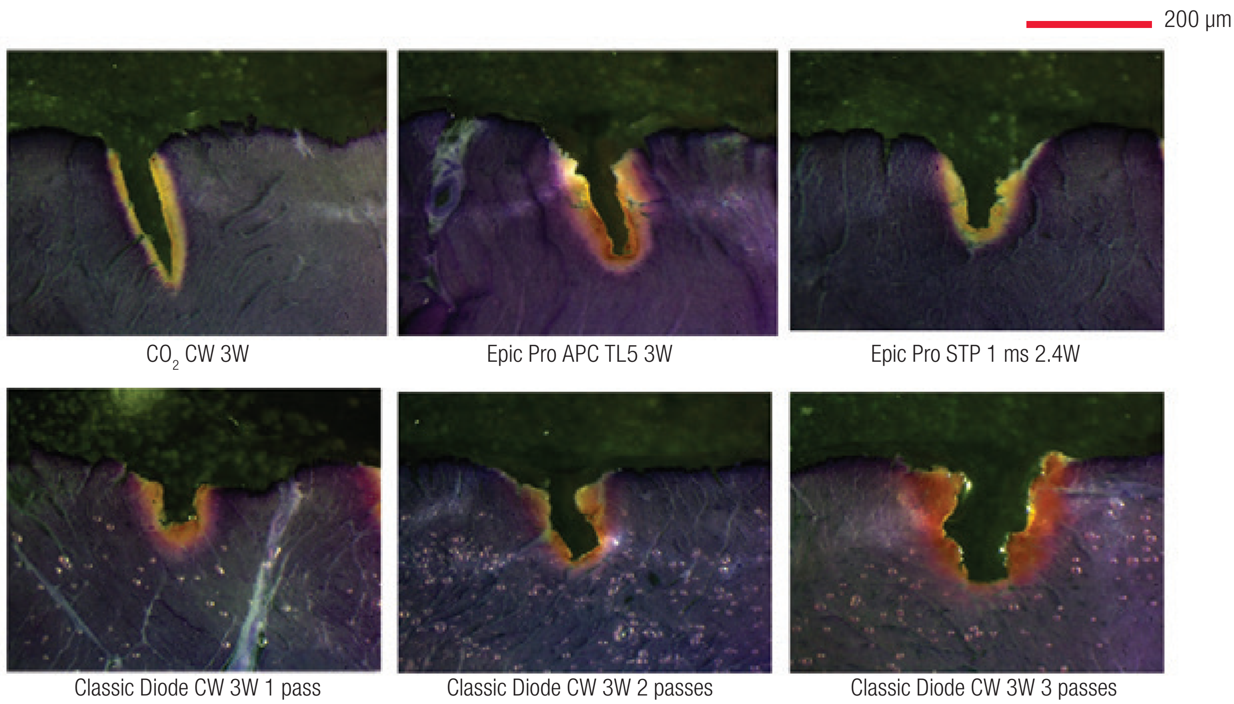

Figure 12. *NTBC histology of vertical cross-section of tissue cut with Epic Pro (APC mode, Thermal level 5, power limit 3W), Epic Pro (STP mode, 1 ms, power limit 2.4 W), CO_2 laser (3W) and classic diode laser (Picasso, 3 W) for one, two and three passes*

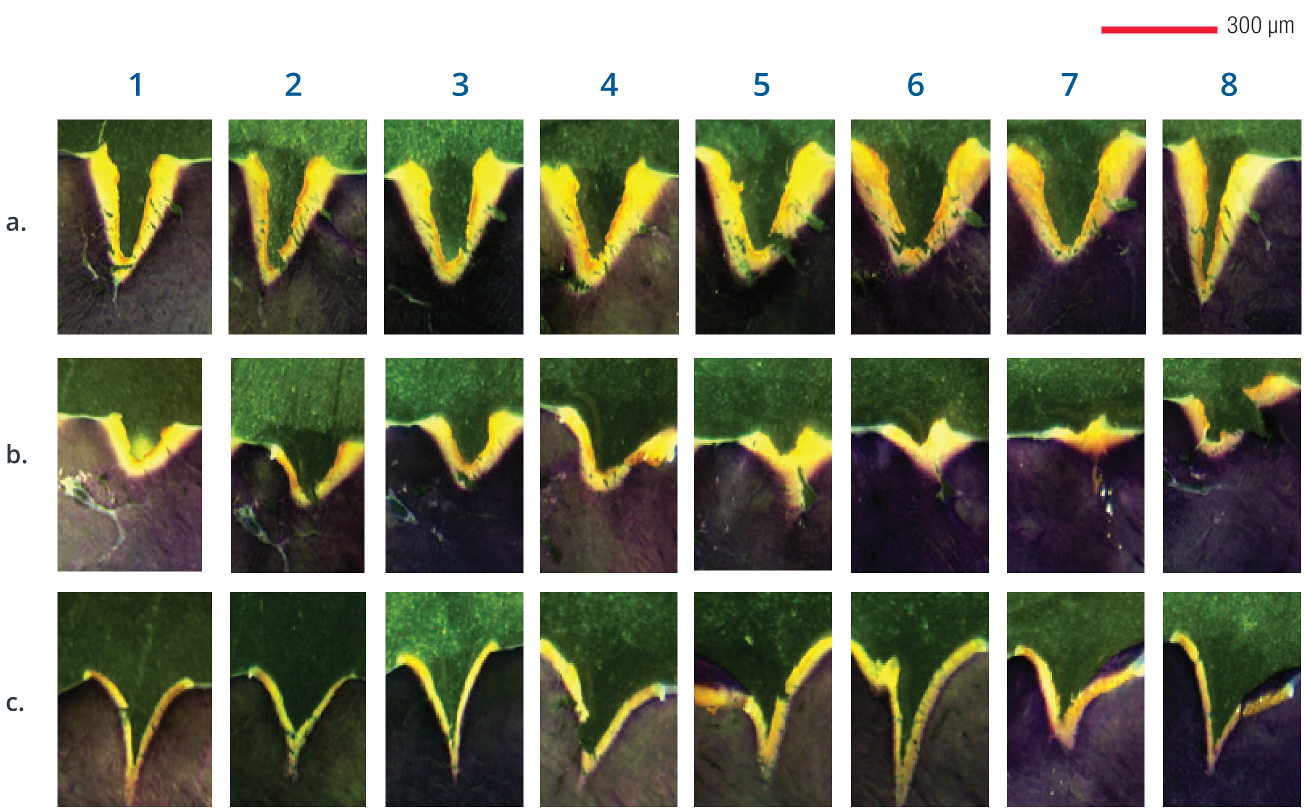

Figure 13. *General view and NTBC histology of vertical cross-section of tissue cut with (a) Epic Pro, (b) classic diode laser and (c) CO_2 laser.*

computer-controlled setup has been built, allowing comparison between different cutting modalities in an objective and operator-independent way. Some of the results are exemplified in Figs. 12 and 13. Fig.12 illustrates differences between cross-sections of the cuts obtained with three modalities: CO_2 laser, conventional laser diode with cork-initiated tip (Picasso), and Epic Pro in APC and STP modes. As can be seen, at comparable or lower power level, Epic Pro delivered a much deeper cut than Picasso. In order to match the depth of Epic Pro cuts, multiple passes had to be done with Picasso, resulting in significant amount of collateral thermal damage. On the other hand, the morphology of Epic Pro cuts is closer to that of a CO_2 laser.

This observation is further illustrated by Fig.13, where several transversal cross-sections are compared along the same cuts for Epic Pro and Picasso lasers. Not only does Epic Pro deliver a significantly deeper cut, the consistency of the wound along the length of the cut is considerably higher.

Fig.13 also illustrates cutting with high speed, high power limits and compares results with those of a CO_2 laser. As can be seen, the resulting cuts of Epic Pro are close to those of CO_2.

The Epic Pro Specialty Laser Concept

The first Epic Pro system was designed in mind with the needs of a general practitioner that uses a laser for a wide range of soft-tissue applications, with a special focus on aesthetic, restorative and implant applications. As shown in Fig. 14, the device has over 20 preset procedures organized in 7 clinical categories.

Each procedure is optimized to fit the needs of clinical conditions specific to a patient. The presence of thin tissue biotype, thick tissue biotype, and high vascularization may significantly modify the recommended settings, or even suggest a change in the treatment mode to best meet the needs of that specific case.

Figure 14. *Epic Pro Procedural Categories*

Available treatment modes for Epic Pro:

APC (Automatic Power Control)

A sophisticated temperature monitoring and feedback system which measures the temperature at the tip of the handpiece. The thermal level of the tip is maintained constant by the system by adjusting power up or down to account for clinical conditions, or variance in speed of cutting. This setting applies constant cutting power to tissue with minimized collateral thermal effect.

USES: CONTACT (PRE-INITIATED EPIC PRO PI TIPS)

- Soft-tissue procedures where cutting speed with good hemostasis are the primary clinical objectives. Adjustable from very slow with reduced tissue interaction to very fast with high cutting capability.

STP (Super Thermal Pulse)

The flagship treatment mode of the Epic Pro system uses computer controlled super-pulsed bursts of thermal power to interact with the tissue, resulting in pinpoint precision with little or no collateral thermal tissue damage. The pulse duration and the average power limits are preset by the user, while the system sets the thermal level, rep rate and peak powers in accordance with the clinical conditions.

USES: CONTACT (PRE-INITIATED EPIC PRO PI TIPS)

- Soft-tissue cutting where collateral thermal effects are undesirable, such as gingival contouring in the aesthetic zone.
- Working around sensitive materials, such as dental implants
- Low impact tissue removal, such as troughing

CW (Continuous Wave)

In this setting, the laser power (measured in Watts) is increased or decreased, resulting in more or less cutting potential, respectively. A timer may be employed as a modifier to control the amount of time the power is applied to tissue. This is the classic diode laser setting.

USES: NON-CONTACT (WHITENING HANPIECE)

- Teeth whitening procedure

Pulse

This mode uses the Super Pulse capability of the laser system without temperature control. It is used exclusively for non-contact (non-initiated tip) procedures and allows an increased precision in the application of laser energy to tissue.

USES: NON-CONTACT (NON-INITIATED EZIPS)

- Sulcular debridement as part of a periodontal procedure
- Aphthous ulcers/herpetic lesions
- Bleeding (Hemostasis) control
- Micro-coagulation

Clinical Implications of Real-time Thermal Control and Super Pulsing

The Epic Pro System with its exclusive computer controlled thermal pulsing capability and real-time thermal monitoring and control opens new pathways for tissue interaction, and will provide the technological basis for new and exciting clinical modalities. This will also expand the potential of everyday routine clinical procedures, making them safer, faster and easier to perform for every general practitioner, and in some cases completely change the way clinical procedures are performed.

SOME EXAMPLES:

Restorative Procedures

Soft-tissue troughing for restorations is by far the most widespread restorative soft-tissue procedure performed in general practices today. Many practices have subscribed to the hope that lasers might provide a safe and efficient way to perform this step in the total restoration. But the drawbacks of classic diodes make it hard to achieve a consistently superior result, due to tissue tagging, inconsistent cutting, carbonization and even black spots on dentin, which may trigger subsequent tissue shrinkage (recession) and restoration failure.

The Epic Pro in STP mode has a special troughing setting that allows a clean bloodless trough without charring or carbonization, with perfect margins for digital imaging. And performing a quick adjunctive trim to excess gingiva for restorative is just as fast and easy in STP mode, without charring or collateral damage. Only high-power thermal pulsing can provide such a perfect result.

Aesthetic Procedures

Correcting a gummy smile with a classic diode laser can be a long and arduous procedure, painting the same area over and over again to provoke the desired clinical reaction, and often requires multiple retouching to overcome uneven gingival lines created by inconsistent diode power output. In addition, there is a risk of tissue necrosis.

The Epic Pro System with its computer controlled APC mode can provide bloodless single-pass cutting that is fast and efficient without inconsistency or charring, creating a new paradigm for aesthetic dentistry.

Implant Procedures

Classic diode lasers are indicated for implant uncovery, however, given their thermal nature, it is not recommended to use a classic diode laser around an implant for extended periods of time. It is a simple fact that diodes will lose their initiation at least once, possibly several times during an implant uncovery procedure, blasting unabsorbed laser light deep into tissue and overheating implants and bone. A recent peer-reviewed study[4] looked at the temperature increase in implants during an uncoverying procedure and found a dramatic temperature increase with classic diodes vs. the Epic Pro system used in Super Thermal Pulse mode[4]. Working on or around an implant with a classic diode will very quickly raise the internal temperature of an implant and may cause bone necrosis and/or implant failure. Because of the ultra-durable Epic Pro PI tips with almost complete conversion of laser light to thermal power, the Epic Pro is the only diode laser on the market today that can safely work around implants in the computer-controlled STP mode without fear of raising the internal temperature of the implant.

Surgical Procedures

Soft-tissue surgery is perhaps the most difficult area for classic diodes to handle[5]. Inconsistent initiation, instant loss of initiation during use, the need to constantly paint tissue to reinitiate the fiber makes it very hard to cut tissue efficiently, and the risk of extensive collateral damage is quite significant. This becomes obvious for a biopsy procedure, where it is necessary to excise a precisely defined amount of tissue for subsequent lab analysis; the classic diode can create a massive zone of thermal necrosis and potentially destroy the biopsy specimen in the process. Practitioners using diodes for this procedure are forced to excise a larger piece of tissue than necessary to ensure viability of the tissue sample. With Epic Pro, STP mode allows for rapid and efficient tissue removal with minimized tissue collateral impact; making the procedure much safer and more comfortable for patients and clinicians alike.

The Epic Pro can really shine for surgical procedures where larger amounts of tissue need to be incised or removed. A typical example is frenectomy. Some lingual frenectomies require extensive cutting, and classic diodes can take a lot of time and effort to complete the procedure, leaving behind a wound with significant collateral damage; bleeding can also be quite extensive, sometimes requiring surgical intervention.

The STP mode is used for procedures where more precision is required, while the APC mode provides the power to cut large amounts of tissue quickly and efficiently. Both modes strictly control the thermal output, so the resulting incisions exhibit significantly reduced thermal collateral damage to surrounding tissue, making the procedure much more comfortable for patients post-op. Most strikingly, the procedures can be executed very quickly, at a speed and collateral impact similar to those of the much more expensive CO_2 laser – unique in soft-tissue surgery.

Soft-Tissue Management Redefined

The Epic Pro is the most advanced diode laser on the market, offering the best-in-class price-to-feature ratio, providing similar clinical outcomes to that of Nd:YAG[6] and CO_2 lasers at a fraction of the price in a small portable package.

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