

# COMPREHENSIVE BROCHURE

## THE DIODE LASER IN YOUR EVERYDAY PRACTICE



doctor smile<sup>®</sup>  
dental laser



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# 1. INTRODUCTION

## IT'S TIME TO BELIEVE IN A NEW LASER.

The future is here, in laser technology, and it will innovate your profession incredibly.

Despite recent technological advances, there still are many difficulties in the everyday work of the dental practice, especially related to pain and bleeding. Usually dentists dedicate a lot of time to injections of anaesthesia and to waiting for its effects, therefore decreasing the overall productivity of the practice. Furthermore, with anaesthesia generally it is recommended to work in only one quadrant per session, to limit the risk that the patient may bite or hurt himself inadvertently. Injections increase patient anxiety, and make them feel uncomfortable waiting for the effects to wear off. Bleeding is the other aspect that creates more anxiety and inefficiency: a surgical field covered in blood makes any job difficult for the dentist and unpleasant for the patient. These aspects limit the efficiency of the dentist in practical and economic terms, and do not help the patient to face the session serenely.

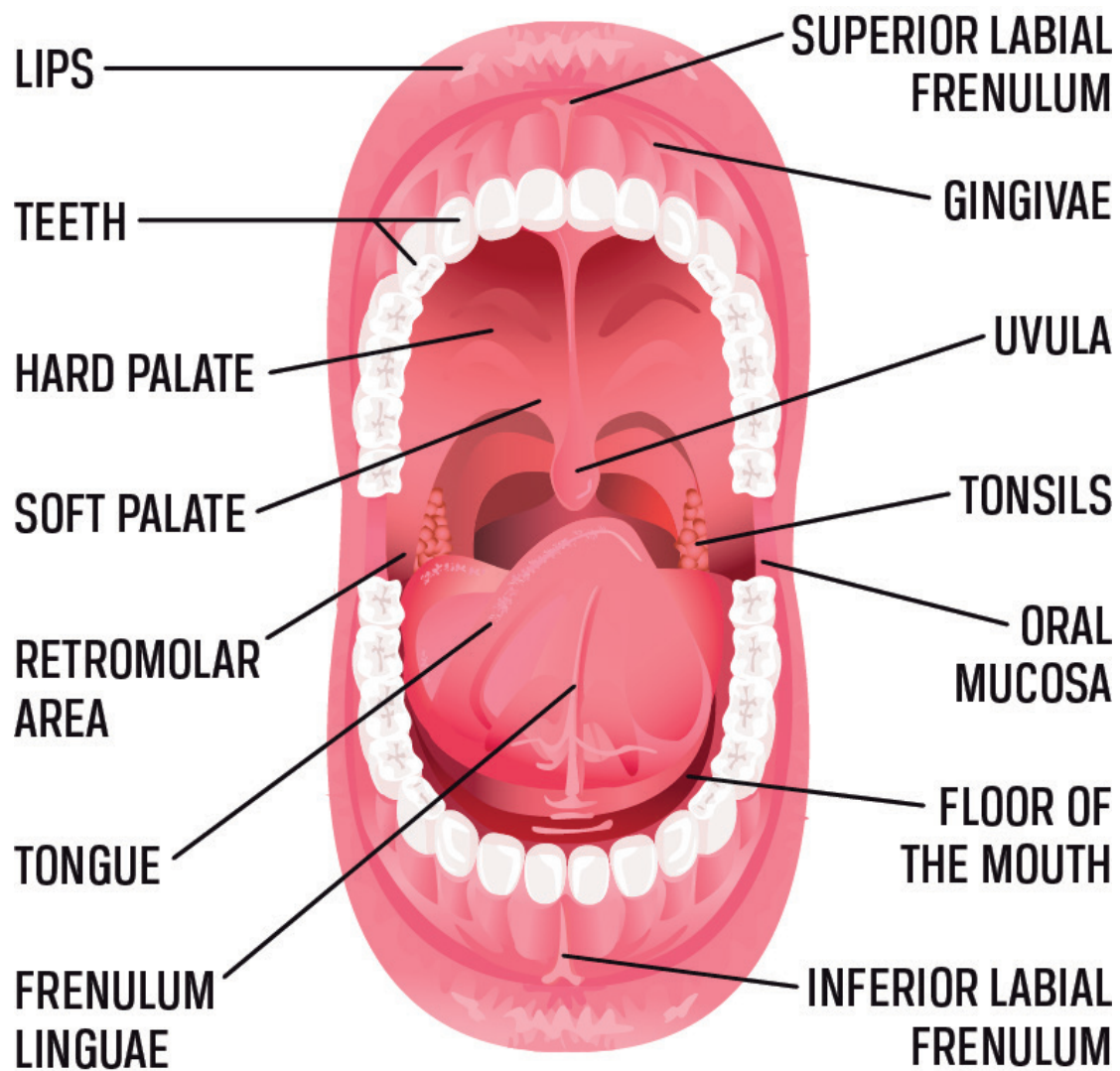
Laser surgery is virtually blood-free and requires less anaesthesia. Thanks to the bio-stimulating properties of laser, post-operative healing will be faster with a lower risk of complications.

A laser in your practice will also give you the opportunity to broaden the range of treatments that can be offered to patients: antalgic therapy, relief from canker sores and herpes, fast and safe whitening treatment, biostimulation and much more.

## NEW HARMONY FOR BOTH PATIENTS AND DENTISTS

Now imagine being able to work without causing pain to the patient, and to control bleeding during and after surgery. You'll be more relaxed, and patients will be amazed by how little painful their visit to the dentist has been. You'll save time and resources, and patients will exit the practice amazed of the comfort and the speed of your work.

**They will not hesitate to spread the word.**



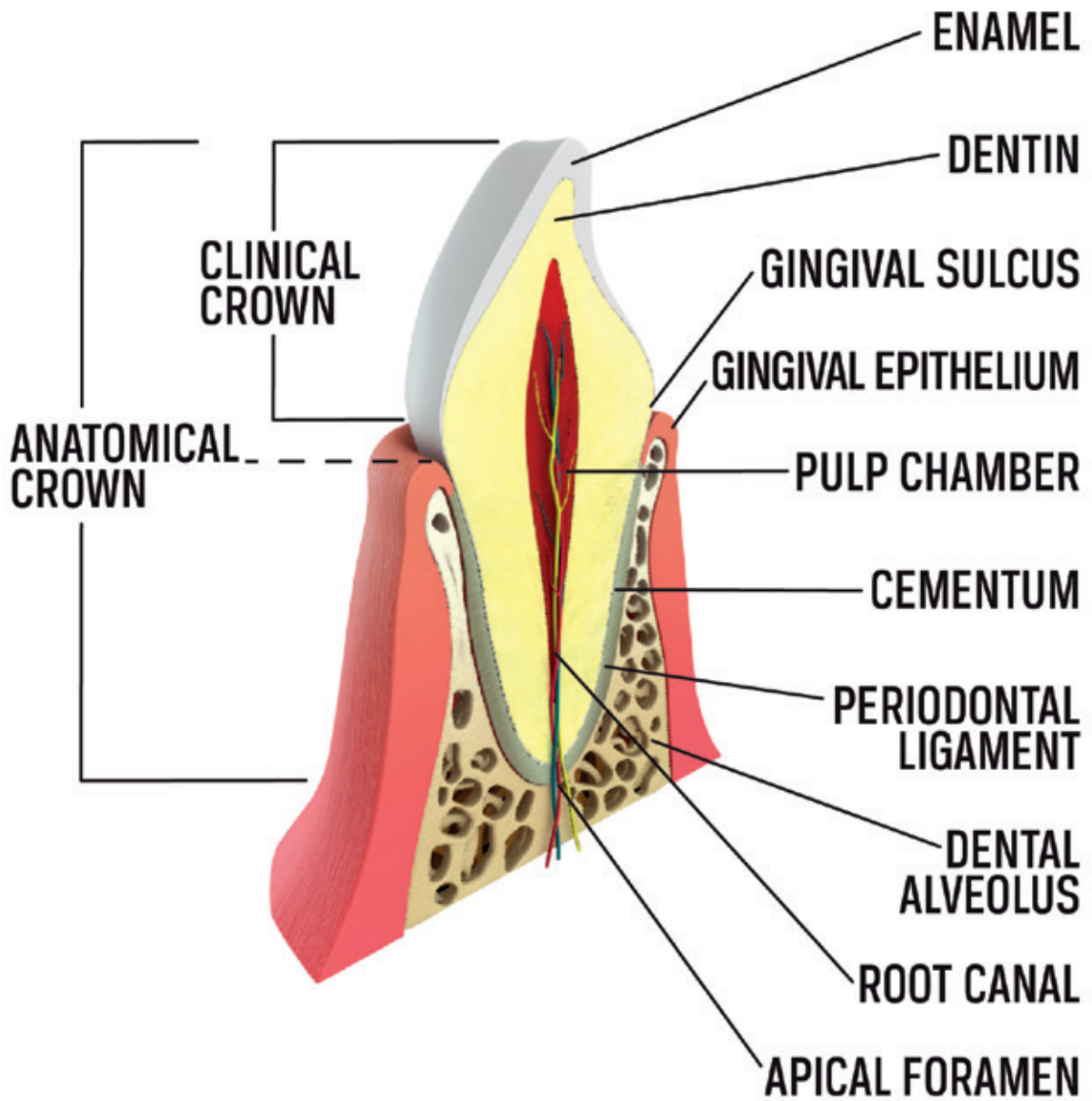
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# 2. THE ORAL CAVITY

## 2.1 THE BRANCHES OF DENTISTRY

Dentistry is the branch of medicine that treats disorders of the oral cavity. Since the oral cavity is composed of various elements, such as teeth, gums, muscles, bone, dental care can focus on a single element and not on the total. Given that these issues are often very different, dentistry has been divided into several sections:

- **ENDODONTICS** (root canal treatment, inside of the tooth)
- **CONSERVATIVE** (care of the crown, visible part of the tooth)
- **PERIODONTOLOGY** (treatment of gum, tissue around the tooth)
- **SURGERY** (surgery on bone or tissue)
- **IMPLANTS** (insertion into bone of retentive implant)
- **PROSTHODONTICS** (artificial replacement of natural teeth)
- **GNATHOLOGY** (troubleshooting articulating)
- **ORTHODONTICS** (restoration of proper occlusion)
- **PEDODONTICS** (dental care for children)





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## 2.2 TEETH

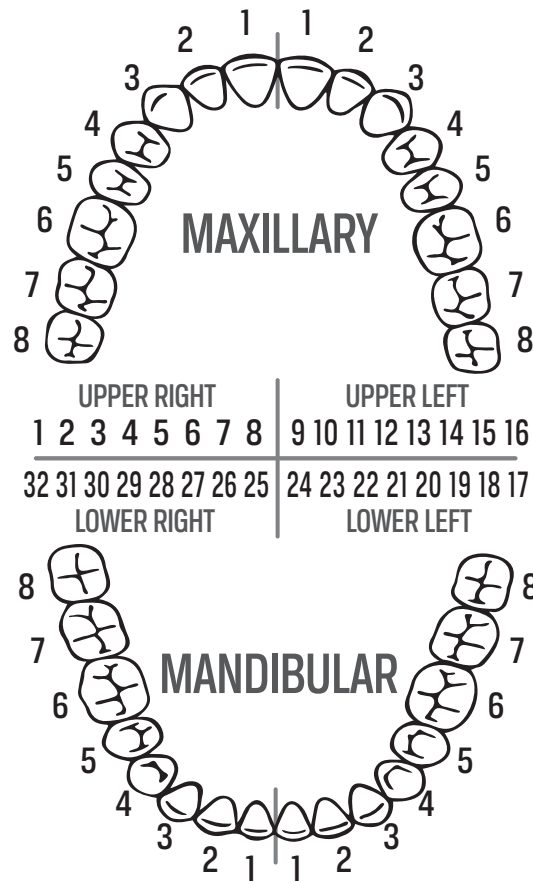
The human tooth is composed essentially of two components: the crown is the visible part while the root is in the dental cavity, inside the bone. Crown and root are separated by the neck. Inside there is the pulp cavity. The teeth are composed of three calcified tissues: enamel, dentin, cement and a soft tissue, the pulp.

Tooth structure includes the following elements:

1. The enamel, which completely covers the tooth crown and is the hardest substance present in the human body (almost like quartz) and is the most mineralized of all tissues of the organism. It consists for 97% of calcium salts and only 3% of organic substances. Whereas cement and dentine have a limited capacity or regeneration, enamel cannot be repaired physiologically.
2. The dentine, body and main mass of the tooth, with a tissue similar to the bone, is made from collagen fibrils cemented together with tribasic calcium phosphate. It is located under the enamel and the cement, and it covers both the pulp and the radical canals. (It is neither as hard or resistant to caries as enamel is.)
3. The pulp, or pulp canal, is the nerve centre of the tooth and contains the nerve and vascular tissues that extend both in the root and in the crown. In the crown this cavity is called the pulp chamber and it contains the pulp chamber, while the root of the root canal contains the pulp canal. The pulp canal communicates with the outside of the root by the apical foramen through which blood vessels and nerves pass.  
The root canals are in equal number to that of the roots and their diameter decreases towards the apex; from the main channels a secondary channel may arise all the way to the apex.
4. The cement is a hard and rough substance that covers the root.

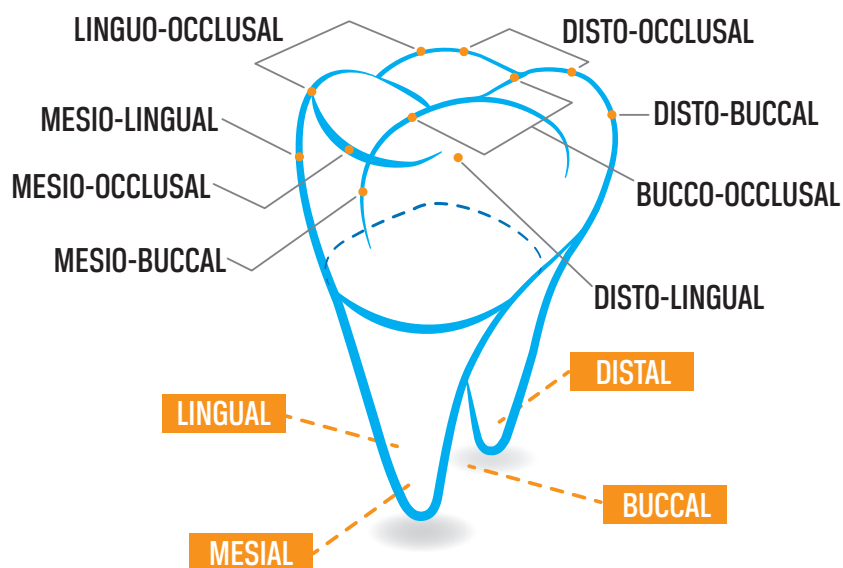
The tooth is also supported and surrounded by:

1. The bone, in which the alveolus is located and the tooth implanted.
2. The gum, which firmly adhering to the neck of the tooth, protects both the alveolus and tooth roots from the onset of bacterial plaque (The gum, when red or swollen, is the signal of an inflammation taking place).
3. The ligament, or the periodontium, is composed of thousands of tiny fibres that anchor and cushion teeth; one end is fixed to the cement, and the other to the surrounding bone.



## TOOTH NOMENCLATURE

To identify the position of each morphological element of the tooth, a terminology that refers to the different planes of the oral cavity is used: VESTIBULAR, LINGUAL, OCCLUSAL, MESIAL, DISTAL.



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## 2.3 TOOTH GLOSSARY

### TOOTH NUMBERING SYSTEM

By international convention, standardized by the World Health Organization (WHO), the mouth is ideally divided into four areas by two planes perpendicular to each other, one mesial that divides the dental arch in two half-arches and one occlusal that is imagined passing between the two arches.

**1** = deciduous and permanent central incisor

**2** = deciduous and permanent lateral incisor

**3** = deciduous and permanent canine

**4** = 1st premolar permanent and 1st molar deciduous

**5** = 2nd premolar and 2nd deciduous molar

**6** = 1st permanent molar

**7** = 2nd permanent molar

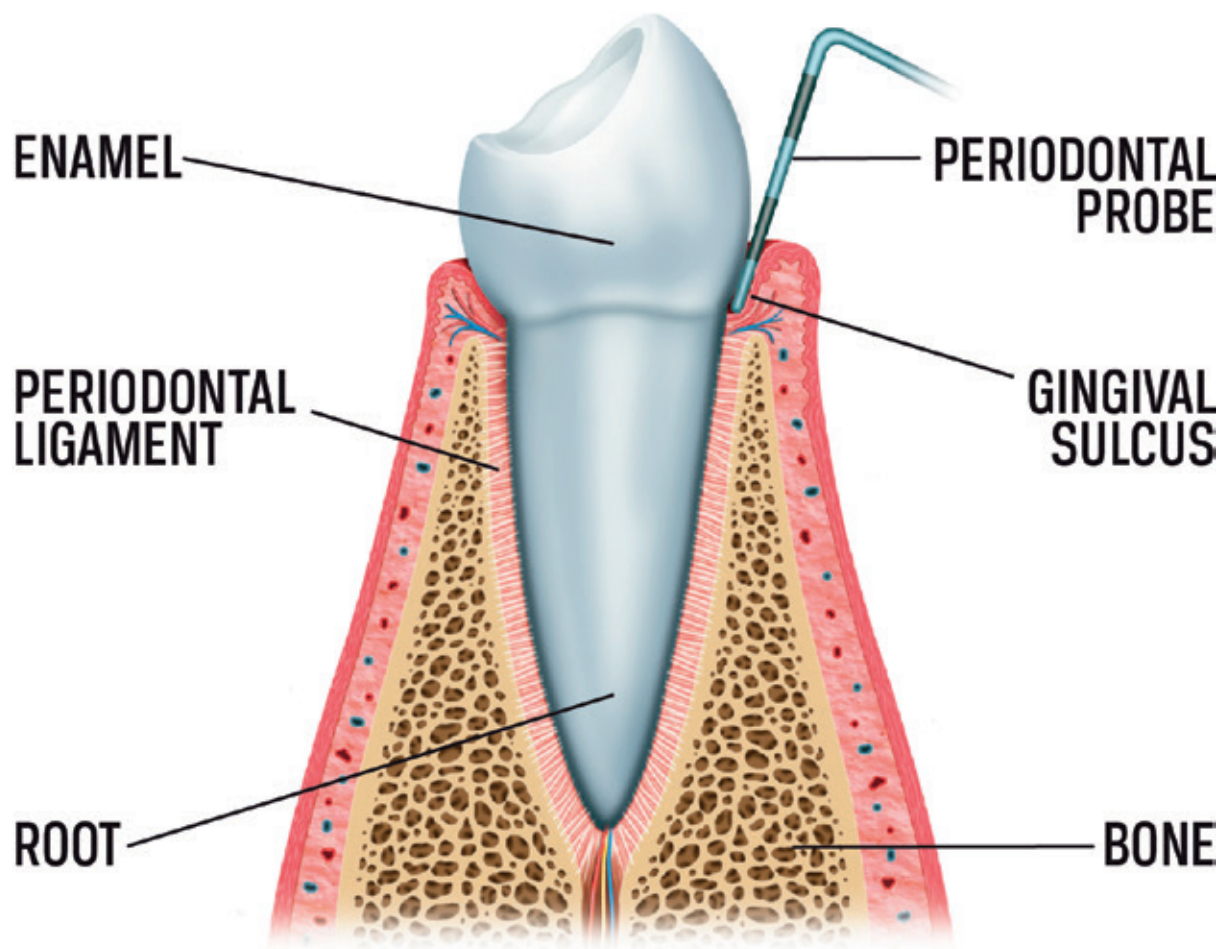
**8** = 3rd permanent molar

### ANATOMICAL PARTS OF THE CROWNS

**CUSPS:** is an occlusal or incisal eminence on a tooth; premolars possess, in general, two cusps, and four or more molars.

**RIDGE:** any linear elevation on the crown of a tooth.

**GROOVES:** a linear channel or line; when the grooves are extremely deep they are named FOSSA.



Vestibular – lingual section of an upper central right incisor with its supporting tissue.

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## 2.4 THE PERIODONTIUM

Periodontics is the branch of dentistry that treats periodontal diseases, namely that cures diseases and biological function of the tissue surrounding the tooth.

The buccal mucosa, in the part that covers the alveolar bone, is called gum. The gum around the tooth at the neck level is very vascularized and includes the trigeminal nerve. The part of the gingiva which fills the spaces between the teeth creates the gingival papillae.

The teeth are set in the alveoli of the bone in which they are connected by fibres that support and ensure a physiological mobility.

Fibres connect the cement (lining tissue of the dental roots) to the alveolar bone, a bone of spongy type covered by a periosteum to which the gingiva attaches. In the alveolar bone, there are alveoli in which the roots of the teeth are articulated. The surface of the alveoli is covered by a perforated bone tissue through which vessels and nerves (cribriform plate) pass.

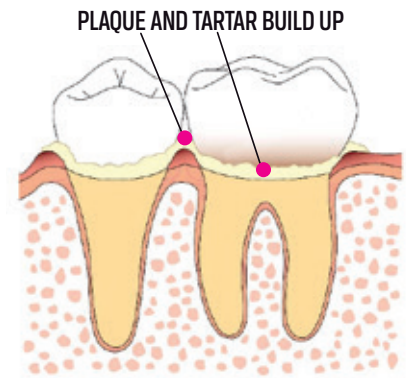
In order to provide a viable and healthy support structure of the tooth, the function of these structures is interdependent, but from the anatomical point of view are distinct.

**GINGIVITIS** Gingivitis is the inflammation of the gum with no loss of attachment.

REVERSIBLE SITUATION with removal of the trigger factor it is possible to return to a physiological situation.

- Organization of bacterial plaque
- Colonization of the gingival sulcus

Inflammation: swelling, redness and bleeding, possible pain.

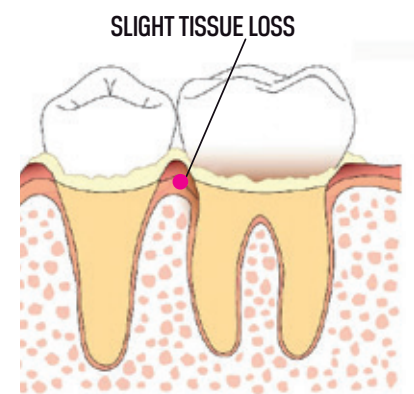


**PERIODONTITIS** Periodontitis is an inflammation with loss of the attachment on connective level and formation of periodontal defect (pocket) and can have different degrees and location.

IRREVERSIBLE SITUATION

Outcomes can be treated but it is not possible to return to an initial situation.

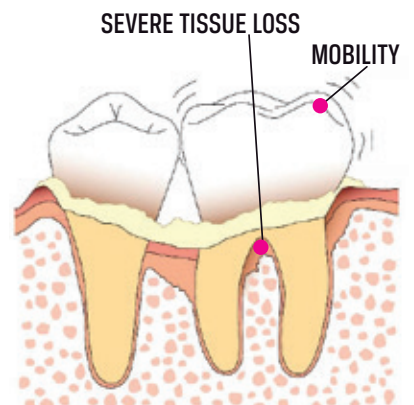
- migration of the bacteria into the deeper tissues
- release of enzymes and degradation of the connective fibres



- persistence of inflammation and inflammatory condition
- invasion of deeper tissues with involvement



- progressive reabsorption of bone tissue support
- possible pain and periodontal abscesses
- increasing mobility and migration with subsequent loss of teeth



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The typical disease of the periodontium is gingivitis / periodontitis, i.e., inflammation and detachment of the gingiva from the tooth, with the consequent loss of stability. It presents gingival inflammation without bone resorption. It is characterized by a change in the colour and texture of the gums, that becomes swollen, reddish, glossy and bleed easily.

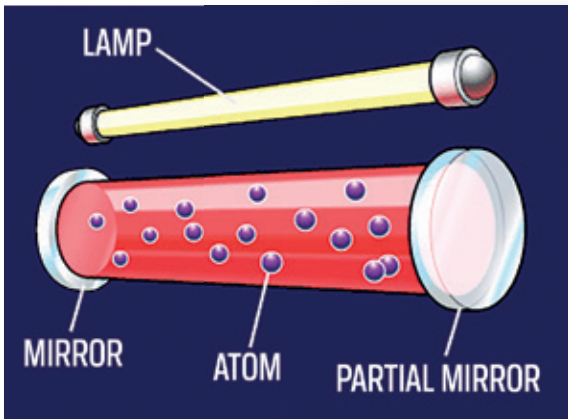
Periodontitis is, in most cases, the extension to the deep tissues of inflammatory changes of gingivitis. These alterations lead gradually to the creation of periodontal pockets (gum detached from the tooth), the gingival recession and, at the last stage, the loss of the tooth (periodontal disease).

Treatment of periodontal pockets consists in trying to fit the bone or replace it with other bio-compatible products (synthetic bone, hydroxyapatite, natural bone, etc.). Tissue regeneration is to return to the original tissue compromised by disease or by the intervention of the dentist. In recent years, periodontal surgery, because of its strong invasiveness and scarce predictability, has been replaced by minimally invasive and non-surgical therapies.

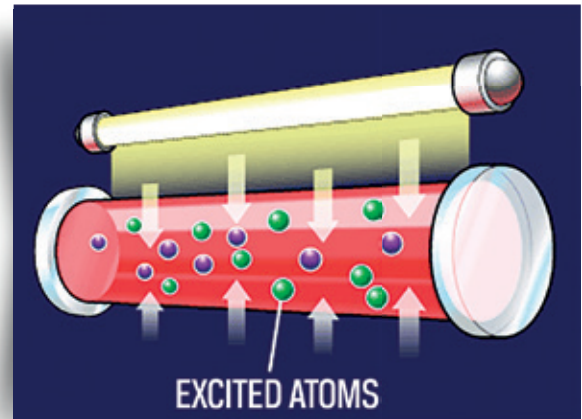
Hundreds of research papers have demonstrated how the use of the diode laser for tissue biostimulation and periodontal pockets decontamination, is today the best technique to reduce the pocket and regenerate the connective tissue, so to avoid many diseases such as periodontitis and periodontal disease.

## **ORAL HYGIENE**

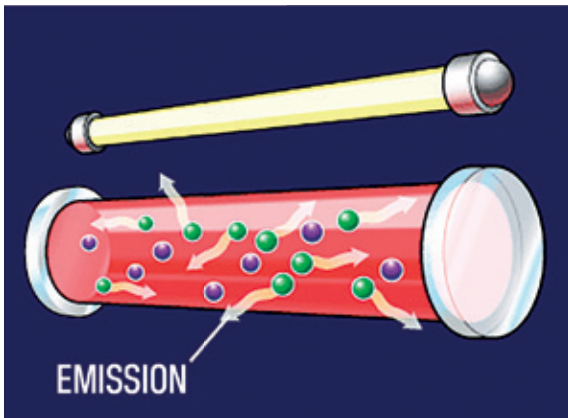
Oral hygiene means prevention and prophylaxis (cleaning in the studio). It is normally performed by a "dental hygienist", a profession that is gaining importance within the dental practice.



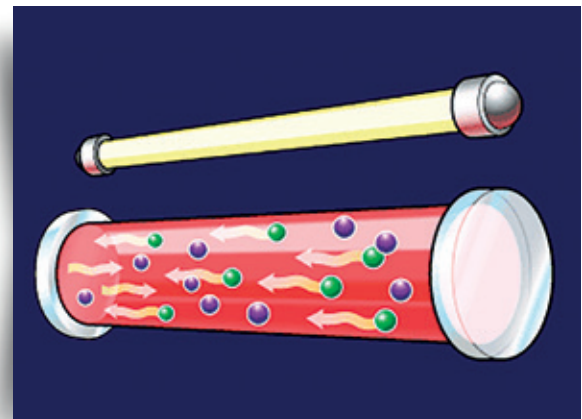
Components of the optical cavity of a laser



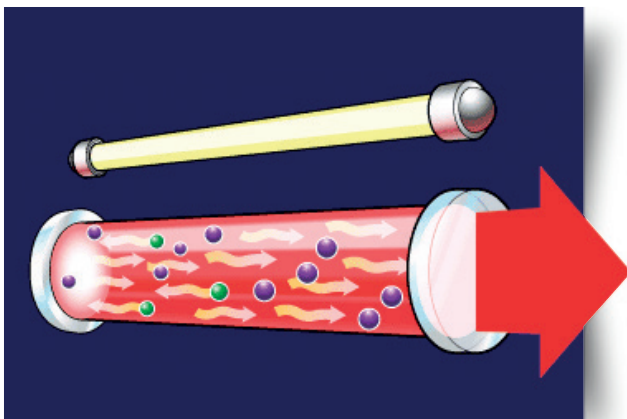
1. The lamp excites the atoms of the active material



2. The material starts emitting photons in all directions



3. The optical cavity mirrors align the movement of the photons



4. The photons exit the optical cavity through the partially reflecting mirror with all the characteristics of a LASER.



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# 3. WHAT IS A LASER?

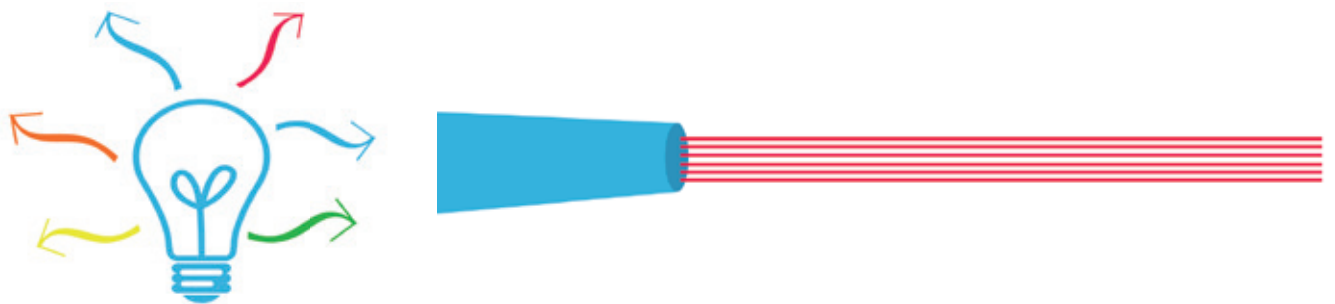
## 3.1 LASER LIGHT

The LASER (acronym of Light Amplification by the Stimulated Emission of Radiation) is a special instrument that can be applied in many different fields. Lasers have specific features that make them different from ordinary sources of light:

**MONOCHROMATIC:** a light bulb emits many different wavelength whereas a laser will emit photons at a single wavelength, so that its application is very specific and the interaction selective.

**COHERENT:** all photons in the laser beam travel with the same space and time undulation.

**POLARIZED:** all photons in the laser beam travel in the same direction..

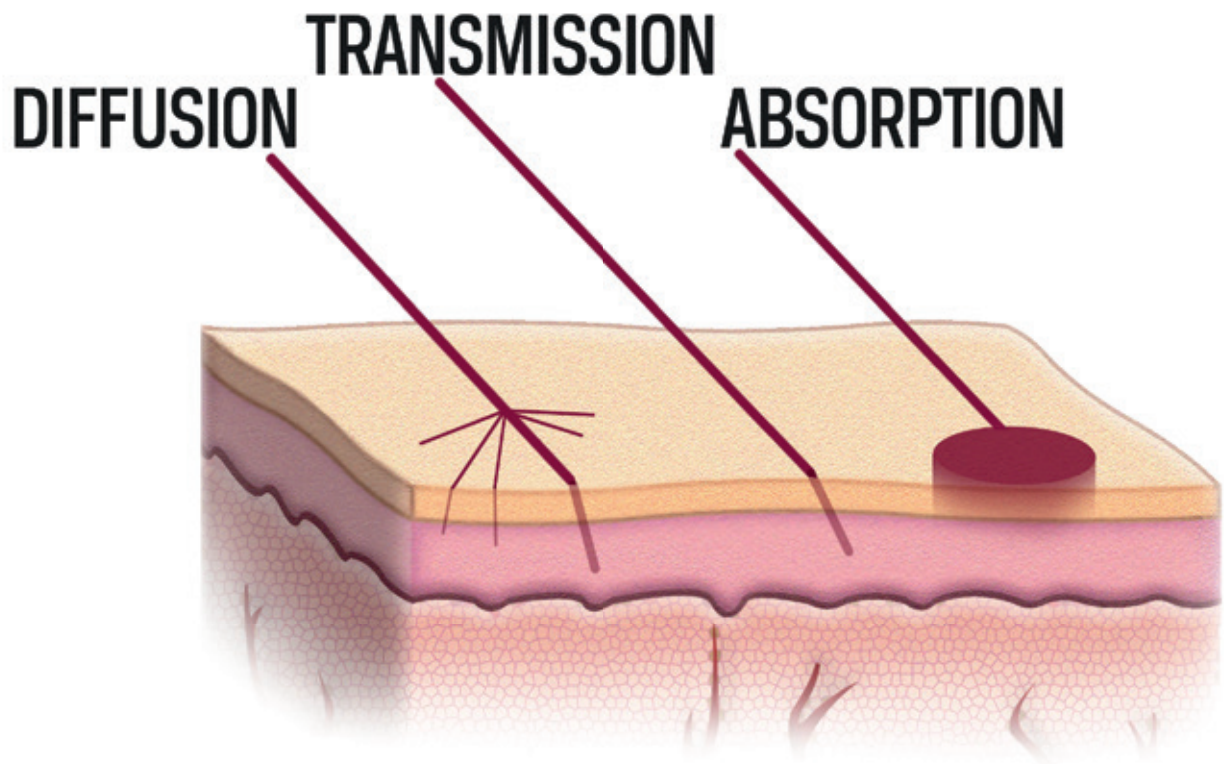


Compared to other sources of light, the laser is monochromatic, coherent and polarized.

## 3.2 LASER COMPONENTS

To stimulate the emission of light with these characteristics, three elements are necessary:

1. an **ACTIVE MATERIAL** (the Wisser uses a diode semi-conductor) capable of producing photons with a specific wavelength and increase their energy at each passage.
2. a **SOURCE OF ENERGY**, such as a lamp or electricity, also known as optical pump, that can increase the energy of each photon so that stimulated emission may occur.
3. an **OPTICAL CAVITY:** an arrangement of mirrors that can perfectly line up each electron until they reach the energy and coherence necessary to become a laser beam



## PHOTO-THERMAL EFFECTS ON TISSUE ACCORDING TO THE TEMPERATURE REACHED:

40°-45°C	Vasodilatation and endothelial damage.
50-60°C	Enzyme activity stops – protein denaturation. Collagen is more resistant. Increase in blood viscosity.
80°C	Perivascular and intraparietal collagen shrinks.
100°C	Vaporization of interstitial and intracellular fluids.

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# 4. LASER-TISSUE INTERACTION

## 4.1 LASER EFFECTS ON TISSUE

Biological tissue interacts with laser light mainly by absorbing its energy, but other important phenomena must be taken into account:

- **DIFFUSION:** energy will be dispersed in the tissue in the form of heat and will not contribute to the main effect of laser such as ablation or vaporization. It is important to evaluate its effects in the areas surrounding the point of application of the laser beam. With the diode laser diffusion of energy is predominant and generally involves the penetration of heat between 2 and 8mm into the tissue.

- **TRANSMISSION:** energy that passes through tissues without any interaction. It is important to evaluate the underlying presence of other materials that may instead absorb the laser beam.

- **ABSORPTION:** energy that induces a transformation in the tissue, mainly through its change into heat. Chromophores are materials capable of absorbing the energy of specific wavelengths. In the oral cavity water, hydroxyapatite, haemoglobin and melanin are the main elements that can absorb laser energy.

Since biological tissue is composed 80-90% of water, the 980nm wavelength of the diode laser is very effective on soft tissue: effective vaporization occurs with very little heat diffusion in the surrounding area. Also small blood vessels are perfectly coagulated.

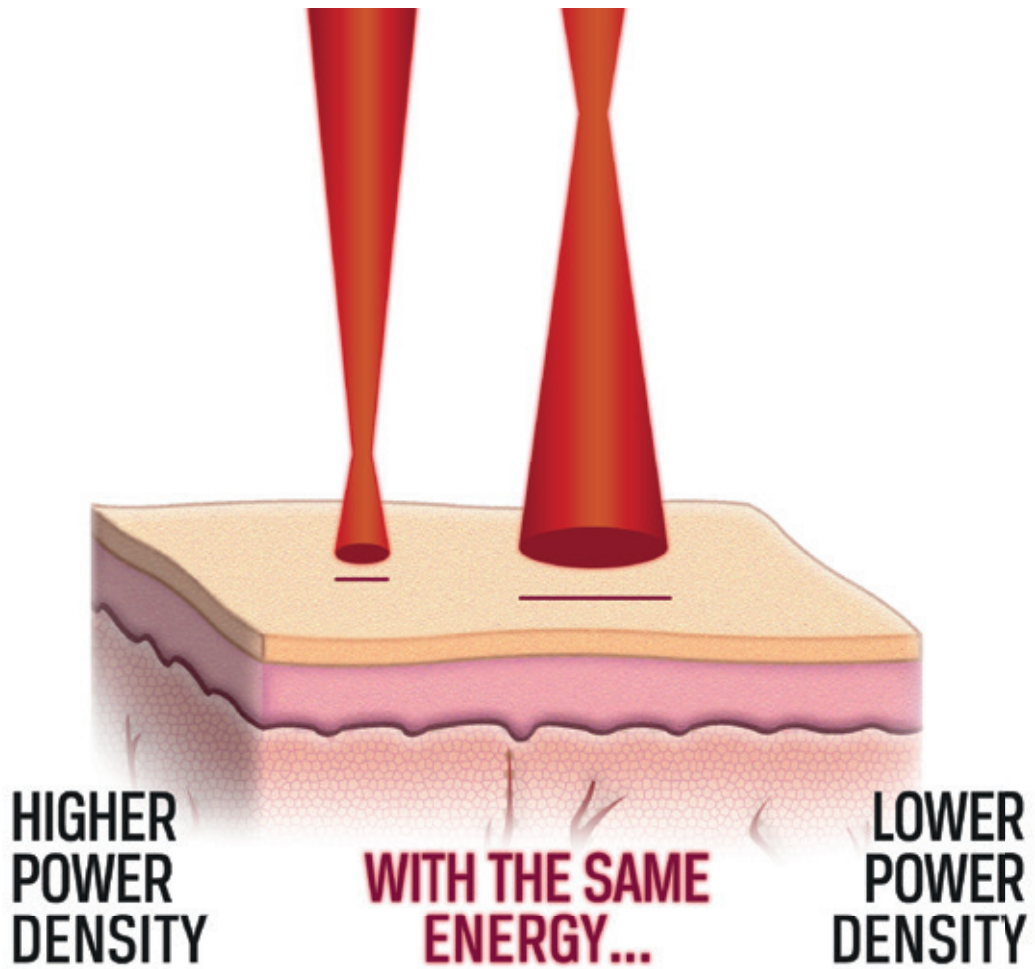
The absorption of laser energy by a tissue depends on factors linked to the laser beam:

- wavelength
- laser emission mode (pulsed or continuous)
- time of exposure
- power density

and on factors linked to the tissue:

- degree of vascularization
- tissue tension
- presence of chromophores
- optical and thermal conductivity

## POWER DENSITY



## CONTINUOUS EMISSION



## PULSED EMISSION



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## 4.2 VARIABLES

The main laser tissue interaction consists in the transformation of radiant energy into thermal energy. In order to obtain the desired effects on biological tissue, it is possible to increase or decrease the energy distribution by modifying these variables:

**POWER:** W (watt) – the total power of the laser beam can be increased or decreased.

**TIME:** exposure time to laser light for each treatment.

**POWER DENSITY:**  $W/cm^2$  – it is the amount of power in the laser beam divided by the area of the beam on the irradiated surface. With the same power emission, as the size of the laser spot decreases, the power density increases. As the surface increases the power density on that area will decrease. This will radically change the effect: with the same energy but with different power densities it is possible cut, coagulate or biostimulate. If using a focused laser it will be possible to concentrate all the energy in a small area. When a laser is unfocused the irradiated surface is greater.

**EMISSION MODE:** laser emission can be continuous or pulsed.

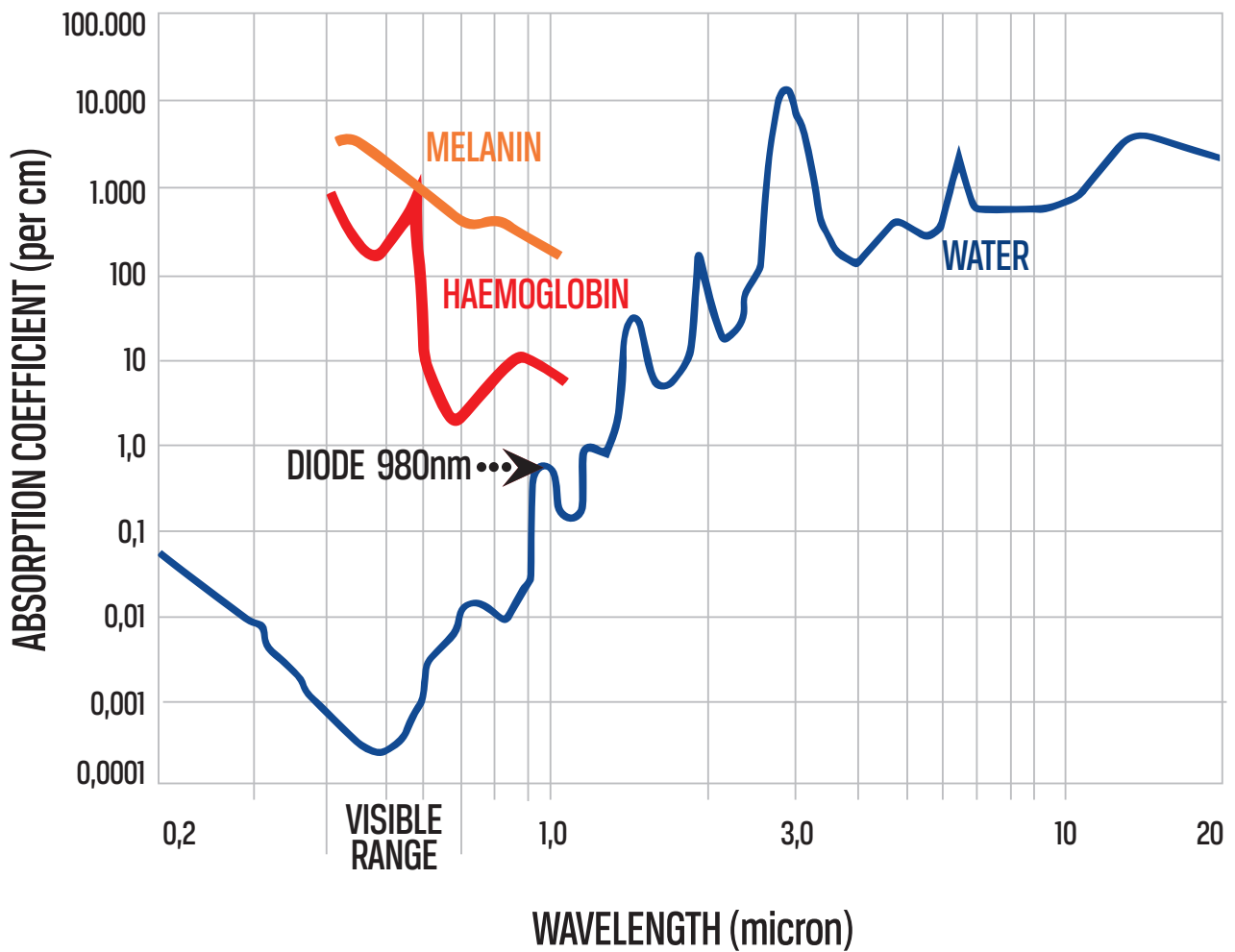
CONTINUOUS WAVE EMISSION means that laser energy is delivered without interruptions. This mode is ideal for quick incisions and no bleeding.

PULSED EMISSION creates a succession of laser pulses separated by pauses. In the pulsed mode the average power emission is therefore lower than the peak power created by each pulse, proportionally to the ratio emission time  $T_{on}$ /pause  $T_{off}$ . The pulsed mode is not as fast in cutting procedures but it can avoid the charring of tissue, since it allows time for the tissue to cool off in between pulses. This cooling-off time is a very important aspect of what is referred to as THERMAL RELAXATION TIME.

**FREQUENCY:** Hz (Hertz) - measures the number of pulses per second. The combination of frequency and  $T_{on}$  –  $T_{off}$  values characterized pulsed emission. This leads to two important clinical advantages:

1. during the  $T_{off}$  interval, the heat accumulated in the tissue can dissipate (thermal relaxation).
2. during surgical procedure less anaesthetic will be necessary.

# ABSORPTION COEFFICIENT OF WATER, MELANIN, HAEMOGLOBIN AGAINST WAVELENGTH



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## 4.3 EFFECTS

All of the variables mentioned above lead to different effects on biological tissue:

**VAPOURIZATION, ABLATION, CUTTING** – these effects require high levels of energy usually emitted by focused lasers. Pulsed emission mode can avoid excessive heat build-up on the surrounding tissue.

**DECONTAMINATION – BIOSTIMULATION – PHOTO COAGULATION** – these effects occur with less energy over a wider surface (low power density), so that more heat is transferred to the tissue, using continuous or extended pulses.

## 4.4 WHY 980 nm

Soft tissue contains a high percentage of water. For this reason the 980nm wavelength is the most effective for laser ablation, since water has an absorption peak at 980nm. Haemoglobin is also an important component for optimal coagulation, haemostasis and no charring. Its absorption peak is at 810nm, but since it absorbs 8 times less than water at the 980nm peak, for direct ablation, rather than cutting from secondary heating, 980nm is the most effective wavelength.

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# 5. APPLICATIONS

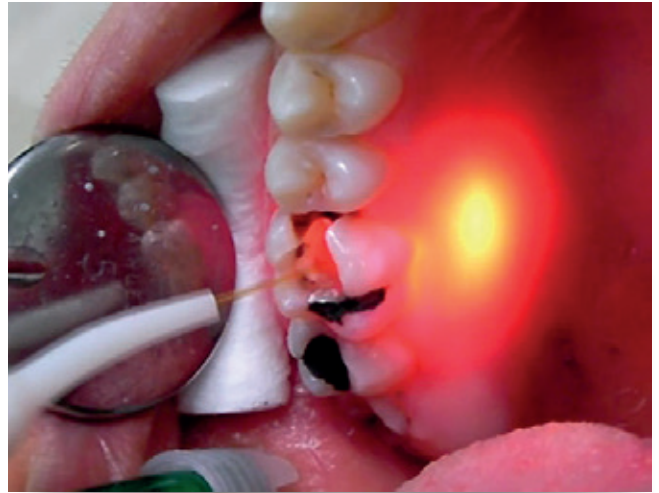


## 5.1 ENDODONTICS

root decontamination - pulp capping - apicectomy

### Root decontamination

In endodontics, papers indicate that the diode laser is effective in the disinfection of the root canal. The fine diameters of the endodontic tips (200  $\mu\text{m}$ ) enable effective delivery of laser light to the root canal to help with reduction of bacterial contamination. The antibacterial effect observed reaches over 1 mm deep into the dentin, surpassing the effective range of chemical disinfectants, such as NaOCl and displaying moderate effectiveness against *Enterococcus faecalis* even in the deeper layers of dentin. Root canal spaces are rarely straight but more often curved. Thanks to the special curved tips, the laser can decontaminate the space throughout root canal length and can follow the curvatures in a tooth root, cleaning the entire area.



### Pulp capping

#### Pulpectomy

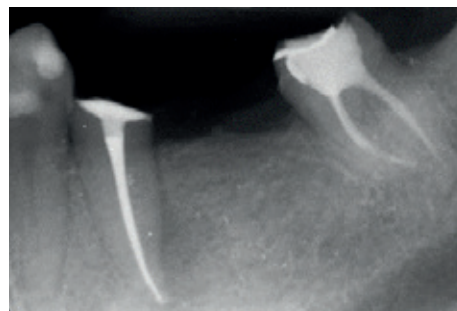
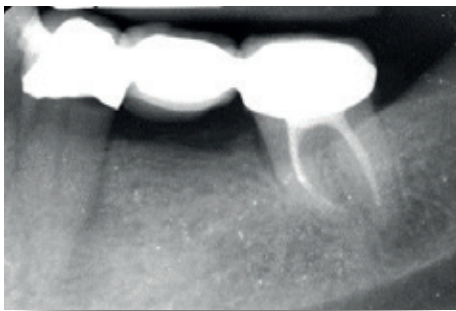
A pulpectomy is necessary when the pulp is irreversibly compromised. Conventional treatment requires complete pulp removal and canal boring. Then the root canal can be closed with guttaperca, and the cavity filled. With the laser the canals will be completely decontaminated in their entire length; haemostasis of the residual pulp fibres of the main and lateral canals will occur and the canal walls will strengthen. Compared to the conventional method the canal will be cleaner, without organic residue, with a better adhesion of the canal filling.

#### Pulpotomy

Pulpotomy is a partial pulpectomy in which only the pulp chamber is removed. The patient may feel sensitivity to heat, cold and sweets. Pain is usually greater when lying down and it is often difficult to identify the affected tooth. Such a situation may evolve in the complete loss of the pulp, ending in a granuloma or abscess. The removal of the pulp with a laser assisted canal therapy is much less painful and predictable in its result: all bacteria are eliminated and a drug therapy may not be necessary. The haemostatic effect of the laser speeds up the drying of the pulp chamber.

## Apicoectomy

An apicoectomy is indicated when there is an obstruction of the canal, be it natural or artificial. In the presence of a granuloma and an obstructed canal this minor surgical procedure is carried out, even though it is invasive and debilitating (the tooth will lose length and strength). The apex of the root and the surrounding infected tissues must be removed, since it is not possible for it to heal spontaneously or with a drug therapy. The bactericidal properties of the laser are therefore indicated during this type of surgery.



The laser during the phases of root canal decontamination. Images Prof. Tempesta.



## 5.2 PERIODONTICS

gum analgesia - pocket decontamination -  
gum biostimulation - gum recession

During the past ten years much focus has been placed on diode laser applications in periodontics and its application in oral hygiene protocols. Results confirm that this technique used in combination with conventional instruments leads to a greater success of the periodontal therapy.

Periodontitis is caused by the inflammation or infection of the periodontium, and may affect up to three out of five people. Once it is onset, it is very rare that it heal spontaneously. Therefore a specialized dentist or hygienist must begin an adequate therapy to control and stop such disorder. Anaerobic gram-negative bacteria are the most common cause of chronic periodontitis in adults. The aim is to obtain good gingival health by repairing the alveolar bone and restoring the shape and function of the mucosa. Treatment begins by cleaning the surface of the roots and eliminating any infected material or concretion, to aid the growth of the healthy connective tissue. In this phase the laser is very helpful in the removal of concretions because it weakens the tooth- tartar bond thank to its photochemical effect.

### **Gum analgesia**

When beginning a periodontal therapy, an initial passage with the laser is useful for its analgesic effects; laser energy inverts the sodium-potassium pump of the cellular membrane for 30 minutes. In this time it will be possible to operate with other instruments without provoking excessive pain in the patient.

### **Pocket decontamination**

The main use for the 980nm dental diode laser in the periodontal therapy is the removal of diseased pocket lining epithelium and disinfection of periodontal pockets. Laser tips with the proper diameter enable extremely easy access into the periodontal pocket. After hard and soft deposits have been removed, the pocket architecture is re-assessed, with emphasis on the depth. With regard to the disinfection of periodontal pockets, studies have shown the effectiveness of diode laser in eliminating bacteria commonly implicated in periodontal disease and bone loss. The infected plaque that deposits in the gingival crevice will cause inflammation and the destruction of the attachment and the tooth structures if it is not removed.

Laser treatment within periodontal pockets is minimally invasive and well tolerated by patients. The decontamination of the pocket with laser energy will begin a process of elimination of the bacteria and regression of the inflammation. Three to five sessions will be necessary to obtain a complete decontamination and 'closure' of the pockets thanks to the biostimulating effects of the laser.

### **Gum biostimulation**

Another fundamental effect of the laser is its biostimulating effect. By defocalizing the laser beam with a specific handpiece, it is possible to irradiate tissue that has undergone surgery with sufficient energy to stimulate the metabolic process with consequent tissue regeneration.

### **Gum recession**

In the case of gingival recession, the combined biostimulating and decontaminating effect will lead soft tissue to reacquire their physiologic shape, within a complete oral hygiene therapy.



Measurement of the periodontal pocket before and after periodontal therapy; the laser during pocket decontamination. Images Prof. M.Roncati.



## 5.3 SURGERY

granulotic tissue, normal tissue and fibrotic tissue - coagulation- abscess - sulcus preparation - gingivectomy - frenectomy - granuloma - fibroma - hyperplasia - fistula

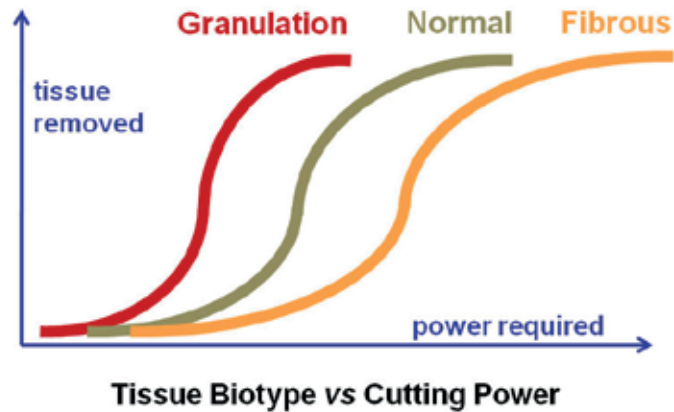
The 980 nm diode laser can be used for numerous soft tissue procedures including gingival hyperplasia, tooth exposure and hyperpigmentation. Additionally, there is a range of gingival adaptation procedures, both to allow restorative procedures and to allow access to restorative margins during restorative procedures. The laser energy will act primarily as a means of incision, excision or ablation, with advantages over the scalpel such as no or minimal bleeding, no sutures, less chance for infection of the wound. When possible, any laser surgical procedure in and around the gingival cuff should seek to preserve a biological width (the zones of connective and epithelial tissues attached to the tooth), minimum 3 mm in depth, which will help to maintain gingival margin stability, alveolar bone height and health and prevent overgrowth.

When an incision is made with a scalpel blade small blood vessels are cut in the skin and the layer of tissue just under the skin. Normally they are taken care of by clamping the cut with haemostasis, cauterizing, or holding gauze sponges on them until they stop. All of these procedures take time, which means the surgery takes longer and there is more post operatively swelling. The laser beam is a highly effective coagulator of small blood vessels. Less bleeding during surgery means less anaesthetic time and faster recovery time. The 980 nm wavelength diode laser transverses the epithelium and penetrates 2 – 6 mm into the tissue. When laser cutting is in progress, small blood and lymphatic vessels are sealed due to the generated heat, thereby reducing or eliminating bleeding and edema. Denatured proteins within tissue and plasma are the source of the layer termed "coagulum", which is formed because of laser action and serves to protect the wound from bacterial or frictional action. Clinically, during 48-72 hours post-surgery, this layer becomes hydrated from saliva, swells and eventually disintegrates to later reveal an early healing bed of new tissue.

The reduction in pain is a result of the unique characteristics of the laser beam as it cuts the tissue, preventing the raw ends that are characteristic of scalpel blades. Whenever an incision is made in tissue with either a scalpel blade or scissors inflammation is started in the affected tissue. This inflammation is a result of interaction with the circulatory and lymphatic systems. Because the laser beam effectively cauterizes the lymphatic system there is much less post-operative swelling. This makes the patient much more comfortable while it is convalescing from surgery. Moreover, the laser beam radiation operates at a temperature that makes it highly effective at killing bacteria that have the potential to cause an infection. This is particularly important in areas where it is difficult to prevent bacteria from contaminating the surgical site.

## Granulotic tissue, normal tissue and fibrotic tissue

Not all types of soft tissue are the same. For this reason the TOP (Tissue Optimized Pulse) laser modulation system was developed. Specific protocols are available for each tissue type. Each treatment parameter such as the power and impulse length has been calibrated so that the laser beam can operate selectively and allow the tissue the right tissue relaxation time, i.e. the time it takes for excessive heat to dissipate. Each tissue reacts differently to the laser beam because of the different content on melanin and haemoglobin it contains. For example, fibrotic tissue that has scarce vascularization requires more energy for ablation, but if the energy is given in short impulses it will be possible to avoid the formation of necrosis, because of the thermal relaxation time between one impulse and the next.



## Coagulation

The haemostatic property of laser energy is a key feature for the control of haemorrhages during and post operation. The diode laser immediately cause tissue to heal over thus avoiding the onset of the bleeding that occurs with conventional instruments. When conventional instruments are used, the laser can be used after cleaning the area and removing excess blood by passing the laser in contact directly over the wound. This property is therefore very useful whenever it is necessary to maintain a clear operating field or when natural coagulation is slow or insufficient.

## Abscess

A dental abscess is a localized collection of pus associated with a tooth. The most common type of dental abscess is a periapical abscess, and the second most common is a periodontal abscess. Draining an abscess with a laser is much less painful than with conventional instruments. By lowering the energy or applying a topical anaesthetic pain can be controlled throughout the operation. Bleeding is minimal so drainage can be carried out without compression. Any problem arising from build-up in the gauze is therefore avoided. The laser's antiseptic property will help in avoiding post-op infection.

## Sulcus preparation

Sulcus preparation is an extremely important phase of the creation of a prosthesis that should be long lasting and functional. The impression must be perfectly adherent to the real dental and tissue shape of the patient's oral cavity.

The laser is used for this application to shape gingival tissue and mucosa, without interaction with the underlying bone structure of natural elements or implants, as well as for its haemostatic properties.



## Gingivectomy

In a gingivectomy the gingival tissue is surgically removed at the epithelium in order to create a new gingival margin. This procedure is usually necessary to eliminate periodontal or gingival pockets, to access periodontal tissue that is not readily accessible, or to reach the inside of a pocket for tartar removal. The use of the laser means limiting trauma in patients because healing is favoured tissue vaporization and no bleeding occurs. Anaesthesia may not be necessary. If the patient does feel pain a topic anaesthetic can be applied and a laser analgesia treatment carried out beforehand.

Images Prof. Frosecchi.



## Frenectomy

The frenulum of tongue is a small fold of mucous membrane extending from the floor of the mouth to the midline of the underside of the tongue. A frenectomy will partially remove or reposition the frenulum in order to stabilize the position of teeth or alleviate the traction on the tongue. Usually it is carried out on young patients, and for this reason the laser is an ideal instrument. The patient will not feel pain but an anaesthetic gel can be applied on the frenulum. The lased tissue will instantly vaporize and no bleeding will occur, making it easier on the patient. Post op is simple and easy without the need for stitching.

Images Prof. N. Tempesta.



## Granuloma

An apical granuloma is made of modified granulation tissue containing elements of chronic inflammation located adjacent to the root apex of a tooth with infected necrotic pulp. It is visible in RX as a darker area. It is sometimes painful and at times does not show symptoms. Usually it is caused by an untreated cavity in which the infection reaches the pulp chamber, yielding either an abscess or a granuloma in its chronic form.

Granulomas will not heal spontaneously since bacteria continues to proliferate inside the root and migrate toward the bone through the apex. The laser is an ideal instrument to decontaminate the area from the bacteria present.



## **Fibroma**

The laser can be used as a cutting instrument to remove parts of tissue or neoplasm, benign or malignant. A gingivectomy may later be necessary in some cases.

Fibromas are generally present in the buccal plane and must be removed if they grow excessively or are annoying to the patient. Epulis is any tumour like enlargement situated on the gingival or alveolar mucosa usually caused by bad oral hygiene. The removal of the epulis must be accompanied by an adequate anti-inflammation therapy.



## **Hyperplasia**

This surgical procedure is often associated with a gingivectomy: excess tissue is removed without bleeding and the gum is shaped into its correct periodontal morphology. With the diode laser it is possible to model the gingival profile to improve overall aesthetics and facilitate oral hygiene.

## Fistula

A fistula is an opening in the gingival tissue through which an abscess can drain. By lasering the opening, internal and external coagulation begins the healing process and the area is decontaminated.



Fistula- pre



Treatment laser



Post



Advanced healing



## 5.4 IMPLANTOLOGY

exposure - perimplantitis -  
biostimulating - alveous decontamination

In implantology, the 980 nm dental diode laser can be used for second stage implant recovery and the treatment of peri-implantitis.

### Exposure

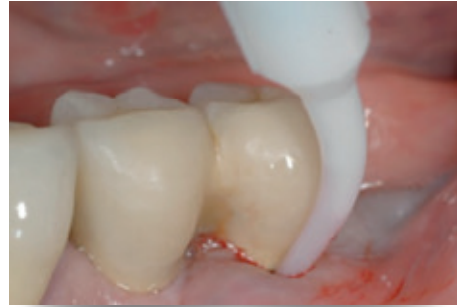
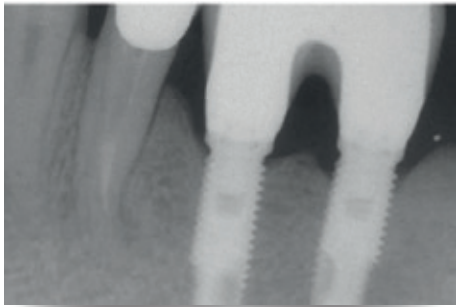
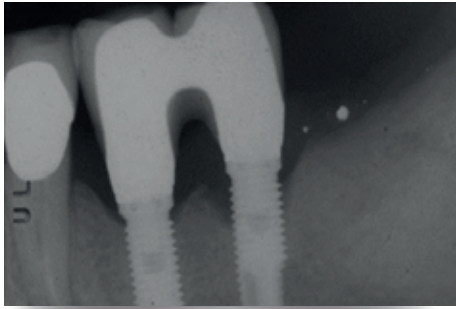
In second stage implant recovery care must be taken to avoid contact with the implant body. The laser can be used successfully for a minimally invasive de-epithelialization or remodelling of soft tissue. The advantages of using a diode laser to perform this procedure are easier visual access to the cover screw due to hemostasis and the production of the protective coagulum to aid in healing and patient comfort. The screw can be uncovered with a tiny incision and after its precise localization can the opening can be enlarged gradually. Soft tissue ablation leads to precise and predictable healing and the procedure can usually be performed with the use of a topical anesthetic.



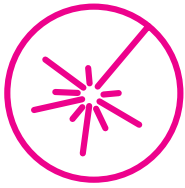
Implant uncoverig

## Peri-implantitis

Peri-implantitis is one of the most important causes of implant loss and is not restricted to any one type of implant design or construction. It can be recognized as a rapidly progressive failure of osseointegration, in which the production of bacterial toxins leads to inflammatory change and bone loss. An assessment must always be made to determine the causative factors associated with the condition (infection, implant overloading, occlusion and other local, systemic and life-style factors), to establish whether the implant can be saved. Curettage of granulation tissue is especially important. Research has shown that a diode laser can be used to perform the procedure with the added bonus of disinfecting the treated area. The laser will not alter the implant surface, and the biostimulating properties of the laser will accelerate the healing process.



Laser treatment of peri-implantitis. Images Prof. M. Roncati.



## 5.5 THERAPY

herpes simplex - biostimulation - flat top handpiece - aphtae - cheilitis angle - desensitization - trismus (TMJ) - analgesia laser

Laser therapy is one of the most important applications of the diode laser because of its antalgic and anti-inflammatory effects, when laser energy in the infrared part of the spectrum is radiated at low power level. Many studies have shown that doses of energy levels ranging from 10mW to 1 W increase the production of ATP therefore increasing cell metabolism and synthesis of collagen in the fibroblasts; stimulation of DNA and RNA formation; local effects on the immune system; greater leucocyte activity; neoangiogenesis and neurostimulation.

### Herpes simplex

Cold sores are usually located around the lips and can be transmitted through direct contact. They can cause great discomfort since they can last for more than a few days before healing begins. The decontaminating and biostimulating properties of the laser will speed up the healing process, reducing the pain and discomfort. The application of anaesthetics is not required. After 24 hour the ulcer will start to dry and after three days healing is complete.



### Biostimulation – Flat top handpiece

Laser biostimulation is a safe and effective way to treat many painful conditions, especially after surgery. To do so, a non-focalized low-energy density laser beam is necessary: the Flat top Handpiece offers pain relief, not only around the oral cavity. The energy absorbed by tissue stimulates the metabolic process and tissue regeneration thanks to the thermal and photochemical effects of the laser energy.

## **Aphtae**

Aphteous ulcers (cancker sores) are white or grey lesions, variable in size, that occur inside the mouth, on the gingival or buccal mucosa. They can be painful, especially when eating spicy or salty food. They can last many days, but with a few seconds of laser treatment the pain and discomfort are drastically reduced and healing time is much faster. The laser treatment can be done in direct contact, with quick and light strokes.



## **Cheilitis angle**

Cheilitis angle is a lesion that usually occurs at the corners of the mouth. It can be caused by stress, antibiotics, allergies or candida. Its symptoms include itching, exfoliation of the lips, painful cuts. Laser treatment on and around the affected area will destroy the bacteria responsible for the inflammation. For best results one treatment every three days for two weeks will yield definitive results.

## **Desensitization**

Many attempts have been made to treat dental hypersensitivity by sealing exposed dentinal tubules, primarily using fluoride preparations, strontium chloride, and hydroxyapatite. However, these treatment methods have the disadvantage that the preparation is effective only for a limited period of time and must be applied repeatedly, at short intervals. The laser has been shown to have an excellent sealing effect on hypersensitive dentinal surfaces. The patients suffering from dentinal hypersensitivity have normally a higher number of dentinal tubules open and their diameter larger. Compared to conventional fluoridation, combined laser irradiation and fluoridation has shown to be effective in the treatment of hypersensitive dental necks and dies. As shown in many studies, patient treated with laser feel complete freedom from pain. The success rate in the laser therapy is effective more than 96.5%. Moreover, examinations of irradiated teeth under the scanning electron microscope revealed the complete closure of the dentinal tubules four and six months after laser treatment.

### **TMJ therapy**

Therapeutic indications of diode lasers include TMJ arthralgia (treatment of the joint); myofascial pain related to TMJ (treatment of the muscle related to painful trigger points); and muscle relaxation (related to pain and muscle stiffness after dental procedures or in general). The therapeutic mechanisms of action of diode lasers include increased micro-circulation in tissue, photo-activation of inactive enzymes, improved cellular function, and increased ATP production. Pain relief with laser therapy is effective, fast and drug free.



### **Laser analgesia**

The antalgic and anti-inflammatory effect of the laser can be used for a drug-free antalgic therapy to treat painful conditions in the oral cavity. Patients will benefit in only a short number of sessions.

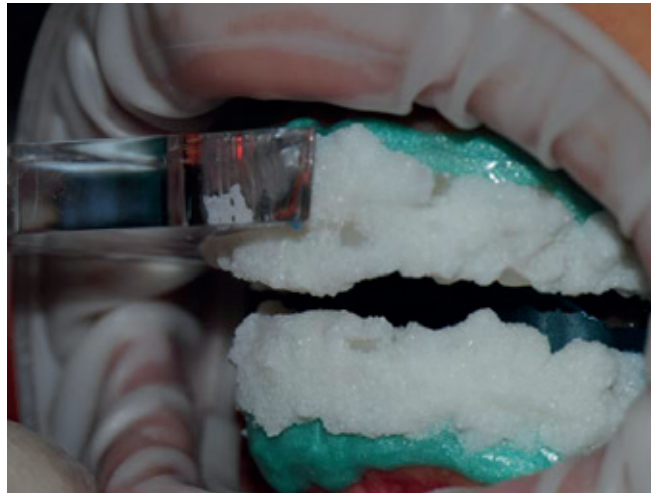


## 5.6 COSMETICS

whitening single - whitening arch - gum smile - haemangioma - depigmentation

### Whitening

The laser is undoubtedly the fastest and most effective way to achieve naturally white teeth. The laser light is used to activate a special whitening gel that can also be used on sensitive teeth, without discomfort. A gel containing hydrogen peroxide  $H_2O_2$  spread over the surface of each tooth can be activated with a special defocalized laser handpiece. The activation sets off the release of the oxygen that breaks the double bond of the pigments on the teeth, making them lose



their colour. Laser activation of hydrogen peroxide greatly speeds up the bleaching process: a 30 minute session is often sufficient to obtain great results. To protect the gums from any irritation, a liquid dam can be applied. The LWS  $TiO_2$  Bleaching Gel system was developed by a cooperation between Vienna Dental School and Vienna University of Technology under the direction of two professors, Dr. Johann Wernisch and Dr. Andreas Moritz. They focused their attention on creating a product with high bleaching efficiency combined with very high protection of the dental enamel.  $TiO_2$  (Titanium dioxide) is an effective photocatalytic pigment mixed in the powder which provides a natural whiteness and acts a physical blocker of light avoiding unwanted increase of heating to the elements, so that it can be used even on patients with dentinal sensitivity.

### Gum Smile

Excessive gingival tissue is often known as a gummy smile. It is an important cosmetic treatment because it can radically improve the overall aesthetics of a smile, with a simple and minimal invasive procedure. The laser can shape the contour of the gum into a perfect shape, without pain or bleeding.

### Haemangioma

Haemangiomas often cause discomfort and are certainly not pleasant aesthetically, especially when they are quite large in size. If they are present around the mouth (cheek, tongue, lip) they can also



become a functional problem when they interfere with mastication: if cut by teeth they may bleed intensely. Often they are treated with surgical procedures that require stitching. On the other hand a few minutes of laser energy are sufficient to coagulate the mass of blood in the hemangioma, without it spilling out. The lesion will turn whitish and then disappear over a few weeks.



### Depigmentation

With the laser, it is possible to remove stains present on the gum, be they natural or caused by the presence of amalgam or other pigmented substances. The ablative and coagulating effect of the laser beam can remove the stains without pain or bleeding.



## 5.7 CONSERVATIVE

sealing groove - cavity decontamination

The laser is useful during **groove sealing**, because it decontaminates the occlusal surface. This improves the effectiveness and the duration of the sealant over time.

For the same reason a passage of laser energy is recommended for an accurate and thorough **decontamination during cavity preparation** before filling.



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# 6. WISER LASEREVOLUTION

## MORE VALUE TO YOUR PROFESSIONAL SKILLS.

- **POWERFUL** – up to 16W peak power.
- **TISSUE OPTIMIZED PULSING** – specific settings for all types of soft tissue.
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## AN EXPERT FOR ANY SPECIALIST.

Performance at its best. The success of the treatment is guaranteed by three different user modes:

- **Laser Assisted Protocol:** a tutorial will guide you step by step with all necessary actions to guarantee the success of any operation. The interface suggests power, time and specific tip to use.
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- **Advanced mode:** includes a broader range of specific applications in each treatment category. This mode allows the customization of any parameter of the laser emission.



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For your educational needs, Doctor Smile is a partner of **Master Class Academy**, a non profit higher education institute dedicated to offering top level knowledge in the medical field, especially in the use of laser and other technology. Thanks to its world wide base of academic collaborations, Master Class Academy has a global approach to education that aims at bringing state of the art information to medical doctors in every country.



## The Academy's objectives:

- to Promote excellency in the medical field
- to broaden the use of technology especially in the medical field
- to connect and network research institutions and associations with the same objectives as the Academy
- to organize conferences and events, courses and scientific debates on a national and international level and promote and organize post graduate courses, that include credits where applicable.
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# 7. TRAINING

**EVOLUTION** MEANS KNOWLEDGE.

Doctor Smile, in collaboration with Master Class Academy, offers courses at various levels held by our skilled laser tutors that include the analysis of a wide array of clinical cases and hands on practical sessions.

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