Peri-Implantitis and ER-YAG Laser

Peri-implantitis is becoming increasingly prevalent; its etiologies are varied and often combined. Among the existing treatments, the Erbium YAG laser is probably the least well-known despite its numerous clinical advantages: removal of granulation tissue, tartar and decontamination of the titanium while conserving the healthy tissue and the implant structures.

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The action to be taken for any case of peri-implantitis must be firstly an in-depth analysis of the clinical situation and the identification of the causes in order to remedy them (hygiene, prostheses, lack of tissue…), and to evaluate whether the implants should be treated or removed.

Certain situations will have a more favorable outcome with removal of the previous work rather than treatment of the problem.
This option then allows a tissue reconstruction which will make the new treatment more predictable, on better bases.

However, there are numerous "conservative" treatments of peri-implantitis which are indicated in many situations, associated or not with tissue regeneration.
The etiology must be remedied, the pathological tissues must be removed and decontamination must be carried out.
This is generally effected by (manual or ultrasonic) techniques of scaling, air polishing, photodynamic therapy [1], local/general antibiotics [2]...
It is often a good idea to acquaint the patient with the impacts of the different options, since his cooperation is crucial; it should also be remembered that in the case of extreme complication or change of treatment, his experience will be less negative.

After having emphasized that the action to be taken in face of peri-implantitis is not systematically conservative, it is important to stress the need to deal with the different causes in order to ensure healing.

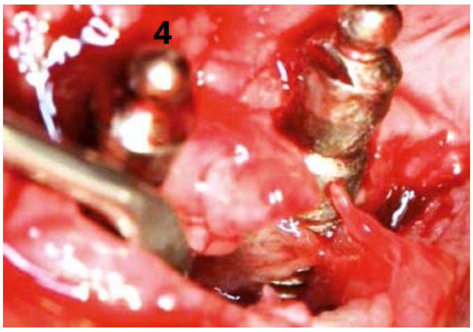
There is no miracle instrument that would allow treating of all types of peri-implantitis. It is in this treatment context, which includes treatment of the gums, the bone, the pathological tissues and the titanium, that the Erbium-YAG laser presents a major advantage.

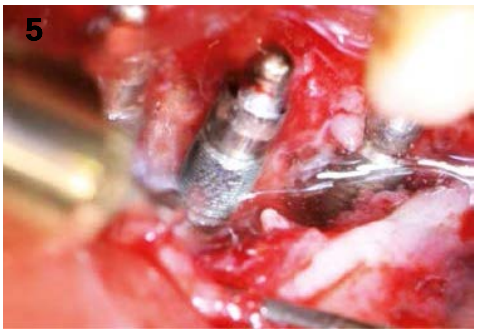
Bases for a better understanding

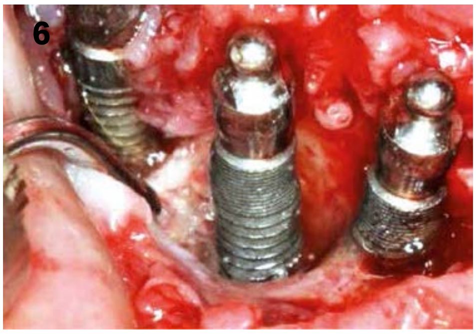
A laser is a photon beam with considerable energy. This electromagnetic beam emitted in very short pulses interacts with matter in a predictable way differing from the traditional instruments, which are more dependent on Newton's laws of physics.
Here, quantum physics allow anticipated effectiveness that is parameterizable in advance. The action is without direct contact and the intensity depends on the methods of emission, application, and the tissue.

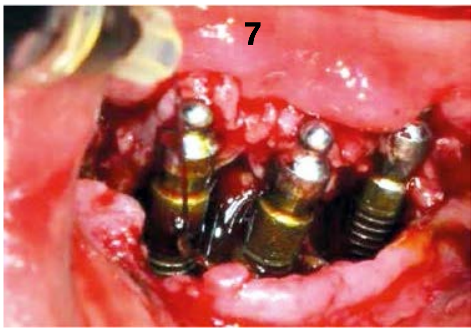
Like sunlight which irradiates the surface of the earth, according to the season (distance), the time (angulation) and the matter (molecular nature/color) our laser beam acts more or less intensely beyond the parameterization.
By varying the intensity (power), the emission frequency (Hz), the parameters cited above - distance, angle… - and the distribution surface of the energy emitted, we will "control" the effects.

The Er-YAG lasers have a 2,940 nm wavelength, infrareds (invisible) to a very great extent absorbed by water and by hydroxyapatite (bone).
It is this extreme absorption which is at the origin of the photoablative effects allowing selective removal of pathological tissues and the different deposits and leaving healthy tissue and a controlled bacterially detoxified surface.
The efficacy of the ablation is 540 μg/J and the depth of removal by pulse is greater than 0.4 mm [3].
The visual control in use of the Er-YAG lasers is optimal since the tips are extremely fine, translucent, working without contact.









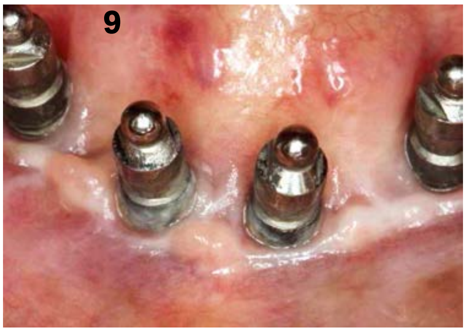


Fig. 2: Initial appearance of the very shrunk mandible, major peri-implantitis

Fig. 3: Periodontal probe that is too short, pockets of more than 30 mm all around the implants

Fig. 4: the first centimeter and even more is only granulation tissue, of differentiated, inflammatory, hemorrhagic appearance; it is very difficult to approach this type of site with a cold knife

Fig. 5: Removal of the granulation tissue by Er-YAG laser, scaling without contact, without “leakage” of unsupported tissue, maintaining the healthy tissues and removing all the unsupported tissue down to the implant in the bone

Fig. 6: Bone craters cleaned, implants decontaminated along the entire surface outside the bone

Fig. 7: 3 mn Betadine irrigation, then rinsing with saline solution

Fig. 8: Sutures (no bone or other filling was carried out)

Fig. 9: Appearance of the tissues at 1 year of healing, maturation, absence of clinical relapse, organization of keratinized tissue adhering around the implants, hygiene could be improved

Fig. 10: Stage of change of attachment system (balls> Locators) for the patient's comfort

The Erbium-YAG lasers are particularly efficacious for several key points of treatment of pathological peri-implant.

Removal of granulation tissue

These photoablative effects vaporize matter and break up the granulation tissue, making its total elimination possible, and easier.

The precision of the action that it allows and its method of action limit the iatrogenic nature of our scaling.

The penetration of the erbium laser is almost nil (less than 30 μ) which prevents any bone damage, unlike a round burr which causes far greater damage, has less ablative effect, greater thermal effect with greatly inferior visual control [4, 5, 6, 7].

Precise work with maintaining of the healthy tissues is then possible, even more so since this instrument is used in conjunction with an operating microscope or high-power fiber magnifying glasses.

Removal of the tartar
Decontamination of the titanium

This allows:

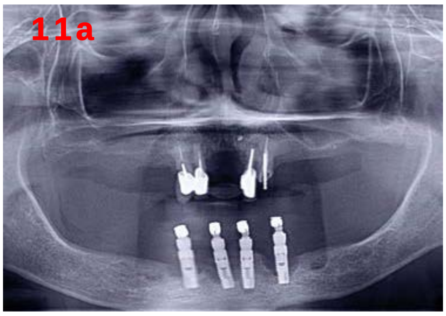
- Mucous membrane cleared of the infiltrated area
- Bone cleaned of granulation tissue but preserved, without aggression ("cold" laser), for avoidance of any necrotic halos, sources of complications or failure
- Decontaminated titanium that can be osseointegrated again

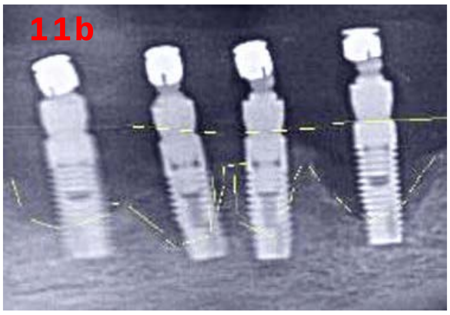
Clinical case Ms. M. N.

Poor initial situation: 76 years old, very poor hygiene, xerostomia, oral thrush, poorly adapted prosthesis, non-passive, no vestibule.

Peri-implantitis developing since 2004, first visit to our clinic in July 2010.

A non-conservative treatment seemed indicated: removal of the implants and scaling, associated secondarily with reconstruction of bone and keratinized mucous membrane if necessary.





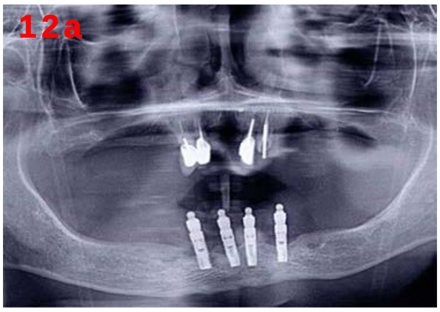
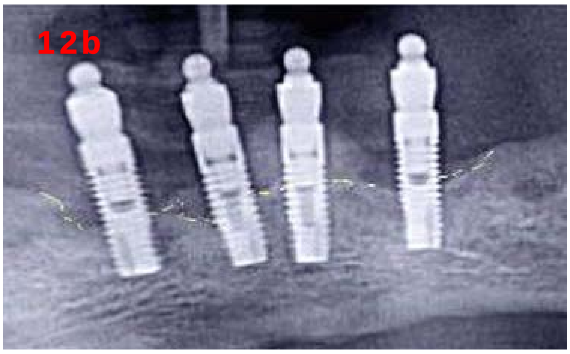
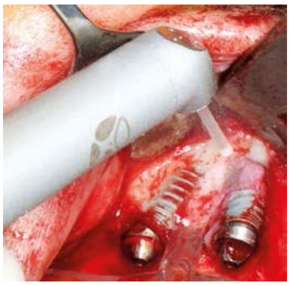


Fig. 11a and 11b: initial panoramic x-ray, global and detailed view with bone level highlighted

Fig. 12a and 12b: visit after 1 year: apart from the external aspect that shows no sign of peri-implantitis, the spontaneous bone regeneration that followed the debridement is considerable; the comparison of the two x-rays shows vertical bone gain and bone-titanium contact in this place.



However, the dental context of the patient and the difficulty in managing the delay (alimentation problems in this very fragile patient) led us to try and conserve her very infected implants, which had peri-implant pockets of over 13 mm.



Conclusion

The traditional alternative instruments such as curettes, specific ultrasound inserts, titanium brushes are many and and their use is intuitive. This may well explain a certain reluctance to change over to an instrument such as the Er-YAG laser.

In the same way we cannot transpose the qualities of one laser to another. Each type of laser will have very specific and sometimes opposing effects.
For instance, diode lasers will not damage the titanium, but will cause a harmful temperature rise, or Nd YAG lasers will damage the surface of the titanium.

In treatment of peri-implantitis, the qualities of the Erbium lasers are evident: work ergonomics , capacity to precisely and selectively remove pathological tissueto decontaminate the titanium without staining it to allow renewed osseointegration.
However these procedures are operator and equipment-dependent. With an even longer period of observation, it will be possible to improve the predictability of these treatments, interpreting more precisely the treatment guidelines and detailing the protocols to be implemented.

The fact remains that the democratization of implantology and revolution of the old implant treatments lead to this new pathology and in face of this reality we dentists must have a treatment arsenal commensurate with the general medical developments where lasers are omnipresent, and for good reason.

Bibliography

1. Dorothee Schar, Christoph A. Ramseier, Sigrun Eick, Nicole B. Arweiler, Anton Sculean, Giovanni E. Salvi - Anti-infective therapy of peri-implantitis with adjunctive local drug delivery or photodynamic therapy: six-month outcomes of a prospective randomized clinical trial - *Clinical oral implant research*

2. Niklaus P Lang, Thomas G. Wilson, Esmonde F. Corbet - Biological complications with dental implants: their prevention, diagnosis and treatment-Clin *Oral Impl Res* 2000: 11 (Suppl.): 146-155

3. Walsh JT Jr, Deutsch TF. Er-YAG laser ablation of tissue: measurement of ablation rates. *Lasers Surg Med.* 1989; 9(4): 327-37

4. Lewandrowski KU, Lorente C, Schomacker KT, Flotte TJ, Wilkes JW, Deutsch TF. Use of the Er-YAG laser for improved plating in maxillofacial surgery: comparison of bone healing in laser and drill osteotomies. *Lasers Surg Med* 1996; 19: 40-45

5. Attrill DC, Davies RM, King TA, Dickinson MR, Blinkhorn AS. Thermal effects of the Er-YAG laser on a simulated dental pulp: a quantitative evaluation of the effects of a water spray. *J Dent.* 2004 Jan; 32(1): 35-40

6. Katia M. Sasaki, Akira Aoki, Shizuko Ichinose and Isao Ishikawa - Ultrastructural Analysis of Bone Tissue Irradiated by Er-YAG Laser *Lasers in Surgery and Medicine* 31: 322-332 (2002)

7. Stefan Stubinger, Kristina Biermeier, Beatus Bachi, Stephen J. Ferguson, Robert Sader, and Brigitte von Rechenberg, -Comparison of Er-YAG Laser, Piezoelectric, and Drill Osteotomy for Dental Implant Site Preparation: A Biomechanical and Histological Analysis in Sheep-*Lasers in Surgery and Medicine* 42: 652-661 (2010)