ERBIUM AND DIOIDE LASERS FOR OPERCULISATION IN THE SECOND PHASE OF IMPLANT SURGERY: A CASE SERIES

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Objective: Decontamination of the operative field, tissue ablation, possibility of haemostasis and reduced pain symptomatology are a few of the benefits brought together by laser technology. All these advantages can be enlarged particularly in the second phase of implant surgery, when it was decided to create an operculum to uncover the loading fixture. Materials and Methods: Authors present two clinical cases in which the soft tissue covering the implant has been removed to create an under dimensioned operculum and subsequent positioning of the healing screw, by using two different wavelengths: Er:YAG laser and Dioda laser. Results: Both laser wavelengths demonstrated high level of performance during the surgical phase. Erbium laser proved to be faster in cutting, with higher macroscopic cleaning of margins, no clinical evidence of carbonization, a very good healing process and only a light intraoperative bleeding. Dioda laser permitted an excellent cutting control, a perfect haemostasis and a very good view of the operative field, but with a little bit of delay and discomfort in the healing process. Conclusions: Considering in the end the total reflection of Er:YAG laser on implant surfaces without complications linked to overheating (opposite to the Dioda laser), authors prefer the use of Erbium laser for operculisation of implant fixtures during the second surgical phase in implantology.

Key-words: implant, operculum, laser Er:YAG, Dioda laser

INTRODUCTION

Different laser wavelengths available nowadays on the market permit to clinicians to achieve excellent results in oral surgery, overall thanks to their specific features. Tissues ablative capability, haemostatic properties, biostimulating effect of light on live tissues, decontamination and antibacterial action, are only some of the reasons that can drive doctors to chose a laser device instead of a conventional blade.¹,²
In implant surgery, in particular when there is no need to improve or to preserve the amount of adherent gum and a two steps implant protocol is chosen, the approach to the uncovering of the fixture can consist of an over implant mucous operculum. In this way, a laser integrated approach can provide many advantages, such as the reduction or the absence of anaesthetic use, the reduced or absent bleeding, the excellent healing of tissues during the preprosthetic conditioning.

**Er:YAG LASER**

Er:YAG laser (λ = 2940 nm) has many applications in dentistry. Its versatility gives the possibility to treat both hard (enamel, dentine, bone) and soft tissues.4-8 This wavelength’s maximum affinity is on two particular molecular targets: water and hydroxyapatite. Soft tissues are rich in water, and therefore the cut is performed either using only the inside water (endogen cromophore) or the air – water spray of the handpiece (exogenous cromophore). The photoablative effect can be integrated to a photoacoustic effect in the second situation. The air-water spray not only reduces the thermal effect on tissues, but also improves the efficiency of cutting, leading to the microexplosion of water drops that together with the photoacoustic effect concur to the final result: the cutting effect. The use of a mirror handpiece, with a spot diameter of 0.5 mm, permits a high level of precision during the incision, a minimum dispersion of energy with a quite fast execution. Moreover, using this technique, it’s easily possible, after identifying the centre of the implant head, to create the operculum of the exact size needed. For this target, practitioners are advised to perform circular movements with an increasing diameter, in a centrifugal way, until the operculum is sufficiently enlarged. Last but not least, Er:YAG laser permits a simple and fast elimination of the bony part grown upon the cover screw, not an unusual situation, in particular in subcrestal positioning of implants.

Many studies on this topic demonstrated the safety of this wavelength on the implant surface (Fig.1-4). The absence of fixture and adjacent tissues overheating and the lack of implant surface alteration give nowadays to the 2940 nm laser the title of “the safest” on endosseous implants.9,10

![Figure 1. Titanium implant: control](image1)

![Figure 2. Imperfection of manufacture](image2)

![Figure 3. Surface after laser irradiation](image3)

![Figure 4. No damages on covering screw](image4)
**DIODE 810 nm LASER**

Diode lasers have a great diffusion into the dentistry market, above all because of their practicability, the small dimension of the device and the low cost. The 810 nm wavelength was chosen because of its ideal relation between the affinity for chromophores (hemoglobin, melanin, etc.) and the tissue penetration depth.\(^1,2,11\) In fact, this laser fiber turns up to be considerably safe and with few uncontrolled scattering phenomena. The main feature of ray continuous emission (Continuous Mode) permits, during soft tissue surgery, to obtain a well defined cut, fast and with a really limited or absent charring. The great decontamination capability of this laser permits to work in an almost sterile operative field (a 98% reduction of pathogenic bacteria), with clear advantages for the wound healing time and decreasing possibilities for post-operative infections.\(^12\) The thermal effect released during cutting permits to obtain a good hemostasis, improving the visibility during surgery and limiting the necessity for suture.

In this case-report study, Er:YAG laser and Diode laser were used to remove the soft tissue covering the implants, to create an under dimensioned operculum and for subsequent positioning of the healing screw.

**CLINICAL CASE 1**

**Findings**

The 1st clinical case involves A.M., a 45 years old man, Caucasian, with a very bad oral status. Following the oral examination, a lot of destructive carious lesions on many dental elements, the presence of radicular residuals, incorrect prosthetic rehabilitations, and a very bad oral hygiene were noticed.

**Clinical procedure**

After patient treatment plan approval, we proceeded to an oral rehabilitation with elimination of all infective origins, proper instructions for improved self-cleaning procedures, new conservative restorations, endodontic treatments and exodontic surgery.

After all these procedures, we decided to continue with the positioning of two endosseous implants (Biomet 3i Palm Beach, Full Osseotite Certain, respectively of 4 x 11.5 mm and 4 x 8.5 mm) in the right hemimaxillary bone, ex 1.5 and 1.6. Six months after positioning the fixtures, and two X-ray evaluations (intraoral film with centrator), we decided to proceed with implants uncovering by a simple operculisation in prediction of the prosthetic rehabilitation, and to keep an adequate space for implants detersion. Because there were no specific aesthetic requests for the patient and the positioning, we proceeded with the intervention. The Er:YAG laser (Fotona Fidelis Plus, Slovenia) was used according to the following parameters: mirror handpiece (0.5 mm spot diameter), pulse duration 100 μsec (VSP mode), energy of 250 mJ, frequency 20 Hz, fluence 125 J/cm\(^2\). There was no need for local anaesthesia, neither by infiltration nor superficial. The operculisation was created by putting the end of an instrument in correspondence with the centre of the fixture, than exerting circular movements with the spot of the laser. The time elapsed was no more than a few seconds of effective work. The patient discomfort was absent or poor and in an autoevaluation of the pain on a scale from 0 (absence of pain) to 10 (maximum pain imaginable) the patient referred a score equal to 2 (light discomfort). The intraoperative bleeding was very poor and the haemostasis was obtained by positioning the healing screw with consequent compression of the surrounding tissues. For this purpose and to permit a good gingival conditioning, the operculum was created with a slightly under dimensioned design.

**RESULTS**

During the following days, the patient didn’t report any pain or discomfort and he restarted a normal alimentation the same evening of the intervention. (Fig.5-13)
CLINICAL CASE 2

Findings

Patient FZ, Caucasian, 38 years old, presents to our observation with a missing tooth in position 4.6, extracted many years ago for unknown reasons. During inspection, the site appeared to be of very good quality and with a sufficient amount of soft tissue; moreover, no important bone loss was detected during palpation. After X-ray observation (intraoral and OPT), in accordance with the patient, we proceeded to the endosseous implant positioning (Biomet 3i Palm Beach, Full Osseotite Certain, size 4 x 11.5 mm) in crestal position.

Figure 7. Immediate post-operative x-ray after the positioning of the implants (mesial: 4mm x 11.5mm; distal: 4mm x 8.5mm)

Figure 8. Occlusal post-operative view after Erbium laser operculisation: poor bleeding, good marginal precision and little underdimensioning of the operculum

Figure 9. Positioning of the healing screws for tissue conditioning: the presence of poor bleeding can be easily manage by using an adequate screw diameter

Figure 10. Healing 7 days after: the mucosal tunnel, although short for prosthetic reasons, appears to be stable.

Figure 11. Metal test of the prosthetic
Clinical procedure
During the following months, two more intraoral X-ray investigations were performed. After 4 months we proceeded to the second step. The implant appeared partially uncovered, so just a limited operculisation of the soft tissues was necessary. We decided to use the Diode laser (Fotona XD-2 810 nm, Slovenia, fiber of 300 μm, 2 Watts, Continuous Wave), to avoid intraoperative bleeding. Local anaesthesia was not used, either by infiltration or superficial. The patient didn't report any pain during the intervention and the operative field was clean and without blood during all the procedure. After the creation of the operculum was finished, we realized a tissue modeling by vaporization, with the laser fiber in a non-contact mode (1-1.5 mm from the surface) where it was necessary. The cover screw was removed and the healing one was positioned. The carbonization was poor and limited to the points where the fiber was in contact with the tissues for too long.

RESULTS
During the following days the patient didn't complain of any problem during alimentation and self-cleaning procedures. Very good healing was noticed seven days later (Fig. 14-21).
DISCUSSIONS

Nowadays, different laser wavelengths can be used on soft tissue during oral surgery. The specific affinity features, transmission, absorption and diffusion of every device, make each one of them more or less indicated for operculisation during the second step in implantology.9,13,14

Moreover, their biostimulating and biomodulating capabilities can improve the speed and the quality of tissue healing process and the conditioning of the tissues before the prosthetic rehabilitation, as well as reduce the need for anaesthesia. The procedures seem to be comfortable for the patients, manageable for the operators, fast and with few contraindications.

In particular the use is resumed to:15,16
Er:YAG:
Pro:
– high affinity for the water inside the soft tissues and, therefore, high cutting efficiency
– photoablative and photoacoustic effects together
– safety, because of small possibility of implant and surrounding tissues overheating
– no side effects on fixture’s surface due to the total reflection phenomenon
– fast and predictable healing process
– the possibility to easily remove the bone grown over implants, due to the hidroxyapatite affinity
– rapidity during surgery
Adverse:
– poor intraoperative haemostasis
– annoying noise of the device

Diode 810 nm
Pro:
– high affinity for haemoglobin and melanin and, therefore, high cutting efficiency on gingival tissues
– no bleeding during surgery
– no noise during intervention
– poor or absent discomfort for the patient
– good or excellent quality of healing
Adverse:
– possibility to overheat the implants and or the surrounding tissues
– no action on bone tissues
– slower in comparison with other laser wavelengths
– longer healing process due to the overheating, the carbonization and the activation of the monocyt-macrophagic complex for charring debris removal
CONCLUSIONS

Both laser wavelengths (Er:YAG and Diode 810 nm) demonstrated a good clinical performance for operculisation of over implant soft tissue during the second step in implantology. Many scientific studies demonstrated the capability of biostimulation and decontamination of these lasers, and therefore the important role in obtaining a good result for the final rehabilitation.

The opinion of the authors is that the use of Erbium laser is preferable in comparison to the Diode laser 810 nm during the second step in implantology, because of the fast cutting execution, implant and tissue safety, patient comfort and very short healing time.

REFERENCES