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Combined laser, guided bone regeneration and probiotics approach in the treatment of periimplantitis: a case report

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ABSTRACT

Biological complications which involve osseointegrated implants created up today a great interest in dentistry, and several kinds of treatments were proposed in these last years to avoid the loss of the implant due to the bone reabsorption. The aim of this case report was to show an original approach to treat periimplantitis by combining the use of Er:YAG and bone guide regeneration during the intervention, followed by a probiotics therapy in the immediate follow-up.

Key words: periimplantitis, Er:YAG laser, photobiomodulation, PBM, guided bone regeneration, GBR, probiotics, K12.

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Introduction

Biological complications which interest osseointegrated implants created up today a great interest in dentistry, both in the their two forms: peri-implant mucositis and periimplantitis.[1]
Even if the presence of an inflammatory lesion is a feature both conditions have in common, only the second presents the supporting bone loss[2] and, in every case, mucositis precedes always peri-implantitis.[3]
According to a 2015 meta-analysis, the prevalences of peri-implant mucositis and peri-implantitis were 42.9% and 21.7%, respectively.[4]
In these last years several kinds of treatments were proposed to avoid the loss of the implant due to the bone reabsorption.
Giok KC, et al, in 2024, made a systematic review with network meta-analysis to analyze the current evidence on nonsurgical and surgical interventions for the treatment of peri-implantitis.[5] They included a total of 45 articles in the quantitative analysis and they concluded that the mechanical debridement with adjunctive systemic antibiotics or photodynamic therapy results in improved clinical outcomes.
Also Grundström, in 2024, showed, by a randomized placebo-controlled trial on 84 patients,[6] that adjunctive systemic antibiotics resulted in additional improvements in marginal bone level stability even if the potential clinical benefits of antibiotics need to be carefully balanced against the risk of adverse events and possible antibiotic resistance.
A recent narrative review[7] described the non-surgical and surgical management of periimplant complications: while the non-surgical therapeutic approach alone (manual instruments, ultrasonic devices and air abrasives) is considered particularly inadequate in managing this condition,[8] surgical approaches have been recommended for treating peri-implantitis[9] and Wang *et al.* demonstrated that the adjunctive use of Er:YAG laser in regenerative therapy significantly reduced the pocket depth compared to the control group.[10]
At present, only a limited number of randomized clinical trials have been conducted on regenerative treatment of peri-implantitis, thus, determining which material is superior is challenging, Moreover, Castro *et al.* in 2023, by a systematic review of randomized clinical trials, stated that surgical regenerative treatment may be a predictable option in the management of peri-implantitis, particularly by the improving the clinical parameters of peri-implant tissues in the short term, mainly when using porous titanium granules, alloplastic bone grafts, and xenografts.[11]
Furthermore, the use of probiotics for the management of peri-implant diseases seems to represent a novel interesting approach.[12] In one RCT, the administration of *Lactobacillus reuteri* as an oral probiotic along with non-surgical mechanical therapy resulted in significant improvements in the clinical parameters of implants with peri-implant mucositis or peri-implantitis.[13]
The aim of this case report was to show an original approach to treat periimplantitis by combining the use of Er:YAG and bone guide regeneration during the intervention, followed by a probiotics therapy in the immediate follow-up.

Case Report

General information

A 45-year-old female patient came to our clinics for a problem in the left lower arch.
She reported that two years ago she was treated in our hospital for implant surgery and upper implant (3P 4,5 x 10, B&B, Italy) crown restoration due to the absence of posterior teeth. The follow-up was without any problem until six months ago, when the gum of the implant site became swollen, and food impaction and discomfort started to be present.
The clinical examination revealed in the zone 37 a slight swelling of the buccal gum of the implant with presence of exudate and absence of keratinized tissue and also a scanty bleeding was appreciated (*Supplementary materials, Figures 1 and 2*). The depth of the buccal probe inserted into the margin of the implant was 4mm.
CT examination showed that the alveolar bone around the implant 37 was absorbed into l/4 of the neck of the implant (*Supplementary materials, Figure 3*).
To avoid the complete loss of the implant, it was decided to perform a surgical intervention consisting on the debris removal around the implant and the guided bone regeneration.
After the patient was informed about the details of the intervention as well as the risks and the possible unsuccess, she approved and signed her consent for the intervention.

Materials and devices

During the intervention were employed these devices and materials: Er:YAG laser (LiteTouch, Light Instruments, Israel), diode laser (Smart M Pro, Lasotronix, Poland), Deproteinized bovine bone mineral (Bio-Oss bone powder 0.25g, Geistlich, Germany), absorbable collagen membrane (Bl0-gide 13*25mm, Geistlich, Germany), surgical tool box.

Intervention and follow-up

One day before intervention the patient assumed 1000mg oral Amoxicillin+Clavulanate antibiotics (Augmentin®, GlaxoSmithKline, Italy) while just before she rinsed for 3 minutes by a mouthwash containing chlorhexidine (Nan Yue Pharm, China).
After a routine facial disinfection with towel and a local infiltration anesthesia by articaine/epinephrine injection (Articaine, Anhui Yisheng Technology Co., LTD, China), the crown of the implant 37 was removed (*Supplementary materials, Figure 4*) and, by a scalpel, a mucoperiosteal flap was performed (*Supplementary materials, Figure 5*).
It was observed that the thread of the neck of the implant was exposed at 2mm and, due to the abundant granulation tissue around the fixture, Er:YAG laser (200mJ and 35Hz, contact mode) was used for implant surface decontamination, as well as for debris and infected bone renoval (*Supplementary materials, Figure 6*).
After screw positioning over the implant (*Supplementary materials, Figure 7*), Bio-Oss artificial bone powder was inserted inside the bone defect area and BlO-gide absorbable collagen membrane was put for covering the exposed area (*Supplementary materials, Figures 8 ad 9*).
After suture apposition (*Supplementary materials, Figure 10*), Photobiomodulation was performed by 635 nm diode laser (SmartMst, Lasotronix.Poland) with the aim to reduce pain and discomfort as well as to enhance the healing process.
The intervention area was irradiated six times for 20 sec in continuous mode and non-contact, with an interval between them of 20 sec.
The handpiece diameter was 8mm, output power 100mW, the total time was 120 sec and the total fluence was 20J/cm^2.
The patient was instructed to assume 1000mg oral Amoxicillin+Clavulanate antibiotics (Augmentin®)/day for the following three days and 1 cpr/day of Streptococcus Salivarius K12 probiotics (Bactoblis®, Pharm-Extracta, Italy) for 3 months starting one week after the intervention. Ten days after intervention, sutures were removed and the patient was checked at 1,2,3,4,5 and 6 months (*Supplementary materials, Figure 11*).
Six months after surgery, the clinic and radiographic follow-up showed a complete "restitutio ad integrum" of the lesion: presence of keratinized tissue, absence of exudate and gum swelling, no bleeding and no pocket at the probe test.
Panoramic X-Ray showed that implant was completelt surrounded by the bone (*Supplementary materials, Figure 12*).
So, Er:YAG laser was used to remove soft and hard tissues covering the fixtures, in order to re-apply the upper crown of the implant (*Supplementary materials, Figure 13*).

Discussion

In clinical practice, mechanical debridement is considered the "gold standard" for managing peri-implant diseases,[14] with adjunctive therapies like laser therapy and antimicrobial agents.[15] Er:YAG laser has shown the ability of minimally invasive, safe, efficient and promoting bone formation promoting, so becoming one of the clinically available treatment for periimplantitis.[16]
At the same time, it is able to destroy the plaque biofilm on the surface of the implant, so reducing inflammation and promoting cell proliferation, without damaging and destroying the implant surface.[14] *In vivo* studies by Swider *et al.*[17] showed that bone surface irradiated by Er:YAG laser presents characteristic microstructure, able to increase the fibrin and blood clot preservation, to enhance production of extracellular matrix components, and to promote bone tissue healing.
Moreover, thanks to the air/water spray released by this device on the operating area during the irradiation, thermal elevation is very low, so avoiding the risk of tissue overheating.[18]
The photobiomodulation performed by low energy red laser is useful for stimulate the proliferation and differentiation of osteoblasts[19] so promoting new bone formation.[20]
Due to peri-implantitis is considered a polymicrobial

infection associated with *Staphylococcus epidermidis* and specific gram-negative periodontopathogens, such as *Porphyromonas gingivalis, Tannerella forsythia, Fusobacterium nucleatum* and *Porphyromona intermedia*[21] and also due to several studies have found a positive association between the use of certain probiotic bacterial strains and oral health,[22] they have been proposed to be utilized for the treatment of peri-implantitis.[23]
The main advantage of deproteinized bovine bone mineral is that it holds volume, and the graft is deemed non/low resorbing In fact, the results of histological analyses of human samples have clearly demonstrated the ability for xenografts, of which DBBM (BioOss), is the most widely used, to be found within native bone even several years following their grafting.[24]
The originality of this case report consists in the integration of most of the factors that were suggested by the literature as favoring the success of the periimplantitis treatment: Er.YAG laser, deproteinized bovine bone mineral, photobiomodulation and probiotics.

Contributions: all authors contributed equally to the work. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of interest: the authors declare no conflict of interest.

Ethics approval and consent to participate: no ethical committee approval was required for this case report by the Department, because this article does not contain any studies with human participants or animals. Informed consent was obtained from the patient included in this study.

Informed consent: the patient gave her written consent to use her personal data for the publication of this case report and any accompanying images.

Availability of data and materials: all data underlying the findings are fully available.

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Online supplementary material:

Figure 1. Preoperative frontal view.

Figure 2. Preoperative occlusal view.

Figure 3. Pre-operative oral radiography.

Figure 4. After crown removal.

Figure 5. Mucoperiostal flap performed.

Figure 6. Bone decontamination and debris removal by Er:YAG laser.

Figure 7. The screw is inserted into the fixture.

Figure 8. Artificial bone powder insertion.

Figure 9. Collagen membrane apposition.

Figure 10. Suture apposition.

Figure 11. Oral radiograph after intervention.

Figure 12. Six months after intervention radiograph.

Figure 13. Re- application of the crown.