LITERATURE REVIEW

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APLICAÇÃO DO LASER NO TRATAMENTO DA PERIIMPLANTITE

LASERTHERAPY FOR THE TREATMENT OF PERIIMPLANTITIS

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RESUMO | Objetivo: avaliar e discutir a aplicação do laser no tratamento da periimplantite através de uma revisão da literatura. **Método:** pesquisa eletrônica na base de dados PubMed em busca de publicações entre 2012 e 2017. De um total de 26 resultados, foram escolhidas 17 publicações as quais foram complementadas por outras referências relevantes para a realização do trabalho. **Resultados:** Segundo a literatura pesquisada, os lasers de Diodo, Nd:YAG, Er:YAG e o de CO_2 têm sido relatados como um método terapêutico viável para a periimplantite, pois parecem influenciar a descontaminação da superfície dos implantes e melhorar os sinais clínicos de inflamação. Porém não foram observados trabalhos clínicos controlados que provem sua efetividade a longo prazo, bem como a superioridade da laserterapia frente aos outros métodos terapêuticos aplicados no tratamento da periimplantite. **Conclusão:** Ainda não existe consenso na literatura a respeito do tipo de laser e suas configurações para tratamento da periimplantite. Não é possível afirmar que o tratamento a laser é melhor que as terapias convencionais para a periimplantite, sendo importante a realização de mais estudos clínicos a respeito desse assunto.

Palavras-chave: periimplantitis, laser, sistematic review.

ABSTRACT | Aim: To evaluate and discuss the application of laser in the treatment of periimplantitis through a review of the literature. **Methods:** An electronic search in the PubMed database in search of publications between 2012 and 2017. Out of the total of 26 results, 17 publications were chosen which were complemented by other references relevant to the work. **Results:** According to the literature, Diode, Nd:YAG, Er:YAG and CO_2 lasers have been reported as a viable therapeutical method for periimplantitis because they appear to influence the surface decontamination of the implants and improve the clinical signs of inflammation. However, no controlled clinical studies have been observed that prove its long-term effectiveness, as well as the superiority of laser therapy compared to other therapeutic methods applied in the treatment of periimplantitis. **Conclusions:** There is still no consensus in the literature regarding the type of laser and its configurations for periimplantite treatment. It is not possible to affirm that the laser treatment is better than the conventional therapies for the periimplantite, being important to carry out more clinical studies on this

Keywords: periimplantitis, laser, sistematic review.

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INTRODUCTION

The implantology has been allowing the rehabilitation of partial and total edentulous spaces with success. However, although studies indicate the high survival rate of osseointegrated implants, there is a variable percentage that identifies the loss of osseointegrated implants over the years1. The long-term success of dental implants is greatly influenced by the oral hygiene of the patient and the periodic follow-up by a dental surgeon[2,3,4].

After the implant procedure, clinical and radiographic changes around the implants may occur, including saucerization and peri-implant diseases such as mucositis and peri-implantitis. The saucerization is a process of initial bone reabsorption in the form of a crack located around the implant and that can be confused, due to professional inexperience, with peri-implantitis[5]. Mucositis consists of reversible inflammation of peri-implant soft tissues, while peri-implantitis is characterized as an inflammatory process associated with bone loss around osseointegrated implants[2,4,6,7].

As etiological factors for the development of the peri-implantar disease, we have the subgingival plaque accumulation and the colonization of the spaces at the implant-abutment interface, mainly by gram-negative anaerobic bacteria and other periodontopathogenic species[1,8]. Environmental factors such as tabacco and the presence of systemic diseases may play a significant role in the development of peri-implantitis[1].

For the early diagnosis of peri-implant changes, it is recommended to evaluate the probing of depth, gingival, plaque and bleeding indexes, presence of exudate or suppuration, position of the gingival margin, implant mobility and radiographic examinations[1,2,4,8,9,10]. It is worth emphasizing the importance of using plastic probes during the clinical examination to avoid scratching the surface of implant/abutment therefore minimize trauma[2,4].

Among the suggested therapeutic proposals are mechanical debridement, decontamination of the surface of the implant with antimicrobial substances, local application and systemic use of antibiotics, photodynamic therapy, laser therapy, ressective and regenerative surgeries and explantation[2,3,4,7,8,11]. Thus, the aim of all these therapies is bacterial decrease and the improvement of the clinical conditions of the patients[3].

The laser is indicated in implantology for implant surface decontamination and peri-implantitis treatment, edema reduction, postoperative pain and inflammation, second-stage surgical procedures of submerged implants (incision/excision), soft tissue plastic surgery and , experimentally, during the preparation of the implant installation[12,13]. However, proper professional training regarding laser use is important in order to improve clinical outcomes and to control possible complications such as lesions to noble anatomical structures and damage to the surface of implants.

The objective of this work was to perform a literature review regarding the usefulness of laser as a therapeutic method in the treatment of peri-implantitis. We used the PubMed database covering studies published between 2012 and 2017 supplemented by other relevant references.

MATERIAL AND METHODS

This work consists of a review of literature conducted through electronic research in the PubMed database in search of publications since 2012 with the keywords “peri-implantitis and laser and sistematic review”. Out of a total of 26 results, 17 publications were selected. The titles and abstracts were read and analyzed. The criteria for inclusion of the references were established: definition and diagnosis of peri-implantitis; use of laser therapy in the treatment of peri-implantitis; full text available. These publications were complemented by other relevant references for the accomplishment of the work due to the need for concepts not described in previously selected articles, in addition to other references mentioned in at least two of the referenced articles.

Table 1. Description of the results found in the works used in the study in question.

Author/Year	Kind of study	Laser	Indication / Result
Alsheri FA, 2016[27]	Systematic review	Er:YAG	Implant surface disinfection
		CO_2 laser	Implant surface disinfection Improvement of bone/implant contact in previously infected sites
Arisan V et al., 2015[26]	Randomized clinical trial (sample: 24 implants)	Diode laser –pulsed mode 1,0W power, 01 min – (810nm wavelength, 3J/cm2 energy density; 400mW/cm2 power density; 1.5 J energy; 1mm light diameter)	Diode laser + mechanical debridement - peri-implant healing similar to the non-laser exposed group > Marginal bone loss in exposed group after 6 months of treatment
Figuero E et al., 2014[21]	Systematic review	Er:YAG (100mJ energy, 10Hz frequency)	Reduction of bleeding at the probe and in the probing of depth - first 06 months Possibility of recurrence of infection after 1 year of treatment
Kotsakis GA et al., 2014[22]	Systematic review	Er:YAG (2,940nm wavelength)	Only one application - efficient in controlling inflammation for at least 06 months Reduction of the probing of depth Improvement of the level of clinical insertion
Monzavi A et al., 2014[28]	Randomized clinical trial (sample: 03 implants)	Er:YAG (energy of 100mJ/pulse, 10 pulses/second during 60s)	Indicated for surface decontamination of implants It is safe when used with or without refrigeration It is recommended to use <10ºC
Muthukuru M et al., 2012[20]	Systematic review	Er:YAG + mechanical debridement	Reduction of clinical signs of inflammation (bleeding at probing for example) in greater proportion when compared to mechanical debridement associated chlorhexidine irrigation
Romanos GE e Weitz D, 2012[25]	Literature review	CO_2 laser	Disinfection and bacterial reduction Does not damage implant surface
Romanos GE et al., 2013[12]	Literature review	Diode laser	Contrary effects with power> 0.2W (mainly bone tissue)
		Nd:YAG	Contraindicated for periimplantitis - temperature rise
		CO_2 / Er:YAG lasers	Indicated for periimplantitis at low power
Romanos GE et al., 2015[17]	Literature review	CO_2 laser (2W power/continuous or pulsed wavelength)	Surface decontamination of implants It should not be used for more than 10s and more than 10ºC, similarly to the Er: YAG laser
		Nd:YAG	Contraindicated for periimplantitis - temperature rise
Schwarz F et al., 2015[18]	Systematic review	Er:YAG	It reduces bleeding at the brope in the first 06 months, without continuity after 01 year. Failure to reduce bacterial load, especially in more advanced cases.
Shahi e Ardabili, 2017[11]	Literature review	CO_2, Diode and Er:YAG lasers	Indicated for treatment of periimplantitis
		Nd:YAG	Causes temperature rise, with high absorption on titanium surface. However when used in low power (1.0 -1.4W) it can be indicated for disinfection of implant surfaces.
Smeets R et al., 2014[15]	Literature review	Er:YAG	Reduces bleeding Does not cause changes in the probing of depth, clinical insertion level, plaque and gingival indices
Suarez F et al., 2013[24]	Literature review	CO_2 laser	Good disinfection effect Not absorbed by metal surfaces
		Diodo laser (690nm wavelength during 60 seconds)	Significant reduction of *A. actinomycetemcomitans*, *P. gingivalis*, *P. intermedia*

DISCUSSED REVIEW OF THE LITERATURE

Peri-implantitis – Definition

Osseointegration allows direct contact between implant and bone tissue, which justifies the absence of periodontal ligament in implants[14]. Thus, when there is failure in osseointegration, peri-implant alterations can appear, including mainly peri-implantitis.

Peri-implantitis is defined as an inflammatory process of peri-implant tissues associated with bone loss around osseointegrated implants[7,12,15]. It consists of a disease of slow progression and usually diagnosed in its initial stage during periodic consultations[16]. Therefore, the importance of early diagnosis and adequate treatment planning and follow-up.

Peri-implantitis – Treatment

The goal of peri-implantitis treatment is to reduce bacterial load, provide health to the peri-implantar mucosa and, where possible, regenerate bone lost during the inflammatory process[20]. There are several protocols to treat peri-implantitis including non-surgical methods of mechanical instrumentation associated with the use of antiseptics such as chlorhexidine and citric acid, use of local and systemic antibiotics such as amoxicillin, metronidazole, azithromycin and ciprofloxacin, regenerative and ressective surgical treatments, photodynamic therapy[11,12,15].

Mechanical instrumentation can be performed with manual curettes, ultrasound, air polishing systems, besides prophylaxis with polishing paste and rubber cups[8,11,15,21]. Sallum et al. (2009)[3] report that peri-implantitis mechanical non-surgical therapy alone or associated with local action antibiotics is not sufficient. However, Ramanauskaite et al. (2016)[19] argue that the use of systemic antimicrobials provides a reduction in bleeding and in the probing of depth.

Surgical therapeutic techniques are indicated for the most advanced cases of peri-implantitis, where a probing of depth greater than 5mm associated with bone loss is found[17] and in cases in which there was no improvement after non-surgical treatments. However, Ramanauskaite et al. (2016)[19] carried out a review of the systematic literature and concluded that treatments for peri-implantitis of different non-regenerative surgical modalities have limited efficacy.

Laser is indicated as an adjuvant to conventional non-surgical treatment, since its thermal effect promotes denaturation of bacterial proteins, leading to cellular necrosis and improvement of peri-implant clinical parameters[11,21,22,23]. Thus, the therapeutic and antimicrobial effects of the laser justify its use for the treatment of peri-implantitis[11,24].

Laser Therapy

The laser appeared in Dentistry in 1989 when Dr. William and Terry Myers designed the first laser through a modification of an ophthalmic laser[12]. Many laser wavelengths are available and have popularity in dentistry in the last decades and are well applied in implantology. Among them are the diode semiconductors, the solid state ones as Nd:YAG, Er:YAG and the gaseous state lasers as the CO_2 laser[12]. Diode, CO_2, Nd:YAG lasers can be used for soft tissue applications providing excellent coagulation. The Er:YAG laser is indicated for applications in hard tissues due to the high absorption of hydroxyapatite[12].

According to Romans and Weitz (2012)[25] lasers are suggested as adjuvants to the conventional peri-implantitis treatment, being the high-power (surgical) and low-power (non-surgical) indicated for decontamination of implant surfaces and improvement of clinical and radiographic findings. Laser treatment seems to control peri-implant inflammatory reactions, reduction of bleeding, and help in bone regeneration around implants[3,25]. However, despite the benefits associated with the use of lasers in implantology, the risks of irradiation on the surface of implants and peri-implant tissues such as temperature increase should be considered in order to avoid injuries[11,12].

Diode (Gallium-Aluminum-Arsenic) laser seems to be a good option for use with implants since the devices are smaller and have ease in handling, although adverse effects have been identified when used in high power (> 0.2W), mainly injury to bone tissue[12]. According to Suarez et al. (2013)[24], Diode laser with a wavelength of 690nm for 60 seconds demonstrates significant reduction of bacterial count of Actinomyces

actinomycetemcomitans, Porphyromonas gingivalis and Prevotella intermedia.

In contrast, Arisan et al. (2015)[26] carried out a randomized clinical trial in which 24 random implants out of a total of 48 implants from 10 patients were stimulated by a 810nm wavelength Diode laser, pulsed mode 1.0W power for 01 minute associated with mechanical debridement. In this trial, the use of the laser attached to the conventional treatment did not show an additional positive influence on peri-implant healing when compared to the control group, in addition to a greater marginal bone loss in the group exposed to the laser after 6 months of treatment.

The Nd:YAG (Neodymium: Aluminum-Itrium-Grenade) laser penetrates deeply into the tissues, reduces the amount of bacteria, but causes a temperature increase, changes in implant structure, and possible damages to the bone tissue being contraindicated for peri-implantitis treatment[12,17]. Disagreeing with this statement, Alshehri (2016)[27] report the use of the Nd:YAG laser associated with non-surgical peri-implantar therapy to reduce tissue inflammation and decontamination of the surface of implants, which allows clot formation and filling of bone loss gap preventing formation of epithelial tissue.

The Er:YAG (Erbium: Aluminum-Itrium-Grenada) laser can also be used effectively for decontamination of the implant surface, but at low power[12]. Kotsakis et al. (2014)[22] argue that, for non-surgical laser treatment, only one application of Er:YAG laser (wavelength 2.940nm) is efficient in controlling inflammation around implants for at least 06 months, in addition to having effect on the reduction of the probing of depth and on the improvement of the level of clinical insertion.

Figuero et al. (2014)[21] describe studies that indicate the use of a 100mJ Er:YAG laser and a 10Hz frequency, using a cone-shaped sapphire tip, around the peri-implant pocket and state that there is improvement in the clinical results of bleeding at the probe and in the probing of depth in the first six months, however, there may be recurrence of infection after one year of treatment. Already Monzavi et al. (2014)[28] report that the Er:YAG laser is safe when used at an energy of 100mJ/pulse and 10 pulses/second for 60 seconds regardless of whether it is used with or without refrigeration. The authors are advised to use it at a temperature below 10°C.

Sallum et al. (2009)[3] report that the Er:YAG laser has a similar effect to the use of chlorhexidine associated to mechanical debridement in the 6 months following the treatment, with a considerable improvement in probing of depth and at the level of clinical insertion. The advantage of the laser is that, in addition to these improvements, it also promotes a greater reduction of bleeding during the probing of depth and is indicated as a complement to the peri-implantitis surgical treatment and may improve the clinical results of this therapy.

Schwarz et al. (2015)[18] also affirm that the Er:YAG laser promotes a significant reduction of bleeding during the first 6 months after treatment, but this improvement does not perpetuate after 1 year, in addition to failure to reduce bacterial load, especially in more severe cases. In disagreement with these authors, Smeets et al. (2014)[15] affirm that the Er:YAG laser has been shown to reduce bleeding, but does not cause alterations in the probing of depth, clinical insertion level and plaque and gingival indexes.

The CO_2 laser (Carbon Dioxide) has a lower tissue penetration depth when compared to Nd:YAG and is indicated for the treatment of peri-implantitis when used in low power[12,25]. In this way, the CO_2 laser allows disinfection and bacterial reduction and does not damage the implant surface[12,25]. Romanos et al. (2015)[17] indicate the CO_2 laser for surface decontamination of implants at a power of 2 Watts with continuous or pulsed wavelength.

According to Suarez et al. (2013)[24] and Shahi and Ardabili (2017)[11], authors affirm that the CO_2 laser is well absorbed in water, has a potential disinfecting effect and is not absorbed by metallic surfaces, reducing injuries to the peri-implant tissues and surface of the implants. CO_2 laser irradiation on the surface of the implants has no negative effects on osteoblast proliferation or cell attachment to the surface, facilitating bone formation[11,25].

For Romanos et al. (2015)[17] Er:YAG and CO_2 lasers have been used for the treatment of peri-implantitis, however, care must be taken with regard

to the risk of damaging the surface of the implants when manipulated for more than 10 seconds at a temperature greater than 10°C. Alshehri (2016)[27] also indicates Er:YAG and CO_2 lasers for the disinfection of implant surfaces without damaging them, because the Er:YAG laser has a high absorption in water and the CO_2 laser is indicated to improve contact bone-implant in previously infected sites.

However, there are reports in the literature of negative results associated with the use of Er:YAG laser, justified by the type of laser device, professional inexperience and sensitivity to the technique used[27]. The minimum absorption of the laser and its repercussion in the implant and peri-implant tissues must be assured to be safely indicated[11,15]. Thus, the knowledge of the laser energy to be used is crucial for success of peri-implantitis treatment.

CONCLUSIONS

In this literature review, it was verified the importance of future researches describing in detail the specific characteristics of the laser for peri-implantitis treatment, as well as power, wavelength, exposure time and duration of treatment.

There are no comparative clinical studies or randomized controlled clinical trials available to provide the best therapeutic protocol for peri-implantitis, as well as a protocol for the use of laser as a therapeutic method for peri-implantitis.

Given the information available in the publications, it is not possible to affirm that the laser treatment is better than the conventional therapies for peri-implantitis, and there is a need for more clinical studies.

COMPETING INTERESTS

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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