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LASERTHERAPY AS A COADJUNCTIVE TREATMENT IN OSSEOINTEGRATION OF DENTAL IMPLANTS

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Abstract: In the postoperative period, implant surgery triggers an inflammatory process that, when not well conducted, can compromise implant osseointegration, an important condition for survival and success of dental implants. This way, the laser has been pointed out as an ally in implantology, its biomodulatory, analgesic, anti-inflammatory action and ability to improve osteoblastic activity contributes from effective osseointegration to acceleration of postoperative healing. This work was carried out in the form of an integrative literary review, based on articles from international journals and aims toto evaluatethe effects of laser therapy on the osseointegration of dental implants. The survey of scientific articles was carried out in the electronic, VHL, Medline and PubMed databases using the descriptors dental implant * AND Osseointegration * AND Laser Therapy *, with a time frame from 2017 to 2022. Nine (9) articles were analyzed in in full, in English and Spanish. The results indicate that low-level laser may be a viable option for adjunctive therapy with regard to osseointegration, due to its ability to improve osteoblastic activity, thus inducing bone neoformation. Consequently, it contributes to better post-surgical recovery. However, low-level laser therapy is capable of producing satisfactory results in the osseointegration process, however, more robust studies, especially in humans, are needed to legitimately prove the effectiveness of laser in osseointegration of implants.
Keywords: Dental implant; Osseointegration; Laser therapy.

INTRODUCTION

During life, several factors can interfere with oral health, such as caries, fractures or periodontal disease, causing the loss of dental elements. The absence of teeth is capable of negatively interfering not only with the

social life of individuals, but also with the masticatory and phonetic ability (Sharma *et al.*, 2011), something that causes the need for rehabilitative treatment, which can be performed by different protocols.

Some patients find it difficult to adapt to removable prostheses, making implant-supported prostheses well accepted among patients because they have high stability when compared to tooth- supported or mucous supported prostheses. This makes the popularity of this method increase more and more.

After implant surgery, there is an inflammatory process in the peri - implant bone repair, which may be associated with the presence of lymphocytes, plasma cells and macrophages, proliferation of blood vessels, fibrosis and tissue necrosis, as stated by Mayer *et al.,* (2013), compromising the osseointegration process, which is defined as the physical union of the osseointegrated implant with the idealized recipient bone.

The growing advance of research in relation to the use and indication of laser (light amplification by stimulatedemission of radiation) provides more knowledge about its method of action and results. In addition to the already known power of biomodulation, analgesic and anti-inflammatory action, laser improves osteoblastic activity, inducing bone neoformation. Thus, reflecting on the best post- surgical recovery (Zayed *et al.*, 2020).

Biocompatible artificial root, extending from the preparation of the periodontal tissue to the improvement in the postoperative situation. Therefore, the good results presented are due to the increase in epithelial proliferation and stimulation of collagen synthesis, increase in phagocytic activity, and also to the increase in calcium hydroxyapatite deposition by osteoblasts, according to Karaca*et al* (2018).

Even in the face of several evidences that suggest the success of laser as an adjunct treatment for an adequate post-surgical rehabilitation, some studies have contradictory results, this may occur due to discrepant variations in the irradiation protocols or in the experimental models used, or even failure in the execution. of the technique. Therefore, the present work aims to evaluate, through an integrative literature review, the effects of laser therapy on the osseointegration of dental implants.

MATERIAL AND METHODS

This study is an integrative literature review, characterized by the careful selection of bibliographic data through the search for articles in the following databases: VHL (Virtual Health Library), Medline (Medical Literature Analysis and Retrieval System Online) and Pubmed (US National Library of Medicine NLM). The search strategy included the use of the following descriptors together with Boolean operators: Dental implant * AND Osseointegration * AND Laser Therapy *. In the Descriptors in Science and Health (DeCS).

For the selection of articles, those published in the last five years in English and Spanish were used as inclusion criteria, being randomized, controlled clinical case studies and case series that refer to the use of low-level laser therapy in implant dentistry. Monographs, dissertations, theses, in vitro studies and those that did not present data on the idea addressed or that there was a lack of clarity in the methodology were excluded. A reference manager, Mendeley, was used to systematically organize the titles and abstracts of articles found in the databases. Removal of duplicate articles was performed using a Mendeley tool. Subsequently, after applying exclusion criteria, the final sample consisted of 9 articles. After the selection, the full text version of the included articles was downloaded and a complete and detailed reading of the PDF articles was performed.

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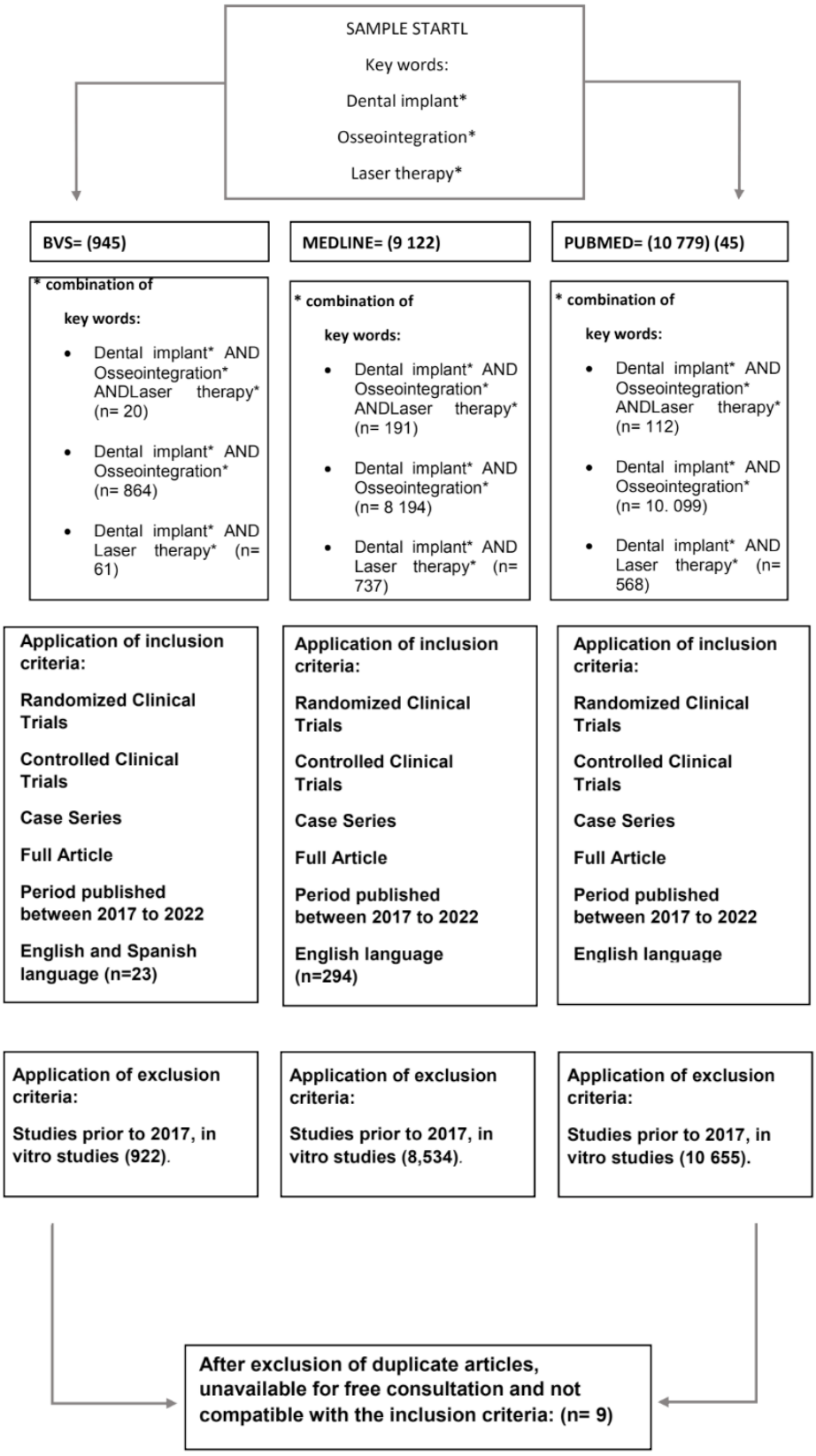
SAMPLE STARTL
Key words:
Dental implant*
Osseointegration*
Laser therapy*
BVS= (945)
MEDLINE= (9 122)
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* combination of key words:
Dental implant* AND Osseointegration* ANDLaser therapy* (n= 20)
Dental implant* AND Osseointegration* (n= 864)
Dental implant* AND Laser therapy* (n= 61)
* combination of key words:
Dental implant* AND Osseointegration* ANDLaser therapy* (n= 191)
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Dental implant* AND Laser therapy* (n= 737)
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Dental implant* AND Osseointegration* ANDLaser therapy* (n= 112)
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Dental implant* AND Laser therapy* (n= 568)
Application of inclusion criteria:
Randomized Clinical Trials
Controlled Clinical Trials
Case Series
Full Article
Period published between 2017 to 2022
English and Spanish language (n=23)
Application of inclusion criteria:
Randomized Clinical Trials
Controlled Clinical Trials
Case Series
Full Article
Period published between 2017 to 2022
English language (n=294)
Application of inclusion criteria:
Randomized Clinical Trials
Controlled Clinical Trials
Case Series
Full Article
Period published between 2017 to 2022
English language
Application of exclusion criteria:
Studies prior to 2017, in vitro studies (922).
Application of exclusion criteria:
Studies prior to 2017, in vitro studies (8,534).
Application of exclusion criteria:
Studies prior to 2017, in vitro studies (10 655).
After exclusion of duplicate articles, unavailable for free consultation and not compatible with the inclusion criteria: (n= 9)

RESULTS

In view of the searches performed, randomized, controlled clinical case studies and case series were selected, including the use of low-level laser therapy (LLLT) in dental implants.

AUTHOR / YEAR	OBJECTIVE	METHOD	RESULTS
Mikhail *et al.*, (2018)	To evaluate the radiodensitometric effect of low-level laser therapy (LLLT) on the osseointegration of immediate loading dental implants in patients undergoing therapy with vitamin C, omega-3 and calcium.	1 implant was placed in 20 patients who were divided equally into two groups. The laser group received LLLT with a wavelength of 904 nm in contact mode, continuous wave, output power of 20 mW and exposure time of 30 sec with a dose of 4.7 J/cm2. The control group received no intervention.	LLLT significantly promoted bone healing and accelerated the osseointegration process, emphasizing the biostimulating effect of the laser.
Karaka; Ergun; Ozturk, (2018)	Investigate the effects of biostimulation lasers and ozone therapy on osseointegration of immediately loaded implants	100 implants were placed in 25 patients. The implants were divided into four treatment groups (Group 1: LLLT (gallium-aluminum- arsenide diode) group, Group 2: ozone therapy group, Group 3: group with different ozone therapy protocol, and Group 4: control group.) each with 25 implants. Ozone therapy was performed with an ozone generator (OzoneDTA) with an intraoral probe for Group 2 and Group 3.	LLLT and prolonged application ozone therapy are methods that may have a positive result in improving bone healing around immediately loaded implants and increasing implant stability. However, further studies on the subject are needed for these methods to become routine applications.
torkzaban*et al.,* (2018)	To evaluate the effectiveness of LLLT to improve dental implant stability.	80 implants were placed in 19 patients. The implants were randomly divided into two groups (n =40). Seven sessions of LLLT (940 nm diode laser) were scheduled for the test group implants for 2 weeks. The same procedure was performed in the control group with the laser handpiece in "off" mode.	LLLT had no significant effect on implant stability in bone density D3 and D4 during 3 weeks postoperatively.
Allende *et al.*, (2020)	To report the resolution of 3 clinical cases of peri-implantitis through the combined use of mechanical therapy and diode laser.	Three clinical cases diagnosed with peri-implantitis underwent joint therapy between a mechanical ultrasound treatment using plastic tips (PI EMS®, Switzerland) and laser therapy (940 nm diode (Biolase ®, USA) with a power of 2 W in CW mode, with 300 μm tip).	The use of combined mechanical and laser therapy at a continuous dose of 2W, using a 300 μm tip, was effective for the treatment of peri-implantitis in the three clinical cases.
Bernardi *et al.*, (2020)	To report the clinical evaluation of the effective benefits of LLLT in implant surgery.	Applied LLLT as an aid in osseointegration in two patients undergoing implant surgery in the upper jaw. LLLT was applied to one hemi-arc and the other was used as a control.	Radiographically, in the first case there was a small gain in the irradiated sites, in the second, the biostimulated implant site showed no difference with the control site. However, the biomaterial used for the sinus lift appeared to be well integrated.

Lobato *et al.*, (2020)	To evaluate the influence of LLLT on implant stability in implants placed in fresh extraction sockets.	50 implants were placed in 44 patients where they were randomly allocated according to the control or LLLT groups. The LLLT consisted of the application of a GaAlAs laser (808 nm, average power density: 50 mW, diameter and area of the circular spot: 0.71 cm/0.4 cm2). LLLT was applied only in the dental implant placement session.	LLLT did not influence implant stability in implants placed in fresh extraction sockets when evaluated at healing abutment placement.
Mohajerani*et al.*, (2020)	To evaluate the effect of the combined use of LLLT and light emitting diode (LED) on the stability of dental implants during the healing phase.	Randomized clinical trial where patients were divided into two groups: In group 1, patients received LLLT and LED 20 min/day for 10 days after implant insertion. Patients in group 2 (controls) did not undergo LLLT and LED.	Simultaneous use of LLL and LED increased implant stability after 9 weeks of follow-up.
bozkaya*et al.*, (2021)	To assess whether Photobiomodulation Therapy (PBMT) improves implant stability and affects the microbiota around them in the early stage of osseointegration.	Prospective randomized controlled clinical trial, split-mouth, single-blind. The implants were randomly divided into two groups. Those in the test group were treated with a gallium aluminum arsenide (GaAlAs) diode laser with PBMT immediately after surgery and for 15 days. In the control group, the implants were not irradiated.	PBMT did not have a clinically significant effect on implant stabilization, especially in terms of implant stability quotient (ISQ) values at the onset of alveolar bone healing.
Kinalski*et al.*, (2021)	To evaluate the influence of low-level laser therapy (LLLT) on the stability of implants placed in healed sites.	64 implants were placed in 33 patients Patients were randomly allocated to LLLT (GaAlA 808 nm - applied before implant site preparation and after suturing (80 seconds; 11J/cm2)) or control groups.	LLLT did not influence the stability of implant placed in healed sites compared to a control group.

DISCUSSION

For at least 30 years, dental implants have been widely used and accepted in the scientific environment, with the purpose of rehabilitating partially or totally edentulous patients (Nascimento *et al.*, 2010). For the treatment to achieve clinical success, it is necessary to control factors that are directly linked to success. Among these, morphology, wound healing, implant stability as well as infection control are important conditions for the survival and success of osseointegrated dental implants. (Lioubavina; Lang; Karring, 2006). The absolute prerequisite for achieving a functional implant is achieving primary stabilization.

Several factors interfere with the stabilization and osseointegration of implants. Bone quality and quantity, morphology, surface topography and use of the appropriate technique, as well as the roughness of the implant surface and the absence of inflammation are relevant to obtain primary and secondary stability(Marquezan*et al.*, 2012).

In a considerable number of patients, it is not possible to find bone in its ideal conditions to achieve primary stability. However, for aesthetic and functional reasons, patients would like the process, which lasts an average of 6 months, to be accelerated. Therefore, it is necessary to use techniques that are capable of accelerating the process of bone neoformation

around the implants (Torkzaban*et al.*, 2018).

Due to its non-invasive way of acting, the low power laser is a treatment method that does not cause tissue damage. It is used by low-level lasers (low power) or light-emitting diodes. Due to its tissue and bone repairing action, the laser can be indicated at different times of the proposed treatment. From disinfection of the site that will receive the implant to recovery of tissues injured in the surgical process. Its ability to biostimulate osteoblasts may be an indication that it is also capable of inducing bone neoformation in less time (Garcia *et al.*, 2012).

Mikhail *et al.*, (2018) in their study sought to evaluate the effectiveness of laser in the osseointegration of immediate loading implants in patients using omega 3, vitamin C and calcium. It was possible to conclude that the method proved to be very effective, accelerating the bone healing process, in addition to emphasizing the biostimulating effect. Karaka; Ergun; Ozturk, (2018), made the association of low power laser with ozone to achieve satisfactory osseointegration in less time. After application in the study group, it was possible to visualize a significant improvement in bone healing around the implants when compared to the control group.

Despite reports of successful treatment, Torkzaban*et al.,* (2018) concluded that LLLT did not provide any significant improvement in osseointegration in type D3 and D4 bones, even after 2 weeks of application. This goes against the results of the study by Allende *et al.*, (2020), where even in peri-implantitis situations, the device was able to reduce inflammation and increase implant stability. Bernardi *et al.*, (2020) reported the beneficial effects of LLLT in implant surgery, where it was verified that in the first case there were bone gains in the irradiated sites, unlike the second case where this improvement was not verified, but the grafted biomaterial seemed to be well integrated.

Lobato *et al.*, (2020) determined in their study that the laser was not able to influence the stability of implants placed in fresh extraction sockets. In turn, Mohajerani*et al.*, (2020) adapting the technique to produce effects not only of tissue biostimulation, but also bone, using joint LLLT and LED was successful in the treatment, increasing the stability of the implants after 9 weeks of follow-up.

Bozkaya 's Study*et al.*, (2021), using gallium aluminum arsenide diode (GaAlAs) lasers with PBMT for 15 days, did not observe any improvement in alveolar bone healing in its initial phase. Photobiomodulation Therapy had no clinically significant effect on implant stabilization. Just like Kinalski*et al.*, (2021) reported that the low power laser was not able to influence the stability of implants placed in already healed sites.

CONCLUSION

It is pertinent to state that the literature is divergent regarding the applicability, efficacy, stability and ability of the laser to produce satisfactory results. It is notable the need to improve existing protocols so that their application in order to provide osseointegration has better results, taking into account the particularities of each case. Failure can occur due to the diversity of technique, application methodology and irradiation parameters used. Low-level laser therapy is capable of producing satisfactory results, but further studies are needed, especially in humans, to adjust its application parameters in order to optimize its response in bone tissue.

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