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High-power laser in the treatment of gingival pigmentation: an integrative review of the literature

Laser de alta potência no tratamento da pigmentação gengival: uma revisão integrativa da literatura

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ABSTRACT

Objective: To perform an integrative literature review about effectiveness of high-power laser in the treatment of gingival melanin pigmentation. **Methods**: This research consists of an integrative review conducted from September 2021 to May 2022 seeking to answer the following question: "What is the clinical effectiveness of laser in the treatment of gingival melanin pigmentation?". The articles were analyzed by two researchers and the information about these was collected with emphasis on the following data: authors, year of publication, study objectives, methodology, results and conclusion. **Results**: Of the 16 articles initially selected, 08 were excluded (3 literature reviews, 4 internship reports and 1 monography). Thus, 8 articles were selected. **Conclusion**: Among several types of lasers and techniques

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for its use, laser, especially diode laser, was the most used technique and presented better aesthetic results, less pain, faster healing, preference and patient satisfaction after treatment. More good quality randomized control trials are needed in different techniques currently used to generate conclusions with high scientific evidence.

Indexing terms: Gingival tissue. Laser therapy. Melanosis.

RESUMO

Objetivo: O objetivo desta pesquisa é avaliar se há efetividade do laser de alta potência no tratamento da pigmentação melânica gengival. **Métodos**: Esta pesquisa constitui-se de uma revisão integrativa realizada no período de setembro de 2021 a maio de 2022 buscando responder à seguinte pergunta: "Qual é a efetividade clínica do laser no tratamento da pigmentação melânica gengival?". Os artigos foram analisados por duas pesquisadoras e as informações dos artigos foram coletadas com ênfase nos seguintes dados: autores, ano de publicação, objetivos do estudo, metodologia, resultados e conclusão. **Resultados**: Dos 16 artigos selecionados inicialmente, 08 foram excluídos, sendo 03 revisões da literatura, 04 relatórios de estágio e 1 trabalho de conclusão de curso. Desta forma, 08 artigos foram selecionados. **Conclusão**: Dentre diversos tipos de lasers e técnicas para sua utilização, o laser, especialmente o laser de diodo, foi a técnica mais utilizada e apresentou melhores resultados estéticos, menos dor, cicatrização mais rápida, preferência e satisfação dos pacientes após o tratamento. São necessários mais ensaios de controle randomizado de boa qualidade em diferentes técnicas usadas atualmente para gerar conclusões com alta evidência cientifica.

Termos de indexação: Gengiva. Terapia a laser. Melanose.

INTRODUCTION

The search for dental aesthetic treatments is increasing, and it is known that in addition to teeth, gums also play a role important in the search of a beautiful smile. Aesthetics have always been highly sought after by patients and professionals who are interested in ensuring a smile more beautiful, in which there is an integration of the dental and gingival elements, improving facial harmonic aspects. Especially in the field of Periodontics, the combination of cosmetic surgery and state-of-the-art technical resources enables the professional to meet the cosmetic needs of each patient with greater certainty and predictability [1,2].

Melanic pigmentation is characterized by spots produced by the excessive deposition of melanin in the epithelial layers. The pigmentation of the gingival mucosa is very common and its causes are also diverse. Benign pigments include ethnic origins, spots, nevus, acanthoma nigrican, post-inflammatory pigmentation, and "smoker's melanosis". Some rare genetic syndromes such as Peutz-Jeghers disease, Laugie-Hunziker and Addison, and they are characterized by the presence of benign melanosis. The physiological and ethnic pigmentation of the oral mucosa is the most common abnormality. Between different types of pigmentation, it can be seen that there is no gender preference for their occurrences. It is characterized by diffuse melanic pigmentation and multi-location and its prevalence varies in different ethnic groups, especially black, asian, and mediterranean [2,3].

In view of the appearance of these gingival stains, the questioning of the current scientific community brings to the fore a discussion about the needs of the aesthetics of a smile in harmony with the gingival structure. Factors such as the shape of the lips, the symmetry and proportion of the teeth, the location of

the smile and the dynamic high smile line, are decisive for evaluation of the aesthetics of a smile, paying attention to the subjectivity of each person. The presence of melanin-pigmented gingival tissue at the boundary of the dynamic smile line, especially overexposed gums and large area of tissue, are factors that patients consider non-aesthetic [4,5].

As a means of treating gingival pigmentation, melanoplasty is a periodontal cosmetic surgery designed to remove areas of hyperpigmentation of melanin. It can be accomplished by various techniques, such as wear with scalpel blade, drill wear, cryosurgery and electrosurgery. An alternative method used to remove melanin and gingival pigmentation is laser [3].

The "laser" phenomenon, which comes from the abbreviations of Light Amplification by Stimulated Emission of Radiation, is an device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. It can be classified as "high power" (with destructive potential, used for cutting, hemostasis, among others) and in "low power" (no destructive potential, commonly used for photobiomodulation) [6]. The laser presents monochromaticity, coherence, direction, and the possibility of focusing on a small area [7].

According to the American Laser Society, the interaction between the laser and the tissue to be radiated is determined by the affinity of the wavelength of the laser and the chromophore (hemoglobin, water, and hydroxyapatite) present in the tissue target (soft tissue or hard tissue). Each laser has therapeutic applications, but not all of them produce the same effects. In addition, the effect of the laser varies with emission parameters and irradiated tissue, and may even have different effects in a single tissue [3,8].

Some high-power lasers emit light with wavelengths in the infrared band of the electromagnetic spectrum, and are being used as an alternative method for the removal of this pigmentation, either by interaction of some absorbent chromophores found in the tissue, either by ablation process, interaction with water molecules present in it [2,3,8].

Laser treatment has many uses in periodontal surgery and the comparison with traditional surgical methods highlights some advantages: side effects are minimized, tissue damage is reduced, which is beneficial for healing; may improve patient comfort; hemostasis and coagulation are possible, which makes laser essential for patients with medical disability; some surgeries can only be performed under local anesthesia [8].

The principle of laser treatment of gingival pigmentation is photopyrolysis selective. The laser beam must have an appropriate wavelength or specific chromophore removed is absorbed. Melanin has a range. Absorption spectrum 352-1,064 nm. The energy of the laser is also converted into cut off energy, causing cells to rupture and vaporize, minimizing the heat of the surrounding tissue cells [8]. Lasers of different wavelength (Er lasers, diode lasers, CO2 lasers and new lasers q-switched) are already readily available as minimally available techniques invasive diseases, with good aesthetics and good tolerability, as reported in many articles published [9].

The gingival epithelial structure is basically similar to the epithelium of the hard palate. The average thickness of the hard palate epithelium is 0.31 ± 0.05 mm and the thickness of the buccal gingiva is approximately 0.30 ± 0.07 mm. The lasers have a range of wavelengths, each with an interaction with the target tissue. The Er:Cr:YSSG and Er:YAG lasers (wave length 2790 and 2940 nm, respectively) and CO2 lasers (wavelength 10,600 nm) generate invisible infrared light that is highly absorbed by the water. Whereas semiconductor diode lasers (with a wavelengths of 810-980 nm) produce near-infrared light invisible, which

is weakly absorbed by water. As for the pigmentation of the melanin, the ability of melanin-containing melanocytes to absorb light laser also depends on the wavelength; diode lasers wavelength 810-980 nm are well absorbed by the pigmentation of the melanina [9,10].

Thus, it is important to know the correct indication, the effects and the management of high-power lasers for their correct application in corrections gingival esthetics resulting from pigmentation spots melanic plants, bringing greater predictability, comfort and a good prognosis to the patients treated with it, with a direct impact on quality of life of the people treated. Therefore, the aim of this research is to evaluate whether high-power laser is effective in the treatment of gingival melanic pigmentation.

METHODS

This research consists of an integrative review carried out in the period September 2021 to May 2022, seeking to answer the following question: "What is the clinical effectiveness of laser in the treatment of melanic pigmentation?"

To carry out this research, articles published in electronic databases, Latin American and Caribbean Literature in Health Sciences (LILACS), International Literature in Health Sciences (MEDLINE), Scientific Electronic Library Online (SCIELO) and National Library of Medicine (PUBMED) were analyzed. The following descriptors were used, appropriately registered in the Health Science Descriptors (DeCS): "melanosis"; "gingival tissue" and "laser therapy".

The inclusion criteria of the study comprise scientific articles written in English and Portuguese, indexed from 2017 to 2021, and that are available in full. Publications in the format of thesis, dissertation and book chapter were excluded.

The articles were analyzed by two researchers (JVCL and MHCR) and, when there was disagreement between them, a third person (SLSP) decided on the inclusion or non-inclusion of the article. The information in the articles was collected with emphasis on the following data: author, year of publication, title, objective, methodology, results and conclusion. Firstly, assessments of the theme were carried out and subsequently the abstract was critically read to evaluate the eligibility criteria. The articles that met the inclusion criteria were then fully read.

RESULTS

Of the 16 articles initially selected, 08 were excluded, 03 of which literature reviews, 04 internship reports and 1 monography (figure 1). Thus, 08 articles were selected, elaborating a table which contains the main information on the studies aimed at use of high-power laser in the treatment of gingival pigmentation (table 1). Thus, the visualization of the conclusions helps in a better discussion of the theme.

DISCUSSION

Melanoplasty performed with a conventional scalpel is a technique relatively simple, but it has some disadvantages: Large wound area, no primary closure and requires secondary scarring, which may cause more postoperative pain and discomfort to patients. In view of this, laser technology has been used to minimize these complications.

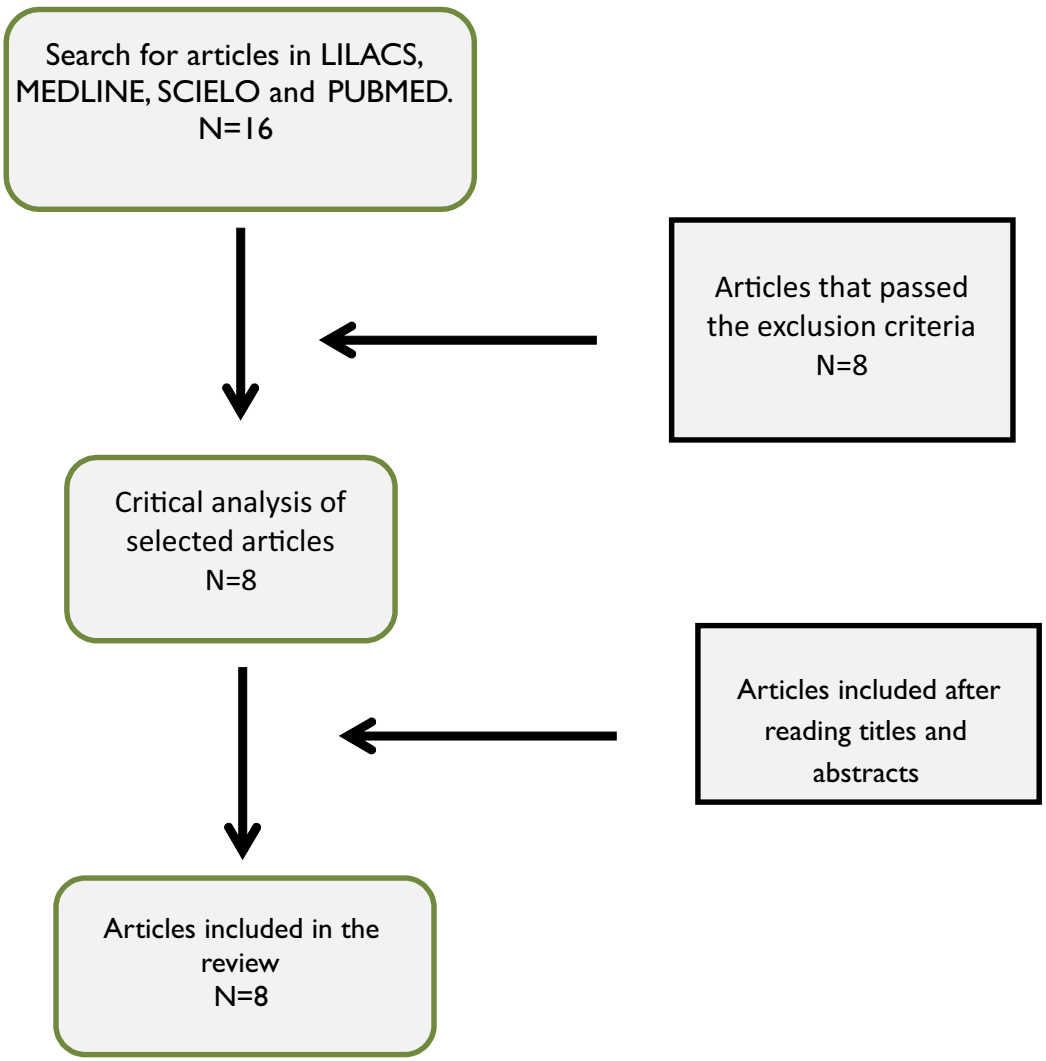

Figure 1. Descriptive guide of the methodological sequence developed to survey scientific articles.

Table 1. Studies selected according to main author, year of publication, title, objective and conclusion. Fortaleza, 2022.

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Author	Year of publication	Título	Objective	Conclusion
Mahajan et al. [11]	2017	To compare the gingival melanin repigmentation after diode laser application and surgical removal.	To compare the gingival melanin repigmentation after diode laser application and surgical removal.	The incidence of repigmentation was slightly lower at laser-treated sites compared to surgical depigmentation, although the difference was statistically significant at up to 3 months.

Table 1. Studies selected according to main author, year of publication, title, objective and conclusion. Fortaleza, 2022.

Author	Year of publication	Título	Objective	Conclusion
Bakhshi et al. [9]	2018	Gingival depigmentation by Er, Cr: YSGG laser and diode laser: a split mouth, clinical trial study Lasers in gingival depigmentation	To evaluate the efficacy of diode laser and Er,Cr:YSGG laser ablation in the treatment of physiological gingival melanin hyperpigmentation	The diode laser was more efficient in reducing the DOPI and Edin melanin index scores.
Gholami et al. [12]	2018	Comparison of gingival depigmentation with Er, Cr: YSGG laser and surgical stripping, a 12-month follow-up	To compare the surgical pattern/removal method with two different laser configurations Er,Cr:YSGG in order to find the best treatment method	Configuration 2 of the Er,Cr:YSGG laser, with longer pulse duration and less water spray, resulted in better coagulation effects and can be used to control hemorrhage whenever necessary in clinical practice
Mojahedi et al. [13]	2018	Effect of 810 nm diode laser on physiologic gingival pigmentation	To evaluate the efficacy of diode laser for the treatment of physiological gingival pigmentation	Diode laser therapy is an effective and minimally invasive modality for gingival depigmentation.
Vassoler et al. [14]	2019	Gingival melanin depigmentation with diode laser-case report	To report a clinical case of the gingival depigmentation technique using a high-power diode laser in the anterior region of the jaw, to ablate pigmented tissue to improve gingival aesthetics.	The diodo laser was a good alternative to melanin depigmentation because it is a procedure with lower morbidity and satisfactory postoperative results.

Table 1. Studies selected according to main author, year of publication, title, objective and conclusion. Fortaleza, 2022.

Author	Year of publication	Título	Objective	Conclusion
Nammour et al. [10]	2020	A randomized comparative clinical study to evaluate the longevity of esthetic results of gingival melanin depigmentation treatment using different laser wavelengths (diode, CO2, and Er: YAG).	To evaluate the longevity of gingival depigmentation and the consistency of aesthetic results using three wavelengths (Er:YAG laser, CO2 laser and diode laser, 980 nm) in two different groups (smokers and non-smokers).	The diode laser provides the longest-term stability in treatment. Smoking negatively affects the longevity of gingival depigmentation. The Er laser has the shortest time before the reappearance of gingival pigmentation.
Agha & Manaf [15]	2020	Laser treatment for melanin gingival pigmentations: a comparison study for 3 laser wavelengths 2780, 940, and 445 nm	To compare the results of three lasers (Er, Cr, YSGG 2780 nm, Diode 940 nm, and 445 nm) in the removal of gingival melanin depigmentation	All three wavelengths were fast, effective in removing pigmentation, and well tolerated by patients. The aesthetic results were excellent, and the patients were highly satisfied.
Altayeb et al. [16]	2021	Gingival depigmentation with diode and Er, Cr: YSGG laser: evaluating re-pigmentation rate and patient perceptions	To evaluate the efficiency of depigmentation, patient perception, and recurrence rates of physiological gingival pigments during a 2-year follow-up after ablative depigmentation using two laser wavelengths: diode 940 nm and Er,Cr:YSGG 2780 Nm.	Both lasers effectively removed gingival pigments. Diode laser treatment showed better long-term stability of gingival color, with a lower incidence of repigmentation.

Bakhshi et al. [9] reported that the use of lasers has several advantages such as not having to put on a periodontal dressing, short healing period and no or slight pain. Still under the aspect of pain, other authors observed that diode laser provided lower morbidity in the postoperative period [13-15], although the Er:YAG laser causes less pain due to less thermal damage due to its shallow penetration, which would lead to less tissue necrosis [9].

As with any surgical procedure, care in the control of hemorrhage has also been highlighted in the literature. Gholami et al. [12] observed that the Er,Cr:YSGG laser provided better effects coagulators

and can be used to control bleeding whenever required in clinical practice. Bakhshi et al. [9] agreed with these results, when observing slight controllable bleeding with the same type of laser, especially when the pigmentation is localized deeper, due to the ablation effect. Under this aspect, the diode laser would be more advantageous as it would cause the sealing of the blood vessels allowing a better homeostasis of the operative field [10,12,16].

Regarding the immediate aesthetic result, Bakhshi et al. [9] observed that the diode laser was more efficient in reducing the melanic pigmentation compared to Er:YAG laser, despite both reach and eliminate melanocytes in the basal layer of the external oral epithelium, as reported by Altayeb et al. [16]. This aspect was corroborated by Agha & Manaf [15], who pointed out that melanin demonstrates a strong absorption by the wavelengths of the diodes in comparison with the Er:YAG laser, providing a clinical procedure less traumatic, faster and more effective, because after a week the gums were completely epithelialized, resulting from its photobiomodulatory process [9,12,15].

Long-term stability and the risk of repigmentation of the areas is also a recurrent theme and discussed in the literature, since in conventional therapy, this factor is also observed, especially after a years of preservation. The recurrence of pigmentation has been attributed to migration of melanocytes from adjacent untreated sites or remnants of melanocytes left at the surgical site. These can be activated and synthesize melanin again [12,15,16]. Mahajan et al. [11] observed that recurrence was effectively reduced with the use of laser, due to the ablation effect of melanocytes, which does not occur in the conventional technique.

Altayeb et al. [16] observed better stability in long-term use of diode laser, agreeing with Gholami's study et al. [12]. Likewise, Nammour et al. [10] compared the durability of aesthetic results after depigmentation by diode, CO2 and Er:YAG lasers. The results showed that the laser of diode produced the longest stability after treatment, while the laser Er:YAG provided the shortest time before of the recurrnence of gingival pigmentation. These results confirm the data obtained by other studies [11,13,14].

Finally, laser therapy, especially using diode, has been shown to be effective in removing gingival pigmentation in the short and long term, due to the its high affinity for melanin and hemoglobin, in addition to not interacting with the hard tissues of the oral cavity, making it a safe method for gingival depigmentation [12,15,16]. The only drawbacks may be the high cost of equipment, requirement for greater precision and control of its use, as improper use can compromise gingival homeostasis and underlying alveolar bone, causing gingival recession and cosmetic damage potentially irreversible [9,15,16].

Some limitations are found in the selected studies, such as divergences in sample size and long-term postoperative follow-up. Better standardization and longer time of evaluation in future randomized controlled trials are needed to comparison of data and better scientific evidence.

CONCLUSION

This review showed that laser is just as effective, if not better, than conventional technique in the evaluation of different clinical parameters. Lasers, mainly diode ones, are the most widely used technology, with better aesthetics, less pain, faster healing, patient preference and satisfaction after treatment, with greater efficacy in the short and medium term when compared to the conventional technique.

Collaborators

JVC Lima, idealization of the study, writing and conception of the research design, data analysis and interpretation, article writing. MHC Rodrigues, idealization of the study, writing and conception of the research project, analysis and interpretation of the data, writing of the article, final approval for publication. CKK Pereira, critical review of the article, formatting of the article, final approval of the article for publication. SLS Pereira, idealization and orientation of the study, analysis and data interpretation, critical review of the article, formatting of the article, final approval of the article for publication.

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