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Review Article

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Use and Success Rate of Lasers in the Treatment of Gingival Melanin Pigmentation: A Systematic Review

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ABSTRACT

The pigmentation of oral soft tissues is predominantly an aesthetic problem because lifestyle, media, and social influences impact people's perception of beauty, which in turn affects their self-esteem as well as their relationships. The melanin pigmentation of the gingiva has become a real concern in the Gulf region, especially for younger people and females, who seek aesthetic solutions to remove the pigmentation. The pigmentation caused by melanin can be removed by surgical blades, diamond burs, chemicals, and lasers, among other methods. A systematic literature review from 2012 to 2022 was performed using databases such as PubMed, Medline, and Sciencedirect. The keywords used were "Diode laser", "Erbium laser", and "Melanin pigmentation". PRISMA flowchart was used to describe the selection process of searched articles. Findings revealed that 6 out of 8 studies listed superior characteristics and treatment outcomes of diode lasers as compared to Erbium lasers. It can be concluded that the diode laser is the better option to treat gingival melanin pigmentation as compared to the Erbium lasers.

Key words: *Dental lasers, Melanin, Gingival pigmentation, Systematic review*

INTRODUCTION

Gingival pigmentation appears in the form of deep purple discoloration or irregularly shaped patches, stripes, or strands of dark brown or light brown color. This pigment is made up of melanin granules that are produced by melanoblasts. There are three main types of endogenous pigment: melanin, hemoglobin, and keratin. Melanin, which doesn't come from hemoglobin, is most commonly produced in the basal and suprabasal layers of the epithelium. Gingival pigmentation can result from several endogenous and exogenous causes, including numerous lesions and conditions. A variety of methods can be used to reduce the melanin pigmentation of the gingiva and prevent it from returning [1]. dental practitioners on laser use was found to be on the lower side [2].

Pigmentation of oral soft tissues is predominantly an aesthetic problem because lifestyle, media, and social influences impact people's perception of beauty, which in turn affects their self-esteem as well as their relationships. The melanin pigmentation of the gingiva has become a real concern in the Gulf region, especially for younger people and females, who seek aesthetic solutions to remove the pigmentation [3].

The pigmentation caused by melanin can be removed by surgical blades, diamond burs, chemicals, and lasers, among other methods. Researchers compared three lasers (Er, Cr, YSGG 2780 nm, Diode 940 nm, and 445 nm) for removing melanin-derived gingival depigmentation. The appearance of oral pigmentation, particularly in the gingiva, can be unpleasant [4].

The degree of success and recurrence of gum depigmentation is variable according to the method used. Among the therapeutic arsenal used to treat depigmentation, lasers have found a substantial place today. The wavelength of the laser has been varied by using carbon dioxide (CO2), semiconductor diodes, and yttrium-aluminum-garnets doped with neodymium (Nd: YAG) and erbium (YAG), respectively (Er: YAG) [5].

A deepithelialization procedure using these devices presents fewer risks such as pain, edema, and infection than a surgical procedure. The diode laser is a solid-state semiconductor laser that emits continuous waves and gated pulses. It is composed of different components that convert electrical energy into light energy, which is then converted into heat [6].

Dental laser energy is particularly suited for sensing hemoglobin and melanin [7-9]. Its wavelength ranges from 800-980 nm, which is targeted at soft tissues in particular. This can therefore be used to depigment gums. It has been found that the diode laser has a higher absorption capacity with less penetration than the Nd: YAg laser, causing more severe tissue damage and deeper coagulation. In contrast to the erbium laser, melanin exhibits strong absorption of diode wavelengths. As a result, melanin is removed faster and the diode treatment process is shorter [10].

In order to properly depigment the gingival epithelium, the basal and suprabasal layer, which contains the melanocytes, must be removed. An advantage of using a laser is that the epithelium and rete pegs can be removed uniformly. There is a significant reduction in bleeding associated with soft tissue surgery using lasers [11].

Laser depigmentation allows the dental surgeon to act faster and more accurately during wound sterilization due to better visibility. The diode laser's bactericidal effect has to demonstrate that locally sterile conditions can be achieved. Laser-treated patients reported less pain than those treated with surgery or electrosurgery, which is probably due to the laser's ability to seal blood vessels and nerve endings [12].

Even so, there are some disadvantages to using the laser, such as the fact that it can cause ulcerations and recessions, that it is an expensive tool, resulting in additional costs to the patient, as well as the possibility of pigmentation recurrence. After pigmentation treatments, the recurrence of coloration is one of the most common problems that can occur. The nature of the technique used, the race of the patient, and the recolonization have been proposed as possible activated melanocytes from adjacent tissues are present on the treated surfaces [13].

In another study, by the 16th week, clinicians had achieved complete healing with the use of an 808 nm diode laser for gum depigmentation. Additionally, it is safe and effective for achieving an acceptable aesthetic result and maximizing patient comfort**.** The onset of repigmentation must be monitored over a longer time [14].

The rationale of the study

The results of this systematic review will help clinicians to decide which laser can be used effectively to treat gingival melanin pigmentation.

Study hypotheses

Diode laser is more effective and safe to use as compared to Erbium (Er) lasers in the treatment of melanin pigmentation.

PICO question

P: Patients with Melanin pigmentation
I: Diode laser
C: Erbium laser
O: Treatment of melanin pigmentation

Aims of the study

The purpose of this systematic review was to determine the efficacy and success rates related to two different types of oral surgery lasers.

MATERIALS AND METHODS

A systematic literature review from 2012 to 2022 was performed using databases such as PubMed, Medline, and Sciencedirect. The keywords used were “Diode laser”, “Erbium laser”, and “Melanin pigmentation” **(Table 1)**. PRISMA flowchart was used to describe the selection process of searched articles **(Figure 1)**.

Table 1. Inclusion and exclusion criteria

№	Inclusion criteria	Exclusion criteria
1.	Case-control and randomized control studies	Systematic reviews or meta-analyses or expert opinions or narrative reviews
2.	Published between 2012 and 2022	Out of the specified time range
3.	Studies including Diode and Erbium lasers	Lasers other than Diode and Erbium
4.	English language of publication	Language other than English
7.	In vivo (humans)	In vitro

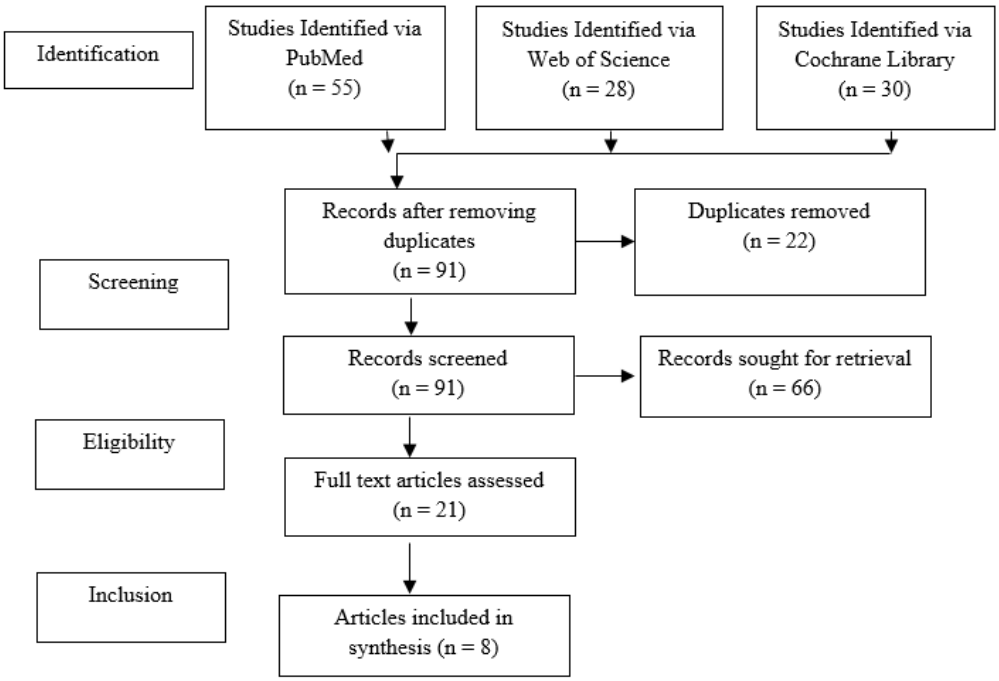

Figure 1. PRISMA Flow Diagram

Risk of bias assessment

The Cochrane risk of bias assessment method was used to assess the quality of the studies included **(Table 2)**.

Table 2. Summary of Cochrane Risk of Bias Assessment

Study	Selection Bias/Appropriate control selection/baseline characteristics similarity	Selection bias in randomization	Selection bias in allocation concealment	Performance-related bias in blinding	Reporting bias/Selective reporting of outcomes	Detection bias Blinding outcome assessors	Accounting for confounding bias
Kaya *et al*., 2012 [15]	+	+	+	+	+	+	-
Giannelli *et al*., 2014 [16]	+	+	+	+	-	+	-
Bakhshi *et al*., 2018	+	+	+	+	+	_	+
Nammour *et al*., 2020 [17]	+	+	+	+	+	+	-
Taher Agha & Polenik, 2020 [18]	+	-	+	+	+	+	+
Altayeb *et al*., 2021 [19]	+	+	+	-	+	+	+

Arif *et al*., 2021 [20]	+	+	+	+	+	+	+
Jnaid Harb *et al*. 2021 [21]	+	+	+	+	+	+	-

RESULTS AND DISCUSSION

Kaya *et al*., (2012) compared the use of diode and Er: YAG lasers in managing gingival melanin pigmentation (GMP) with regards to gingival depigmentation, local anesthesia requirements, postoperative pain/discomfort, depigmentation efficacy, and the entire length of treatment [15]. Procedures were conducted without the necessity for any topical or local anesthetic, and no unpleasant events transpired in the course of the actual process or the healing period. The total length of treatment was considerably shorter with the diode laser as compared to the Er: YAG laser. No melanin reappearance was discovered during any follow-up session. There it was concluded that both Diode and Er: YAG lasers resulted in satisfactory depigmentation of gingival melanin pigmentation (GMP).

Giannelli *et al*., (2014) assessed the efficacy of diode and Er: YAG lasers for the treatment of GMP. Both diode and Er: YAG lasers presented excellent outcomes in gingival hyperpigmentation [16]. On the other hand, Er: YAG laser prompted deeper gingival tissue injury than diode laser, as adjudicated by bleeding at surgery, slow healing, and histopathologic investigation. The use of a diode laser revealed added advantages compared to Er: YAG with regard to a reduced amount of postoperative discomfort and pain.

Bakhshi *et al*., (2018) estimated the success of Diode laser and Er, Cr: YSGG laser ablation on the management of physiologic gingival melanin hyperpigmentation. Findings exhibited statistically substantial differences in decreasing pigmentation index in each treatment group distinctly whereas the diode laser group had superior results. There was no statistically significant difference between groups in terms of re-pigmentation. It was concluded that the diode laser had more effectiveness in the reduction of the pigmentation index as compared to the Erbium group.

Nammour *et al*., (2020) designed to measure the endurance of gingival depigmentation (GD) and the stability in esthetic outcomes presented by various laser types [17]. The time before pigmentation recurrence was: Diode > Er. The lengthiest time before the rebound was detected with the Diode group for the nonsmoker group. It was concluded that the diode laser delivered the longest-term permanency in treatment. Smoking negatively impacted the durability of GD. Er, laser gave the shortest time before the recurrence of gingival pigmentation.

Taher Agha & Polenik (2020) reported that both diode and Erbium lasers were fast, proficient in removing the pigmentations and well accepted by the patients [18]. The aesthetic outcomes were certainly encouraging, and the patients were extremely satisfied.

Altayeb *et al*., (2021) gauged the effectiveness of depigmentation, patient opinions, and the relapse rates of physiological gingival pigments after 2 years by diode and Erbium lasers [19]. At all-time intervals following depigmentation treatment, the overall pigmentation scores were less considerably compared to the baseline in both groups. Treatment was substantially faster with Er, Cr: YSGG laser and did not need anesthesia, with quicker healing and less postoperative pain after 1-week of treatment, compared to the diode laser treatment. The re-pigmentation intensity and extensity were greater significantly in the Er, Cr: YSGG group than in the diode group at 1 year and 2 years. It was concluded that both lasers proficiently eradicated gingival pigments with comparable clinical results and in general positive patient perception. Diode laser treatment displayed improved long-term constancy of gingival color, with a lower chance of recurrence.

Arif *et al*., (2020) conducted a trial to recognize and compare the efficiency of two types of lasers, Er: YAG laser-2940 nm and Diode laser-980 nm, in gingival depigmentation in the maxilla and mandible [20]. There was a noteworthy reduction in the oral pigmentation index scores, after the procedure. No significant differences were identified between the two study groups concerning the mean ranking on the oral pigmentation index pre-operatively, 1 month after the procedure, and 6 months after the procedure. It was concluded that Er: YAG laser and Diode laser both significantly decreased gingival pigmentation with no substantial differences between the efficacy of the two types of laser in treating gingival hyperpigmentation.

Jnaid Harb *et al*., (2021) revealed that both methods were proficient for gingival depigmentation [21]. However, bleeding in the course of surgery was statistically greater for Er: YAG laser procedure as compared to the diode laser. Wound healing displayed statistically nonsignificant differences between the two lasers, although Er: YAG appeared to offer better consequences as compared to the diode. The patients were happy with both laser procedures during and after gingival depigmentation. Yet, the pain score was greater for Er: YAG laser than for the diode laser. It was concluded that both laser systems are effective for gingival depigmentation. Nonetheless,

the diode laser looked to demonstrate a reduced amount of painful experience and comparatively better bleeding control.

This systematic review aimed to assess the effect of two types of lasers on the treatment of melanin depigmentation. Diode and Erbium were evaluated in different aspects including their ability to remove discoloration, pain, bleeding, longevity, and overall patient experience. It is evident from the findings that the diode laser seems to be much more effective as compared to the Erbium lasers. The majority of the included studies have reported that diode lasers revealed a minimal degree of pain and discomfort among the patients. This finding was supported by Elemek (2018), who revealed that patients treated with diode lasers were recalled at weeks 1, 4, and 12 to assess the healing and recurrence rate [22]. It was observed that the patients had no postoperative pain or edema, and complete healing was observed in week 12.

It was also noted from the results that although both types of lasers were somewhat effective against melanin pigmentation, factors such as smoking played an important role in the accomplishment of successful outcomes. This was well supported by a study conducted by Ribeiro *et al*., (2020) who reported that nicotine affects the overall repair process by releasing catecholamines that decrease tissue perfusion [23]. Moreover, carbon monoxide produced also reduces tissue oxygenation and hydrogen cyanide also prevents oxidative metabolism, hence impairing the healing process initiated by lasers of any type.

It was also noted in one of the included studies that erbium laser caused some extent of soft tissue injury, which was not the case with a diode laser. Ortega-Concepcion *et al*., (2017) supported this argument and reported that the diode laser is minimally invasive equipment that proposes great advantages, better than those of the conventional scalpel, for example, decreased bleeding, inflammation and the lower possibility of scars [24]. Its efficiency is comparable to that of other forms of lasers, besides being a selection of lower cost and higher ease of consumption. Its employment in soft tissues has been assessed, being a safe and effective technique for the accomplishment of various soft tissue procedures.

CONCLUSION

Although both types of lasers effectively treat gingival melanin pigmentation, diode lasers showed better features when it comes to pain reduction, bleeding control, and being minimally invasive. It can be concluded that the diode laser is the better option to treat gingival melanin pigmentation as compared to the Erbium lasers.

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