Review Article

UTILIZATION OF SOFT TISSUE DENTAL LASERS IN ESTHETIC DENTISTRY: A SYSTEMATIC REVIEW

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ABSTRACT

Clinicians in this field help patients achieve good-looking smiles and oral health and gain tremendous clinical advantages like sterile procedures and increased patient comfort. Laser ablation is one of the most reliable, pleasant, and effective methods for gingival depigmentation. It has been shown that chromophore tissue components may absorb laser photon energy. Melanin, hemoglobin, related pigmented proteins, hydroxyapatite, and scales comprise oral tissue chromophores. Using databases including PubMed, Medline, and ScienceDirect, a systematic review of the literature spanning 2010 to 2023 was conducted. "Soft tissue," "dental laser," and "systematic review" were the main phrases chosen. The procedure for choosing the articles to be searched for was illustrated using a PRISMA flowchart. The systematic review covered a total of 10 investigations, of which 9 studies showed that the use of lasers produces results that are noticeably superior to those of surgical techniques. Soft tissue lasers are a good choice of method used in esthetic dental treatments, and they can be a successful substitute to the conventional dental procedures which increase the chance of infection and inflammation.

Key words: Soft tissue, Dental lasers, Esthetic dentistry, Systematic review.

Introduction

Its acronym is LASER, or Light Amplification by the Stimulated Emission of Radiation. Dental lasers greatly advance cosmetic dentistry by giving practitioners useful resources for a range of procedures [1]. Clinicians in this field help patients achieve good-looking smiles and oral health and gain tremendous clinical advantages like sterile procedures and increased patient comfort [2]. There are parallels between lasers and aesthetic dentistry when one considers their early ideas, and the moment this advancement may be successfully used therapeutically [3].

The first laser was brought to medicine and dentistry by Goldman *et al*. in the 1960s, but the heat damage was too great to consider this laser a clinical device [4]. Pick, a pioneer in clinical periodontology, published a study on laser gingivectomy in 1985, a year after W. R. Bennet and D. R. Herriott invented the first helium-neon laser in 1961 [5, 6]. An instrument known as a laser converts light of various frequencies into colourful emissions in the ultraviolet, visible, and infrared spectrums. All waves in the spectral region can produce a lot of heat and power when focused up close. A specific type of electromagnetic energy or radiation are laser beams. From radio waves with wavelengths of thousands of metres to gamma rays with wavelengths of 10 to 12 metres, the spectrum contains the entire range of wave energy [7].

Laser use in esthetic procedures
Depigmentation

One of the most dependable, enjoyable, and efficient techniques for gingival depigmentation is laser ablation [8, 9]. It has been shown that chromophore tissue components may absorb laser photon energy. Melanin, hemoglobin, related pigmented proteins, hydroxyapatite, and scales comprise oral tissue chromophores. The electromagnetic spectrum of lasers includes a range of wavelengths, some of which may be absorbed by chromophores [10, 11]. The water in the cells absorbs laser photon energy, reaching the boiling point and igniting in a small explosion known as water-induced ablation [12]. High-powered lasers are used to conduct gingival depigmentation. Because they produce heat and raise the kinetic energy of the damaged tissue, these lasers have a therapeutic effect known as thermal interaction. They also have additional effects on the tissue, including coagulation, vaporization, necrosis, carbonization, and denaturation [13].

Gingival cosmetic re-sculpting

Present-day patients have substantial worries about the aesthetics of their smiles related to cosmetic dentistry concepts such as gingival shape and contour, tooth proportionality, and crown heights. As a result, crown/height asymmetries correction, gingival form and contour enhancement, tooth proportionality improvement, and crown lengthening are the four main applications of lasers in soft tissue. Continuous operation at 0.8 to 1.2 W is frequently utilised with diode lasers with an advanced tip. Stabilisation of gingival shape and contour is one of the key cosmetic dentistry ideas crucial to the final aesthetic outcomes of orthodontic therapy. The shape of a tooth's

gingival margins is referred to as its gingival form, and the gingival zeniths of the mandibular and maxillary lateral incisors should be parallel to one another [14].

Lengthening the crown

Crown lengthening is recommended for the treatment of aesthetic restrictions such as altered passive eruption, excessive gingival show, sometimes known as a gummy grin, or to improve the cosmetic results of final restorations. Gingivectomy with or without osseous resection surgery is the most commonly used procedure for clinical crown lengthening. Other treatments include laser-assisted gingivectomy and osseous surgery with an apically positioned flap [15].

Materials and Methods

Using databases including PubMed, Medline, and ScienceDirect, a systematic review of the literature spanning 2010 to 2023 was conducted. "Soft tissue," "dental laser," and "systematic review" were the search terms utilised **(Table 1)**. The procedure for choosing the articles to be searched was illustrated by a PRISMA flowchart **(Figure 1)**.

Table 1. Inclusion and exclusion criteria for the studies

Inclusion criteria	Exclusion criteria
Case-control and randomized control studies	Systematic reviews or meta-analyses or expert opinions or narrative reviews
Published between 2010 and 2023	Out of the specified time range
Studies including soft tissue and dental lasers.	Studies including hard tissue and conventional methods
English language of publication	Language other than English
In vivo (humans)	In vitro

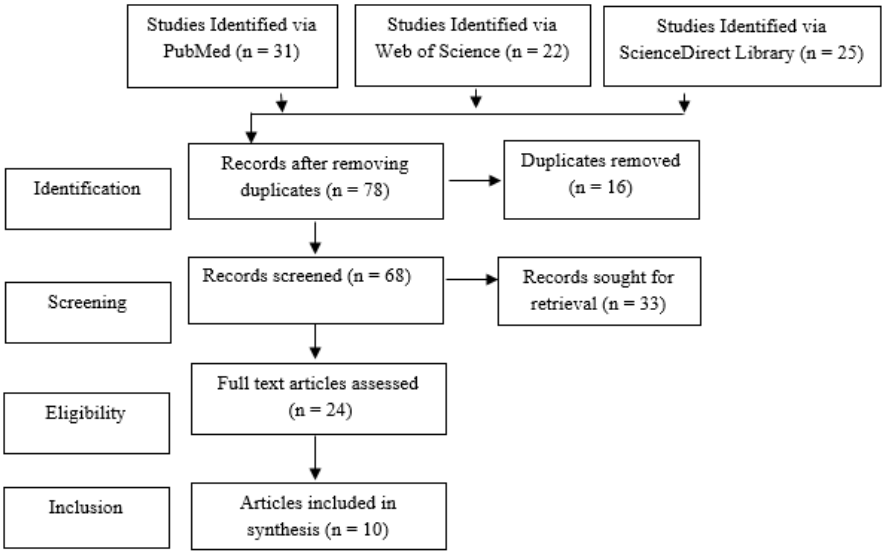

Figure 1. PRISMA Flow Diagram

Risk of bias assessment

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
Fornaini *et al*., [16]	+	+	+	+	+	+	-

Farista *et al*., [17]	+	+	+	+	+	+	-
Kaur *et al*., [18]	+	+	+	+	+	_	+
Gupta *et al*., [19]	+	+	+	+	+	+	-
Soliman *et al*., [20]	+	+	+	+	-	+	+
Pai *et al*., [21]	+	+	+	-	+	+	+
Patel *et al*., [22]	+	+	+	+	+	+	+
Azma *et al*., [23]	+	-	+	+	+	+	-
Derikvand *et al*., [24]	+	+	+	+	+	-	+
Tuncer *et al*., [25]	+	-	+	+	+	+	-

Results and Discussion

Table 3. Efficacy of soft tissue dental lasers in esthetic dentistry

Author's name	Objectives	Patients	Laser Wavelength (nm)	Laser Power (W)	Results
Fornaini *et al*., [16]	This research aimed to assess the features of the intervention and patient compliance for low-power laser-assisted power laser-assisted KTP surgery	52	532	1	The end outcome was good healing with few or no scorching spots in the tissue that had been treated.
Farista *et al*., [17]	The objective of the clinical trial is to evaluate the clinical efficacy of a functional crown lengthening surgery using a diode laser and to compare it to a traditional operation using a scalpel.	14	940	1.5	when the two groups were compared on the tenth day, there was no significance (P>0.14).
Kaur *et al*., [18]	The purpose of this research was to examine the efficacy of a soft-tissue diode laser in the treatment of oral mucosal lesions.	2	810	3	It was conclude that laser treatments may be more effective than traditional methods in terms of quick ablation, simple cleaning, and hemostasis, as well as being less uncomfortable during and after the surgery
Gupta *et al*., [19]	The purpose of study to assess semiconductor diode laser treatment for gingival hyperpigmentation.	1	980	2-4	There were no infections or serious postoperative issues, such as discomfort or bleeding.
Soliman *et al*., [20]	The purpose of this research was to assess effectiveness of Soft Tissue Diode Laser to treat Oral Hyperpigmentation.	20	808	1-2	Most patients did not have any postoperative pain, edema, or deformity.
Pai *et al*., [21]	The goal of this study was to determine the efficacy of a diode laser for fibroma excision.	2	810	1	The diode laser fibroma ablation is a safe, rapid operation with little postoperative pain and consequences.
Patel *et al*., [22]	The purpose of this research was to compare the effectiveness of traditional surgical techniques versus diode lasers with labial frenectomy procedures	20	980	10	There was no discernible difference between the groups regarding wound healing.
Azma *et al*., [23]	The goal of this study was to evaluate Diode Laser in Soft Tissue Oral Surgery.	2	940	1.5 -3.5	Despite adequate ventilation, the patient had minor pain throughout the treatment due to the little smoke and

					burning smell. After one month, a follow-up was conducted, and the epithelium had fully recovered.
Derikvand *et al*., [24]	This case study sought to ascertain the 980 nm diode laser's versatility in dentistry	5	980	1.5	No postoperative problems occurred for any patients with a typical healing process. During follow-up appointments, favorable laser surgical results were seen.
Tuncer *et al*., [25]	The research aimed to assess the impact of collateral thermal damage on histological diagnosis and compare conventional surgery with carbon dioxide (CO 2) laser treatment of oral soft tissue diseases.	43		3-4	With each treatment, there were no intraoperative or postoperative problems.

Table 3 shows that the research done by Fornaini *et al*. [16] aimed to assess the features of the intervention and patient compliance for low-power laser-assisted power laser-assisted KTP surgery. In this work, we discuss using the KTP laser (532 nm), a novel and newly introduced wavelength in dentistry, utilized at low power (1 Watt - CW), to evaluate the duration of interventions and the intraoperative and postoperative pain using a Numeric Rating Scale. When the KTP laser is utilized at low power, it is possible to provide adequate pain management during procedures that exclusively focus on the cosmetic aspect as measured by VAS evaluations. During surgery, the KTP laser was used to treat 52 patients (27 men and 25 women; mean age 23 years and 16 months) with various benign oral diseases of soft tissues. The end outcome was good healing with few or no scorching spots in the tissue that had been treated.

The objective of the clinical trial done by Farista *et al*. [17] is to evaluate the clinical efficacy of a functional crown lengthening surgery using a diode laser and to compare it to a traditional operation using a scalpel. Between the ages of 20 and 40, 14 male and female patients were recruited and divided into two groups for crown lengthening operations using either a scalpel or a laser. A 940nm diode laser was used for the procedure. The laser unit, which has a 400-m disposable tip, was used in contact mode with a setting of 0.8 to 1.5 watts in continuous mode along the delimited region with paintbrush-like strokes that moved gently in order to remove the gingival tissue and reveal a reasonable amount of tooth structure. An unpaired t-test was used to compare the data across groups, and an ANOVA was used to compare the data within groups. An analysis of the pain intergroup data showed that the patients in the laser group had significantly lower VAS scores than those in the scalpel group on the third and seventh days ($P = 0.002$). On the tenth day, however, when the two groups were compared, there was no significance ($P > 0.14$).

In order to determine how well a soft-tissue diode laser can cure oral mucosal ulcers, Kaur *et al*.'s research [18] had this goal. A 28-year-old lady complained about her gums growing out. Until it reached its present size gradually two years ago, the expansion accelerated. The patient's complaint was painless discomfort that was only experienced for aesthetic purposes. In the second instance, a woman in her 40s has been enduring development in the left retromolar region for the past six months. It began small and has subsequently expanded to reach its present size. Two patients were treated with a soft tissue diode laser for the removal of various soft tissue lesions, and photographs were used to visually assess the healing of the wounds. Under local anaesthesia, the lesion was surgically removed using a diode laser with a 300 m fibre tip, an 810 nm wavelength, and 3 W of power for 3 60 s. The patient didn't experience any pain during or following the laser procedure. Even though only a tiny amount of local anaesthetic was applied, no stitches or antibiotics were recommended. There was no edoema, minimal bleeding, and rapid wound healing. We come to the conclusion that laser procedures might be more efficient than conventional ones in terms of rapid ablation, easy cleaning, and hemostasis, as well as being more comfortable both during and after the procedure.

Gupta *et al*.'s study [19] aimed to evaluate the effectiveness of semiconductor diode laser therapy for gingival hyperpigmentation. A semiconductor diode surgical laser unit (wavelength 980 nm, power 2-4 W) was used to depigment the maxillary and mandibular anterior gingiva up to the second premolar on both the right and left sides. The periodontics division at the Institute of Dental Studies and Technology in Modinagar received a visit from a 23-year-old male patient who complained that his gums were too coloured. The patient had a vibrantly coloured gingiva but was otherwise in good health. On the maxilla and mandible, the gingiva was removed in twenty to twenty-five minutes. After laser ablation of the pigmented epithelium, a melanin-pigmented-free surface was produced without any carbonization. The wound seemed to be new and wasn't bleeding. There were no infections or serious postoperative issues, such as discomfort or

bleeding. Follow-up after 15 months revealed no evidence of pigmentation recurrence.

The purpose of this research done by Soliman *et al*. [20] was to assess effectiveness of Soft Tissue Diode Laser to treat Oral Hyperpigmentation. Twenty patients, particularly those with gummy smiles who complained of ugly, highly pigmented patches in their gingivae, labial, and cheek mucosa, were included in this research. For most patients (18 Pts.), two treatment sessions were necessary to eradicate the melanotic lesions successfully. After one, two, and three weeks, the patients were examined. The maxillary and mandibular anterior gingiva and the buccal mucosa were depigmented using a soft tissue diode surgical laser unit provided by a 400-m diameter fiber at a wavelength of 808nm 5. After one week, eight patients (40%) had an excellent reaction, ten patients (50%) had a very good response, and only two patients (10%) had a poor response and needed a third treatment session. In the successful patients, restoration of the normal gingival and mucosal texture and color was accomplished with the best possible aesthetic outcomes in the third postoperative week. Most patients did not have any postoperative pain, edema, or deformity.

The goal of the study done by Pai *et al*., [21] was to determine the efficacy of a diode laser for fibroma excision. A 28-year-old female patient came to the periodontics division complaining of a little growth at the mouth corner. A 36-year-old female patient with a lesion in the mid-palatal area of her maxilla for one month and difficulties speaking and eating for 15 days was sent to the department of periodontics. A female patient, age 45, presented to the department of periodontics' outpatient unit with the primary complaint of a gum lesion on the left upper back side of the jaw that had lasted for the previous six months. After topical anesthesia, a diode laser unit was used to completely remove the gingival growth (wavelength 810 nm). 1 W was the laser's continuous mode output power. The soft tissue healing process was acceptable; no scars were seen in the operation area. The diode laser fibroma ablation is a safe, rapid operation with little postoperative pain and consequences.

The purpose of the research done by Patel *et al*. [22] was to compare the effectiveness of traditional surgical techniques versus diode lasers with labial frenectomy procedures. Twenty patients with papillary or papillary penetrating frenal attachment in the anterior maxillary area, ranging in age from 16 to 40, were chosen. Ten individuals were chosen to use the diode laser technology. At intervals of one week, one month, and three months, several criteria, including pain, inflammation, edema, the complexity of the operation, and wound healing, were assessed. It was decided to compare the two groups using the Mann-Whitney U test. The laser was run in contact mode at a 10 W power level and a 980 nm wavelength. The results revealed that patients who underwent diode laser surgery experienced less postoperative pain (P = 0.0001) and required fewer analgesics (P = 0.001) than those who underwent the conventional knife procedure. On the seventh day and one month later, both groups' wound healing showed statistically significant differences, with Group A achieving a better outcome. But after three months, there was no real difference between the groups in terms of how quickly the wounds healed.

The goal of the study done by Azma *et al*. [23] was to evaluate diode laser in soft tissue oral surgery. An exophytic lesion in the buccal mandibular gingiva of a 53-year-old lady who was sent to the dentistry faculty of the Guilan Medical University had developed eight months before the referral. Excisional biopsy of the lesion and histologic analysis of this anomaly was the intended course of treatment. We employed a class IV diode laser with an output power of 3.5 W CW and an 810nm wavelength. Ten days after the lesion was removed, the treatment procedure was continued, and in some mysterious way, the surgical site healed, and the epithelial repair was finished. In Case 2, a 26-year-old lady was sent to the office because she had concerns about the gingival color worsening when she smiled. The authors employed a sweeping motion with a diode laser Ezlase 940 nm wavelength, 1.5W CW, and 400 m fiber. Despite adequate ventilation, the patient had minor pain throughout the treatment due to the little smoke and burning smell. After one month, a follow-up was conducted, and the epithelium had fully recovered.

This case study done by Derikvand *et al*. [24] sought to ascertain the 980 nm diode laser's versatility in dentistry. A private practice received five patients as referrals. After thoroughly studying each patient's medical history and oral examination, the following oral evaluations and therapeutic plans were developed. Diode laser surgery with an output power of 1.5 W in CW mode at a wavelength of 980 nm was the recommended course of therapy for all patients. No postoperative problems occurred for any patients with a typical healing process. During follow-up appointments, favorable laser surgical results were seen.

The goal of Tuncer *et al*.'s study [25] was to evaluate the effect of collateral thermal damage on histological diagnosis and the effectiveness of carbon dioxide (CO2) laser treatment vs. traditional surgery for treating oral soft tissue illnesses. 43 patients with a mean age of 54 who needed soft tissue treatments were randomly assigned to receive a CO2 laser procedure or standard surgery using a knife. Depending on the size of the lesion, the laser power was adjusted to 3–4 W, continuous wave (CW), while under local anaesthesia. Only 10 (42%) of the laser group's patients needed local anaesthesia after receiving topical anaesthesia treatment, compared to every patient in the traditional group who received local anaesthesia. There were no intraoperative or postoperative issues with any of the treatments. A histological analysis of 39 samples

revealed that collateral heat damage on the incision line had no effect on the histopathological diagnosis.

A new opportunity to fully exploit the bio-modulating effects of lasers is provided by using the wavelength 532 at low power (1 watt) for soft tissue surgery of the oral cavity. This allows for a good healing process and an effective ablative capability with reasonable pain control and postoperative discomfort. Even if this research has to be combined with more instances owing to the number of patients treated, the usage of this wavelength with the parameters presented here can be expanded to practically all illnesses and tissues of the oral cavity [26].

Only individuals with enough connected gingiva to warrant a straightforward gingivectomy treatment using a knife or a laser were included in our research. Contrasting using a scalpel and a laser, both methods provided an appropriate amount of gingival tissue ablation and dental structural visibility. Participants in the laser group experienced less unpleasant bleeding compared to those in the scalpel group, which resulted in painful bleeding and poor visibility of the surgical region. This allowed for better evaluation of the exposed vital tooth structure and better visualisation of the operating area [27].

The benefits of laser use include minor edema, generally bloodless operation, scarring and coagulation, a shorter surgical procedure, a need for fewer sutures, and little or no postoperative discomfort. Moreover, the tissue has no mechanical stress, and the laser immediately disinfects the surgical site. By delivering energy to the cells, lasers may warm, weld, coagulate, denature proteins, dry, vaporize, and carbonize tissues [28].

The application resembles electrocauterization. The rate of heat production is more significant with a diode laser, but tissue penetration is less than with an Nd: YAG laser. Diode lasers have the benefit of being smaller, more affordable, and better performance. The root surface did not experience any adverse effects from the diode laser. As a result, it is widely believed that diode laser surgery may be carried out safely near dental hard tissue. The authors' laser, the Q-switched Nd: YAG, has also been utilized successfully. Q-switching has the following effects: lower pulse repetition rates, higher pulse energies, and longer pulse durations [29].

The authors' pigmented gingiva had melanotic areas that were treated with a variety of treatment methods. After surgery, periodontal packs had to be used for 7 to 10 days to cover the exposed lamina propria; the incision took six weeks to heal and left a tiny scar [30]. For treating soft tissue lesions, laser surgery is faster, less painful, and more accurate, results in less scarring and tissue contraction, and preserves the elastic qualities of the tissue. In the abovementioned situation, the patient was happy with the laser therapy since it was painless intraoperatively and postoperatively. Photochemical, thermal, or plasma-mediated diode laser processes that result in the ablation or breakdown of biological materials [31].

Compared to knife surgery patients in our research, those treated with the DIODE laser experienced much less postoperative pain on days 1 and 7. Their use of analgesics was also reduced in the laser group. They claimed that the soft tissue laser therapy utilized during frenectomy surgeries offers patients a better impression of postoperative discomfort and function than the knife approach [32]. Other investigations [33-35] showed the therapeutic benefits of employing diode lasers in dentistry. For instance, in clinical research, soft tissue mucogingival issues related to orthodontic therapy were managed with a diode laser vs. traditional surgery. According to the authors, patients who had surgery with a diode laser needed less infiltration anesthetic, experienced quick postoperative hemostasis without sutures, and had better postoperative comfort and recovery. The drawbacks associated with diode lasers were comparable to those related to other lasers, such as delayed repair that is more pronounced in more extensive lesions and charring tissue in smaller lesions compared to traditional scalpel surgical techniques. The use of laser plumes in the excision of exophytic lesions caused by the human papillomavirus may result in lesions similar to those in the upper respiratory tract of the laser operator [36, 37].

Conclusion

Soft tissue lasers are a good choice of method used in esthetic dental treatments, and they can be a successful substitute to the conventional dental procedures which increase the chance of infection and inflammation.

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