Laser-assisted treatment in oral pathology

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Abstract

Nowadays, Laser stands for an avantgarde technology in dentistry. Its applications continues to expand since it was introduced to the dental profession, being available on a wide range of wavelengths. Lasers provide a simple and safe in-office treatment alternative and at the same time reducing the risks of infection, swelling, discomfort and scaring. The present article reviews the most common applications of lasers in oral pathology.

Keywords:
Laser, oral pathology, herpes labialis, oral lichen planus, aphtous stomatitis

Rezumat

În prezent, laserul reprezintă o tehnologie de avantgârdă în domeniul medicinii dentare. Aplicațiile sale sunt într-o continuu expansiune începând cu momentul introducerii sale în acest domeniu, la ora actuală fiind disponibilă o varietate mare de lungimi de undă. Echipamentele laser asigură o alternativă de tratament simplă, sigură și care în același timp reduce riscurile de apariție a infecției, inflamației, confortului și cicatrizării. Articolul de față face o trecere în revistă a celor mai des utilizate aplicații ale laserului în patologia orală.

Keywords:
Laser, patologia orală, herpes labialis, lichen plan, stomatita aftoasă
Introduction

The history of lasers started in the early 1900’s, when Albert Einstein mathematically demonstrated the possibility that some portions of the electromagnetic field could be stimulated to emit amplified light. Then, in the early 1950’s, American physicist Charles H. Townes, amplified microwave frequencies by the stimulated emission process (MASER). Schawlow and Townes (1958), wrote a paper in which they discussed extending the maser principle to the optical portion of the electromagnetic field. Finally, Theodore Maiman (1960) inserted a ruby rod into a photographic flash lamp turned the switch and light amplification by stimulated emission of radiation (LASER) became a reality.

The main advantages of the laser are the cutting effect on tissue at the same time tissue is removed and bleeding is almost stopped. By using the laser beam in the bare fiber mode one of the disadvantages is the temperature rise at the edges of the wound. Due to this effect the wound healing is prolonged in comparison to the standard scalpel cut. Lasers produce energy that can be absorbed by a target tissue, and this absorption proceeds as a photo-thermal reaction; that is the radiation produces a thermal reaction in that tissue. The ability to control bleeding during surgery enables much better visualization of the area. Some wavelengths achieve better hemostasis than others. The erbium family whose radiation is emitted in a free running pulse mode offers less sustained energy so soft tissue surgery may not be totally bloodless. At the same time lasers have been shown to have offer bio-stimulatory effects. These are not clearly understood, but are clinically significant during and after treatment, adding to the value of health care. Other advantages include the lessening need for sutures, less painful treatment and reduced swelling post-operatively, less wound contraction, easier contouring of gingival tissues compared to a scalpel, and generally better patient acceptance of a procedure.

The present paper reviews the literature concerning the laser applications in oral pathology, focusing on the treatment of herpes labialis, oral lichen planus and aphthous stomatitis.

Herpes labialis

Oral herpes infection represents one of the most common manifestations of HSV (Herpes simplex viruses), type 1 (HSV-1) and type 2 (HSV-2) being the main causative agents. Both viral HSV-1 and HSV-2 can present clinical manifestations. HSV infection is spread by direct contact with mucosal surfaces or skin traveling from nerve endings to ganglions. The virus can remain latent for indefinite periods of time and is noninfectious during the latency period. However, horizontal transmission can occur due to viral replication. HSV-1 and HSV-2-induced ulcers cause discomfort to patients, manifested as itching, tingling and pain with functional and esthetic implications where local trauma is present. The available antiviral drugs have not been successful in completely eliminating the virus and its recurrence. Currently, different kinds of laser treatment and different protocols have been proposed for the management of recurrent herpes labialis. According to the literature, none of the laser treatment modalities is able to completely eliminate the virus and its recurrence. However, laser phototherapy appears to strongly decrease pain and the interval of recurrences without causing any side effects. The main advantages of the laser treatment appear to be the absence of side effects and drug interactions, which are especially helpful for older and immunocompromised patients. LLLT has been used to treat a number of conditions, particularly herpes simplex 1 and 2, permitting the host cells to remain viable, with in vitro results indicating a decrease of 68.4% and 57.3% in acyclovir-resistant HSV-1 and HSV-2, respectively. LLLT presents both antiinflammatory and analgesic effects, contributing to tissue repair and fibroblast proliferation and an increase in the interval between infections; moreover, it does not contribute in viral resistance. Munoz et al. used a 670-nm laser irradiation, 40 mW, 1.6 J/cm², 51 mW/cm² per blister in the prodromal stage and 4.8 J in the crust and secondarily infected stages, plus 1.2 J at the C2-C3 vertebrae. Patients were monitored daily during the first week to control healing, and monthly for 1 year to check on recurrence. They concluded that LLLT of herpes simplex virus 1 (HSV-1) appears to be an effective treatment modality without any observed side effects. De Carvalho et al aimed to evaluate the effectiveness of laser phototherapy in prevention and reduction of severity of labial manifestations of herpes labialis virus. Seventy-one patients, divided into experimental (n = 41) and control (n = 30) groups were followed up for 16 months. Patients in the control group were treated topically with aciclovir and patients in the experimental group were subjected to laser phototherapy (one session per week, 10 weeks): 780 nm, 60 mW, 3.0 J/cm² or 4.5 J/cm² on healthy (no HSV-1 infection) and affected (with HSV-1 infection) tissues. They suggested that that this treatment should be further considered as an effective alternative to therapeutic regimens for herpes labialis lesions. Bello-Silva et al used an association of high-intensity (erbium-doped yttrium aluminum garnet, 2.94 mJ/pulse, 2-4 Hz) and low-intensity (indium gallium aluminum phosphide, 660 nm, 3.8 J/cm², 10 mW) to treat HSV-1 infection. During treatment, no systemic or topical medication was used. Pain sensitivity was completely gone after the first irradiation with the...
low-intensity laser. During the healing process, lesions were traumatized twice, on the days 4 and 7. Even though the lesions were completely healed within 10 days\(^{90}\).

**Oral lichen planus**

Oral lichen planus (OLP) is a common autoimmune disease resulting from auto-cytotoxic T lymphocytes triggering apoptosis of epithelial cells, leading to chronic inflammation of oral mucosa. Regarding the symptoms, atrophic and erosive OLP are generally painful for sufferers\(^{10, 11}\). Due to its inflammatory effects, lichen planus can be painful both in atrophic and erosive forms. The incidence of oral mucosae involvement in the course of the disease is estimated to be 0.3–2.5\%. Clinically, six types of mucosal lesions can be identified: network, papulous, plaque-like, erosive, atrophic and bullous. Individual patients may be affected by more than one type of lesion. Malignant transformation most often involves erosive, atrophic and plaque-like lesions, but is also possible in the remaining types. The rate of malignant transformation in OLP has been estimated to be approximately 1% in all cases\(^{10}\). The management of OLP is still symptomatic relief by reduction of inflammation, aiming for pain control. There is a range of treatment options, such as avoiding initiating factors, applying a topical steroid, or taking an immune-suppressive drug or systemic steroid. Low intensity laser therapy is an additional therapy for conservative treatment of OLP\(^{11}\).

Several low level lasers have been used to treat oral lichen planus, including ultraviolet (waves of below 350 nm length), Helium-Neon (632 nm), and more recently, diode (a spectrum of red to infrared wave lengths, 600 to 1100 nm) lasers. These lasers have been used with different wave lengths, intensities, powers, durations, number of sessions, and therapeutic approaches (with or without tissue absorbent)\(^{14, 15}\). In a study of Mahdavi et al. the patients underwent laser therapy with low level red diode laser of 630 nm, 10 mill watts, 1.5 J/cm². Each lesion was emitted for 150 seconds during each session. Sessions were attended every three days during one month. The lesions were photographed each session. The patients were followed for three months, and therapeutic approaches (with different wave lengths, intensities, powers, durations, number of sessions, and accelerating ulcer healing. The recommended treatment modalities include topical agents such as topical steroids and anti-inflammatory agents and systemic therapy such as predisone and immunopotentiating agents\(^{27, 28}\). Recently, there were a case report and clinical trials showing benefit of immediate pain relief on aphthous ulcers by using CO\(_2\) laser at 0.7 to 1.5 W irradiating to the transparent gel. On the basis of no clinical alteration, this was called the non-thermal CO\(_2\) irradiation\(^{29-32}\). By comparison with laser ablation for replacing aphthous ulcer with the laser-kered wound\(^{29, 33}\) this technique appeared to be non-invasive. In a pilot study, Zand et al used a CO\(_2\) laser device (1 W power in defocused continuous mode, scanning rapidly over the lesion). The placebo lesion was irradiated with the same laser, but with an inactive probe. The healing times of the lesion were recorded by a blinded physician. They concluded that single session of non-thermal, non-ablative CO\(_2\) laser therapy (NACLIT) could be used to promote wound healing in minor aphthous ulcers, with no visible side effects\(^{34}\). The Nd:YAG laser is also used for the treatment of aphthous sto-
mati(25, 26). The applied physical parameters were a pulse energy of 80 mJ and a frequency of 30 Hz (power setting 2.4 W). Albrektson et al indicated LLLT in the treatment of aphthous stomatitis. The intervention group was treated with LLLT on 3 occasions, with a 1-day interval. (809 nm; power, 60 mW; pulse frequency, 1800 Hz; duration, 80 seconds per treatment; dose, 6.3 J/cm²). They found that LLLT reduced the pain and the inconvenience of eating, drinking, and brushing teeth for patients with aphthous stomatitis as compared with placebo(27).

Conclusion

For the last two decades, lasers have become an excellent tool in oral pathology and therefore, it may increase the positive effects by providing reliability for the practitioner and comfort for the patient.

Bibliography