Removal of Refractory Erosive-atrophic Lichen Planus by the CO_2 Laser

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Abstract

Aim, Study and Background: The erosive-atrophic form of Oral lichen Planus (OLP) is often associated with severe pain and burning sensation. This study investigated the efficacy of CO_2 laser surgery for management of refractory erosive-atrophic OLP.

Methods: Ten patients with thirteen erosive-atrophic OLP resistant to standard therapy participated in this study. The size and clinical scores of the lesions and the level of pain/discomfort were recorded before treatment. The lesions were then removed with a CO_2 laser device (10600 nm, continuous wave, 5 W, slightly defocused). The subjects were evaluated 1 month and 3 months later and the response rate was assessed according to the decrease in pain, sign scores and size of the lesions.

Results: There was a significant reduction in pain and lesion size at 1 and 3 months following laser treatment ($p<0.05$). The sign scores of the lesions were also significantly improved at follow-up periods compared to the pretreatment state ($p<0.05$). At the end of the follow-up period, 54% of the lesions showed 3 or 4 degrees of improvement in the clinical score and 23% improved 1 or 2 degrees, whereas 23% remained unchanged post-operatively compared to the pretreatment evaluation.

Conclusion: The present results indicate that the CO_2 laser surgery is an effective modality for management of erosive-atrophic OLP and can be considered as a suitable alternative to standard treatment.

Key words: Lichen Planus, Erosive-atrophic, Laser, CO_2, Surgery, Refractory

Introduction

Lichen Planus is a chronic mucocutanous inflammatory disease that causes destruction of the basal cell layer of the epithelium as a result of a T-cell mediated immunologic reaction of unknown etiology. The prevalence of Lichen Planus has been reported to be from 1 to 2% in different populations [1,2] and it is more frequently observed in females [3,4]. Oral Lichen Planus (OLP) usually occurs bilaterally in the buccal mucosa, the lateral border of the tongue and the gingiva in keratotic (reticular, popular, plaque-like) and nonkeratotic (erosive, atrophic and bullous) forms [4]. The nonkeratotic forms of OLP are usually associated with severe pain/ discomfort and intolerance of the patient to consume hot or spicy food. Furthermore, the risk of malignant transformation in erosive lesions may be higher than other types of OLP [3,5], because the deeper epithelial layers are exposed to oral carcinogens [6]. Therefore, these lesions should be treated and monitored in the long term.

Despite the great attempts to develop efficient modalities for managing OLP lesions, no definitive treatment is now available and the current approaches mainly focus on relieving the signs and symptoms of the disease rather than to be curative. Topical corticosteroids are considered as the mainstay in the treatment of OLP, but they can produce adverse effects including thinning of the oral mucosa, secondary candidiasis and possibly tachyphylaxis and adrenal suppression [7,8]. Furthermore, the long period of pharmacologic therapy and the necessity for repeated applications are unpleasant for most patients. Several potent immunosuppressive and immunomodulating agents have been proposed as alternatives to corticosteroids for the treatment of painful symptoms of OLP affected patients [7], but complete and persistent improvement has not been achieved by any of them and all may cause adverse effects. Non-pharmacological approaches have also been tried for OLP treatment such as photodynamic therapy, and low-level or high-power laser treatment [7].

Laser surgery is an effective method for elimination of signs and symptoms of OLP. The CO_2 laser is well suited for ablation of superficial soft issue lesions of oral mucosa including leukoplakia and lichen planus because of its strong absorbance in water. The advantages of CO_2 laser surgery are the sealing of blood and lymphatic vessels, sterilization of the surgical wound, no need for sutures, and healing of the excised tissue with minimal scar [9,11]. This laser also helps to eliminate or reduce pain and burning sensation associated with the lesions because of its effects on the nerve supplies [9].

This study aimed to investigate the effectiveness of CO_2 laser evaporation for the treatment of patients presenting drug-resistant, erosive-atrophic OLP.

Materials and Methods

Ten patients with erosive-atrophic OLP were selected from those attending the Department of Oral Medicine, School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran. The inclusion criteria limited patients to those that had been treated with medications including topical corticosteroids for at least 1 month beforehand, but the lesions were not eliminated completely or recurred. The diagnosis of lichen planus was made clinically according to the definition of World Health Organization (WHO), and then was confirmed by histopathologic examination where vacuolar alteration of the basal layer of the epithelium and a band like infiltrate of lymphocytes in the lamina propria were evident [12,13]. The patients who had signs of dysplasia, in-situ carcinoma or any other malignancy, as well as those with lichenoid reactions

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and those who received topical or systemic medicine for OLP within the last one month were excluded from the study. The research protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences. The patients were explained about the treatment procedure and an informed consent was obtained from each participant before the commencement of the study.

The patients were asked about the demographics and medical history by an oral medicine specialist (S.B) and the site, type (erosive or atrophic) and size of the lesions was recorded. The degree of pain/discomfort was also evaluated before laser treatment (T0). A CO_2 laser device (Daeshin, model DS-40U, Daeshin Enterprise Corp, Guro-gu, Seoul, Korea) was used for evaporation of OLP lesions under local anesthesia. The laser operated at continuous-wave mode with power of 5 W. The lesion was vaporized with a slightly defocused beam using sweeping movement until the subepithelial tissue was reached. A safety margin of about 2 mm was taken around the lesion. The patient and the clinician wore protective glasses during the surgery. A Persica mouthwash (containing an extract of Salvadora persica) and a Non-Steroidal Anti-Inflammatory Drug (NSAID) were prescribed for postoperative care.

The patients were followed up at 1 month (T1) and 3 months (T2) after laser surgery. In each follow-up, the lesion size and type as well as the degree of pain and discomfort were recorded similar to the pretreatment evaluation, and digital photographs were taken. The lesion size was defined as the longest distance in mm from the end to the end of the atrophic and erosive areas of the OLP lesion. A caliper was used for measuring lesion size. The severity of pain and discomfort was determined using a Visual Analogue Scale (VAS**)** and the patient was requested to mark the degree of pain experienced on a 10-cm scale with 0 indicating no pain and 10 indicating the worst possible pain. The pain data were then scored according to the classification described in *Box 1* [6].

In addition to measuring lesion size and pain level, the Thongprasom sign scoring **[**14] was used to represent the clinical data (sign) before the laser treatment and at follow-up periods as indicated in *Box 2*.

Efficacy Index (EI) [6] was calculated using the following formula:

[(total score of the lesion before treatment-total score of the lesion after treatment)/total score of the lesion before treatment]×100

The EI was categorized into a 5-rank scale as demonstrated in *Box 3***.**

Score 3: severe pain/discomfort (7<VAS ≤ 10)

Score 2: moderate pain/discomfort (3.5<VAS ≤ 7)

Score 1: mild pain/discomfort (0<VAS ≤ 3.5)

Score 0: without pain/discomfort (VAS=0)

Box 1*. Classification of pain scores.*

Score 5: white striae with erosive area ≥ 1 cm2

Score 4: white striae with erosive area <1 cm2

Score 3: white striae with atrophic area ≥ 1cm2

Score 2: white striae with atrophic area <1 cm2

Score 1: mild white striae only

Score 0: no lesions, normal mucosa

Box 2*. The Thongprasom sign scoring criteria.*

Healed: EI=100%

Marked improvement: 75% ≤ EI<100%

Moderate improvement: 25% ≤ EI<75%

Mild improvement: 0<EI<25%

No improvement: EI=0

Box 3*. The efficacy index of the treatment.*

Statistical analysis

The data were analyzed with SPSS software (Statistical Package for the Social Sciences, version 16.0; SPSS Inc., Chicago, IL, USA). A Wilcoxon signed rank test was used to determine any significant difference in pain and clinical scores between the baseline and each follow-up period, while the difference in lesion size was assessed by a paired sample t test. The significance level was determined at $p<0.05$.

Results

Three males and 7 females participated in this study. The average age of the patients was 49.6 years (age range 35 to 64 years). The selected patients experienced OLP for a mean period of 2 years (between 4 months to 5 years). The systemic diseases affected the patients were depression (1 case), hypertension (1 case), asthma (1 case), cardiac disease (1 case) and diabetes mellitus (1 case). These patients were on medication for the relevant condition. Overall, 13 erosive-atrophic OLP lesions were treated.

The average size of the erosive/atrophic lesions was 13.7 ± 4.6 mm before laser treatment. The lesion size reduced to 4.9 ± 4.9 mm at 1 month and 3.2 ± 6.1 mm at 3 months after surgery (Figure 1). At the 3-month follow-up, the complete disappearance of the erosive/atrophic area was observed in 54% of the lesions, while 38% showed just reduction in size

Table 1. *The percentage of OLP lesions showing different Thongprasom sign scores at the treatment intervals.*

	Scores 4 and 5	Score 3	Score 2	Score 1	Score 0
T0	85%	-	15%	-	-
T1	54%	-	38%	8%	-
T2	23%	-	23%	54%	-

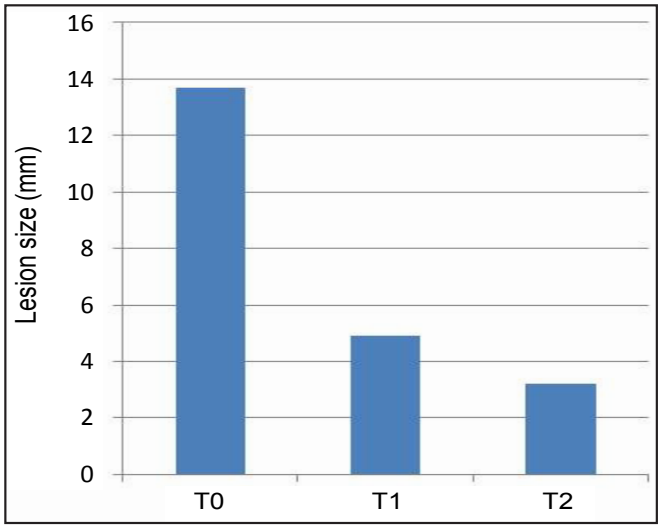

Figure 1. *Comparison of lesion size (mm) at pretreatment and after 1 and 3 months of laser surgery.*

at both follow-up periods compared to the pretreatment state. In one patient (8%), the lesion size increased from 10 mm at the pretreatment state to 17 mm at the 3-month follow-up. This case was affected with severe depression and showed extensive cutaneous and OLP lesions. The paired sample t-test revealed that the decrease in lesion size was statistically significant at 1 and 3 months' follow-ups compared to the pretreatment state ($p=0.014$ and $p=0.021$, respectively).

Regarding pain scores, most patients (80%) reported severe degrees of oral discomfort before laser treatment (VAS scores 2 and 3). At the 3-month follow-up, 8 patients reported no pain/discomfort (VAS score=0) and 2 patients experienced a relief in their pain/discomfort from score 3 to score 1. The Wilcoxon signed rank test revealed that the degree of pain/discomfort reduced significantly from pretreatment to both 1 and 3 months after laser surgery ($p=0.004$ and $p=0.002$, respectively).

Table 1 presents the Thongprasom sign scoring at the initial time point and during follow-up sessions for the patients included in this study. At the 3-month follow-up, 23% of the lesions exhibited scores 4 and 5, 23% of the lesions were scored 2 and 54% showed score 1. According to the statistical analysis, the sign scores decreased significantly from pretreatment to 1- and 3-months' periods ($p=0.016$ and $p=0.005$, respectively).

The efficacy index (EI) of laser treatment was defined as the reduction in sign score of the lesions compared to the pretreatment level. The patients in this study showed different degrees of improvement: 23% of the lesions revealed no improvement (EI=0); 8% revealed mild improvement ($0<EI<25\%$); 23% of the lesions showed moderate improvement ($25\% \leq EI<75\%$) and 46% experienced marked improvement ($75\% \leq EI<100\%$) after three-months of laser surgery (*Figure 2*).

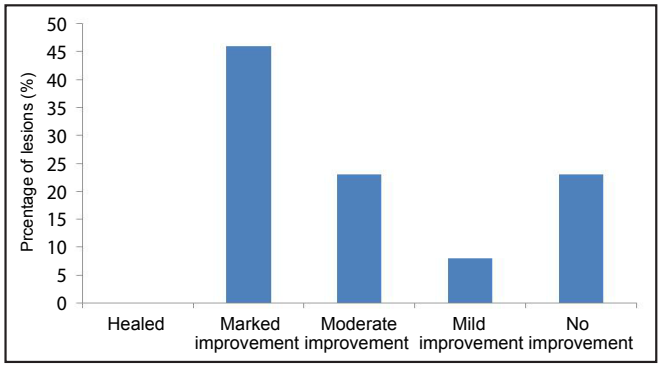

Figure 2. *The efficacy indices of the CO_2 laser for OLP treatment.*

Discussion

The patients affected with erosive-atrophic lichen-planus may exhibit widespread and painful lesions which are often unresponsive to conventional treatments. In the present study, the CO_2 laser was applied in continuous-wave mode with medium output power to vaporize the epithelial layer of OLP. Another option is to use the CO_2 laser in the superpulse mode to give pulses of higher peak power and shorter duration, and with sufficient intervals to allow the tissue to cool down between pulses and minimize untoward thermal effects [5,15]. Because of the strong absorbance of the CO_2 laser in water which limits its penetration depth to 50-100 microns, the CO_2 laser application in the continuous mode should be considered safe on oral mucosal lesions especially when low and medium output powers are employed. The first follow-up was performed one month after removing the epithelium by the laser, because previous authors found that complete healing occurs within third week to a month in laser-treated areas [10,16,17].

Previous studies used low or high power lasers for the treatment of OLP. The most commonly used laser for surgical elimination of OLP is the CO_2 [5,6,9,10,16-19], although the diode [20], Nd:YAG [19] and erbium family lasers [21] have also been employed for this purpose. Removal of OLP lesions with high-power lasers is mainly focused on relieving the symptoms associated with the disease. Some authors assumed that Low Level Laser Therapy (LLLT) may be more effective than laser evaporation, because it can modulate the immune system, accelerate wound healing, and reduce inflammation and pain [6,18,22,23]. Agha-Hosseini et al. [18] applied visible red and infrared lasers to affect both the superficial and deep cellular layers and found that LLLT revealed better results than CO_2 laser therapy in the treatment of OLP. Jajarm et al. [6] reported that LLLT was as effective as topical corticosteroid for OLP management.

The patients in this study showed a significant relief in pain and discomfort after laser treatment. At the end of the follow-up period, 8 patients reported no pain and 2 patients exhibited downward shift of the VAS from score 3 to score 1. This finding is consistent with outcomes of previous

authors [10,16,18] who found a pronounced reduction in pain symptoms after surgical ablation of OLP with the CO_2 laser. Loh [10] found immediate relief of pain and the ability to tolerate hot and spicy food in all 10, OLP patients treated with the CO_2 laser, which lasted throughout the follow-up period of 6 months to 4 years for most cases. Van der hem et al. [16] found that after laser therapy significant reduction in pain and burning sensation will be achieved.

The size of the erosive-atrophic areas of the lesions was statistically reduced after laser surgery and the reduction remained significant until the 3-months' follow-up. Previous authors [18] also reported a significant decrease in lesion size after laser ablation of OLP lesions. In 54% of the lesions, the erosive-atrophic area disappeared completely at the end of the follow-up period and for 38%, a reduction in lesion size was observed. However, one patient (8%) exhibited an ulcerative and erosive OLP lesion at the 3-months' follow-up with greater size than the pretreatment state. This patient had extensive mucocutanous involvement and experienced severe depression and psychological problems. It is assumed that stress is the main cause of acute exacerbation in OLP affected patients [12,13,24].

The Thongprasom sign scoring was used to represent the clinical data (sign) before treatment and at follow-up periods, and to reveal the efficacy of CO_2 laser for OLP management. A significant improvement was noticed in the clinical scores of laser-treated OLP lesions at both follow-up periods compared to the pretreatment examination, which is consistent with the findings of previous authors [18]. At the 3 months' follow-up, 54% of the lesions showed score 1 (white striae only), 23% showed score 2, and 23% showed scores 4 and 5. Although a significant reduction in sign scores was obtained in the follow-up periods, the healthy and normal mucosa was not observed in any of the patients. In contrast, Kok [17] reported that one month post laser, the healed mucosa was almost imperceptible from the surrounding normal mucosa in five from six patients treated with the CO_2 laser. Loh [10] reported that after healing, the laser-treated mucosa was similar in appearance to the adjacent normal mucosa. It should be noted that the transformation of erosive lesions to atrophic or reticular types is of valuable benefit in OLP affected patients, as it can reduce painful symptoms and the risk of malignant transformation.

We calculated the efficacy of laser treatment as the percentage of the difference between baseline and end-point scores of OLP lesions. After 3 months of laser surgery, a marked improvement in sign scores was achieved in 46% of the lesions ($75\% \leq EI<100\%$) and 23% showed moderate improvement ($25\% \leq EI<75\%$). However, 23% of the lesions exhibited no improvement in the clinical characteristics after laser treatment (EI=0). Agha-Hosseini et al. [18] reported that 22% of patients with erosive-atrophic OLP showed 4 degrees of improvement in clinical scores after CO_2 laser surgery, while 18% revealed 3 degrees and 45% displayed 1-2 degrees of improvement.

Almost all treatment modalities used for removal of OLP lesions are associated with a high risk of relapse, as is for the laser treatment. We did not take a second biopsy of the OLP site at the follow-up periods, because normal mucosa was not observed in any of the patients in this study. To reduce the risk of relapse in laser-ablated areas, the clinician should consider a clear safety margin around the lesion. It is also important to clean the surface area of the lesion with sterile gauze damped with saline during treatment to remove the carbonized surface area and allow better visualization of any remaining lesion. Because of the low penetration depth of the CO_2 laser in oral soft tissues, the clinician should be careful about reaching the subepithelial layer. Therefore, the procedure should be repeated until achieving the desired penetration depth. A diode laser can also be used as an alternative to the CO_2 laser in order to provide deeper penetration and easily destroying the underlying connective tissue, but further studies are required to reveal its efficacy and possible side effects compared to those of the CO_2 laser.

A limitation of the present study was the small sample size. This was related to the inclusion of only refractory erosive-atrophic lesions and excluding other forms of OLP. Another limitation was the short follow-up period, as some patients were not available at a longer follow-up visit. We did not include a control group who received conventional treatment with topical corticosteroids, because all the lesions had received pharmacologic therapy beforehand. Further studies with greater sample size and long-term follow-ups are required to evaluate the stability and efficacy of CO_2 laser treatment in patients affected with erosive-atrophic OLP. Comparison of the effectiveness of CO_2 laser with other non-pharmacologic approaches or other types of lasers should also be made in future investigations.

Conclusion

The CO_2 laser evaporation of oral epithelium improved the painful symptoms and the clinical scores of patients with unresponsive erosive-atrophic OLP and therefore it can be suggested as a suitable alternative to corticosteroids.

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