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CO_2 Laser Surgery for the Excision of Leukoplakia: A Comparison with the Traditional Technique

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Purpose: CO_2 laser biopsy and photo-thermal ablation has been accepted as a diagnostic/treatment modality for leukoplakia. We hypothesized that CO_2 laser would be an excellent tool for diagnosis/treatment of leukoplakia, facilitating improved outcome and patient satisfaction.

Materials and Methods: A retrospective study was performed comparing CO_2 laser to the standard surgical technique, considering the treatment protocol and patient compliance. In toto, 8 patients were diagnosed using the clinical features prominent for leukoplakia. These were further subdivided into two categories. Category A defined patients undergoing bilateral treatment with CO_2 laser and the traditional surgical technique. Category B was further divided into two subcategories, in which patients underwent either CO_2 laser or the traditional technique. Immediately postoperatively, the samples thus obtained were subjected to histopathological study. After the treatment protocol, the patients were asked to determine pain on the faces scale and numerical rating scale. A follow-up of the patients was done after 7, 14 and 21 days.

Results: The study showed improved operating conditions, more rapid healing than for other thermal instruments, minimal tissue handling, and improved patient compliance.

Conclusion: Because of its comfort level for the operator and the patient's benefit, CO_2 laser can be recommended in oral therapy. It is a precise means of removing soft tissue lesions in selected patients. Patient postoperative satisfaction after laser excision was greater when compared with those who had conventional excisions. Postoperative pain was less, as was the pain experienced during the first week of recovery.

Keywords: biopsy, leukoplakia, CO_2 lasers, dysplasia, scalpel, ablation.

J Oral Laser Applications 2009; 9: 213-218.

The World Health Organization has defined leukoplakia as: "A white patch or plaque which cannot otherwise be characterized clinically or pathologically as any other disease."[1] Leukoplakia is a potentially malignant lesion of the oral cavity and according to one study, has an annual malignant transformation rate varying from 0.13 percent to 15.7 percent.[2]

Leukoplakia is caused due to local factors such as tobacco, alcohol, chronic irritation, candidiasis and some systemic factors like syphilis, deficiencies of vitamins A, B12, and folic acid, sideropenic anemia, nutritional deficiency, xerostomia, viral herpes simplex and idiopathic leukoplakia.[3] Clinically it appears white or yellowish white in color with small, well-localized, irregular patches, up to a diffuse lesion involving considerable portion of oral mucosa.[3] The usual age of incipience is 30 years, peaking at 50 years. The ratio of men:women in the West is 1:1, while in India, more males are affected.[3]

Figs 1a and b Toluidine test: White patch on buccal mucosa at third molar region. Toluidine blue indicates worst area of lesion.

The diagnosis of leukoplakia is done by elimination of possible cause; observation of the lesion for a defined period, then reassessment; and toludine blue staining (Fig 1) or oral brush biopsy.[4]

Oral leukoplakia is a relatively common lesion with a significant proportion of cases progressing into cancer. Since most leukoplakias are asymptomatic, the primary objective of treatment must aim at the prevention of such malignant transformation. The main objectives of this study were to observe the efficacy, safety and acceptability of the CO_2 laser in the management of oral leukoplakia.

The basic management for leukoplakia starts with the elimination of smoking habits, removal of irritants or any other etiological factor. The conservative line of treatment involves use of vitamin therapy.[4] Lesions which don't subside with the basic line of treatment must be surgically excised, eg, with conventional scalpel surgery, cryosurgery, electrosurgery/cautery, laser surgery.[3,4]

Surgery is done by defining the lesion with toluidine blue stain as shown in Fig 1. Scalpel excision is done by making an incision which should be deep and wide and the area should be undermined and dissected, followed by sutures. While cryosurgery is done with a refrigerated probe by liquid nitrogen or pressurized nitrogen oxide, which causes cell damage at -20°C, it has several drawbacks: for instance, it cannot be used to cut tissue, it is difficult to assess the extent of treatment, it causes excessive swelling, its effect at the periphery (dysplastic changes can be initiated), the whole lesion is not available for pathology, multiple sessions are required.[5] Electrosurgery is another procedure which uses high voltage electric current to coagulate the lesion. Similarly, it also has some disadvantages, such as distastefulness, odor, explosion hazard, profound LA and some time GA, slow healing, pain and scarring.[5]

CO_2 lasers are gaseous lasers consisting of carbon dioxide, nitrogen and helium.[9] The relatively long wavelength (10,600 nm; Fig 2) falls within the infrared range and is invisible.

The depth of penetration is very low as compared to other lasers, so it helps to excise the lesion easily without harming the underline tissues.[7]

It has two modes of operation: continuous and super pulsed, and one can change the mode to achieve desired effect. Each mode has a different effect on the tissue (Fig 3 [courtesy of Clayman and Kuo[8]]).[7]

According to one study,[6] dentists specializing in oral and maxillofacial pathology, oral medicine, and oral surgery clinically characterized 647 lesions as benign. At least 29 of these were diagnosed malignant or dysplastic upon scalpel biopsy.[6] Thus, to be on the safe side, we should remove the lesion and evaluate the pathology.

The present study comprises a total of 8 patients, who were divided in two categories: Category A included bilateral cases of leukoplakia, in which excision was performed on one side with a scalpel and on the other side with laser to facilitate comparison of the procedures; Category B has cases of superficial lesions treated by CO_2 laser ablation.

Category A: Case 1

A 44-year-old man with no past medical history, but who had a 15-yr habit of chewing tobacco (7-8 sachets a

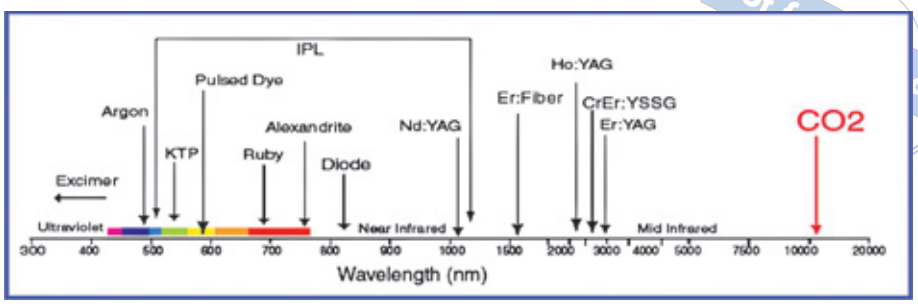

Fig 2 Laser wavelengths.

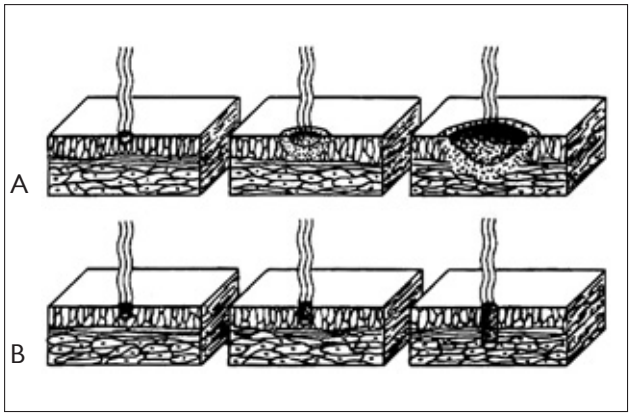

Fig 3 Schematic drawing of effects on tissue of CO_2 laser in continuous vs super pulse mode (courtesy of Lewis Clayman and Paul Kuo, Laser in Maxillofacial Surgery and Dentistry).[8]
A) Continous wave, B) Super pulse.

Fig 4 Case 1: Left buccal mucosa demonstrated a 2x3 cm area of leukoplakia.

Fig 5 Case 1: Similar lesion on the right side.

day), presented with a white patch on the buccal mucosa. The left buccal mucosa demonstrated a 2x3 cm area of leukoplakia (Fig 4) with a similar lesion on the right side as well (Fig 5), which stained mildly positive with toludine blue.

On the left side, superpulsed CO_2 laser was used with the power density adjusted to achieve the desired effect for the excision of the lesion (Fig 6). On the right side, the lesion was removed with a scalpel (Fig 7).

Histopathology of the lesions (Figs 11 and 12) shows hyperorthokeratosis, nuclear hyperchromatism, basilar hyperplasia, and increased nuclear cytoplasmic ratio. The overall picture is suggestive of mild dysplasia.

With the help of PFS (pain facial scale) and NRS (numerical rating scale) (Fig 16), which were presented to the patient to rate the severity of pain, we found that the laser-treated side showed less pain than the scalpel side (Figs 17 and 18). Healing after excision using both techniques proceeded unremarkably (Figs 8 to 10, 13 to 15).

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Fig 6 Case 1, left side after laser excision.

Fig 7 Case 1, right side after scalpel excision.

Fig 8 Case 1, lasered side after one week.

Fig 9 Case 1, 1 week post-excision. Scarring due to sutures.

Fig 10a Case 1 after complete healing, lasered side.

Fig 10b Case 1 after complete healing, scalpel side.

Advantages

Lasers surgery offers rapid incision or ablation (as most laser surgery involves epithelium only),[11] minimal adjacent tissue damage, preservation of histological margins, sterilizing action, no need of elaborate preparation of the field and a 'No touch' technique.

The patient benefits from minimal postoperative swelling,[12] lack of fear of a blade, very low infection rates as laser seals the lymphatic channels, less pain during treatment and after treatment, minimal scar formation,[13,14] no need for antibiotics, minimal analgesics, minimal tissue handling, faster healing than with other thermal instruments, and reduced recurrence rate and malignant transformation.[15]

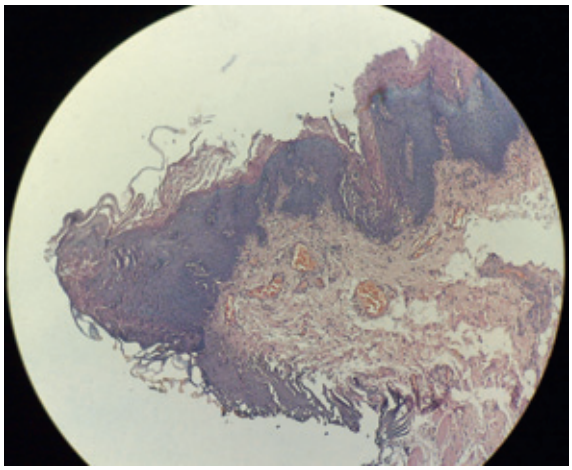

Fig 11 Case 1, histopathology slide, with CO_2 laser.

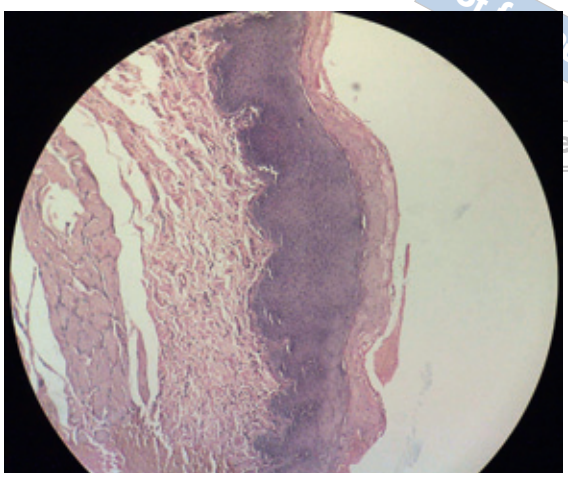

Fig 12 Case 1, histological slide, with scalpel.

Fig 13 Case 2, leukoplakia patch on right buccal mucosa.

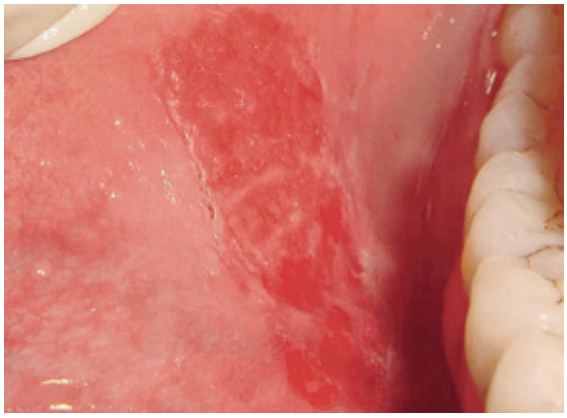

Fig 14 Case 2, area immediately after CO_2 ablation.

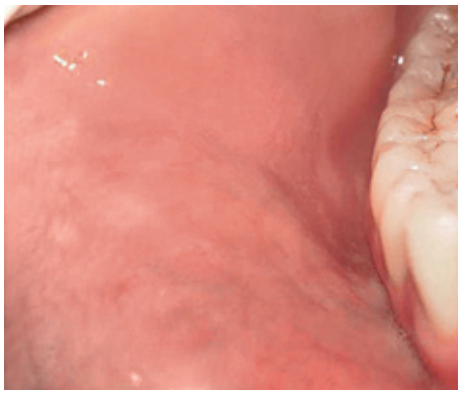

Fig 15 Complete healing after CO_2 laser ablasion.

Disadvantages

Laser does have some disadvantages like loss of tactile sense with which surgeon is more comfortable, additional safety requirements, laser safety required of personnel (laser technician), laser specific education and qualification required,[10] high cost of equipment.

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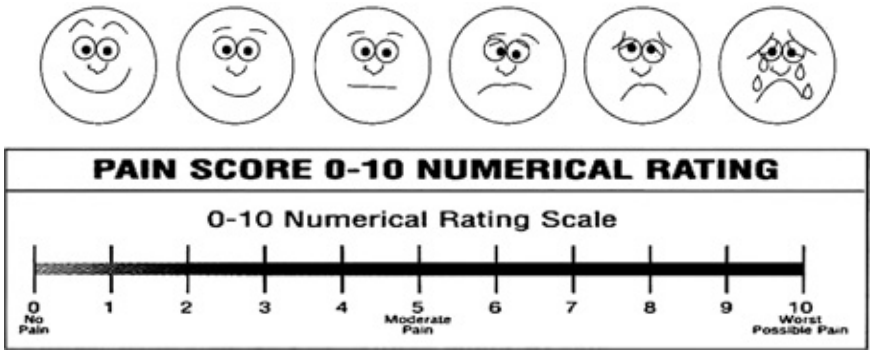

Fig 16 Pain assessment scales "faces" (PFS) and numerical (NRS).

Patient Laser/ scalpel	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day
1.	6 / 7	7 / 8	5 / 6	3 / 4	2 / 2	2 / 2	0 / 1
2.	5 / 6	6 / 7	6 / 6	5 / 6	4 / 5	4 / 4	2 / 3
3.	8 / 8	7 / 8	6 / 7	6 / 6	4 / 5	3 / 4	2 / 2
4.	7 / 8	7 / 6	6 / 5	5 / 5	3 / 4	2 / 3	1 / 2
5.	7 /0	8 / 0	7 / 0	6 / 0	4 / 0	1 / 0	0 / 0
6.	0 / 8	0 / 7	0 / 5	0 / 4	0 / 3	0 / 1	0 / 0

Fig 17 Development of reported pain over time, using PFS/NRS.

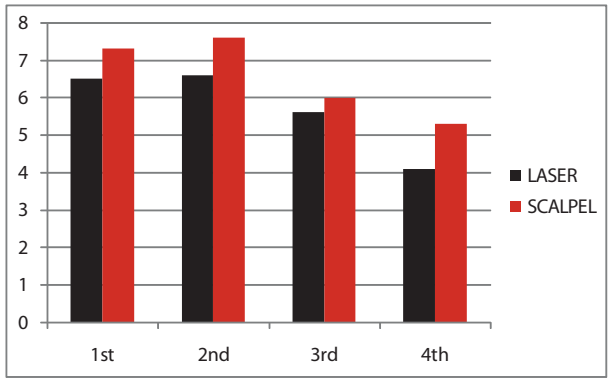

Fig 18 Bar graph of average pain, using PFS/NRS.

CONCLUSION

In an era when the medical consumer makes decisions based on the efficacy of treatment by using criteria such as pain and length of operative time, CO_2 lasers have emerged as a surgical tool that can fulfill these criteria for such procedures. The use of the carbon dioxide laser presents several advantages over conventional techniques when treating soft-tissue pathology.

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